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Contents

Strategies of Urban Green Infrastructure Planning in Existing Cities

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Abstract: Year after year, the impacts of climate change become more destructive. Accordingly, finding the appropriate solutions to adapt with such impacts begins to be a constant concern of many cities worldwide. In this field, urban green infrastructure or (UGI) provides appropriate solutions for different climate change impacts such as floods, urban heat island, pollution, drought, water scarcity, soil erosion, energy deficit, etc. Literature review indicates a limited knowledge about UGI planning strategies as climate change adaptation (CCA) in existing cities. Accordingly, the current research seeks to extract these strategies from the real world practices of UGI. The applied methodology is known as 'learning by doing'. Many eminent practices of UGI planning in existing cities for the purposes of CCA are selected. A cross analysis is conducted between them to extract their common UGI strategies. The research's results reveal that the explored practices almost depend on similar strategies which based on injecting the natural green and blue assets into the exiting urban land uses such as streets, parking, public buildings, etc. This strategy can be called "urban green injection". So, the opportunity to have UGI in the crowded cities depends on the innovative investment of the public land uses and converting them to vegetated or water-covered assets. Following such a strategy can ensure the alteration of the city image from the traditional natural-lacking character to a more sustainable and vibrant one. Adopting urban green injection can also ensure the maximum possible benefit of UGI employing as it was extracted from the successful outcomes of other practices.

Keywords: Strategies; Urban green infrastructure; green injection; Existing cities

الخلاصة: تزداد اثار التغيير المناخي دماراً عاماً بعد عام. لذا فأن ايجاد الحلول المناسبة للتكيف مع هكذا اثار قد اصبح الشغل الشاغل للعديد من المدن حول العالم. بهذا الخصوص تحديدا، توفر البنى الارتكازية الخضراء جؤاباً موحداً للعديد من الاسئلة حول الحل المناسب للتعامل مع التبعات المناخية المختلفة كالفيضانات والجزر الحرارية الحضرية والتلوث والجفاف وندرة المياه وانجراف التربة ونقص الطاقة وغيرها الكثير. وجد من خلال مراجعة عدد من الدراسات ذات الصلة ان هنالك قلة في المعرفة المتوفرة حول ستراتيجات تخطيط البنى الارتكازية الخضراء لاغراض التكيف مع التغيير المناخي في المدن القائمة. لذا فان هذا البحث يهدف الى توفير المعرفة حول هذه الستراتيجات. يفترض البحث امكانية استنتاج هذا الستراتيجات من ممارسات العالم الحقيقية للبنى الارتكازية الخضراء. تعرف هذه المنهجية بـ" التعلم من خلال التطبيق". وفقا لذلك، فقد تم انتخاب ثلاث تجارب سابقة لتخطيط البنى الارتكازية الخضراء في المدن القائمة. بعد ذلك، تم عمل تحليل مقارن بين هذه الممارسات لاستخراج ستراتيجاتها. وقد وجد نتيجة لذلك، ان التجارب الثلاثة قد اعتمدت تقريباً على ستراتيجات متشابهة في تخطيط البنى الارتكازية الخضراء. وان هذه الستراتيجات قد تمثلت بحقن العناصر الطبيعية الخضراء والزرقاء في استخدامات الارض القائمة كالشوارع ومواقف السيارات والابنية العامة وغيرها. لذلك فأن من الممكن ان تسمى هذه الستراتيجية بستراتيجة "الحقن الحضري الاخضر". وفقاً لهذه الستراتيجية فان فرصة وجود البنى الارتكازية الخضراء في المدن المزدحمة تعتمد على الاستثمار المبتكر لكل الاستخدامات العامة وتحويلها الى عناصر مزروعة او مغطاة بالمياه. ان اتباع مثل هكذا ستراتيجة يضمن قلب الصورة التقليدية للمدينة الى صورة اكثر استدامة وحيوية. كما وتضمن استراتيجية الحقن الحضري الاخضر تحقيق اعلى الفوائد الممكنة ذلك لكونها قد بنيت من الاساس على النجاح الذي حققته التجارب الرائدة السابقة.

1. Introduction

Climate change (CC) continues to happen and its impacts continue to be disruptive. In the past, it caused many species' extinction, large people migration, and many substantial weather changes. So, CC is not a new phenomenon but what is new is increasing the speed of current CC which surpasses the earth's natural ability to absorb or cope. Accordingly, CC became the center of global concern [1]. CC is an inevitable result of the increase of long-lived greenhouse gases (GHG) within the atmosphere. Greenhouse gases trap the solar radiation that reflects from the earth and return it towards the surface. In nature, this process is essential to keep the climate warmer; without it the earth's temperature would be 30° C lower than what it is today. These gases are in a continuous manner of increase. In 2016, for example, it was found that GHG concentration has increased by 46.7% above what it was in 1990. It was projected that this percentage will still grow in the future [2]. Observational evidence proved that global warming had caused many CC impacts [2]. According to UNFCCC, the most frequent identified impacts sequentially include extreme weather (e.g., hurricanes and cyclones, heatwaves, sand and dust storms, wildfire and cold spells, etc.), floods, precipitation change, droughts, temperature rise, sea level [2].

Cities play a crucial role in CC formation as they are responsible for producing about 70% of GHG emissions. On the other hand, cities are more vulnerable to CC impacts than other areas. That is because they already have relatively higher temperatures than rural and non-urban sites [3]. Many pieces of evidence assured that cities' climate is warming up rapidly than rural areas causing the formation of the 'urban heat island' (UHI) phenomenon [4].

To deal with such impacts, many adaptation strategies were adopted. Levina and Tirpak (2006) approved, by conducting a detailed

comparison among the publications of many adaptation- promoting organizations, that there are no single unified definitions for the key terms of climate change adaptation (CCA). Each organization such as IPCC, UNFCCC, UNDP, UKCIP, etc. has its definition for CCA and its related terms. This means different interpretations, expectations and aspirations for different stakeholders. In the light of this, Levina and Tirpak pointed out the urgent need to find a unified precise definition across institutions and organizations to achieve more progress in the field of CCA [5].

IPCC in 2014 defined CCA as "the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects" [6]. While UNFCCC refers to CCA as "adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change" [7]. UKCIP adopts a definition which is very similar to that of IPCC as "the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" [8].

To define adaptation, these three organizations use the same key term of an "adjustment" in response to the same stimuli of "actual or expected climate and its effects" to achieve the same aim of "moderate harm or exploit beneficial opportunities". So, the difference between the global organizations concerning CCA becomes simpler than it was in 2006 when Levina and Tirpak reviewed it. Accordingly, the adopted CCA definition in the current research is as follows (the process and its result of depending the appropriate adjustments in the human and natural systems to cope with climate change adverse impacts and invest its beneficial opportunities).

Urban green infrastructure support the aims of climate change adaptation. In general, the term 'infrastructure' is used to indicate the systems and structures built-up by human to provide many services. In the 1980s, some scientific opinions considered the natural ecosystems as an 'infrastructure'. That is because these ecosystems, in case of being healthy, also offer many services which are essential to human life. This type of natural infrastructure was known as 'green infrastructure' [9]. UGI was clearly defined in 2013 by the Department for Environment, Food and Rural Affairs (Defra); one of UK twenty-five ministerial departments. The definition states that UGI refers to "the planned network of living systems either within urban areas or located outside but affecting the quality of life in urban areas". This network includes all green spaces, water elements and environmental features founded within and surrounding an urban area. According to Defra, UGI was used to achieve the local target of the green economy [10]. Accordingly, this research aims to offer knowledge about the strategies of UGI planning as CCA in existing cities. To achieve this aim the 'methodology of learning by doing' will be employed.

2. Literature Review

The term 'strategy' refers to "a long-range plan for achieving something or reaching a goal, or the skill of making such plans" [11]. So, following the appropriate strategy assists in achieving the pre-defined aims. Planning UGI as a vital strategy of CCA should depend on certain strategies and steps.

Related to the planning strategies of UGI, there are some publications which were presented by Jack Ahern, a landscape architect and regional planner [12] [13] [14]. In these publications, he assured that selecting the appropriate strategy of UGI planning must depend on the analysis of the site ecosystems and the pre-defining of the planning goals. So, he presented four main strategies which are:

- Protective strategy: this strategy is usually adopted prior to change as a local green ecosystem is already working efficiently. It includes many protective measures to prevent natural elements' structures and functions from getting damaged by any future change. Accordingly, natural assets will be proactively preserved before occurring of any physical or functional alternations [14]. The protective strategy features by two main characteristics; the first is defining the most desirable areas and protecting them and, concurrently, defining the most suitable locations for development or human change. The second is that the protective strategy is a low-cost strategy as it depends on preventing harm instead of treating it. This strategy employs some polices to achieve its targets such as planning theories, law and regulation, significant land acquisitions, education and public awareness, etc. [13].
- Defensive strategy: this strategy is usually adopted when the local green ecosystem is already getting harm such as fragmentation, exhaustion, etc. It includes many defensive policies that reduce and control that negative impacts of current changes [15]. This strategy refers to the 'last opportunity' to deal with harm as it seeks to put the current impacts of change on the brakes. If the climate impact is inevitable, the defensive strategy will not be useful any more as its role limits just on delaying the certain negative impacts [16].
- Offensive strategy: this strategy is usually adopted when the local green ecosystem is deficient and cannot work efficiently. It includes many restorative and remedial policies which aim to strengthen the ecosystem structures and functions. This strategy depends entirely on the spatial planning that takes the site's natural and social character in its account. The offensive strategy is usually requiring high costs and having uncertain results. This strategy involves replacing the current intensive pattern of development (i.e. high urbanized areas) with an extensive pattern where green and open spaces are dominated on the landscape scene [13].
- Opportunistic strategy: this strategy depends on functioning all the non-contributing natural elements which can deliver many

ecosystem services. These elements, regardless of their location, can present good opportunities to counter the change. The potential sites can be founded as separated green corridors and patches. Accordingly, the opportunistic strategy will work on linking them in a useful network [13] [14].

It can be noticed that all proposed strategies are "landscape strategies". This conclusion was based on the following aspects:

- All mentioned strategies propose, regardless of their conditions, the existence of natural ecosystems in the site. The studies assured that defining the appropriate strategy of UGI planning depends mainly on the conditions of the site's ecosystems; what is the current and
- previous status of these ecosystems, and what is the opportunity to enhance their functions and services.
- No mention was noticed about the built-environment or existing cities; the researches spatial scale.

The literature review reveals that there is limited knowledge about the strategies of UGI planning in existing cities.

3. Methodology

Identifying the strategies of UGI planning in exiting cities will be conducted by using the methodology of 'Learning by doing'. This methodology represents a reliable research approach which proved its success in the landscape researches. Learning by doing refers to the process of extracting the theoretical knowledge from the practical experiences [14] [17]. This methodology involves three main processes which are:

- Exploring the strategy of UGI in each practice.
- Proceeding a cross-analysis between the strategies of UGI planning between the selected case studies.
- Concluding the common strategies of UGI planning in existing cities.

In light of being similar as existing cities with arid and temperate climate that followed clear strategies of UGI planning, three main practices were selected. They include Philadelphia in USA, Melbourne in Australia and Tucson in USA. Some practices were also explored to offer more knowledge about the common strategies of UGI planning.

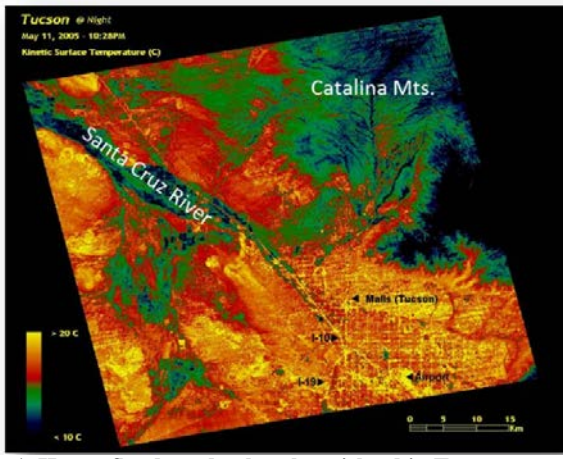


Fig. 1. Heavy floods and urban heat island in Tucson

3.1 Tucson, USA

Tucson is considered as one of the oldest settlements in USA as it dates back to about 2000 ago. Over time, it has developed from a small farming area to a huge urban city with about 520.000 population [18]. Most of the city's neighbourhoods are planned by following the network pattern (grid pattern).

In the first place, UGI was adopted to control floods and urban heat island (Fig. 1) [19]. Tucson's UGI strategy depends on the concept of 'stormwater harvesting' at the neighbourhood scale [20].

Although the primary target of adopting UGI strategy is to control floods, this strategy offers an integrated solution that can also provide many other services. These services include mitigating the urban heat island, increasing the green spaces ratio, supporting friendly environment transportation, etc. [19]. Urban heat island, for

example, has a high rate in the city of Tucson. This heat stress forms a real problem in the state of Arizona which witnessed the highest national rate of weather-related deaths since 1986 [21]. Trees, for example, can reduce the temperature of adjacent built surfaces by 4.45°C. Plants evapotranspiration can lower the air temperature in open green terrain and open suburbs which do not have trees [22].By detailing the potential risks of climate change, many maps have resulted. When these maps were overlaid, the priority places where UGI was needed became obvious. The most suitable spots to have UGI appeared where these maps intersected and overlapped. In general, Tucson's strategy of UGI depends on concentrating the assets in areas where rainwater usually collects instead of spreading them through the whole city [20]. The city UGI strategy includes many assets such as different types of native vegetation, surface mulch, heathy soil, vacant green plots, green street sides, in-street green assets and green parking lots (Fig. 2) ([20]. By reviewing some related publications [23] [20], it was found that most of these assets had previous grey functions as they related to the some grey infrastructure especially transportation. In addition to that, Tucson's UGI strategy was based on preserving nature in the sites of new development and protecting it in the sites of existing development [20].

Fig. 2. Heavy floods in Tucson

A- Native vegetation B- Surface mulch
C- Healthy soil D- Green vacant plots
E- In-street green assets F- Street green sides
G- Green parking

3.2 Philadelphia, USA

Philadelphia is the biggest city in Pennsylvania and locates at 40° 0′N and 75° 8′W at the eastern coast of USA [24] [25]. Originally, Philadelphia is planned by William Penn as a green country town. The city center, which dates back to the 17th Century, has a grid layout with an orientation of east-west and north-south. Within this grid, houses were separated by green squares to prevent the fire spread. This clear master plan cannot stop the parcels' division and the buildings' height increase [26].

UGI strategy was declared in 2019 to control the overflow of the combined sewer system. The combined sewer system, which serves about 48% of the city, refers to the sewer network that collects both of sewage and stormwater in the same tubes and carries them towards the water treatment plant to be reclaimed before discharging into the waterways. In case of moderate or heavy rainfall, the combined sewer system reaches its peak capacity and directly discharges sewage and stormwater into the city water bodies causing in clear water pollution (Fig. 3). The program of Green city- Clean water was identified to control this case of the combined sewer overflow.

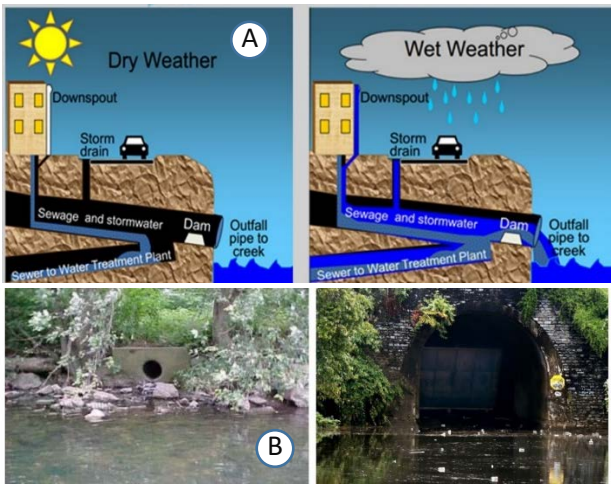


Fig. 3. Floods in Philadelphia

A- Work mechanism of combined sewer system in Philadelphia in dry and wet weather.
B- Rainwater discharge to Philadelphia waterways.

In addition to saving water quality and quantity, the Green city- Clean water program achieves multiple targets such as supporting the old local

infrastructure, controlling climate change other impacts, supporting sustainability and enhancing people well-being. So, this program lays the foundations to transform Philadelphia into a sustainable city [27].

Green city- Clean water program officially began in 2009. By 2035, this program envisions to transform about 35% or 10000 acres of the impervious land that is served by the combined water system to UGI or "Greened Acres". The green acer refers to a particular area of stormwater runoff from a given impervious surface that is controlled by UGI system instead of being directed towards the existing combined sewer system of Philadelphia [28]. This can be calculated by the following formula:

$$GA = IC * Wd$$

Where

GA: the green acres

I.C.: the impervious areas that were transformed into green infrastructure. This includes the area of UGI asset itself and the area served by it.

WD: the depth of the water that covered the impervious lands and managed by UGI.

UGI assets aim to control at least 1 inch of water; otherwise, it will be not feasible [29]. In general, Philadelphia UGI strategy consists of eight different "Green Programs" designed and managed to convert the city impervious lands into the Green Acres. These programs include green streets, schools, public facilities, parking, public open spaces, industry, alleys and homes (Fig. 4). The strategy also provides detail plans to restore and preserve the water stream corridors. By 2035, the target year of Green city-Clean water, over 80% of the impervious land should be converted to green acres [27]. So, these programs include a schedule of five-year plans to achieve this aim gradually [25].

In Philadelphia strategy, brownfield sites represent suitable opportunities to have new UGI within the urban context. UGI, in turn, can assist in converting the image of these sites that were previously used for industrial, commercial, store

Fig. 4. Green Programs in the city of Philadelphia
A- Green streets B- Green school C- Green public facilities D- Green parking
E- Green public open space F- Green industry
H- Green alleys I- Green homes

purposes and contaminated as a result of these uses [30]. An example of such type of UGI assets was the Kensington Creative and Performing Arts High School. It is one of the first components in the green city plan. This project's site was an industrial-contaminated that completely occupied by poor vagrants and unwanted pets. The location was also known as a suspicious area for recreational drug dealing and personal assaults (Fig. 4-B). A powerful youth concept presented to convert the site image from its original dangerous eyesore to a more environmental and social-friendly one. This concept was embodied in constructing a green high school with the minimum possible footprint and full on-site stormwater filtration [31]. This school's green elements formed the starting point for a wider UGI strategy at the city scale [32].

3.3 Melbourne, Australia

Greater Melbourne locates in the southern coast of south-eastern Australia. It is about at 37°49'S and 144°58'E, within the boundaries of Victoria state [33]. In general, Melbourne is featured by a low-density sprawl. In the city's inner areas, construction has predominantly occurred at medium density. Because there were no height limitations, Melbourne city center (CBD) and the surrounding areas have rapidly grown

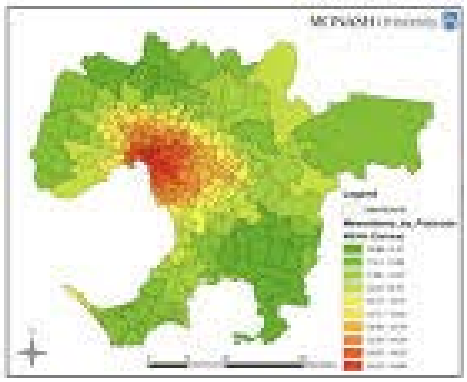
vertically. High skyscrapers dominate the city's skyline, turning it into Australia's most densely area [34].

In Melbourne, UGI strategy was planned to reduce the intensity of surface urban heat island (Fig. 5) [35]. It was found that surface UHI phenomenon has an intensity of about 4°C between Melbourne city center and the surrounding neighbourhoods. The leading causes of increasing temperature in Melbourne include the continuous vegetation loss, dense urban construction, impermeable surfaces increase, high anthropogenic heat, increased air pollution and high capacity and low albedo materials.

Melbourne's UGI strategy aims to reduce the surface radiation by reducing its temperature. This leads to mitigate the surface urban heat islands (SUHI). UGI strategy seeks to achieve this aim by increasing the green cover in the public spaces [36].

Many UGI assets were proposed for Melbourne. All selected assets have a clear effect of temperature reduction at the micro-scale climate [36].

The first represents the public open spaces such as parks, remnant areas, golf courses, and urban agriculture.



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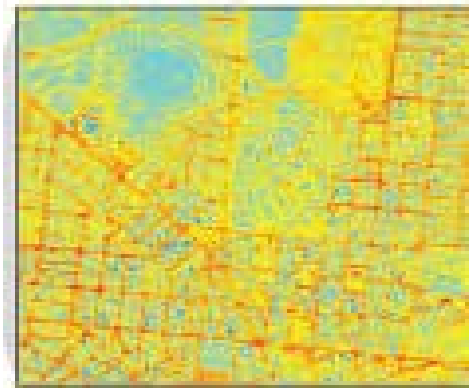

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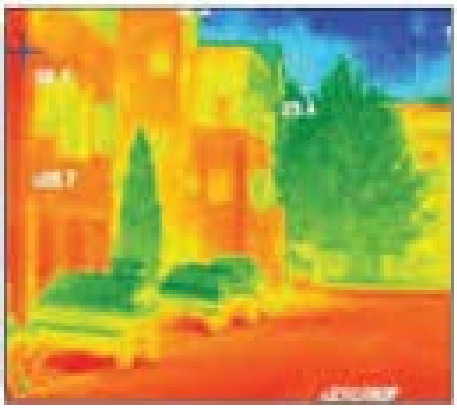

C

Fig. 5. Surface urban heat island in Melbourne

A- SUHI at the city scale using remote sensing techniques.
B- SUHI at the neighborhood scale using airborne thermal imagery.
C- SUHI at the street scale using a thermal camera.

Finding a space for this type of UGI asset is challenging and push to propose innovative solutions such as closing some quiet streets and converting them to small public parks. Others assets include street trees, green roofs, vertical greening system, pervious ground cover. Some additional supplementary assets were also included in the city's UGI strategy such as bio filters, rain gardens and vine-covered walkways. Melbourne's UGI strategy was mainly based on the concept of retrofitting the surface cover from built, impervious, low albedo and high heat storage to natural, filtrated and evaporation-allowed surfaces. This concept proposes many modifications in the existing urban fabric. It aims to retrofit streets, sidewalks, buildings, parking, etc. with intensive vegetation [36].

3.4 Urban Green Infrastructure in Other Practises

In this section, a quick view would be conducted about the employed UGI strategy in many cities around the world. In Menomonee valley in Wisconsin, USA, UGI strategy depends completely on greening the grey river bank. Menomonee valley industrial center and Community Park was considered as one of the most innovative examples of the greening riverbank, brownfield and vacant lands. In original, wetlands were the main theme of this site. In the late 19th century, the site was completely landfilled to establish a new highway road and offer more lands. Since then, the area was intensively used by the companies of railcars and locomotives industry. After companies' closing in 1985, the site was abandoned with hundreds of vacant buildings and acres of contaminated soils [37]. An innovative UGI master plan that balances the social, environmental and economic requirements intelligently was employed to redevelopment the site (Fig. 6). The site is converted to a home for 11 industrial buildings located at a wide green park [38].

Fig. 6. Menomonee valley industrial center and community park in Wisconsin

On the other hand, some more audacious examples of UGI strategy were employed to completely change the current land use to be ideal green activity. In Seoul, South Korea, a major highway of 5.84 km was converted into an ecological stream park (Fig. 7). Many alternative means of transportation was offered and supported. To construct this highway in 1967, Cheong Gye Cheon River had landfilled and covered. Accordingly, the redevelopment plan presented a pragmatic shift in the urban administration by restoring the original river and convert the heavy traffic line into an ecological park [39].

In addition to that, there are specific strategies that appeared in some famous practices of UGI. For example, in Stuttgart, all buildings, routs and means related to transport were greened even cars and buses [40]. In another example which is Québec, Canada, it was recommended for greening the car parking. That is by planting trees at the parameter and within the parking lots. Besides that, all the asphalt surface should be replaced by a mix of concrete, PVC and some other materials that allow plants to grow [41].

Fig. 7. Cheong Gye Cheon Restoration project

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4. Cross-Analysis

To define the common strategies of UGI planning in existing cities, a cross-analysis was conducted between UGI strategies of the three selected practices. This analysis dealt with the following aspects:

- The definition of UGI strategy: the key terms of the adapted definition of UGI strategy are not typical or unified. In Philadelphia practice, UGI was defined as a group of soil-water-plants systems.
  In Tucson practice, it was stated as some constructed elements which employ natural systems, while in Melbourne practice as a connected network of natural and human-added vegetation. This assures that there is no single definition for UGI, but there is an agreed concept from which UGI definition was usually generated. This concept refers to the employment of nature to deliver multiple services.
- The type of UGI strategy: in Philadelphia, there are eight UGI assets which are green streets, schools, public facilities, parking, public open spaces, industry, alleys and homes. With an exception to public open spaces, all UGI assets had previous grey land uses and vegetation and natural elements were injected within them. In Melbourne, there are five proposed UGI assets which include public open spaces, street trees, green roofs, vertical greening system, and pervious ground cover. Four of these assets depends on retrofitting grey land uses with vegetation. The matter is similar in the practice of Tucson as all seven adopted UGI assets were injected within the transport land uses.
- The vision of UGI strategy: in all case studies, UGI strategies were declared as general planning vision with a specific sonorous name such as 'Green city- Clean water', 'harvesting the water', etc.
- The aim of UGI strategy: although UGI can achieve multiple purposes, it was noticed that UGI strategy in each case study involves a well-defined aim such as a desirable reduction rate of overflow or surface temperature.
- The opportunities of UGI assets: in the selected practices, most of UGI assets were added to the public land uses such as streets, parking, public building roofs and walls, etc.

The cross analysis reveals that, in general, there is a great deal of compatibility between the strategies of UGI planning as CCA in existing cities.

5. Extraction of Results

Based on the previous cross-analysis, some results about the strategies of UGI as CCA in existing cities were extracted. These results are represented in the following aspects:

- Urban green injection: UGI strategy, in existing cities, depends mainly on injecting the green and blue assets in different grey land uses such as the public buildings, streets, parks, etc. So, UGI planning strategy as CCA in existing cities can be called 'Urban green injection'. It is preferable to plan and design green infrastructure before starting the construction of any other grey components. In general, it was found that the cost of restoring UGI assets is much higher than the cost of its protection and enhancement. In addition to that, the human-made UGI networks cannot act so effectively like the original ones which develop and grow over time [42]. This does not mean that UGI cannot be used in existing cities that have already witnessed many development stages. But in this case, adopting UGI can be achieved by injecting the green and blue assets within the urban context.
- Planning for achieving the target function: UGI planning should perform an exact primary function. The other functions can be considered as supplementary benefits. This enables all involved stakeholders to directly measure and evaluate the UGI real effectiveness in achieving the target function. The additional functions presented by urban green injection increase this strategy's merit and make it more preferred than others of CCA.

- Starting up with public properties: urban green injection starts up with the public or city-owned properties. This can make UGI strategy more applicable and always under high control. Public or capital projects can act as demonstrating projects that assist in raising community awareness about UGI importance as a necessary type of infrastructure. So, most of UGI strategy are starting up with public properties. In private properties, regulation, incentives, grants and billing programs can be adopted to encourage the use of UGI assets.
- Depending on the site analysis: urban green injection relies on studying what the site offers of opportunities to inject the green and blue elements. In general, most of the urban public land uses can be converted to new UGI assets. So, a trade-off between the available opportunities and their potential UGI assets should be conducted. The urban green injection also depends on many site-related aspects such as the cost and funding, local laws and regulations, community cooperation, etc. To have a pragmatic strategy of urban green injection, defining the most suitable opportunities should be conducted according to both local incentives and constraints.
- Depending on innovation: urban green injection depends on the innovation to find the right method to green the available opportunities that are context-related and vary significantly from site to site.
- Having a clear vision: UGI project should be declared with a clear planning vision and a sonorous name. This will grant the strategy a unique character in the people mind. Having an effective name also helps in announcing and marketing the UGI strategy.

6. Conclusions

The current research aimed to offer knowledge about the strategies of UGI planning as CCA in existing cities. By using the methodology of learning by doing, it was proposed that these aspects of knowledge can be extracted from the UGI real practices. Based on the cross-analysis that was conducted between the selected practices, it was found that:

- Urban green injection represents the most employed strategy of UGI as CCA in existing cities. It refers to inject different natural assets within the traditional grey uses.
- Urban green injection should be planned to achieve a well-defined target.
- Urban green injection should begin in public properties.
- Urban green injection depends mainly on a comprehensive study of the site's incentives and constraints.
- Innovation plays an essential role in having an urban green injection that fits with the site's incentives and constraints.

In addition to that, it can be concluded that the strategy of urban green injection can extend to include almost all grey land use. So, UGI can be employed in densely cities by sharing the positions with grey infrastructure such as buildings, roads, planets, etc. Within the city master plan, these positions will have two land use; one is part of the conventional grey network and the other is a modern green infrastructure. These assets form the points where city infrastructure overlap. So, UGI assets cannot be limited to a certain fixed number as they depend on the opportunities that the context offers to inject the green and blue assets.

As a result, the strategy of urban green injection seeks to increase the city's green and blue percentage and convert the land use traditional character to a more sustainable one. Adopting such a strategy already employed in different cities and subjected to repeated evaluation guarantees success. That is by avoiding the potential loss of cost or time and thereby building the new strategy that depends on what has proved its worth. Such strategy offers an applicable method to plan a vital UGI in any city. So, future researches are required about the possibility of employing the strategy of urban green injection in Iraqi cities such as Baghdad city.

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A Review of COVID-19 Diagnosis and Detection Using Artificial Intelligence

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Abstract: Coronavirus has received widespread attention from the community of researchers and medical scientists in the past year. Deploying based on Artificial Intelligence (AI) networks and models in real world to learn about and diagnose COVID-19 is a critical mission for medical personnel to help preventing the rapid spread of this virus. This article is a brief review of recent papers concerning about detection of the virus; most of the schemes used to detect and diagnose COVID-19 rely on chest X-Ray, some on sounds of breathing, and by using electrocardiogram (ECG) trace images, all these schemes based on artificial neural network for early screening of COVID-19 and estimating human mobility to limit its spread. In some studies, an accuracy rate that was obtained exceeded 95%, which is an acceptable value and that can be relied upon in the diagnosis. Therefore, currently screening tests are better in terms accuracy and reliability for diagnosing patients with severe and acute respiratory syndrome coronavirus, frequently the most used test is the (RT-PCR).

Keywords: Neural network, Coronavirus, COVID-19.

الخلاصة: حظي فيروس كورونا باهتمام واسع من مجتمع الباحثين وعلماء الطب في العام الماضي. يعد النشر استنادًا إلى شبكات ونماذج الذكاء الاصطناعي (AI) في العالم للتعرف على COVID-19 وتشخيصه التي تعتبر مهمة حاسمة للعاملين في المجال الطبي وللمساعدة في منع الانتشار السريع لهذا الفيروس. هذه المقالة هي مراجعة موجزة للبحوث الحديثة المتعلقة بالكشف عن الفيروس ؛ تعتمد معظم المخططات المستخدمة لاكتشاف وتشخيص COVID-19 على بالأشعة السينية للصدر، وبعضها على أصوات التنفس ، وباستخدام صور تتبع مخطط القلب الكهربائي (ECG) ، كل هذه المخططات تعتمد على الشبكة العصبية الاصطناعية للفحص المبكر لـ COVID-19 وتقدير تنقل الإنسان للحد من انتشاره. في بعض الدراسات ، تجاوز معدل الدقة الذي تم الحصول عليه 95٪ وهي قيمة مقبولة ويمكن الاعتماد عليها في التشخيص. لذلك ، تعد اختبارات الفحص حاليًا أفضل من حيث الدقة والموثوقية لتشخيص المرضى المصابين بفيروس كورونا المتلازمة التنفسية الحادة, وغالبًا ما يكون الاختبار الأكثر استخدامًا هو(RT-PCR) .

1. Introduction

In recent years, the Coronavirus (COVID-19) has caused serious impacts on the health care system especially and the global economy in general. Doctors, researchers and experts are interested in finding alternative methods for rapid and accurate detection of this virus and are attempting to develop automatic detection systems for COVID-19. Detection methods play an important and dangerous role stopping its spread in treating patients. Subsequently, many medical scientists and researchers have looked for new techniques to detect diseases more accurately and quickly [1].

Advances in AI (artificial intelligence) in biomedical applications have helped in the development of networks trained to make reliable computer-aided diagnostic decisions and thus reduce stress from healthcare facilities (doctors, healthcare staff, etc.)[2].

Several literature studies have described the application of computer technique and Deep Learning (DL) in diagnosing disease based on medical images since COVID-19 has become widespread, with promising results.

The Computer-aided diagnosis (CAD) systems combine advanced technologies in computers hardware with modern image processing algorithms to perform diagnostic tasks, e.g. the segmentation of tumor and 3D imaging of vital organs[3][4].

Recently, AI has been widely used to obtain accurate diagnosis in many CAD systems fin the field of various medical applications such as brain tumor segmentation and classification [5][6], minimally invasive aortic valve implantation[7], and lung disease detection [8] [9]. Deep learning approaches have become the most advanced approach in the studies that rely on AI. However, SC (Soft computing) technologies, such as; Fuzzy logic, genetics and neural networks have been proven to be as potential tools for detecting the disease [10][11]. These tools can support in decision-making, provide appropriate treatment for patients [12]. Although several mechanism have been suggested to diagnose COVID-19 infection; however, high accuracy has not yet been reached. Figure 1 shows the different diagnostic technique.

The lack of accurate diagnosis or preventive measures led to an increment in the number of infections of infection and an increase in the cost of hospitalization. This was to urge medical industries and scientists around the world to find accurate COVID-19 detection for early preservation, screening, diagnosis, drug improvement and tracing the contact to provide more time for the medical scientific community and health care cadres to reduce the death rate of COVID-19.

Recent reviews showed that the use of new technology in along with AI and machine learning (ML) technologies greatly speeds up diagnosis, screening, tracking, prediction, and progression of vaccines with high reliability.

The field of medical imaging has particularly emerged in recent years in providing reliable automated methods for clinical decision-making and has been widely accepted by scientists and personals in the medical field. In diagnostic case of COVID-19, CT scan and X-ray can have an essential and important function in early detection for the disease. Where X-ray is an effective screening and classification method; it is quick to pick up, less expensive than RT-PCR and widely available worldwide. Additionally, CT scans can be obtained faster and more accurately with an efficient algorithm (particularly deep learning algorithms) to accurately identify affected patients [13].

CT and X-ray imaging have seen wider application in detecting COVID-19 while RT-PCR tests have low sensitivity in medical and clinical examinations. Various studies demonstrated the avail of using CT or CXR by improving the outcome of COVID-19 detection in a clinical scenario. Because of the limited sensitivity of the RT-PCR technology, it necessitates refined negative tests, leads to kit

shortages or unobtainable in certain parts of the world [14]. Furthermore, detection of the disease in its early stages can lead to false-negative results from CT scan. Although CT can become the modality of choice for COVID-19 detection [15], lung US has recently received attention due to the fact that US machines are widely available and comparatively inexpensive, with the enhancing benefit of being safe and disinfected easily in busy centers with lung ultrasound (US).

Although, recent studies recommended avoiding the use of diagnostic images or ruling out COVID-19 because it produces false cases both positive and negative [14]. For the limitations of the X-rays to be overcome, CAD systems have provided a practical solution by assisting the radiologists to detect the potential diseases accurately in low-resolution X-ray images [16].

Additionally, classifying the respiratory sounds have received decent interest by scientists in medical area and research community last year to diagnose COVID-19 virus based on AI models from patient's sounds such as speech, breathes and cough).

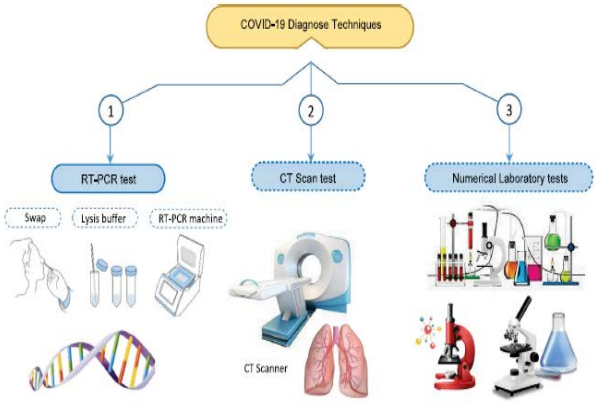

Fig. 1. Diagnosis techniques of Covid-19[17].

2. Literature review

J. Sharma et al. [18] Obtained highly accurate model by classifying the sounds from US8K and ECS-10 datasets using DCNN with channels including ;(multi-feature (MFCC), Chroma gram, GFCC, QCT (Constant Q-Transform)). The proposed model for classifying lung sounds, which was implemented on grouped respiratory sounds by using a digital stethoscope and achieved accuracy, is about 80% for classified sound on the respiratory system and 62% for classifications by audio. The proposed model was improved to achieve better accuracy by using the CNN model and channels multiple features including; (De-noising Auto Encoder, GFCC, and IMFCC) to provide an accurate diagnosis based on a sound crowdsourced dataset.

Kranthi Kumar et al,[19] a DCNN model was proposed to classify the signs of respiratory sound specifically into normal and abnormal cases depends on voice, cough, and sounds of breathing to detect COVID-19 infection. The implemented system obtains the depth features of respiratory voice/sounds by using IMFCC (Improved Multi-frequency Cepstral Coefficients), (DAE) De-noising Auto Encoder technique, and (GFCC) Gamma-tone Frequency Cepstral Coefficients. DCNN transforms the DAE input features; pooling activity is carried out using IMFCC, and GFCC techniques. The processed signal is categorized by using (Softmax) classifier. The DAE is used to extract features of patients voice signals by remove the mummer sounds from background, the IMFCC extracts important features from sounds of respiratory, and the GFCC extracts the transient features from the respiratory sound. Thus the utility of the fundamental function for that study is thus demonstrated. The implemented model approaches around 95.45% accuracy which is better than that of previous work.

Tawsifur Rahman, et al. [20] was the first study explores the ability of using electrocardiogram (ECG) trace images to detect COVID-19 infection using DCNN models. The study used a generic dataset of ECG scans that included 1937 images divided into five divisions: normal, COVID-19, Myocardial Infarction (MI), Abnormal Heartbeat (AHB), and Recovered Myocardial Infarction (RMI). Alternative categorization strategies investigated using six various DCNN models (ResNet18, ResNet50,

ResNet101, InceptionV3, DenseNet201, and MobileNetv2. Schemes of divisions classified into five-classes (normal, COVID-19, MI, AHB, and RMI), two classifying classes (normal vs COVID-19), in addition to three classifying classes (normal, COVID-19, and other CVDs). For each categorization scheme, six CNN models had been trained and tested to improve its validation and to identify irregularity for various ECG images. Figure 2 shows an overview of this methodology. The two and three classification networks reached accuracy about 99.1%, and 97.36%; while the accuracy of five classification network 97.83% was achieved.

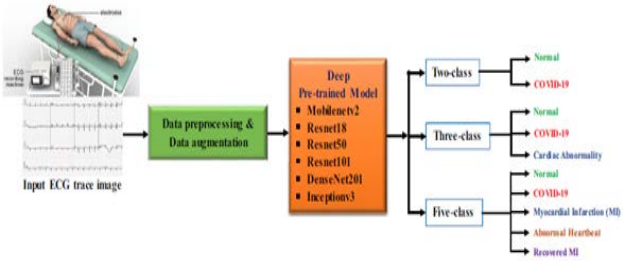

Fig. 2. An overview of ECG based methodology [20].

For CAD based on lung computed tomography (CT) images, many CNN-based approaches were developed. However, the appearances, sizes, and positions of pneumonia lesions in CT scans vary widely; in addition symptoms for COVID-19 in CT scan are likewise comparable to different kinds of viral pneumonia, preventing further advancement of CNN-based approaches. Manual delineation of infection areas is a solution to this problem, however due to the heavy workload of medical staff and physicians through the epidemic, manual delineation is challenging. Bin Xiao et al. [21] suggested a CNN termed PAM-Dense Net (Parallel Attention Module with dense connection network), that can implement coarse label well without requiring to delimit the infected zones manually. The PAM learned to simultaneously reinforce the characteristics informality from both channel and spatial perspectives allowing the network paying greater attention to infected zones without needing manual segmentation. The model provides direct connections between previous layers and all subsequent layers; the dense connectivity structure performs feature map reuse, allowing for extracting exemplary features from fewer number of CT slices. To obtain a suitable model for slice wise prediction, the proposed network was trained firstly using 3530 CT images for lung picked from 382 COVID-19 CT images, 372 lungs CT scan with infections by deferent pneumonia, and 200 normal lungs CT scan. Then researchers applied the pre-trained model to a CT scans dataset contained 93 normal lung scans, 93 other pneumonia CT scans, 94 COVID-19 CT scan and achieved a patient wise predicting using polling mechanism. The suggested network obtained 94.29% impressive accuracy, about 93.75% of precision, 95.74% of sensitivity, and about 96.77% of specificity, that is equivalent to techniques based on manual drawn of infected regions. The appearances, sizes, and positions of pneumonia lesions in CT scan vary widely and the presentation of COVID-19 using CT images is similarly comparable to other various species of viral pneumonia, hampering future advancement of CNN-based approaches. The module is based on a self-learning mechanism which allows the network to improve extracting the informative characteristic. The suggested attention module in this paper is PAM, which is able to learn to both strengthen and suppress features from channels at the same time spatially. The PAM instructs the network to pay more awareness to infected regions in lung CT images, improving performance without the need for manual demarcation.

A novel Hybrid Diagnostic Strategy (HDS) based on laboratory findings of the patient was introduced in Warda M. Shaban et al. [17] employed an unprecedented method based project the ranking features into a virtual Patient Space (PS). A Feature Connectivity Graph (FCG) was created to obtain the weight and the degree for each feature as related to

other features. A feature's rank is determined by two factors: the weight of the feature and its degree of binding to its neighbors in PS. The elements after being ranked were employed to develop a classifying model which can identify new persons and determine whether they were infected before or not. The classifying model was mix of two classifiers: the Deep Neural Network (DNN) and the fuzzy inference engine. Recent techniques have been compared to the planned HDS. The HDS model that was proposed outperforms the competitors related to many parameters such as its accuracy, precision, recall, and F-measure. According to experimental data, the model provided an accuracy of 97.658%, precision of 96.756%, recall of 96.55%, and F-score of 96.615%. Furthermore, HDS had 2.342% an error rate which is the lowest. Statistically, the results were confirmed by the use of two tests Wilcoxon Signed Rank and Friedman. To implement the proposed diagnostic model, Fuzzy Logic (FL) was chosen as the soft computing approach for the many reasons, first fuzzy algorithms are reliable and simple allowing saving computing power, second reason the fuzzy techniques typically take less time to develop than traditional methods especially for online diagnoses detection applications. Third, the FL is simple and flexible to implement ML approaches. Alternatively in FL, it is difficult to specify the values for the membership of fuzzy systems and to store abase storage since it requires a considerable amount of memory. Additionally, FL needs to be carried out with a complete guide of experts.

Address the latest global forecasts for the COVID-19 pandemic. Every country around the world faced this epidemic differently, which was dependent on the statistical number of confirmed cases and deaths. Forecasting the number of confirmed infected cases and deaths may anticipate the future number of infections and provide each country with requisite information to help make decisions depends on expectations. Patricia Melin, et al, [22] built a Firefly Algorithm (FA) that ensemble the architecture of the neural networks for each of the 26 countries. The proposed FA optimized to ensemble NN that applied to time-series prediction of COVID-19 using FL (type two) based on weighted mean integration method. That method determines the number of ANNs required forming a collective neural network and its architecture based on type two FL inference systems to integrate the individual responses of ANNs to make a latest accurate prediction. The type two weighted mean integration approaches has benefits over the traditional method type one weighted mean integration.

Lung ultrasound (US) is properly an effective test for detecting COVID-19, due to easily operation with least protective equipment and ease of disinfection. New, based DL COVID-19 diagnostic model are not easy to be deployed for common use mobile platform. Navchetan Awasthi, et al, [23] researchers developed an easy to use mobile technology, functional DL algorithm for COVID-19 diagnosis by the use of lung US images included three specified classification (COVID-19, healthy , and pneumonia). The developed network, called Mini-COVID Net, was distinguished from other lightweight NN models. The achieved accuracy by the implemented network was 83.2% the time of training required is only 24 minutes. The Mini-COVID Net had fewer network parameters by 4.39 times comparable to next best performing network and required only 51.29MB of memory, which makes diagnostic model using US lung imaging feasible on mobile platform. The developed lightweight network (Mini-COVID Net) can be deployed on embedded platforms; it is versatile, offers optimum resolution performance and having frequent response for the same order. Developed Mini-COVID Net model is available on (https://github.com/navchetan-awasthi/Mini-COVIDNet.).

Aayush Kumar et al. [24] introduced SARS-Net, CADx system for COVID-19 recognition using chest X -ray (CXR) images that combine Graph Convolutional Network and CNN. Extensive testing revealed the suggested SARS-Net model outperforms state-of-art methodologies and achieves the best outcomes among all other proposed networks. The SARSI-Net is a hybrid method that incorporates the SARSI-Net CNN model with the 2L-GCNI model. SARS-Net CNN assists in the extraction of image-level features, while GCN assists in the extraction of relation-awareness features. The proposed model achieved 97.60% accuracy and 92.90% sensitivity in the validation set. Implementing automatic detection of COVID-19 enables faster treatments and enhances the recovery rate, and as a result improves people's overall health. CAD-X systems able to help medical care services and decrease the refrain from physicians and radiologist to develop countries having restricted health care services.

Prottoy Saha et al. [25] by analyzing chest X-ray images, an automated detection mechanism called EMC Net proposed to identify COVID-19 patients. To extract the high level features from X-ray images of patients infected with COVID-19, a CNN was formed with a focus on model naivety. COVID-19 was detected using ML classifiers including (randomly forest, support vectors machine, decision trees, and Ada Boost). The outputs of these classifiers merged to create a crew of classifiers; results improved for varying sizes and different resolutions dataset. EMC Net performed better compared to DL based systems, its precision is 98.91 %; its recall is 97.82 %, and its F1-score is 98.89 %.

Murukessan Perumal et al. [26] inception Nasnet (INASNET) is a proposed model that can divide and categorize X-ray pictures into (normal, infected, and infected pneumonia) classes. The testing technique cheaper compared to testing kits used for diagnosing the disease by the healthcare workers. INASNET is built on a platform that combines Inception Net and NN Architecture; searching would result in more accurate and faster-predictions. INASNET efficient and achieved an accuracy rate of 0.943 compared with DL models. The INASNET model trained with complicated datasets and was optimized using batch normalization and a dense layer which improved the efficiency of detection.

Muhammad Umer et al. [27] presented the usage of a CNN for prognosis using features extracted from X-ray images of the chest. The model used three extracting filters which aid in obtaining the segmented target with the contaminated X-ray area. Ten thousand augmented photos generated by using Keras' Image Data Generator class to overcome decreased amount of training dataset. Classification was done with two, three, and four classes, with X-ray images for people diagnosed with COVID-19, normal, viral-pneumonia, and bacterial-pneumonia. The results showed that the CNN model is capable of accurately predict COVID-19 cases. The accuracy of the implemented two, three, and four classification classes were 0.97, 0.90, and 0.85, respectively. Figure 3 shows the architecture of the proposed approach.

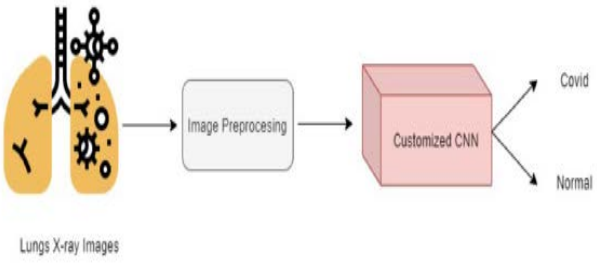

Fig. 3. Architecture of the model. [27]

Kamal KC et al. [28] a comprehensive evaluation provided for eight previously trained models. Training and testing of these models were applied on chest X-ray images belong to five various classes, contains 760 images. The finely tuned models, which were previously

trained in the ImageNet dataset, were functional and computationally accurate. Controlled Dense Net121 had a 98.69% of accuracy and a 0.99 of F1 score for four classifying classes. Only 62 % parameters were retrained to obtain such accuracy, according to the data. The work created and compared the performance of various deep learning models and transfer learning approaches on CXR pictures for COVID-19 classification while keeping computational demands low.

Mohamed Esmail Karar et al. [16] used three cascaded DL classifiers to offer a new framework for the automatic CAD to diagnose COVID-19, viral, and bacterial pneumonia on CXR images. In comparison to prior studies, the implemented cascaded classifiers make promised results when used with the VGG16 model to confirm affirmative COVID-19 cases. The ResNet50V2 and DenseNet169 models correctly detected both viral and bacterial diseases. The major object of that study is to automate the segmentation of COVID-19 infections on chest X-ray scan. Segmentation task would be greatly assisting the clinician in monitoring disease progression in infected patients' lungs. The VGG16 and ResNet50V2 models showed classification and performance accuracy of 99.9% in identifying COVID-19 cases.

Qiuchen Xie et al. [29] a DL model trained with 563 chest CT scan for 380 patients (227 out of 380 cases diagnosed with COVID-19), the CT images collected from five hospitals. Firstly, extracting Lung regions using U-net, then these regions transformed to be fit with ResNet-50 based on IDAN1-Net (Identification and Analysis of Network). Five validation cross points were used to verify the accuracy of the model results. Additionally 318 scan from 316 patients (243 out of 316 with COVID-19 cases) were included prospectively scanned as RWDs to indicate the performance of DL model and compare with three experienced radiologists from two other hospitals. As a Result a three-dimensional DL model was formed. The diagnosing accuracy of COVID-19 infection was 95 %.

Saeed Sani et al. [1] Used chest CT images to diagnose and treat lung disorders, such as viral-pneumonia. The advantages of CT scanning as compared with molecular diagnostic tests are several indications including shorter turnaround time; includes more details about pathology information and quantification of lesion size and lung involvement, which have substantial consequences for prognosis. A novel neural network was introduced for COVID-19 data and detection methods utilizing chest CT to distinguish the symptoms. To enhance the accuracy, a mathematical model was applied, and high-precision Hopfield Neural Network (HNN) was used to identify symptoms. The HNN was trained on a dataset which includes 12 patterns of CT scan, and it was evaluated with 295 CT images from three separate datasets. The model's sensitivity and specificity were 97.4 % and 98.6 %. In addition, the model was able to diagnose the community acquired pneumonia with sensitivity of 97.3 % and specificity of 9.5 %, while its ability to diagnose non pneumonia patients with sensitivity of 100% and specificity of 98.5%.

Amiya Kumar Dash, et al. [30] Also presented a new diagnostic framework of COVID-19 by replacing the proven previous model VGG-16 with fully connected layers with weights initiated randomly based on DCNN. The model learned the discriminatory features, colors, geometric changes, namely, objects and shapes. The VGG-16 was considered as a source base model to classify the patients for training the deep convolutional neural network. The suggested model produces an accuracy of 97.12%, sensitivity of 99.2% and specificity of 99.6%. A fine-tuned model VGG-16 framework also recommended providing a complete solution that is, the input is a CT scan image and the output is a COVID-19 or non-COVID-19 diagnosis with a highly sensitive

rate. The benefits of this model that there are no technical requirements to extract the features from CT scan, inexpensive, and can be a useful tool for assisting radiologists with diagnosis.

3. Discussion

Generally, most of studies focused on two known images, X-ray and CT scan. The most favorably is X-ray because of it is availability; its low memory space, easily accessing public databases and high accuracy results which encouraged researchers to use it. CT images provide many cross-sections for the chest area therefore radiologists can simply recognize patients but CT images are more complicated than X-ray images. It's highly necessary to compare the results for the studies associated with data acquired from several various centers; otherwise, produced sensitivity and accuracy for these studies would be misleading.

Alternative approaches are vital in diagnosis of COVID-19, that it is possible to save more patients' morbidity and mortality real-time systems of diagnosis and detection based on online scanning systems installed on computers or mobiles.

ML algorithms also used by extracting part of the features of deep learning models that improves the performance of the approach.

Despite various studies based on DL approach, it is difficult to provide sufficient and reliable models. Accordingly, many factors affect the results.

Alternatively, diagnosing COVID-19 is now being performed on the coughing sounds and breathing sounds of the patient instead of relying on computed tomography and X-Ray or CT imaging.

Because of all these methods of diagnosing and exanimating voices, it is predicted that detecting COVID-19 patients will highly accurate and stable. Many researchers have achieved a high level of reliability with accuracy crossed 98% and thusly can be dependent in helping healthcare workers and this will open a new broad employing of using AI in the medical sector.

4. Conclusion

Early detection and diagnosis of COVID-19 is vital in the process of preventing spread of the disease, for that a lot of researches conducted to find the fastest and the cheapest method to detect Covid-19. This review covered three main kinds of researches dealing with cardio diagnosis using electrocardiogram (ECG) trace images, chest X-ray diagnosis, and sound diagnosis. Most of researches were concentrating on chest x-ray since it is relatively an effective screening method; it is pick up fastely, cheaper as compared to RT-PCR test and available widely worldwide.

Ultimately, the lack of sufficient information about COVID-19 and the speed of its spread made analyzing the severity of the disease are difficult. The accuracy of the data can be useful and important for categorizing the severity of COVID-19, working more efficient and choosing more suitable and appropriate treatments.

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Cost-effective Automatic Hand Washing System

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Abstract: According to World Health Organization recommendations, people should wash their hands regularly, with soap and water for at least 20 seconds. After that, people should avoid touching surfaces. Several hand sanitizer machines were released in markets. These devices are nothing new, but they all sharing the same problems: (1) They all are expensive and not all people were able to buy them in their houses; (2) They all use a sanitizer which is not as effective as soap and water. In this paper, an automatic and cheap hand washing system, based on soap and water, is designed and implemented using simple and low cost components. The proposed system has two parts: one should be connected to the main water faucet and another must be put nearby. This system keen on reducing any virus transmission, helping people to wash their hands properly without touching the water faucet and reduce rationalize water consumption. A microcontroller is used with some sensors and simple parts to build the system. A sensor will detect hands approaching and automatically allow liquid soap flowing. After 20 seconds, a sound will alert the person that the washing time has expired. Also another sensor will check hands approaching to the water faucet. If so, then the system will allow water flowing.

Keywords: Arduino UNO, COVID-19, IDE, IR, TIP120, WHO

الخلاصة: وفقًا لتوصيات منظمة الصحة العالمية، يجب على الناس غسل أيديهم بانتظام بالصابون والماء لمدة 20 ثانية على الأقل. بعد ذلك، يجب على الناس تجنب لمس الأسطح. تم إطلاق العديد من آلات تعقيم اليدين في الأسواق. هذه الأجهزة ليست جديدة، لكنها جميعها تشترك في نفس المشاكل: (1) جميعها باهظة الثمن ولم يتمكن جميع الناس من شرائها في منازلهم (2) يستخدمون جميعًا مطهرًا غير فعال مثل الصابون والماء. في هذه الورقة، يتم تصميم وتنفيذ نظام غسيل يدوي آلي ورخيص، يعتمد على الصابون والماء، باستخدام مكونات بسيطة ومنخفضة التكلفة. يتكون النظام المقترح من جزأين: يجب توصيل أحدهما بصنبور الماء الرئيسي والآخر يجب وضعه في مكان قريب. يحرص هذا النظام على تقليل انتقال أي فيروس، ومساعدة الناس على غسل أيديهم بشكل صحيح دون لمس صنبور الماء وتقليل ترشيد استهلاك المياه. يتم استخدام المتحكم الدقيق مع بعض المستشعرات والأجزاء البسيطة لبناء النظام. سيكتشف المستشعر اقتراب اليدين ويسمح تلقائيًا بتدفق الصابون السائل. بعد 20 ثانية، سينبه الصوت الشخص إلى انتهاء وقت الغسيل. كما سيقوم مستشعر آخر بفحص الأيدي التي تقترب من صنبور الماء. إذا كان الأمر كذلك، فسيسمح النظام بتدفق المياه.

1. Introduction

To prevent infection with any virus or bacteria, people must wash their hands regularly beside other conditions according to World Health Organization (WHO) recommendations. Washing hands in the right way is an important issue and not all people are committed to it. Many studies were established to shed light on this topic. Some studies found that 63% of students washed their hands, 38% used soap, and 32% washed with soap for more than 5 seconds, but only 2% washed their hands with soap for more than 10 seconds [1].

Another study found that only 3% of people are washing their hands correctly or maybe some of the top 1% are doing it wrong [2]. In 2013, Michigan State University researchers make another study and found that 7% of women and 15% of men didn't wash their hands at all, and the men who did wash, half never used soap, whereas 22% of women skipped the soap. The observations found that only 5% of sample people washed their hands long enough, and with soap, to kill the germs that cause diseases [3].

All the results of these studies were gross. There were many times in which people need to wash their hands. And now with the spreading of COVID-19, there must be more attention for this topic. Many companies tried to focus on this subject and produce an automatic hand sanitizer devices. These devices were very expensive and it is difficult for people to get those [4]. Another issue with these machines, they based on using a sanitizer for cleaning the hands, which will only work if it contains at least 60% alcohol. According to the Centers for Disease Control and Prevention (CDC), alcohol- hand sanitizers may help in reducing the amount of germs and bacteria on the hands, but they do not kill all types of bacteria, especially if the hands have dirt and grease, so should not be used to replace hand washing with soap and water [5][6].

2. The Proposed System

The block diagram of the proposed automatic hand washing system is shown in Figure 1. A microcontroller is completely controlling the system. When a human's hand approaching the soap liquid, it will automatically flow and then the water faucet also will flow to make a lather and help in washing the hands easily. After 20 seconds and if the hand detection system recognizes an imminent approach of the hand to the water faucet, then the water will flow again much longer than the first flow in order to wash the hands thoroughly from soap. This algorithm is performed with the help of sensors, motors, buzzer and water solenoid valves.

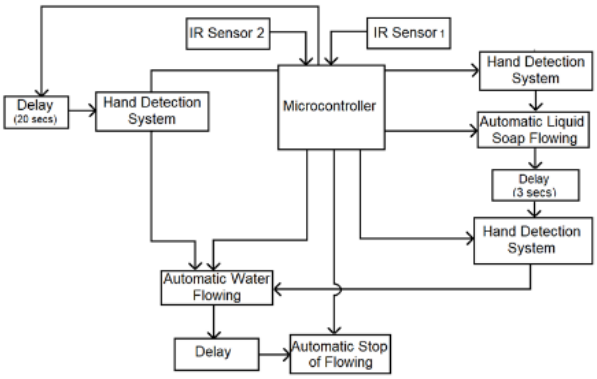

Fig. 1. Block diagram of the proposed automatic hand washing system

3. System Design Components

The components that used to build the proposed hand washing system are:

- Arduino UNO Microcontroller
- Infrared Sensors
- Mini Aquarium water Pump
- Water Solenoid Valve
- TIP120
- 1N4148 diode
- Buzzer

3.1 Arduino UNO

Arduino is an open and free source electronics platform based on a combination of hardware

and software, shown in Figure 2. Over the years, it is used in thousands of projects, from simple objects to complex instruments. All Arduino boards are completely open source, allowed users to build projects independently and adapt them according to their needs. Its software (IDE) is also an open source, and it can be installed in windows and many operating systems [7].

Fig. 2. Arduino UNO

1.2 Infrared Sensor

An infrared sensor is an electronic device that emits in order to sense the surrounding stuffs. It can measure the heat of an object and/or detects its motion. It contains two parts: a transmitter which contain a LED that emits infrared light, as shown in Figure 3, and a receiver which contain either a photodiode or a phototransistor. When the infrared light falls on the photodiode, the output voltages and the resistances will be changed in proportion to the magnitude of the light received and therefore the current passes through it will be less or more [8].

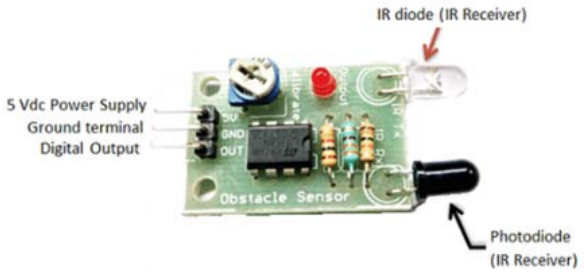

Fig. 3. Infrared sensor

3.3 Mini Aquarium water Pump

This quiet water pump (R385) can be used to water plants, or make a small fountain, and many other projects that concern with water flowing. It has a filter inside, works with a sound-level under 30db and can stick to any smooth surfaces. The R385 can operate normally when it is provided with a voltage between 6 to 12 Volt DC and a current between 0.5 to 0.7 Ampere but it delivers its maximum operating-values when the power is at the upper end of the aforementioned ranges (see Figure 4) [9].

Fig. 4. Mini Aquarium water Pump

3.4 Water Solenoid Valve

Water solenoid valve is used to control the flow of fluid. There are two outlets in this valve as shown in Figure 5. Normally, the valve is closed. When 12V power supply is applied to the two terminals (the + and - terminals), the valve will be open and water can push through in only one direction [10].

Fig. 5. Water solenoid valve

3.5 TIP120 Transistor

TIP120 is an NPN Darlington transistor. It can switch loads up to 8Ampere with a maximum voltage of 60Volt and continuous current of 5Ampere. This makes it very suitable for many electronics like controlling solenoids, motors, and high power LEDs. TIP120 has three pins (see Figure 6): (1)Base used to turn the transistor

ON or OFF by controlling the biasing of it, (2)Collector is normally connected to load and the current flows in through the collector, (3)Emitter is normally connected to ground and the current drains out through it [11].

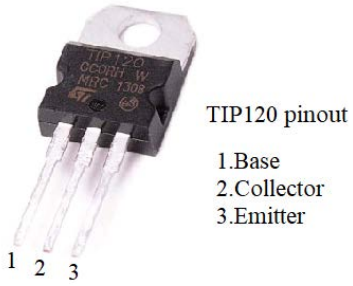

Fig. 6. TIP120 Transistor

3.6 1N4148 diode

1N4148 diode is a standard silicon switching-signal diode which allows current flow through only one direction (flow from the Anode to Cathode), as shown in Figure 7. It is one of the most popular diodes because of its characteristics, fast switching, low cost and dependable specifications. It is very useful in switching applications and protecting devices [12].

Fig. 7. 1N4148 diode

3.7 Buzzer

A buzzer is a small efficient component that add sound features to projects. It is small and compact two pins structure (positive and negative), hence can be easily used. It is widely used in most electronic applications [13]. Figure 8 shown the buzzer and its pins.

Fig. 8. The buzzer and its pins

3.8 Other Supportive Components

In order to connect the above components together, some supportive parts are required. These components, shown in Figure 9, include breadboard, jumper wires, 12 volt power supply and 1kΩ resistor.

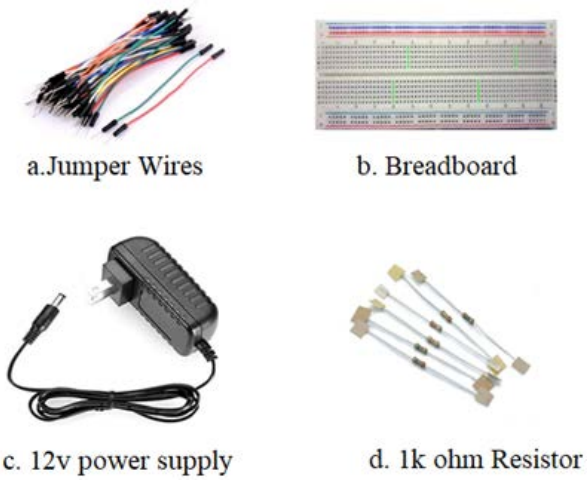

Fig. 9. Supportive Components

4. System Connection and Programming

The system complete connection will be explained by the following steps:

First the connection is performed and established by preparing the GND and VCC from the microcontroller, Arduino UNO, on the breadboard with -ve pin of the power supply.

Two IR sensors, sensor 1 controls the action of the soap liquid parts (pump 1 and solenoid valve 1) whereas sensor 2 controls the action of the water faucet parts (pump 2 and solenoid valve 2), will be connected to Arduino. They have three pins: (VCC and GND) both are connected with connection 1, OUT 1 is connected with digital pin (0) and OUT 2 is connected with digital pin (1) as shown in Figure 10.

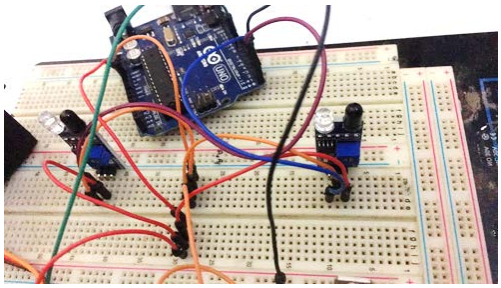

Fig. 10. IR sensors connection

The water pump (R358) must be connected to the solenoid valves using small water hoses. It has two pins: GND is connected the main GND in connection 1, the second pin is connected with the +ve pin of its own solenoid valve, the -ve pin of its own diode and the +ve of the 12V power supply as shown in Figure 11.

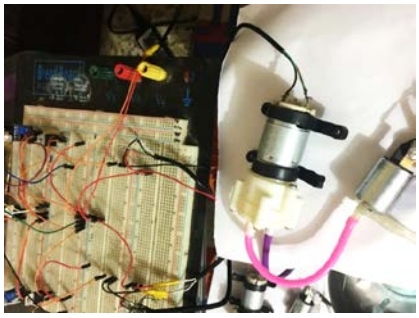

Fig. 11. Water pump connection

Two TIP120 transistors are used as switches to turn the water solenoid valves ON or OFF. TIP120 has three pins: base is connected to Arduino digital pins (6 and 7) through 1k resistors, collector is connected to the -ve pin of its own solenoid valve and the +ve pin of its own diode, emitter is connected to the common GND of connection 1 as shown in Figure 12.

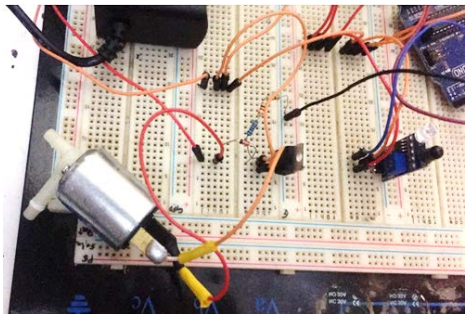

Fig. 12. TIP120 and solenoid valve connection

The buzzer is also connected to arduino. It gives a sound whenever the 20ms is finished so that the people can start washing their hands, with water, from soap lather. Buzzer's positive pin will be connected to digital pin (5) of Arduino UNO and negative pin of it will be connected to GND. Figure 13 shows the connection of the buzzer.

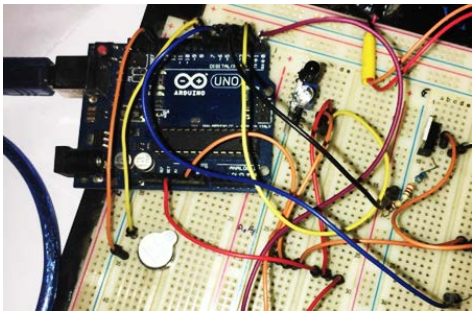

Fig. 13. Buzzer connection

The -ve pin of the power supply is connected with the main GND in connection 1. Figure 14 shows the complete connection of the system.

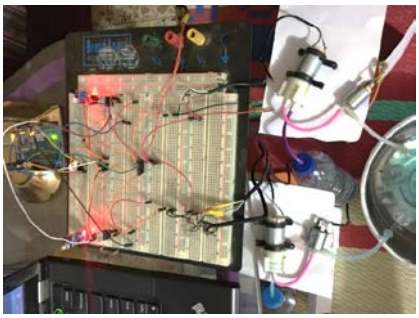

Fig. 14. System full connection

Final step is the programming of the hand washing system. It is performed in IDE platform that assist to logically connect the hardware components with the software.

5. Result and Discussion

After operating project software, the proposed device worked and performed its task properly. The link in [14] shows the system operation and performance. The system allows an automatic soap liquid flow whenever a hand approaching it and after 20 seconds and only when a hand is detected, the water will flow also automatically without any need to touch the water faucet. Both automatic flowing, of soap liquid and water, were done only when the hands is close to the device so that a frugal water consumption will be also presented. The proposed algorithm will make sure to wash the hands for 20 seconds to get rid of all bacteria and germs as the WHO recommended. In these days, there is a high demands for a methods for reducing COVID-19

transmission; the proposed system may contribute a little something to prevent the spread of the virus in crowded places and hospitals.

Based on the proposed system performance, and after gathering some samples of automatic hand sanitizers in the markets; a comparison between specifications of these marketer sanitizers and the proposed system is presented in the table below. The comparison was based on several points in terms of capacity, sterilization material, sanitizing method and price.

As noticed, the specifications of the proposed system had a preference over the rest, as its capacity is subject to change according to need, its price is cheap, and the sterilization material is optimal (washing with soap and water programmed for at least 20 seconds) according to the WHO recommendation.

Table 1: A comparison between the proposed system and the marketer systems

Hand sanitizer system	Capacity (in ml)	Sanitizing Material	Sanitizing Method	Price (in $)
[15]	1000	alcohol	Provide alcohol as hands approach	24
[16]	8000	alcohol	Provide alcohol as hands approach	81.37
[17]	1000	sanitizing gel	Provide gel as hands approach	65.85+ 2.99 shippin g
[18]	1000	alcohol	Provide alcohol as hands approach	107.24
The proposed system	adjusted as need	liquid soap and water	Provide water as only hands approach	24

6. Conclusion

This paper provides a cost-effective approach based on automatic hand washing system. In the current situation, the spreading of coronavirus infection must be completely prevented. The proposed system represents a good way to protect people from being infected by COVID 19 and any virus. Even in daily life, the project can be used to protect against all kinds of germs, bacteria, especially in public outgoing, and any future similar global pandemics.

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Planning Strategy for The Surrounding Attractive Cities (Bismayah New City as a case study)

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Abstract: The creation of attractive peripheral cities is considered one of the most important features of change and renewal in the patterns of urbanization, which have been adopted by most States as an optimal means of alleviating the burden of the metropolitan cities and of addressing their major urban problems, such as population inflation and traffic jam, as well as their active role in promoting economic realities, advancing economic development and increasing imports. Therefore, the study emerged from the particular problem: "The lack of a clear, holistic view of the concept of the attractive city planning strategy", Where the study assumes, "The existence of a set of key indicators extracted from leading global experiences in this field, which is considered one of the main qualification rules that makes the surrounding city attractive to the population and maximizes investment projects". The study aims to diagnose and extract the most effective indicators in this field that enhance the efficiency of the surrounding city in a way that ensures its attractiveness and competitiveness.

Keywords: Economic Cities, Attractive Cities, affordable Population Attraction, Investment Attraction, Urban Synergy.

الخلاصة: تُعد ظاهرة إنشاء مدن النواة المحيطة الجاذبة، من أهم معالم التغيير والتجديد في أنماط العمران الحضري المتصاعد سكانياً وعمرانياً، والتي إتخذتها معظم الدول كوسيلة مُثلى للتخفيف عن عبء المدن الكبرى، ولمعالجة مشكلاتها الحضرية الرئيسة كالتضخم السكاني، والزخم المروري، فضلاً عن دورها الفاعل في النهوض بالواقع الإقتصادي، وتقدم عجلة التنمية الإقتصادية، وزيادة الواردات. لذلك فان الدراسة إنبثقت عن المشكلة الخاصة: "عدم وجود تصور شمولي واضح حول مفهوم ستراتيجية تخطيط المدينة المحيطة الجاذبة"، حيث تفترض الدراسة "وجود مجموعة من المؤشرات الرئيسة المستخلصة من التجارب العالمية الرائدة في هذا المجال، والتي تُعد من أبرز القواعد التقومية التي تجعل المدينة النواة المحيطة جاذبة للسكان وتعظيم المشاريع الإستثمارية". وتهدف الدراسة الى تشخيص وإستخلاص أهم المؤشرات الفاعلة في هذا المجال والتي تعزز من كفاءة المدينة النواة المحيطة بالشكل الذي يضمن جعلها قادرة على الجذب والمنافسة.
الكلمات المفتاحية: المُدن الاقتصادية، المُدن الجاذبة، الجذب السكاني الميسّر، الجذب الإستثماري، التآزر الحضري.

1. Introduction

During the European renaissance in the nineteenth century, several new cities emerged mainly for economic reasons, particularly in areas containing huge mines, such as the "Wetter Ruhr", Germany, with the aim of absorbing the large number of workers and ensuring to provide their accommodations. [1]

Later on several economic research and theories had emerged to address this topic, especially in Britain, the most famous of which was the 1915 AD book by Patrik Geddes, entitled "Cities in evolution," in which he tried to analyze mediocre relationships in the functional territory of cities, and dealt with them using his well-known figure: (Housing, work, population). He tried to develop a balanced urban network in the future by adding new small-scale cities to the activity of metropolitan cities in different urban functions, reducing their dominance and reducing the pressure on them in various areas of urban residential, commercial, economic and educational activities. [2]

The theory of the new surrounding cities was also applied in France, in the middle of the twentieth century, to reduce pressure on the capital, Paris, after its facilities were almost unable to withstand more population pressure on it, which has effects in increasing traffic density in streets and roads, with the increase in water consumption And sanitation and electricity, and with the negative effects that result from these increases on the urban, cultural and tourism environments of the capital. In the context of studying this issue affecting the city of Paris by the Regional Planning Department, a number of suitable sites were selected for the establishment of new surrounding cities, taking into consideration the availability of rapid transportation between them and Paris, with the presence of small urban clusters on the site that serve as the nucleus around which they crystallize New cities, in addition to the availability of development projects for the service economic base in the new sites, especially in less developed sites than in other regions, and as later appeared in the theory of new cities in Britain. [3]

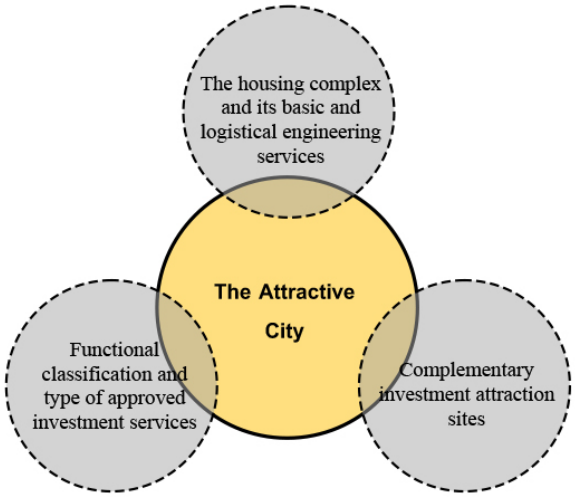

Fig. 1. The three pillars supporting the success of the surrounding attractive city.

The economic dimension is one of the important inputs in the urban development process, as economic cities differ with one another and differ in their economic activities and regional diversification from one place to another, and they are also indicators of the strong economic environment of the state, and one of the most important positive factors that contribute to the process of spatial population attraction, and in Sometimes the new attractive economic city is called in the name of the economic activity that predominates over other developmental activities, for example an industrial, commercial, educational, tourism, administrative or sports city ... etc., and therefore it is necessary when planning a new commercial surrounding city within the site of expansion in existing cities. To get to know the economic potentials available in the main city and in its regional surroundings, in order to know the truth about the specifications of the basic components that can be exploited, in order of the availability of various economic activities, which will ensure the availability of

different job opportunities for the population, and thus contribute to the attraction process. And the achievement of guaranteed income for them, and the advancement of the social and economic aspect of the city in particular and the country in general, which will result in the recovery of the main city in all community urban levels and with all its logistic and support services.

2. Study structure

This study consists of three parts, the first part is concerned with reviewing the most important basic terminology related to the attractive surrounding cities, and the second part emphasizes extracting the most important main indicators, and the third part is a practical and applied study of the reality of the Bismayah new city in aims to check its suitability and efficiency for the commercial characteristics and the factors that make this city attractive for residents and for investment. (See Figure 2) which illustrates the structure of the study.

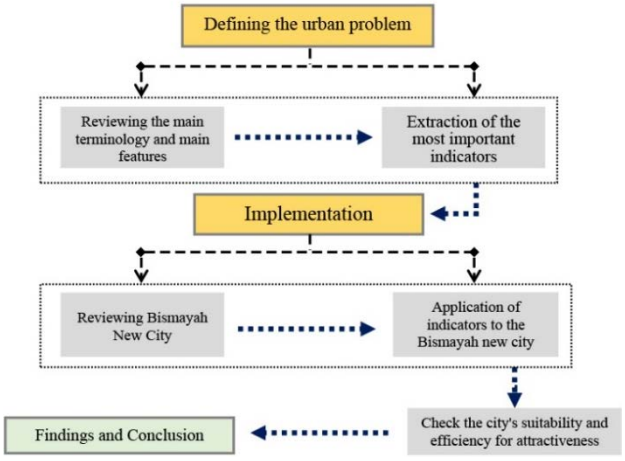

Fig. 2. Study Structure.

3. The most important terms and indicators of the surrounding attractive cities, which are extracted from leading global experiences

3.1. Terminology of Economic Motives and Goals

The economic factors are at the forefront of most of the components and indicators of the surrounding nucleus cities, and are the main factors in considering the establishment of this type of city, in search of reorganizing and reviving economic resources that become a solution to some economic problems within the mother city, which resulted due to the huge increase in population numbers, from which most of the Developing countries are facing recently [4], and there are certain areas in the city which have significant potentials and resources, through which new cities can be built, where these resources are economically exploited to achieve the goals of society. The idea of establishing new cities of an economic character, especially in some economically underdeveloped regions, has a distinct urban and economic role to play in their development and prosperity. In this sense, some attractive surrounding new cities have emerged, which are related exclusively to the economic side, where industrial or commercial areas have been established, accompanied by the rest of the requirements of the city. [5]

The indicators of the main economic goals for the new surrounding cities are as follows:

•The establishment of a new economic base, aimed at achieving economic balance in accordance with regional and national scales.

•Encouraging investment and attempting to attract entrepreneurs regionally and internationally, such as tourism, religious or commercial investment.

These goals can be achieved by:

Creating a commercial core for wholesale trade, light industries to ensure commercial balance between the main city and its geographical surroundings in its various territories, and to absorbs the potential for commercial accumulation in the main city center, as well as to reduce traffic and urban congestion throughout the city and especially the city center.

Note that this process requires setting up integrated programs for the entire new city,

especially ensuring to provide an affordable housing for most workers in the commercial sector, as well as ensuring to provide a tourism, entertainment, cultural and religious sites so that the surrounding city becomes integrated in its services and does not represent an additional burden on the mother city.

3.2. Terminology of Physical Constituent for New Commercial Cities

The physical Constituent that is produced by the new commercial surrounding cities is an essential reality of the building infrastructure, the built physical environment, and the technology used. The first challenge facing new commercial cities is to ensure innovative ways of financing high-quality infrastructure and logistics, which will be crucial to their success. Such an approach should also include ways to understand the most important indicators of full physical components produced by infrastructure and to identify their main investment returns.

The strategy for the development of the new commercial city should also be taken into consideration as the most important indicators of the physical component, as follows:

•**Indicator of Adapting to Context:** By responding to the local needs of the main city and its cultural and economic context, building infrastructure can contribute to broader housing and economic goals, including achieving a sense of ownership and proud for the residents, as well as taking into consideration the new attractive city identity.

Many researchers in the field of new commercial cities projects have turned towards ensuring that they are developed in the vicinity of metropolitan cities, to ensure that local logistical needs are built, to consider maximizing surrounding economic activities to become necessary to give a sense of spatial ownership to people who are moving to new cities, in addition, to ensure that development activities are developed for their building infrastructure and to ensure that development is done. (Urban synergy) Between existing old city centers and new commercial cities, in a way that can make them more valuable to residents and investors.

3.3. Terminology of Economic Constituent for Commercial Cities

The need to support revenues, indirect outcomes, and value in new cities, in which there are recommendations for the production of specific places of special productive value for companies and people, that is achieved by ensuring that relevant locations with companies are available to be established in the new commercial city. Innovation and investment will certainly have a complex task and must include planning strategies to achieve a set of indicators as follows:

•**Indicator of Attracting Entrepreneurs:** Includes ensuring the development of main ways in which new commercial core cities can be used by reducing side frictions and strengthening the ecosystems that start-ups and entrepreneurs may require today.

•**Indicator of Innovative Commercial Business Competitiveness:** Creating the innovative value of competing global businesses within the new commercial city puts it in competition with the city's existing urban centers, which include local residents and their ways of dealing with the city life. New commercial cities can keep in mind different strategies, taking advantage of their "novelty."

3.4 Terminology of Strengthening Local Identity and Place-Making

If residents of major cities are to lead the growth and innovation of their new cities, it is essential that these new cities be designed and planned within the spatial identity in which they live, to fulfill their needs and future existence. Which is one of the most important ways to encourage the making of a vibrant commercial place.

3.5 Terminology of Promotion of Societal Aspirations and its Developmental and Moral Values

In addition to the basic planning and design parameters referred to above, we confirm the existence of some intangible developmental and moral values, to ensure the viability of the surrounding commercial cities, according to the following indicators:

• **Indicator:** leave Open spaces within the city to provide flexibility for (organic development) so that communities would have the opportunity to create some special uses to meet their needs for religious and community customs and beliefs.
• **Indicator:** Planning and building cities on a walkable scale to help the diversity of exchanges that allow society to develop.
• **Indicator:** Attracting Residents.

4. Functions and Components of Attractive City

The commercial function is a justification for the existence of the surrounding attractive city and a determinant of its lifestyle. It is the basis for the revitalization and formation of the mother city. Commercial city functions may overlap, and their trade disciplines overlap, and they must be analyzed according to the classification of their business services, through its-self zoning. There is therefore a need for a clear definition of the basis and rules of classification. The classification of civilian functions is not intended to be spatially but rather to be the types of functions and basic business activities that the city generally carries out, that is, the dominant character on it [8]. The commercial function is one of the oldest and most important activities of the metropolitan cities and their satellite cities. These service activities do not provide commercial services only to the inhabitants of the mother city, but also to the people living outside its borders and regional surroundings. Trade and commercial exchanges in general are the origin, engine, and attractant of urban growth, given the opportunities they provide for employment. (40% of commercial city workers in the United States are engaged in commerce, although only 5% of the city's total area is allocated to it). [6]
Trade is usually closely linked to all layers of society, and it is the area in which all the economic and social characteristics of the population meet and are reflected. Trade plays an important role in the development of urban areas. As for its urban importance, it differs from one city to another, as there are several factors that affect the role it plays in the economies of each of them. [7]
The importance of the commercial function through the executive authority imposed by the central authority, whether in decisions of the economic structure, or in the relationships that characterize the maximization of the economic field, and this importance has led to the multiplication of research, experiments and analysis in this field, which led to the emergence of the so-called commercial reconstruction. [8]

Certainly, the surrounding cities of an attractive commercial character are not limited to commercial activities only, and in order to be a distinct, livable and attractive city for the population, all the elements of the city must be present in it with regard to the logistical services sector within it, and it has independency in the administrative and organizational structure and for each city in general, whether It was a new or existing surrounding city for the logistics services sector, and is depending on the functional and volumetric classification of each service sector in the city. Logistics services can be classified functionally to the whole city into the following, and according to what was mentioned in the experience of the Arab Republic of Egypt (2017): [9]

- **Educational services:** which include kindergartens, primary, intermediate and secondary schools, and public and private universities, which depend on the beneficiary population size.

- **Health services:** which include health units, medical centers, and hospitals of all types.
- **Cultural services:** which include libraries, cultural palaces, cinemas, theaters, etc.
- **Social services:** which includes social organizations, social clubs, etc.
- **Youth services:** which includes youth centers for surrounding villages, youth cities, and youth hostels in the surrounding cities.
- **Sports services:** which include open and closed playgrounds, small and large, and sports clubs
- **Entertainment services:** which include parks, public gardens, green open areas, etc...
- **Administrative services:** which includes the administrative headquarters of the ministries, agencies, government agencies and business sectors.
- **Religious services:** which include mosques, churches and places of worship.
- **Postal, banking and telecommunications services:** This includes post offices, banking companies, and communications and insurance centers.
- **Security services:** which include police stations, fire stations, and private security centers.
- **Commercial services:** which include stores, malls, retail and wholesale places, consumer associations, exhibitions, and everything related to commercial activity that forms the backbone of the city's economy.

4.1 Terminology of new commercial cities and maximizing job opportunities for residents

When the city is large, separate in itself, and crowded with its population with few commercial resources, the percentage of its influence and effectiveness on attracting residents is very weak, as based on contemporary research proposals it is found that the terminology of the link of the population with the multiplicity of employment opportunities, which is one of the basics of demographic attraction for the growth and sustainability of the city, where it is better to ensure the connection between the place of residence and the place of work, so it is imperative that metropolitan cities take priority in managing their commercial and economic activities through their satellite cities, especially some metropolitan cities that are witnessing rapid urbanization and population and urban growth, as in East Asian cities, and in many other cities in the Middle East, where city planners should adopt proactive strategies for the purpose of providing housing and job opportunities through its commercial and economic activities, as well as improving the logistical and supportive living conditions and ensuring easy ways of linking the residents of the new cities with the mother city.

4.2 The terminology of the competitive attractive city as a motive of economic growth

Among the 750 global cities analyzed in the "Competitive and growth" report, which shows that the competitive or attractive city is the city that facilitates the success of its commercial companies and its various industries to ensure job creation for all residents, increase productivity, and increase citizens 'income over time. The principle of improving the economic competitiveness of cities around the world is a way to eliminate unemployment and boost shared prosperity. Where the main source of job creation was the commercial aspect, which usually represents about (75%) of job creation insurance in general. Therefore, city leaders need to be aware of the factors that help attract, maintain and expand their economic activity. Therefore, the new commercial core cities aim to be able to compete. [10]

4.3. The terminology of a competitive commercial city as a factor in attracting residents and maximizing productivity

The success of "competitive commercial cities" is achieved by facilitating their companies and industries, as they work to develop jobs and increase job opportunities, and thus increase the income of citizens. Improving the competitiveness of cities is a path that constitutes an attractive factor in eliminating several problems, the most important of which is to reduce the burden on the growing problems of metropolitan cities, and to work to increase common prosperity. Most global metropolitan cities have grown faster than their national economies since the early 2000s by constructing surrounding cities, and there are still ways for improvement, so that millions of additional jobs could be created every year. And there were more new cities surrounding the metropolitan cities, especially the most competitive ones in the world. But the important research question: How do we make commercial core cities able to compete?! [11]

The successful and attractive surrounding cities have many development dimensions, including social, economic, human and environmental sustainability. Especially those that focus on the commercial economic output represented by the growth of economic output, employment, labor productivity, and the available income for households.

4.4. The terminology of Factors affecting to the success of competitive attractive cities

•**Indicator: Transformation of Economic Factor:** Economic transformation is the first indicator, and efficiency and productivity gains follow. Big cities do not always reform and grow their economies to be competitive. Especially at low income levels, which these cities usually face the challenge of transforming from a service center for retail trade to a wholesale production center, by activating their commercial function, and through it they seek to increase productivity and benefit from maximizing market opportunities, instead of maintaining the reality of their industrial and commercial mix. At higher income levels, cities centers usually become more specialized for industry, financial and creative trade, with the challenge again to transform themselves by maximizing economic activity in them into specialized sectors with higher added value. The growth of commercial jobs and their long-term specialization in cities usually leads to tradable productive sectors at the level of wholesale trade, rather than retail trade or other general daily and weekly services.

•**Indicator: Ensuring the preservation of affordable housing in the attractive city:** Ensuring access to affordable housing is a growing challenge that has been adopted throughout the developed world, and is one of the economic attractions. While the new cities must be attractive, generate profits, to be viable and affordable, and that the primary goal in them is to address the growing social and economic divisions, as a critical issue that must be addressed in their planning and construction, which will constitute the largest and fastest additional demographic growth for the population of the main city, and the poor must have a major role in contributing and participating in any commercial enterprise that enjoys long-term economic, social and political stability as a goal. [12]

Usually, the citizens with middle and low incomes participate in such development projects, especially those who have concerns about the potential for fluctuations and diversification of the commercial housing market, and try to participate in the new commercial diversity, which characterizes the prosperous cities and the vast and distinguished workforce in the production of affordable and suitable housing options for all Socio-economic levels. [13]

•**Indicator of Economies of Commercial, Residential and Service Spatial Integration in Attractive Surrounding Cities:** Integrative economic development usually occurs through the growth of companies, industries, and various trade in them with their housing complexes and

their logistical and supportive services together, Numerous experimental research finds that the effects of spatial integration will increase the economic productive efficiencies resulting from integrative aggregation, which is an integral part of this development. Usually, industry and commerce in general can be characterized by a wide geographical spread, but the advantages of functional integration tend to be spatially uniform. Geographers and economists usually consider that the natural scope of integration takes place within a geographically unified urban area, where workers usually move easily to their work place, as well as the complementarity of common infrastructure and logistical infrastructure systems, and mutual business knowledge can spread between companies. Spatial proximity tends to be more important for industries and commercial activities, which depend on direct face-to-face interaction and the exchange of experiences between them.

Table 1: Extraction of the most important terminology and statistical evaluation indicators for the attractive surrounding cities.

No.	Main Terminology and Indicators	Code	Evaluation				
			V. Good 5	Good 4	Average 3	Poor 2	V.Poor 1
1	Economic motives and goals	A					
2	Physical Constituent for New Commercial Cities	B					
3	Economic Constituent for Commercial Cities	C					
4	Strengthening Local Identity and Place-Making	D					
5	Promotion of Societal Aspirations and its Developmental and Moral Values	E					
6	strategic planning constituent	F					
7	New commercial cities and maximizing job opportunities for residents	G					
8	competitive attractive city as a motive of economic growth	H					
9	Maximize national productivity	I					
10	Successful of competitive commercial cities	J					
total score							

Note:
The evaluation is determined by the researcher based on the specifications and details of the research samples, and the degree of their actual match in the proposed project for the evaluation,

Table 2: The results of the statistical evaluation of the proposed project are calculated as follows

	The evaluation score obtained from the general indicators (%)	Evaluation Result
1	80-100 %	Excellent
2	79-70 %	Very Good
3	69-60 %	Good
4	59-50 %	Average
5	Less than 50%	Poor

Note:
The evaluation is determined by the researcher based on the specifications and details of the research samples, and the degree of their actual match in the proposed project for the evaluation, in addition to the researcher's participation in the personal field evaluation of the project, or by using (an information questionnaire) on evaluation indicators by users.

5. Implementation

5.1 Bismayah New City Analysis

In 2011, the National Investment Commission (NIC) proposed the new Bismayah city project as a model project and the first of its kind in Iraq, as the National Housing Program was launched as part of the economic development plan in Iraq. [14]

The new Bismayah city project is one of the first and largest development projects in the history of Iraq, as it is located to the southeast of the city of Baghdad, about 10 km away from the borders of the city of Baghdad and on the international road linking the governorate of Baghdad and Kut. The area of the project is (1830 hectares), and it is hoped that the city will accommodate about (600 thousand people) in its final stages, in addition to the total number of housing units (100 thousand housing units). An integrated network of infrastructure including electricity, water and main streets will be established, as well as the availability of integrated community services to accommodate the need arising from housing units, which the government of Iraq will develop, including educational, religious, recreational and commercial services, as well as water treatment plants and wastewater treatment. The new city of Bismayah, upon its completion,

will represent a new development pole affiliated with the capital Baghdad, due to the availability of housing for the life of (600 thousand) Iraqis happily enjoying comfortable housing, and it will be one of the most distinguished cities in Iraq and the Middle East, and the first integrated project with its services from the projects of the National Housing Program [15].

5.2 The Location

- The new city of Bismayah is located near the borders of the city of Baghdad, on the international road Baghdad-Kut, and on the left side of the southeastern Baghdad Gate.
- The site can be accessed by using the road linking the governorates of Baghdad and Kut, as well as the possibility of linking it to the eastern governorates of Iraq in the event that it is adopted as a site for trade exchange between Baghdad and the neighboring regions.
- The site is about (10) kilometers southeast of Baghdad (Al-Madaen area), and (25) Km from the city center of Baghdad [16]. (See Figure 3 & Figure 4).

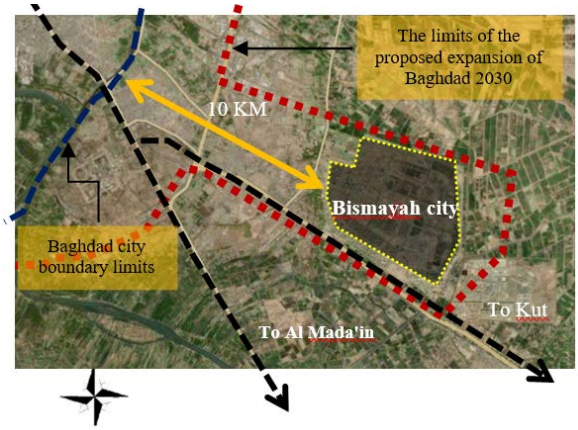

Fig. 3. The location of Bismayah new city and its relationship with the mother city – Baghdad. Source: The Researcher

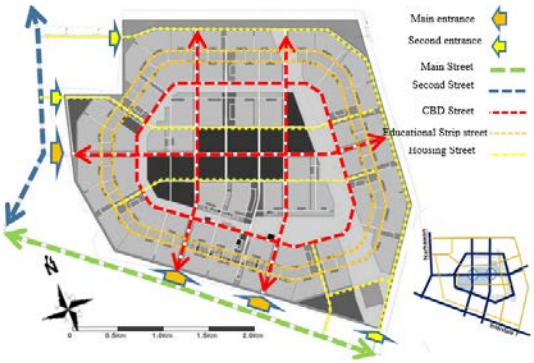

Fig. 4. The main, secondary roads that surround the city, and the main and secondary entrances. Source: The Researcher

5.3 Land Use

The project is divided into (9) sectors, and it contains (8) residential neighborhoods, where the neighborhoods include the residential function with its service and commercial institutions, as for the remaining part, it is located in the city center and has the advantage of being a business center, where all governmental and commercial activities take place [17]. (See Figure 5).

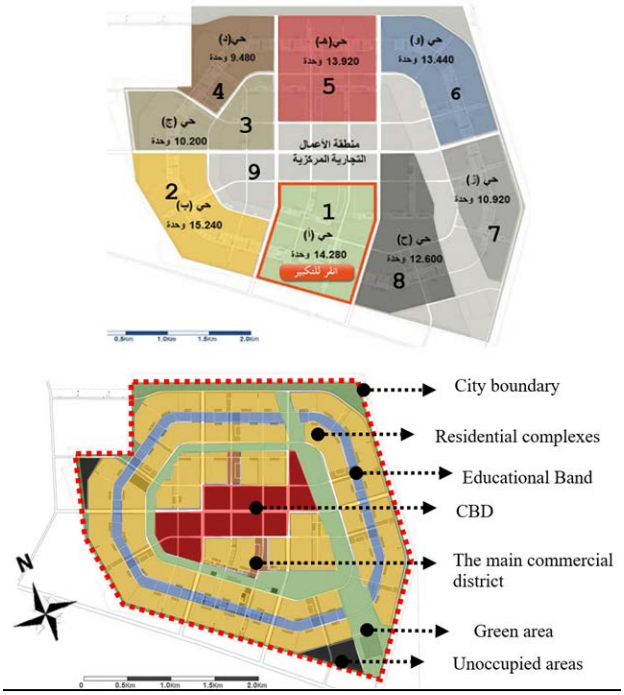

Fig. 5. Sectors and residential neighborhoods of Bismayah city. Source: NIC

The project generally consists of several different functions, including the residential

part, which contains in total (100 thousand) apartments with areas for the possibilities of apartments (100 square meters, 120 square meters, 140 square meters), and in the middle of each of the residential complexes are green open spaces for the elderly to gather and for children to play.

As for the educational band that permeates residential complexes in the middle of it, it includes schools, kindergartens, health institutions, and infrastructure services, as well as markets, shops and general community functions. The project includes police stations, civilian centers, stadiums and shops, sports facilities, places of worship, and other tourist attraction sites, which were decided to be built in phases according to implementation priorities, starting from 2014. The main CBD, in the middle of the city, are distinguished from the areas that will play an important role in the city after its completion. (see Figure 6 & Figure 7).

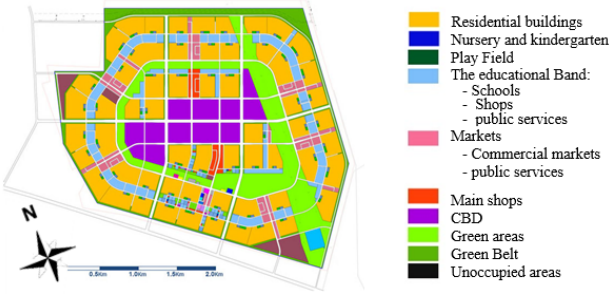

Fig. 6. Land use plan for Bismayah new city. Source: NIC

The land uses in the new city occupy different percentages of the project area as shown in (Figure 6), where the residential area occupies the largest percentage of the project through the central residential logistics service buildings that contain schools, kindergartens, shops and a mosque (for daily use). While the green belt area and indoor green spaces occupy a smaller percentage of the residential sites with the largest proportion, as well as for the proposed Central Business District (CBD), down to the unoccupied reserve areas, which occupy the least percentage of the entire project.

Fig. 7. Perspective shots of Bismayah city components – The Researcher.

5.4 CBD Land Use Proposal

The proposed central area for the new city of Bismayah is of great importance and effectiveness, given the basic and vital activities contained in the design proposal to serve the city and its residents. The central area includes several different jobs; the commercial part occupies (11.5%) of the total area of the central business district. As for mixed use, which is made up of residential towers and other activities, it occupies (40%). As these two parts are among the most important axes of the region, and it can be considered a pole of commercial growth that contributes an active role in the process of trade exchange between the new city and Baghdad governorate, as well as the eastern and southern governorates. The central district also includes the administrative headquarters, the Grand Mosque, the Sports City complex, the cultural and commercial center, mixed use, offices, hospital, hotel, a station, as well as the main park.

The CBD design proposal was put forward by the Korean Hanwha Corporation according to two main principles:

- **The first principle:** by creating a central strip for the central business district, as it relies on densifying the strip in commercial complexes.
- **The second principle:** by creating two central business nodes serving the northern and southern locations of the housing complexes, so that they depend on increasing and maximizing the densification around the two main nodes, and thus

creating an attraction point along the entrance to the city, as well as planning the city's landmarks with the highest density.

As for the commercial area, it was also designed according to two principles:

- **The first principle:** Creating a connected commercial axis, where the commercial area works to connect residential areas with the CBD, and works as a commercial network, as the commercial area is considered a support area for the business strip.
- **The second principle:** an integrated commercial network of services, keeping in mind the experiences of previous countries, as it acts as a commercial nodes of human scale along the commercial area connected to the center of the business area. (see Figure 8).

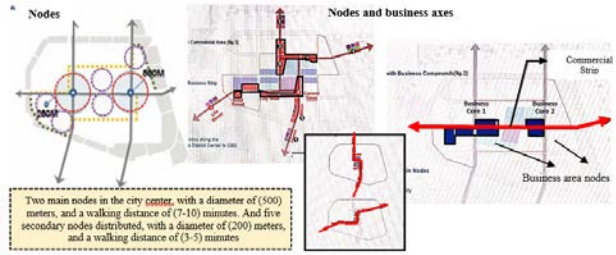

Fig.8. CBD, nodes and commercial axis. Source: The Korean Hanwha Engineering and Construction Company

The commercial district includes the central market, cafes, restaurants and all important commercial activities. The central area also contains mixed-use buildings, commercial activities, and a sports, cultural and educational complex.

The new Bismayah City project is a residential city project with comprehensive and integrated services, and it is a model for possible new residential cities with the aim of expanding the city of Baghdad within the long-term strategic plan, which aims to withdraw the overpopulation of the city of Baghdad and move towards new urban centers, as it is the nucleus of a residential and industrial, or commercial city. The new city of Bismayah is a model for a healthy and sound environment for the growth of young and new generations, ideally, to form an important pole of basic growth for the city of Baghdad, and this is done by constructing and creating a nucleus city that matches existing cities in developed cities in terms of integration of services and availability of decent housing.

The availability of development potentials in the regions surrounding the new city of Bismayah can create new opportunities for residents to work, as the city is integrated with services, but does not have any current economic basis that distinguishes it. Therefore, there are proposals, according to the source, that can be proposed: [18]

- A proposal to establish a university, located to the south of the city, which was among the proposals of the new city of Al-Mada'in on the same axis.
- The integration of the city with the surrounding cities, and the proximity factor plays a role in regional interaction and increasing the availability of job opportunities.

6. Application

Note: An extraction of the terms and indicators of the applied field study referred to above, came through the extensive study that the researcher carried out during the preparation of the master's thesis.... to see

Master's thesis title: Planning and Design Strategy for Satellite Cities (City of Baghdad as a case study).

Table 3: Application of the most important terminologies and indicators to the new city of Bismayah.

No.	Main Terminology and Indicators	Second Indicators	Code	Evaluation				
				V.Good 5	Good 4	Average 3	Poor 2	V.Poor 1
1	Economic motives and goals		A					
	The establishment of a new economic base		1-A					•
	Encouraging investment and trying to attract entrepreneurs		2-A	•				
2	Physical Constituent for New Commercial Cities		B					
	Adapt to the context		1-B		•			
	The social component and infrastructures		2-B		•			
3	Economic Constituent for Commercial Cities		C					
	Attracting Entrepreneurs	Facilitate doing business	1-C	•				
		Reducing establishment costs and risk costs	2-C			•		
	Innovative Commercial Business Competitiveness	Ensuring a convenient built environment	3-C	•				
		Smart multi-use planning	4-C	•				
4	Strengthening Local Identity and Place-Making		D					
	Availability of pedestrian paths and public places		1-D	•				
	Availability of flexible internal signs		2-D	•				
	Retail system		3-D	•				
	Entertainment and logistical services		4-D	•				
	Integration of local heritage styles		5-D		•			
5	Promotion of Societal Aspirations and its Develop-mental and Moral Values		E					
	Availability of spaces for community use		1-E	•				
	The human scale of community participation		2-E	•				
	Attracting residents and investors	Collective participation of the residents of the area	3-E			•		
		Strengthening social relationships	4-E			•		
		Ensuring the personal choice of city residents	5-E		•			
6	strategic planning constituent		F					
	Topographic and geographic suitability of the site		1-F	•				
	Commercial compatibility with surrounding territories		2-F	•				
	Regional contiguity with existing production sites		3-F			•		
7	maximizing job opportunities for residents		G			•		
8	competitive attractive city as a motive of economic growth		H		•			
9	Maximize national productivity		I					
	Expanding existing commercial activities	Ensuring open market cities	1-I			•		
		Increasing production centers for import & export	2-I				•	
		Participation in free trade	3-I					•
	Administrative and financing facilities	Marketing management standards	4-I			•		
		Securing land and infrastructure	5-I	•				
		Activating skills and innovations	6-I		•			
	Ensure financing by companies		7-I			•		
		Relative and subjective commercial features	8-I			•		
10	Successful of competitive commercial cities		J					
	Economic factor shift, productivity gains		1-J			•		
	Facilitate affordable housing		2-J	•				
	Spatial, commercial, residential and service integration		3-J	•				
	The degree of evaluation obtained for the Bismayah City project = Excellent							
	Total score			122 out to 150 (81.33%)				

7. Findings

- The study showed that the new city of Bismayah, which we have evaluated, is a city belonging to the city of Baghdad, and it does not currently have any clear economic basis in it that makes it a self-sufficient city, due to the lack of completion and all its expected activities, especially its central business area and its supportive commercial activities.
- The new Bismayah City project is a residential city project with comprehensive and integrated services, and it is a nucleus model for possible new residential cities with the aim of expanding the city of Baghdad within the strategic plan, which aims to withdraw the overpopulation of the city of Baghdad and move towards new urban centers, as it is the nucleus of a residential and industrial city or Commercial. The new city of Bismayah is a model for a healthy and sound environment for the growth of adolescent and young generations, and ideally, to form an important and essential growth pole for the city of Baghdad, and this is done through the construction and creation of a nucleus city that matches existing cities in developed cities in terms of integration of services and availability of decent housing.
- The residential activity occupies the largest part of the city, making it an attractive residential city in the first place, and the elements of life are available from social, educational, commercial and entertainment activities.
- The city is not surrounded by a clear green belt that defines it and gives it the character of independency, and this is what makes it vulnerable to future expansion in the long run.
- The city is located within a strategic location, on the Baghdad-Kut road, which makes it a good location for attracting investment, and a site for trade exchange between it and between the southern and eastern regions and the nearby areas.
- Residents work outside the city, due to the current lack of job opportunities, which increases the burden on the metropolitan city of Baghdad.
- There are no clear attraction indicators currently in the city to activate the proposed investment operations in it, and to create new job opportunities for residents.
- The comprehensive development plan for the city of Baghdad 2030, which was prepared by the consultant, Khatib and

Alami, proposes that the northern development poles - the sabiyat, be administrative and commercial poles in order to allow trade exchange between them and the northern governorates, and this necessarily requires the presence of another pole from the eastern and southern sides in order to cover the greater part of the regions and governorates adjacent to Baghdad.

8. Conclusions:

In this study, the new city of Bismsayah was reviewed for the purpose of testing its efficiency and suitability for the attractive characteristics, as the study shows the possibility of maximizing the efficiency of surrounding cities and making them cities capable of attracting both population and investment, which increases the effectiveness and importance of the surrounding city and provides opportunities for urban development and attracting residents.

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Prototyping of Multi-Factors Based Vehicle Accident Detection and Reporting System Relying on GPS and GSM

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Abstract : Several car accidents are reported everyday worldwide, and many fatalities and injuries occur that can be predicted and prevented. This paper does not focus on those accidents that get reported, but instead it focuses on the accidents that do not get reported and result in major injuries and fatalities that can be avoided by simple notification that can be sent to the right people at the right time, so that help can be sent even if the people in need of it are not capable of requesting it. The proposed system can be considered as a tool for the safety of the car passengers in addition to the already existing seat belts. The optimum speed of arrival of the help is achieved in this work by implementing GPS such that a website link that contains the exact location of the accident is sent in order to find the location of the accident instantly without having the people involved in the accident to have to report their location. This paper aims mainly to design a system that can detect one of three cases, the first one is when there is an accident and the air bags do not deploy, while the second case is when there is an accident, and the air bags are deployed, and the third case is an SOS message in case there was a need for it. Of course, there might happen a small accident that does not require the system to send a notification, so there is a switch that can be pushed in order to prevent the system from sending faulty alarms.

Key words: GPS, GSM, GPRS, Car accident, MPU IMU 6050.

خلاصة: يومياً يتم الإبلاغ عن العديد من حوادث السيارات في جميع أنحاء العالم، وتحدث العديد من الوفيات والإصابات التي يمكن التنبؤ بها والوقاية منها. هذه الورقة لا تركز على تلك الحوادث التي يتم الإبلاغ عنها فقط، ولكن تركز بدلاً من ذلك على الحوادث التي لا يتم الإبلاغ عنها وتؤدي إلى إصابات ووفيات خطيرة يمكن تجنبها من خلال إخطار بسيط يمكن إرساله إلى الأشخاص المناسبين في الوقت المناسب، بحيث يمكن إرسال المساعدة حتى لو كان المحتاجون إليها غير قادرين على طلبها. يمكن اعتبار النظام المقترح أداة لسلامة ركاب السيارة بالإضافة إلى أحزمة الأمان الموجودة بالفعل. يتم تحقيق السرعة المثلى لوصول المساعدة في هذا العمل من خلال تنفيذ نظام تحديد المواقع العالمي (GPS) بحيث يتم إرسال رابط موقع يحتوي على الموقع الدقيق للحادث من أجل العثور على مكان الحادث على الفور دون أن يضطر الأشخاص المتورطون في الحادث إلى الإبلاغ عن موقعهم. تهدف هذه الورقة بشكل أساسي إلى تصميم نظام يمكنه اكتشاف واحدة من ثلاث حالات، الأول هو عندما يكون هناك حادث ولا يتم نشر الأكياس الهوائية، في حين أن الحالة الثانية هي عندما يكون هناك حادث، ويتم نشر الأكياس الهوائية، والحالة الثالثة هي رسالة SOS في حالة وجود حاجة إليها. بالطبع، قد يحدث حادث صغير لا يتطلب من النظام إرسال إشعار، لذلك هناك مفتاح يمكن دفعه لمنع النظام من إرسال إنذارات معيبة.

1. Introduction

Car accidents are a major public concern since the statistics imply that the lives of more than three thousand people around the world are threatened daily because of road accidents. Also, road accidents lead to large economic wastes as calculated in road accident injury arounds to about 518 billion USD annually. The huge economic losses are a burden for the countries [1]. Car accidents are a concerning matter because of the high rate of death worldwide. Out of all possible causes of death that include all ages of human beings, road accidents are number 11. Road safety is a huge concern that it wouldn't be false to assume it is as great as some of the life-threatening diseases. Lots of research has already been taken on the matter of road safety that cover many aspects of the reasons of accidents that include environmental psychological, and physical aspects [2] [3]. One of the issues is the variety of advertisements on the roadside, which may distract the drivers from observing the road. Other causes of accidents may include talking over the mobile or text messaging. Radio information is also a factor that may affect the focus of the drivers. New studies prove that when a driver gets distracted, the attention is led astray, which causes bad decisions at all times, and leaves a bad impact on his driving skills. This distraction affects the primary duty of the driver, which is focusing on the road and having a stable decision-making process [4]. When accidents occur, it is required to provide assistance to people involved in the accident. Recently, wireless technologies are having more success in their various application uses like never before. Nowadays, cars are equipped with some survival technologies that function as a protection from accidents, one of these technologies is the air-bag system, which get inflated automatically when an accident is detected by the sensors around the car that are dedicated for this purpose [5][6]. In other mobiles there is an accident alarming system that sends an alert message to a nearby hospital in order to send ambulances to the exact location of the accident [7][8].

2. Related work

The large dependence on cars has increased road jams and accidents. The goal here is to get notified of road accidents, and to shorten the time wasted waiting for a clear path, and to acquire an easy-going path for urgent commute. A spontaneous accident detection scheme is beneficial in acquiring the exact place of a car crash, and to reach the crash location quickly. Here are related works on the same goal. In [9], the discussed system detects crashes by utilizing both a sensor for vibration and a Micro Electro-Mechanical System, which is abbreviated (MEMS). In [10] an Arduino controller board was used to acquire the incoming information from both the sensor of vibration, and the distance sensor that is an ultrasonic board. A sensor for heart beats was used as well. A GPS technology board was used to send car crash coordinates to a data acquisition center. These data were compared instantly with a regular data set that is previously saved inside the Arduino controller board. If mismatch happened, then it sent a notification by using Internet of Things, which is abbreviated (IoT). In that case, the car is stopped instantly. Various information was displayed through the use of an LCD. In [11] the proposed system can detect the accident, then the exact coordinates of the car are sent to a phone number that was is predefined in the programming. This process is done using the GSM network. This system had a disadvantage, which is that system will only detect the crash if velocity of moving car is under a certain value for a certain duration of time, which means that when the car is not moving due to a traffic jam, then the system sends an SMS, which is a faulty one. In [12] the researchers explained the importance of smart helmet to ensure safety for the motorcyclists, a system was also implemented by utilizing a raspberry pi board and open CV. The main goal was to introduce the importance of wearing the helmet properly to ensure safety on the road. In [13] the proposed system is rather in a different focus, that is because it aims at theft prevention, but some technologies used in that design are crucial for

The system proposed in the work. The GSM technology was used to provide a signal to the buzzer and alarm the owner of the vehicle about possible theft attempt, so another SMS sent from the opposite direction can prevent the engine from starting. In [14] a microcontroller-based board alerts the police units through a GSM board so that they can triangulate the position. In [15] the suggested system measures the eye closure ratio and considered it the crucial variable to decide the level of drowsiness the man behind the steering wheel. That system used a camera in order to take pictures of the eyes of the driver. In [16] the system introduced an IoT approach in the vehicle for preventing the accidents and keeping the drivers safe.

3. Proposed system

The system that is shown in figure (1) implements Short Message Service (that is abbreviated SMS) based controlling scheme for supervising car accident using an Arduino Mega board, which includes an ATmega2560 Micro-Controller Unit (MCU). The microcontroller acts as the bridge between the Global System for Mobile communications (GSM) board - that contains a SIM 808 communication module, this module may also activate General Packet Radio Service (GPRS) communication which is helpful with various sensors and triggers for monitoring the occurrence of car accident. The GSM board includes the Subscriber Identity Module (SIM) card slow that the device can utilize to send a notification in case of car crash.

This automation system consists of 3 parts: The Mobile Station (MS) which is implemented in a car to be monitored, the Base Transceiver Station (BTS), and the other mobile station which could be a personal number of emergency number in a hospital. The 3 parts are shown in Figure 1. MS is a phone that can use SMS, BTS is an equipment that simplifies communications.

Table 1: General features of SIM808 board.

Band	Quad-band 850/900/1800/1900MHz
GPRS	Yes: GPRS mobile station class B
Bluetooth	Bluetooth 3.0
Dimensions	24.0*24.0*2.6mm
Weight	3.30g
control	Control via AT commands
Power supply	Supply voltage range 3.4 ~ 4.4V at 2A
Operation temperature	40°C ~85°C

Both MS and BTS are already utilized in the country, so the research focuses only on designing and implementing of the accident monitoring system, which includes an Arduino Mega2560 board, a GSM/GPRS Sim808 board, a set of MPU6050 Gyroscope / Accelerometer sensors for SOS trigger input, and a data line from the airbag computer in the car in the event of airbag deployment

SMA antenna interface: there is a GSM antenna interface, a GPS antenna interface onboard and a BT antenna interface. The pins of RXD is the RXD of SIM808 and the pins of TXD is the TXD of SIM808 for communication between the Arduino board and the GSM board. For audio (optional) there is two 3.5 jack interfaces for microphone and speaker. Also, it contains USB interface: This interface is just used to update the firmware of SIM808 module.

The Global Positioning System (GPS) is a technology that got popular since it has many uses. It was developed by the Department of Defense (DoD) in America for only military use in the beginning. Then got released for the public use. It is implemented in a huge number of applications such as location tracking, arrival timing, direction estimation, speed reading, regional surveying, roads traffic monitoring, security, and more.

4. System Implementation

3.1. Arduino Mega 2560

This is a microcontroller - based board that contains the ATmega2560 microcontroller. It's a low-power 8-bit AVR microcontroller that includes 256 KB of flash memory, 8 KB

of SRAM, 4 KB of EEPROM, 86 lines for input or output, some timers and counters, and several PWM pins. It operates on a voltage between 4.5 V - 5.5 V. It contains everything that is required in this work

3.2.GSM sim808

SIM808 board is a four band GSM board that includes GPS as well. The small design that also includes GPRS shortens the time and reduces the costs. Some details listed in table (1)

In our project the used GSM board is the SIM808 EVB-V3.2 module GSM/GPS/GPRS development board. This board features the following interfaces: three power input interfaces: DC044 interface and V_IN and a lithium battery interface the power supply should be 5v to 26 v at 2A,

The spatial range from earth to any GPS satellite can be calculated by knowing the time of travel to the receiver. The receiver needs to acquire the distance from at least four satellites, then it can estimate its location in 3D. In this system the GPS protocol National Marine Electronics Association (NMEA)-0183 is used.

3.3.MPU IMU 6050:

MPU6050 is a nine-axis gyro and motion sensor that has 3 axis gyroscopes and a 3-axis accelerometer. And a wide Digital Motion Processor (DMP), where either Inter Integrated Circuit (I^2C) or Serial Peripheral Interface (SPI) communication technologies can be used to connect this board to other sensors. The output of this sensor board is a 9-axis signal that has to be processed to analyze the acquired data. Angle changing detection in industrial aspects has a lot of applications. For example, the detection of the horizontal angle of an object, or its tilting angle, which benefits in making it simpler to balance a car or a four-rotor aircraft, and it can be utilized in order to identify

The altitude of an object. By the effect of the angle change, a specific control algorithm is utilized, and the Proportional Integral Derivative (PID) algorithm is used to negate the tilt and pan effects of the object. So, the detection of the car crash can be analyzed through the status of the electronic MPU IMU board. In the MPU6050, (VDD) supply pin should be supplied by 3.3V, (CS) is a chip select pin. Data communication can be utilized by using either SPI or I^2C protocol.

MPU6050 has three 16-bit Analog to Digital Converter (ADC) that is used to acquire the acceleration parameter value of the 3 axes, which is then converted to a single digital output signal for the microcontroller to process. The range of the gyroscope boards

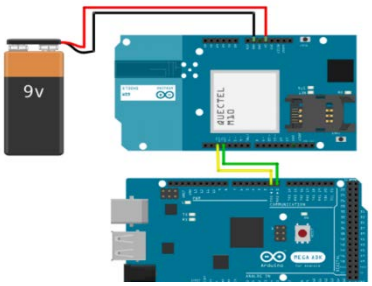

Fig. 2. Arduino Mega connection with GSM board

readings is (±250, ±500, ±1000, ±2000) degrees. The range of accelerometer boards readings is (+2G, +4G, +8G, +16G). There is an on chip 1 MB First in First out (FIFO) memory that can be used by writing data into it and then reading the data from it to act as a data cache.

The serial data interface can be accessed through either the I^2C, which has a maximum rate of data transfer up to 400 K. bps, or the SPI, which has a maximum rate of data transfer up to 1 M. bps.

3.4.The Liquid Crystal Display:

A 4 x 20 Liquid Crystal Display (LCD), it is a display that consists of flat plates that use the modulation of light inside the liquid crystals. It does not send out light and signals by itself, but it relies on two sheets of polarized material with a solution of liquid crystal. If current is passing by, then crystals get arranged so that the light is prevented from passing. Usually, all types of displays require a lot of input / output pins of the microcontroller to be used and reserved in

order to display a message that has a meaning to the user, who makes correct choices in each specific condition based on the displayed message. There exists a board that can be utilized with the LCD display that allows the user to minimize the number of used pins from over eight pins to only two pins by using the I^2C communication protocol. This board is added as a shield to the LCD such that it's not apparent to the user.

4. Detailed Description and Flowchart of The System

4.1.The GSM SIM808 board

The GSM board requires four lines in order to operate, where two of them are the power lines (Vcc and GND), where these two lines are not provided from the Arduino board, but from an external battery since the GSM board requires a high amount of current consumption in order to guarantee a successful call with an end point such as a cellphone.

The other two lines are the transmitting line Tx and the receiving line Rx, where these two lines must be connected to their counterparts in the Arduino board, such that the Tx and Rx lines of the GSM board are connected to the Rx and Tx lines of the Arduino board, as shown in Figure (2) here, where the operation of the GSM board is controlled by the AT commands sent from the Arduino board

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5.2.The MPU IMU 6050 Gyroscope board:

The MPU IMU 6050 gyroscope requires four lines in order to work, two of them are the power lines (Vcc and GND) that are taken directly from the Arduino board, while the other two line are the i2c lines SDA and SCL, which are the data line and the clock lines respectively, where these two lines on the gyro board should match those on the Arduino Mega board. The connection of this sensor board with the Arduino Mega controller board is shown in figure 3.

5.3.I2C LCD 20x4 board

As its name implies, the i2c LCD board requires i2c communication lines to be connected with the Arduino Mega board in order to function properly as shown in figure 4. The same i2c lines are already used by the Arduino Mega board in order to communicate with the gyro board, but that issue is resolved by giving the LCD a different i2c address than that of the gyro board. The LCD is used to display various information to the user, such as the (x and y) angles of tilting, status of the airbags, and the coordinates of the location of the accident upon occurrence. That is all that is concerned with the hardware part of the work. In order for these parts to work together, a program written in Arduino must be transferred into the Arduino Mega board, where the steps are illustrated in the following flowchart

6. Flow Chart of circuit

The programming line codes for this work is written using the Arduino Integrated development Environment (IDE). The steps for this system to operate are:

1. All input and output pins are initialized by deciding their roles and other parameters.
2. The baud-rate of both the GSM board and the Arduino board is specified.
3. A repetitive loop begins to check whether the GSM board is connected to the network or not.

4. Arduino starts gathering various information from multiple sensors, which are:
   4.1. MPU IMU 6050 tilt and pan data
   4.2. Airbag sensors data
   4.3. The emergency SOS data
5. Arduino starts comparing the data acquired through the sensors with predefined threshold levels specified in order to detect whether the circumstances are normal for a driver or there is an accident.
6. In case the sensor readings are all within the regular values, then the system reverts back to updating the acquired information as mentioned in step 4 and continue operation sequence from there until an accident is detected.
7. Upon accident occurrence, the sensors data will be above the threshold level, and therefore the Arduino will start the alarming sequence in the next step.
8. The alarming sequence starts with getting a fixed GPS location (longitude and latitude) at the time of the accident.
9. Then a Google maps link is created from the GPS information in order to send the location data in a method easy to understand and locate.
10. Then an SMS gets sent to the predefined number previously specified by the vehicle driver, which contains the location of the accident sent as a link that can be accessed on the other end in order to acquire the exact location even if the person reading the SMS does not know how to understand location coefficients such as longitude and latitude.

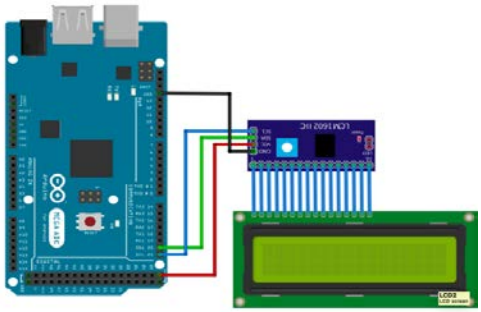

Fig. 4. i2c LCD with Arduino mega

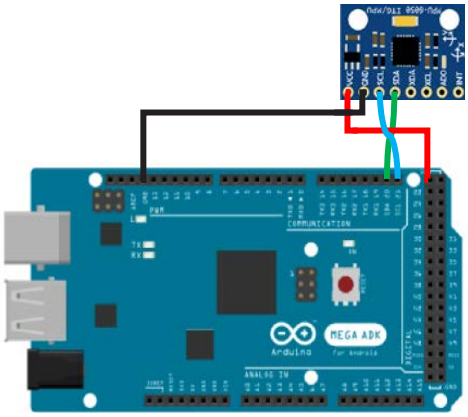

Fig. 3. Arduino mega connection with MPU IMU 6050 gyroscope board

The previous steps are illustrated in the flowchart in figure 5, also, a complete system connection shown in figure 6, and a

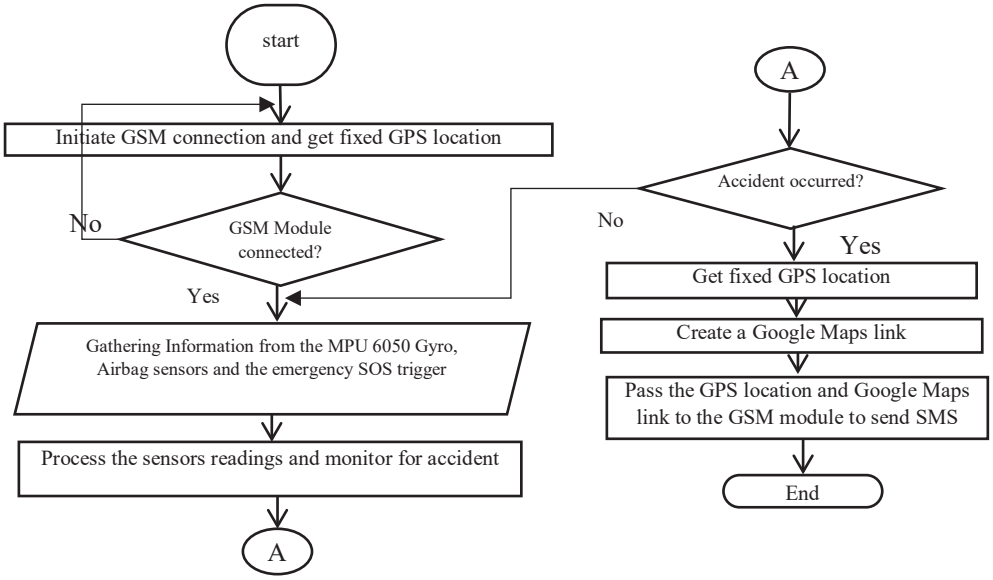

Fig. 5. System operation flowchart

screenshot of the received SMS in a smartphone from Google maps is shown next, as long as the front view and the back view of the implemented system in figures 7, 8 respectively.

7. conclusion:

The proposed system had been tested and it works properly. It decreased the time it takes for the ambulance to arrive the location of the car accident by a great extent. Especially, in the case where there were no witnesses to report the incident, where the system did the work instead and performed it more efficiently by sending the exact coordinates of the incident. Stand byer citizens might not even know the name of the streets or the intersections to report to the ambulance.

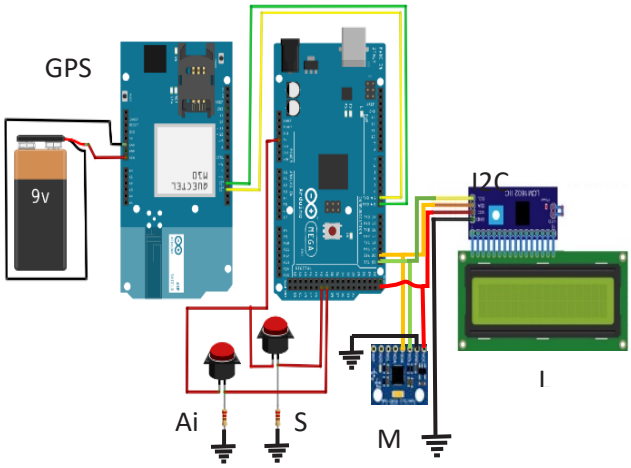

Fig. 6. complete system

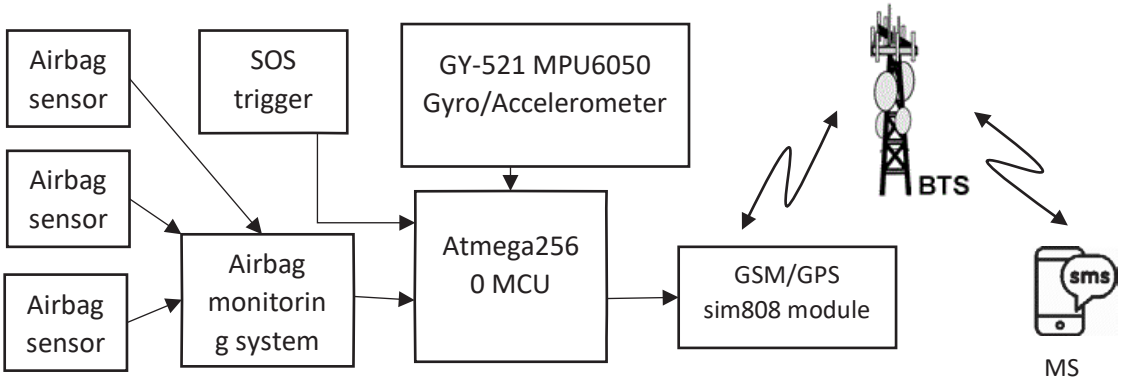

Fig. 1. Block diagram

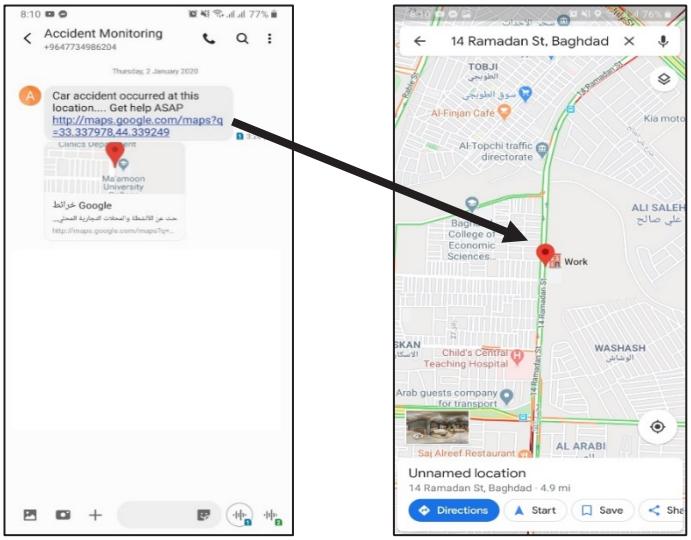

Fig. 7. A screenshot of the received SMS, and the resultant Google maps image after link activation

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Natural fibers and their applications: A review

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Abstract : Natural fibers are playing a major role in so many applications such as biomedical applications, aerospace Industry, structural applications, and automotive. This review aims to provide an overview of technological process (chemical treatment), availability, and the most prominent applications of natural fibers that made them preferable to be employed in these applications.

Keywords: Applications, Chemical treatments, Eco-friendliness, Natural fibers.

الخلاصة: تلعب الالياف الطبيعية دورا رئيسيا في العديد من التطبيقات مثل التطبيقات الطبية وتطبيقات الفضاء والتطبيقات الهيكلية والسيارات. هذا البحث يهدف الى اعطاء صورة عامة عن تقنيات التصنيع (المعالجة الكيميائية)، الوفرة، وكذا أبرز التطبيقات الخاصة بالألياف الطبيعية التي جعلتها مفضلة في الاستخدام.

1. Introduction

In recent decades, there have been a consistent consumer's awareness towards new products made from renewable sources. Green marketing has new directives on recycling social impact and makes changes in cognitive values that led the consumer towards eco-friendly products.

In particular, composite materials are being developed with new styles targeting to improve, adapt, and introduce new products in a sustainable and responsible approach [1-2].

The improvement in environmental awareness and the willing to ensure sustainability of construction materials has encouraged many researchers to seek for some alternative fibers to strengthen those materials. In this respect, natural fibers show a considerable attention according to their reproducibility, low density, high specific strength, and cost effectiveness. Moreover, they do not pose any ecological problems in terms of closing important life cycles (especially CO_2). The replacement of the traditional synthetic fibers by their natural counterparts is preferred not only for the environment but also for economic reasons as the production of synthetic fibers is an energy-consuming process compared to the natural ones [3-4].

In addition, more merits can be obtained by natural fibers that include; but not limited to; low cost, low density, sustainable availability, and low abrasive wear of processing machinery [4].

Thus, polymer composites based on natural fibers as reinforcing agents have shown promising indications not only in mechanical performance, but also in physical and thermal properties compared to the neat polymers. Nevertheless, there are some limitations associated with using natural fibers in composites such as the absence of adequate adhesion between the fiber and the matrix, hydrophilic nature (moisture absorbing), and poor thermal stability [5].

Natural plant fibers possess a hydrophilic nature according to the presence of strong polarized hydroxyl groups in their structure. As a result, these fibers are innately incompatible with polymers matrices which have a hydrophobic nature. Furthermore, due to the presence of hydroxyl groups in natural fibers, moisture absorption is very high and this leads to poor interfacial bonding with the polymer matrices which consequently leads to de-bonding of fibers and makes voids in the final products. The interface between reinforcing fibers and the matrix plays a crucial role in the mechanical performance of the bio-composites. The overall characteristics of natural fibers based polymer composites are intimately associated with the nature of the natural fibers and their compatibility with polymer matrices [6-7].

A number of chemical treatments are available that can be utilized to enhance the compatibility between the fibers and matrices. Apart from the chemical treatments, there are many ways of physical treatments which are used to improve the interfacial bonding between natural fibers and the polymer matrices. The physical structure and surface properties of fibers can be altered by these treatments. Different types of chemicals are employed for the treatment of natural fiber.

The majority of the treatments used on natural fibers are alkali treatments. This kind of treatment removes the lignin, wax, and oil that are covering parts of natural fibers and increases the roughness of the fibers surfaces. This leads to a better interlocking with polymer matrices [7].

Surface modifications represented by chemical treatments offer an effective means to remove lignin from the natural fibers and hence enable better bonding in polymer composites [8].

The fibers from natural plants are utilized for commercial applications such as household applications, automotive industries, and so many others. The natural fiber-based composite’s quality depends mainly on reinforcement properties and matrix attachment. The complete bio-based natural composites are made with a combination of natural fiber and natural-based resin.

This kind of composites is used in many applications such as industrial, construction, marine, electrical, household appliances, automotive, and sporting goods. In addition,

these composites have high strength, high stiffness, light weight and high corrosion resistance [9- 11].

Although natural fibers contain commonly hemicellulose, cellulose, lignin, pectin, wax, and moisture, but the characteristics of those fibers completely depend on the growing environment of plant, type and maturity of the plant, fiber extraction method, and fiber extraction part of the tree [10].
The extraction of natural fibers is made from both resources, renewable and nonrenewable such as oil palm, sisal, flax, and jute in order to produce composite materials. The plants, which produce cellulose fibers can be classified into bast fibers (jute, flax, ramie, hemp, and kenaf), seed fibers (cotton, coir, and kapok), leaf fibers (sisal, pineapple, and abaca), grass and reed fibers (rice, corn, and wheat), and core fibers (hemp, kenaf, and jute) as well as all other kinds (wood and roots) [12].

2. Sources and Properties of Natural fibers

There are different types of plants-based natural fibers classified into two major categories, wood-based natural fibers, and non-wood-based natural fibers, as shown in Figure 1. The subcategories include bamboo, flax, wool, kenaf, jute, hemp, okra, sugarcane bagasse, hemp, banana leaf, pineapple, coconut shell, rice husk, wood or other fibrous materials. These fibers find a variety of applications in paper industry and polymer composites [13].

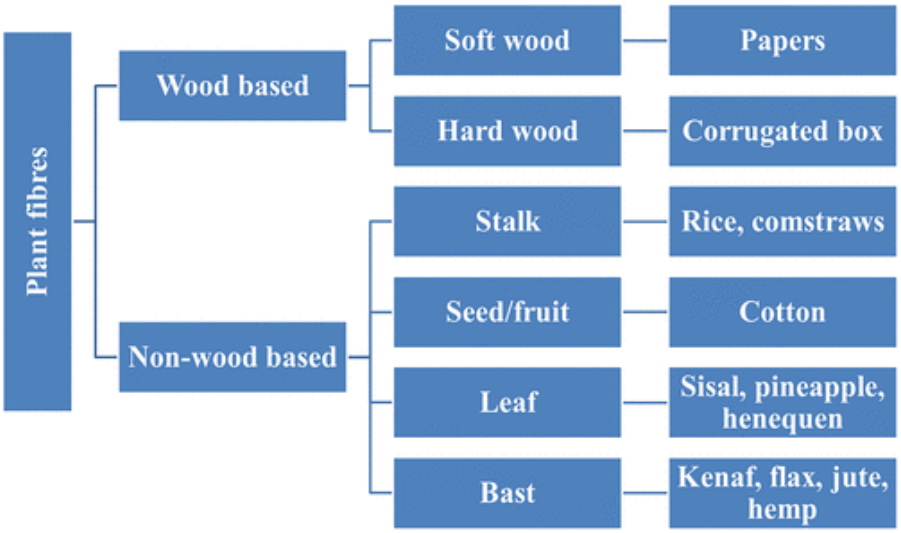

Fig. 1. Classification of plant fibers [13]

2.1 Kenaf (Hibiscus cannabinus)

The kenaf fibers are one of the most important fibers that belong to bast fibers and they are majorly used for producing papers and ropes [14]. Kenaf is a fibrous plant. These fibers have many unique features as they are tough, stiff, strong, and have high resistance to insecticides. These plants are cultivated 4,000 years ago in Africa, Asia, America, and some parts of Europe [15].

2.2 Hemp (Cannabis sativa)

The Hemp is a type of plants species grown particularly in Asia and Europe. It grows up to 1.2–4.5 m and 2.0 cm in diameter [16]. These fibers can be employed in ropes production, textiles, garden mulch, the assortment of building materials, and animal beddings. In recent developments, it is used to fabricate different kinds of composites [17].

2.3 Jute (Corchorus capsularis)

The jute is considered as an important natural fibre grown in specific parts of Asia including India, Bangladesh, China, and Myanmar [18-19]. The jute plant grows up to 15–20 cm within several months, and the fibers are extracted after harvesting which is performed about four months from cultivation. The retting process is done either chemically with the help of chemical agents such as ($N_2H_8C_2O_4$, Na_2SO_3, etc.) or biologically [20].

2.4 Flax (Linum usitatissimum)

The flax fibers are produced from the prehistoric period. These fibers are separated from the stems of the plant Linum usitatissimum that is mainly used to produce linen [21-22]. These are cellulosic plants but they are more in crystalline form. These fibers measure up to 90 cm length and diameter of 12–16 μm. Netherlands, Belgium, and France are the leading producers of these fibers. These fibers are e in furniture materials, textiles bed sheets, linen, and interior decoration accessories [23, 20].

2.5 Ramie (Boehmeria nivea)

Ramie is one of the herbaceous perennial plants cultivated extensively in regions native to China, Japan, and Malaysia where it has been used for over a century as one of the textile fabrics [24-25]. Ramie is a non-branching, fast-growing plant which grows up to 1–2 m height. The fibers extracted from the stem are the strongest and longest of the natural bast fibers. They are used to make sweaters in combination with cotton. Also they are used in upholstery, gas mantle, fishing nets, and marine packings [26]. In addition, attempts have been made for developing bio-based products related to Ramie by utilizing them in various applications of automotive, furniture, and construction. Ramie fibers are extensively used for the production of a wide range of textiles, pulps, papers, agrochemicals, and composites. The processing of ramie fibers is similar to linen from flax [27].

2.6 Nettle (Urtica dioica)

Nettle is commonly grown as a herbaceous plant that consists of 35–40 different species. It is generally grown in Europe, Asia, Northern Africa, and North America [28]. The plant usually grows up to 2.0 m in length, the leaves are soft and green which are 3.0–15 cm long. The leaves and stems are generally hairy and have stinging hairs on them [29]. The typical applications of nettle fibers are textile industry, bioenergy, and animal housing. Nowadays attempts are made to employ nettle fibers in different industrial scales [30].

2.7 Pineapple Leaf (Ananas comosus)

The pineapple plant is one of the abundantly cultivated plants. The pineapple leaf fibre is a crop waste after pineapple cultivation. It is a short tropical plant grows up to 1.0–2.0 m and the leaves are in cluster form consists of 20–30 leaves of about 6.0 cm width. Approximately, 90–100 tons of pineapple leaves are grown per hectare. Among the different natural fibers, pineapple leaf fibers show good mechanical properties. Pineapple leaf fibers are multicellular and lingo-cellulosic. The fibers are commonly extracted by bare hands using specific scrapers [31- 32].

2.8 Sisal (Agave sisalana)

The sisal is one of the most used natural fibers, and Brazil is one of the largest producers of this fibre. It is considered native to south Mexico that consists of the rosette of leaves grows up to 1.5–2.0 m tall [33-34]. The sisal produces about 200–250 commercially usable leaves in the life span of 6–7 years. The sisal fibers are possessing good range of mechanical properties and are used in the automotive industry and shipping industry.

2.9 Date Palm (Phoenix dactylifera)

The date palm is known as palm extensively grown for its fruit. The biodiversity of the date palm is all over the world comprising around 19 species with more than 5,000 cultivators all around the world; [36-37]. The date palm trees (Phoenix dactylifera L.) are the tallest among the Phoenix species and can grow up to 23 m height [38]. The date palm rachis and leaves are accumulated in large quantity after the harvesting of the date farm fruits every year in the farming lands of different countries. These fibers can be used as the potential cellulosic fibre sources. These fibers from leaves and rachis can be used as reinforcements for thermoplastic and thermosetting polymers. Some researchers have found ways to use the date palm fibers in the automotive application [39].

2.10 Cotton (Gossypium)

Cotton belongs to the subtribe Hibisceae and family of Malvaceae; is an important agricultural crop [40]. It is the commonly used natural fibre for the production of clothes. The cotton is grown in tropical and subtropical regions, and China is the largest producer of cotton followed by India and the United States [41]. The leaves of the cotton are removed, collected, and compressed into truckload-sized "modules." Later, the modules are transported to processing plant known as the cotton gin. The gin separates the seeds, sticks, and burrs from the cotton fibers. The cotton fibre is used extensively in textile industries. Recently, attempts have been made to develop the composites based on cotton fibres for improving some industrial applications [42].

2.11 Coconut Fibre (Cocos nucifera)

The coconut fiber is obtained from the husk of the coconut fruit. Among the different natural fibers, coconut fiber is the thickest. Coconut trees are mainly grown in tropical regions [43] Coir fibers (CFs) are versatile lignocellulosoic fibers and are comprehensively utilized in the scope of various industrial applications. Cocos nucifera or coir fibers can be obtained from the tissue surrounding the seed of coconut palm. They are composed of cellulosic fibers with hemicelluloses, pectin and lignin as a bonding material. Fibers used in this work (coir) have low cellulose and hemicelluloses; they are stiff and tough fibers due to high content of lignin [2].The major share of the commercially produced coconut fiber comes from India, Sri Lanka, Indonesia, Philippines, and Malaysia [44].

2.12 Kapok (Ceiba pentandra)

Kapok belongs to the Bombacaceae family. It grows in tropical regions [45]. Kapok fiber is a silk cotton and the colour of the fiber is yellowish or light brown. The fibers enclose the kapok seeds. Kapok fibers are cellulosic fibers, light-weight, and hydrophobic [46]. Conventionally, kapok fiber is used as buoyancy material, oil-absorbing material, reinforcement material, adsorption material, and can be employed as a biofuel [45].

2.13 Bamboo (Bambusoideae)

Bamboo fiber is also known as natural glass fiber due to the alignment of fibers in the longitudinal direction [47]. It is one of the extensively available trees in the dense forests especially in China, where about 40 families, and 400 species are found [48]. Bamboo fiber is used as a reinforcement agent in polymeric materials due to its light-weight, low cost, high strength, and stiffness. Bamboo has been traditionally used for making houses, bridges, and traditional boats. The fibers extracted from bamboo are used as reinforcements for making advanced composites in various industries [49].

2.14 Silk (Bombyx mori)

Silk fibers are extracted from silkworms for the clothing purpose since ancient times. Silk is produced largely in China, South Asia, and Europe [50]. Fibers are extracted from the Cocoons which are the larvae of the insects undergoing complete metamorphosis. Silk

fibers possess good mechanical properties represented by high strength, extensibility, and compressibility [51]. Table 1 shows the natural fibers in the globe and their rates of production [52].

Table 1: Natural fibers in the globe and their world production [52].

Fiber	Source World production (10^3 ton)
Bamboo	30.000
Sugar can bagasse	75.000
Kenaf	2300
Flax	970
Grass	830
Sisal	700
Hemp	375
Coir	214
Ramie	100
Ramie	100
Abaca	70

3. Surface modifications as remedies

The above mentioned drawbacks of the natural fibres can be significantly overcome using different types of surface modifications. These methods may be either physical treatments (i.e. plasma, ultrasound, ultraviolet and so on) or chemical treatments (silane, alkali, acetylation, benzoylation, sodium chloride and so on). Stretching, calendaring, and thermo treatment are physical methods that do not vary the chemical composition of the fibres, but still modify the surface and structural properties of the fibres and thereby affect the mechanical bonding to polymers [53-54]. On the other hand, chemical modification of the fibres changes the surface properties and quantity of chemical compositions in order to enhance the wetting with polymer matrix.

Moreover, it eliminates the unwanted elements such as hemicelluloses, lignin, and pectin from the surface of the fibres which lead to enhance the adhesion with the matrix [55-56]. Compatibilisers are chemicals which decrease the surface energy of fibres to make them more non-polar and compatible with polymer matrices [57- 58]. Improvement in wettability and polymer reactivity can be done by matrix modifications which are generally done by adding coupling agents and Compatibilisers to the polymer matrix. Coupling agents are predominantly accountable for enhancing the adhesion between the matrix and fibres [59- 60].

4. Alkali treatment

Alkali treatment (mercerisation) is the extensively usage of chemical treatment in which the structure of fibre surface is modified by treatment of sodium hydroxide (NaOH) and potassium hydroxide (KOH). Moisture was absorbed by natural fibre in the amorphous region of cellulose, hemicellulose and lignin constituents, owing to the existence of hydroxyl groups. Alkali treatment includes the elimination of the hydroxyl group of fibre as it reacts with NaOH to produce water molecules (H–OH). Furthermore, Na-O combines with the cell wall of fibre to produce fibre cell- O-Na groups as given in equation (1) [61]

$$\text{Fiber} - \text{cell} - OH + NaOH \rightarrow Fiber\ \text{cell} - O^{-}\text{-}Na^{+} + H_2O \text{-------(1)}$$

Alkaline treatments of the natural fibres diminish the moisture related hydroxyl groups and thus weaken the hydrophilic nature of the fibres. This treatment also withdraws a small fraction of hemicellulose, lignin, pectin, wax, and oil coverings from the surface of fibre [56].

A common untreated natural fibre seems to be enclosed by cementing elements such as lignin, hemicellulose, and other impurities such as wax and oils, while the alkali treated natural fibres were found to be rough and clean owing to the partial exclusion of lignin, hemicellulose, and impurities (i.e. wax and oils). After alkali treatment, surfaces of the fibres become rougher which result in a decrease in diameter pointing to an increment in aspect ratio, thereby increasing interfacial bonding, and finally, improvement in the mechanical strength will take place [62]. Mechanical and thermal behaviours of the bio-composites are found to be enhanced extensively by this treatment. The concentration of NaOH, treatment times, and temperature employed during the treatment play a major role in attaining the optimal effectiveness of the fibre. However, a high alkali concentration may cause an excess elimination of covering materials from the cellulose surface and de-lignify the fibre extremely, which can negatively affect the strength of the fibre [63- 64].

5. Natural fibres Applications

Natural fibers reinforced composites are emerging very rapidly as potential substitutes to the metal or ceramic based materials in applications that also include automotive, aerospace, marine, sporting goods, and electronic industries [65]. Germany is a leader in the use of natural fiber composites. The German auto manufacturers, Mercedes, BMW, Audi, and Volkswagen have taken the initiative to introduce natural fiber composites for interior and exterior applications. The first commercial example is the inner door panel of the 1999 S-Class Mercedes- Benz, made in Germany, of 35% Baypreg F semi-rigid (PUR) elastomer from Bayer and 65% of a blend of flax, hemp and sisal. It should be emphasized that luxury automotive manufacturers are on board which could be seen as evidence that natural fiber composites are being used for environmental needs and not to lower costs [66]. Mercedes Benz used an epoxy matrix with the addition of jute in the door panels in its E-class vehicles back in 1996. Another paradigm of natural fiber composites' application appeared commercially in 2000, when Audi launched the A2 midrange car: the door trim panels were made of polyurethane reinforced with a mixed flax/sisal material. Toyota developed an eco-plastic made from sugar cane and will use it to line the interiors of the cars **[67].** Toyota used kenaf to strengthen a door trim [68]. The mechanical performance of bio-epoxy/flax composites along with the environmental benefits make

Them suitable for body chassis, crash elements

And body panels [1]. The applications are shown in Table 2 [69].

Natural fiber-reinforced composite materials are generally utilized in interior parts represented by door panels, dashboard parts, parcel shelves, seat cushions, backrests, and cable linings. Applications to exterior are limited due to the high demand of mechanical strength [70, 71- 72].

Table 2: Applications of bio-composite in industry [69].

Fiber	Applications
Hemp	Paper, textiles, furniture, bank notes, pipes, packaging
Oil Palm	Window, door frame, fencing, roof, panel
Wood	Deck, window, door, fencing
Flax	Tennis racket, bicycle frame, laptop case
Rice husk	Bricks, window frame, panels
Bagasse	Railing system, panel, deck, fencing
Sisal	Paper, pulp, panel, door, roof sheet, shutting plate
Stalk	Drains, pipelines, panel, furniture, bricks
Kenaf	Mobile case, packing, bag, insulation, clothing, animal bed, oil absorber
Cotton	Textile, yarn, goods, furniture, cordage
Coir	Flush door shutters, storage tank, helmet, projector cover, post box, seat filling material, broom, brush, yarn, rope, net, bag, mat, padding for mattresses, seat cushion
Ramie	Industrial sewing thread, fishing net, packing, filters, canvas, household furnishing upholstery, paper
Jute	Geotextiles, chip boards, packaging, door frame, door shutter, panel, roofing sheet

5.1 Other applications

Silk fiber applications

Silk which is a natural fiber and produced in more than 20 countries finds applications in various sectors. Silk proteins are used as special diet for cardiac and diabetic patients due to its low sugar content, easy digestibility, and low cholesterol [73-74]. The Japan Aerospace Exploration Agency (JAXA) has released a recipe as astronauts' food. Silk biopolymer is used in tissue regeneration for treating burn victims and as matrix for wound healing. Silk fibroin peptides are used in cosmetics due to their glossy, flexible, elastic powder coating, easy spreading, and good adhesion properties [75-76]. Silk is reported to be used to fight various health related diseases such as edema, cystitis, impotence, adenosine augmentation therapy, epididymitis, and cancer [77]. Due to the phenomenal mechanical properties of silk as a biopolymer, it is suitable for biomedical applications.

Building material applications

Various natural fibers have been exploited to be used as reinforcements for building/construction industry. Bamboo due to its lightweight and strength is a very popular construction material. Bamboo based materials have been developed to make eco-friendly roofing products. Other similar products such as bamboo mat board (BMB), bamboo mat veneer composites (BMVC), and bamboo mat corrugated sheets (BMCS) have been developed. Sisal fiber-based roofing sheets also have been under development as cost effective alternatives.

Rice husk and rice straw are nowadays used to manufacture medium density fibreboards, particle boards, straw bales, cement bonded boards, etc. Ground nutshell is used for manufacturing building panels, building blocks, chip boards, roofing sheets, and particle boards. Cotton stalk fiber is used for making panel, door shutters, roofing sheets, autoclaved cement composite, paper, and plastering of walls. Coir fiber is a highly durable fiber used in all types of matrices such as fly ash lime, polymers, bitumen, cement, mud, and gypsum. Jute coir composites are seen as cheap and economic alternatives to wood for construction industry. Jute coir boards are used for the production of boards which are more resistant than teakwood against rooting under wet and dry conditions with better tensile strength. Jute with rubber, wood, and coir are considered as good alternative to plywood [78].

6. Summary

Natural fibers and the products designed around these materials possess many distinctive advantages: cost-effectiveness, low coefficient of friction, easiness of availability, exhibition of good thermal and dimensional stability, environmental friendly, and so many other advantages. Because of these and many more reasons, the popularity of natural fibers is on increase, and a lot of scientific data and research is being done around the globe. However, for effective utilization of natural fibers in various potential applications, all the aspects associated with them should be studied and presented. Among these aspects: (a) Targeted applications, advantages and disadvantages of using natural fibers; (b) Product design, studies to be carried out on the development of prototype and other engineering software; (c) Preparation and fabrication technique, particular technique, or process to be identified which should reduce possibility of failure; (d) Commercial production, should be cost effective and eco-friendly; (e) Marketing and sales, product should be marketed to showcase its potential benefits toward society and environment with good after sale service.

Despite of current prevailing aforementioned issues, several commercial products have been launched by various manufacturers. Automotive industry is the most active sector that leading the development of natural fibers based products. Gradually, other sectors related to sports, furniture, and medical will be catching up.

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Difficulties of Explorationests in decision making under complex constraints of Technical/Economical and Geopolitical environment of risk and uncertainties

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Abstract: The ultimate objective of Explorationests and managerial head posts is to make the right decision of exploration and development plans under Technical (Engineering) , Economic and Geopolitical major environments.This decision must respond positively to the target of exaggerating the national reserve necessities and to replace that depleted or about depleted reservoirs or fields with the best efficiency. Thus, The task of a decision maker is in the beginning to evaluate the situation of the problem he has, where certainly falls in one or more of four cases: 1) Certain deterministic consequences 2)Risky of probabilistic consequences 3)Uncertainty of unknown consequence and 4)Conflict of consequences influenced by opponents. Explorationests or manager deeply has to deal with enormous numbers of unknown variables or parameters as more complex situations by more components of risk and uncertainties, particularly the 2nd and the 3rd categories. In both cases Explorationests must develop a criterion like reserve, profits as related to his objective, then applying either a simulation method or analytical approach to reduce the level of probabilities. The probability can be defined by what is called the Expected Value concept, which for Net Present value becomes (ENPV) , which in turn could be either: An event , where a product to be obtained by multiplying the occurrence(frequency)as an outcome by the condition worth value , or : As Decision Alternative , where the probability outcome that could occur, if the decision alternative is occurred . This definition hence, is the most important tool in decision making, while the most popular simulation technique to reduce probability level is what defined as Monte Carlos simulation. It tried to apply it in this work for the western flank of the Mesopotamia, where many exploratory targets of unknown variables assumed to deal with the concept of expected value EV as: a) joint, mutual exclusives probabilistic formula P(total)=P(Tech)*P(Eco)*P(Geopol), and, or: As similar case, but as a decision making alternatives, P(total)=Sum{P(Tech)+P(Eco)+P(Geopol)}.Results of this preliminary study are promising targets, but risky to some extent, thus it seems better to explore this major target, but not to develop it, at least now.

Keywords: Petroleum Exploration, Oil Exploration Constraints, Risk and Uncertainty Evaluation.

الخلاصة: الهدف النهائي من الاستكشافات ووظائف الرؤساء الإداريين هو اتخاذ القرار الصحيح لخطط الاستكشاف والتطوير في إطار البيئات الرئيسية التقنية (الهندسية) والاقتصادية والجيوسياسية. يجب أن يستجيب هذا القرار بشكل إيجابي لهدف المبالغة في ضرورات الاحتياطي الوطني والاستعاضة عن تلك المكامن أو الميادين المستنفدة بأفضل كفاءة. وبالتالي، فإن مهمة صانع القرار هي في البداية تقييم حالة المشكلة التي يواجهها، حيث تقع بالتأكيد في واحدة أو أكثر من أربع حالات: 1) بعض النتائج الحتمية 2) مخاطر العواقب الاحتمالية 3) عدم اليقين من العواقب غير المعروفة و 4) تضارب العواقب المتأثرة بالخصوم. يتعين على الاستكشافات أو المدير التعامل بعمق مع أعداد هائلة من المتغيرات أو البارامترات غير المعروفة باعتبارها مواقف أكثر تعقيدًا من خلال المزيد من مكونات المخاطر والشكوك، لا سيما الفئتين الثانية والثالثة.في كلتا الحالتين، يجب على الاستكشافات تطوير معيار مثل الاحتياطي، والأرباح فيما يتعلق بهدفه، ثم تطبيق إما طريقة محاكاة أو نهج تحليلي لتقليل مستوى الاحتمالات. يمكن تعريف الاحتمال بما يسمى مفهوم القيمة المتوقعة، والذي يصبح بالنسبة لصافي القيمة الحالية(ENPV) ، والذي بدوره يمكن أن يكون إما: حدث، حيث يتم الحصول على منتج عن طريق ضرب الحدوث (التردد) كنتيجة في الشرط قيمته، أو: كبديل للقرار، حيث النتيجة الاحتمالية التي يمكن أن تحدث، إذا حدث البديل للقرار. ومن ثم، فإن هذا التعريف هو الأداة الأكثر أهمية في صنع القرار، في حين أن تقنية المحاكاة الأكثر شيوعًا لتقليل مستوى الاحتمال هي ما تم تعريفه على أنه محاكاة مونتي كارلوس.

1. Introduction

a. Iraq is one of the main producers of hydrocarbons and for exploration, it is a promising country.

b. Different trends of comprehension of the constraint of risk and uncertainty in the exploration stage.

c. Importance of H-C treasure to Iraqi people and country (Geostrategic and geopolitics) is so great.

d. Exploration quality depends on types and needs.

e. Continuity of exploration (geostructural and stratigraphic) is so necessary.

f. Global new era of H-C needs, style, and consumption (Near a new energy break through) .

Note: All coming data are from published literature, personal experience and assumptions.

g. A question may rise, if is still there a new era for Iraqi energy sector

2. Petroleum geology of Iraq:

A. the 3-Tectonic plates are influencing the geologic folding and tectonic activity of Iraq

- Iranian (Zagros) plate
- Arabian plate
- Anadol (Turkish) plate

B. Geology, geophysics and petroleum engineering / drilling / logging / testing , evaluation and production are in successive steps and highly sensitive to technology advancements.

C. It is not easy to insure H-C prospect, thus better to have the good management approach and tool, all view is expressed in figs(1,2,3 &4) concerning geologic map, x-sectional view, fields, reservoirs layers .

D. En their deep western side of the Mesopotamia, difficult to find giant fields for many geologic limitations don't: trapping, facies , depth , age, unconformities , folding , faulting , source rocks, graben, sand stone and migration.

E. Structural and stratigraphic traps, complex migration.

F. Prospect, reservoirs, reserve, grading by volume, by H-C quality by drive, porosity and permeability.

G. Exploration ways: Surface geology / Subsurface and Remote exploration (fig.5),

H. This paper assumed two areal zones for fields distribution: the first is what called Algaziera, between Alfurat river and Tigress river and the second is the desert to the west of Alfurat river.

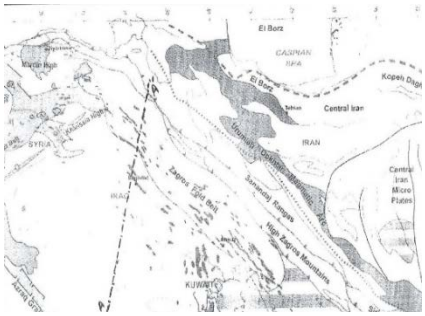

Fig .1. Techtronic elements of Iraq (Curtsey ref.9)

3: Fields and reserve considered:

More than 500 hundreds stromal traps are distributed over the map of Iraq, but we are considering only the western flank of Euphrates river or desert flank, which includes tens of fields, but we considered again only few of them to simplify the qualitative descriptive exercise(figs 3 and 4).

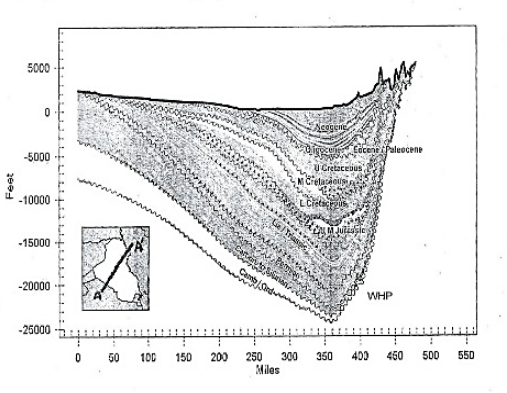

Fig .2. Geologic x-section of Iraq near Baghdad from east to west, perpendicular to Zagros folding (Curtsey of whpierceexploration.com)

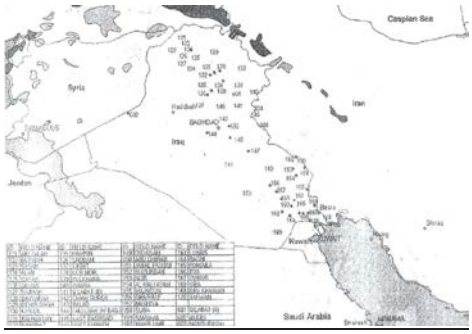

Fig .3. Showing fields in Iraq from Beydoun et al, 1991 (Curtsey of ref-10)

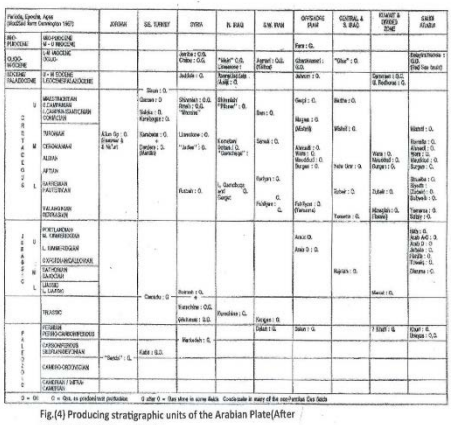

Fig.(4) Producing stratigraphic units of the Arabian Plate(After Beydoun,1991) After Ref.(10).

Fig .4. producing stratigraphic units of the Arabian Plate(Beydoun et al, 1991Curtsey of ref-10)

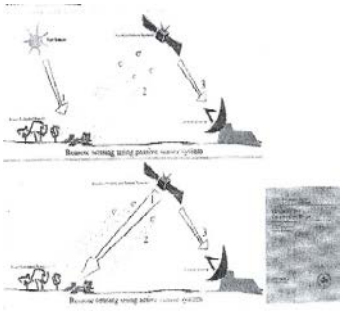

Fig .5. Remote sensing illustration (curtsey Wikipedia, after ref.10)

4. Explorationests and his responsibility in decision making:

→ Proposing and choosing geological, geophysical and remote technologies.

→ Finding Prospects

→ Reserve evaluation

- (No fixed terminology agreement but Petroleum Resources Management terminology SPE , AAPG & WPC @2007, has introduced the P-coding system (or 1P , 2P & 3P classification) as follows:

1) Proved (90% probable recovery) certain, actual recovery probability P ≥ to 1.0 P).

2) Probable (recovery probability 50% of 2+3) Risky Actual Recovery ≥2P

3) Possible (10% Recovery probability of (1+2) Uncertain (RP ≥ 3P)Scared

⟶ Explorationests responsibility comes from the importance of his role in risk and/or uncertainty evaluation and by reducing its level down to classical probability.

- Open nature of exploration

a. Classical probability ⟶ Use close system or well defined event.

b. Event probability ⟶ Frequency of Occurrence

c. Subjective probability ⟶ Experience &Efficiency.

- Also , formulation probabilities:

a. Probability (success) = P(generation) * P(migration) * P(trapping)

* P (reservoir) * P (seal)

b. Ultimate Recovery Probability =

Gross Recovery Volume = P (Ø)* P (h) * P (S0) * P $(\frac{1}{Bo})$ * P (R_f)

- Knowledge of all analysis approaches :

a. Quantitative, Qualitative and sensed.

b. Scientifically capacity : training + basic science

c. Best decision alternatives preparations.

d. Economic considerations.

e. Efficiency& experience to treat enormous variables simultaneously by (objective, subjective, gradual influence).

- Estimations and ranging (by subjective, prior to development capacity.
- Blending of variables
- Estimations of reserve before production,while and after production with the cooptation with the petroleum engineering.

5. The variety of H-C exploration formulas of risk and uncertainty:

a. Many point of views

- Geologic considerations (very old technical)
- Geologic + economic consideration (old technical)
- Geologic + economic + geologist personal considerate (levorsen A.L)
- Geologic + prices
- Political + geological + price + supply & dealt + cost in companies (1)

b. The point of view of this paper is P (total) = Technical (geologic & engineering) + Economical (profit) + Geopolitical (Prices).

, Where in any of constraint group there is a lot of variables has certain level of uncertainty of that factor i.e., from 100% probability to zero value, on the

Standard deviation curve, so probability value is a factor ranging between zero and one.

6. The formulation of Proposed model for the Iraqi case, at least:

6A - Before formulations of the model, better to detail in constrains of each one of the 3-main groups of constraints.

a. Direct volume of treasure Np = Billion bbl / Area are: Porosity Ø, reservoir thickness h, Oil saturation (S_o) = (1 – SW) , Recovery factor R_f = fraction and shrinkage factor $\frac{1}{Bo}$= fraction .

- We note that the volume can be expressed indirectly as a fraction or certain volume per well or per field e.g.: through the frequency distribution and cumulative frequency for each constraint or factor.

b. Probability fraction of economic factors are: reserve estimations, price, geologic and geophysical, lease cost, appraisal well drilling, production depletion cost, tax position and other sub factors.

- We note that all those factors can be expressed influence by a fraction of cumulative frequency.

c-Geopolitical factors : Also they can be expressed as fractions, according to their sub factors influences (via cumulative frequency), some of them are : demand & supply ; crises , clean energy evolution, evolution of world overall demand , USA strategic storage , Basins Depletions, Oil Petroleum Exporting Countries (OPEC) and others

We note here that any of these factors can be treated as individual factors or as collected in one single factor, which is marked here as the price (in both cases as a fraction value on the probability departing from the corresponding S shape curve.

6B – Now for reducing the level of uncertainty applying probability terminologies, grades level and rules, it needs to use Monte Carlo simulation tool to evaluate each sub factor in direct value of influence by a fraction of assigned confidential value for example.

a. For applying the Monte Carlo approach we need to construct the S-shape curve or based on the standard deviation concept or

applying frequency variation for each variable (frequency cumulative curve).

b. It is based on choosing random value from random number table for hand calculate or choose computer no generator to select cumulative frequency (for computer user) then to use it on S-curve to set in associated fraction of volume or frequency of occurrence.

c. For each experiment we select the value for each independent variable in case of technical $P_{(T)}$, or economical $P_{(E)}$ and geopolitical or prices $P_{(P)}$.

6C – Applying probability rules on proposed model Of the triple component $P_{(T)}$, $P_{(E)}$ and $P_{(P)}$.

1. $P_{(TEP)} = P_{(T)} * P_{(E)} * P_{(P)}$

As for each probability Event a single value – Law of multiplication.

2. $P_{(TEP)} = P_{(T+E+P)}$ as alternative decision making probability-Law of adding...

3. For More conditional rules of application for independent factors and non-independent (Joint) conditional event relationships can be summarized as follows :

*We note here that we can work on single compound by neglecting any term of them – also we mention here , we neglect the baye's formula for simplicity , also that formulation as for decision alternative making

7. Preliminary exercise of application:

For a practice example it was noted that we need to construct the frequency distribution of all assumed playing factors or even to start from some or sub factors. But in our case we start from the main factors of reserve, economy and prices of H-C expected. For reason of limitation of data, we did a lot of assumptions for example we assumed that number of fields under consideration are about 50 fields or reservoirs along the two proposed zones of the western flank of Iraq, We propose they can be sub divided in about 10 categories or groups classified as : Null, very poor, poor, fair, very faire, good, very good, giant, super giant, according to other sub factors of field size, closure, petroleum quality and so on.

Case 6d: What type of fraction of distribution can be used to represent 50% of the occurrence of the influence?

If either treated as event valued variable or alternative choice of decision making. Values for the mean of the major triple factor function fraction.

Is it the mean value? Is it the weighted average? Or other assigned average? Nothing that successive factor influence is conserved as cumulative range level on the abscissa, while the cumulative frequency (factor of participation) is to be represented on the coordinate as well.

Event	Mutually $P_{(TEP)}$	$P_{(T+E+P)}$	$P_{(TEP)}$
Independent	Exclusive $P_{(T)}+ P_{(E)}+ P_{(P)}$	Nonmutuallyexclusive $P_{(TEP)}=P_{(T)}+ P_{(E)}+ P_{(P)} - P_{(T)}* P_{(E)}* P_{(P)}= P_{(TEP)}$low of addition	either mutuallyexclusive or Non-mutually exclusive $P_{(T)}* P_{(E)}* P_{(P)}$ low of multiplication
Joint conditional non independent	$P_{(T)}+ P_{(E)}+ P_{(P)}$	$P_{(T)}+ P_{(E)}+ P_{(P)} - P_{(E/T)}* P_{(E/P)}* P_{(T/P)} * P_{(E)}* P_{(P)}* P_{(T)}$	$P_{(T/E)}* P_{(E)}* P_{(E/P)} * P_{(P)}$

8. Results and Advices:

a-We can confirm that the Iraqi western deserts are of frontier stage & still in need for extended deep exploration efforts, although geologic

$P_{(T+E+P)}$ Nonmutuallyexclusive $P_{(TEP)}=P_{(T)}+ P_{(E)}+ P_{(P)} - P_{(T)}* P_{(E)}* P_{(P)}= P_{(TEP)}$low of addition	$P_{(TEP)}$either mutuallyexclusive or Non-mutually exclusive $P_{(T)}* P_{(E)}* P_{(P)}$ low of multiplication
$P_{(T)}+ P_{(E)}+ P_{(P)} - P_{(E/T)}* P_{(E/P)}* P_{(T/P)} * P_{(E)}* P_{(P)}* P_{(T)}$	$P_{(T/E)}* P_{(E)}* P_{(E/P)} * P_{(P)}$

exploration, drilled wells and surficial seepages were not encouraging.

b-Lack of information is a problem (at least to this paper), except little publications, here and there, which affect the accuracy of analysis either for estimation or calculations.

c-Western desert exploration is needed urgently, particularly in Neongene subsidence.

d-We s still say that, using new technologies after a century of old development is becoming more than necessary.

e-The new model is one more as a predictive model, with triple constraints; its accuracy is a function of quality of data, All these models are

f-The model is elementary and still under development, It was introduced as part of new out look to the reservoirs management since 2009.

g-Carbonates, and Sandstones structural reservoirs from Miocene to Triassic, from north to south of Iraq had been well exploited, but those of stratigraphic prospects, are not yet, thus they have to be put under consideration.

h-Supposed reservoirs and fields under consideration .

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The impact of structural inversion on the hydrocarbon system, northwest Mosul area, Case study Sasan (Sarjoon) Oil Field.

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Abstract: Sasan field is in Nineveh governorate, 46 Km northwest Mosul city. The present Sasan structure was discovered from surface mapping and 2D seismic defined the Upper Cretaceous reservoir but due to poor data quality, any estimate of oil in places are highly uncertain. Sasan structure from seismic shows Block-Faulted anticline covering a small area (Sasan East). Several normal faults appear to separate SA-2 from SA-1 affected the hydrocarbon system in these two wells. The more possible realistic interpretation is an inverted graben, thick Shiranish Formation in Sasan wells support this interpretation.

The model suggest that normal faults created the accommodation during Late Cretaceous (Sinjar trough) and subsequent Tertiary compression uplifted the depocenter creating the topographic depression which interpretated as a fault propagation fold. The last compressional structures can only have been filled with remigrated petroleum from breached, older traps, earlier structures could have been filled by migration from an actively generating source rocks. The exploration potential in the old Sasan structure configuration is good but it is still an exploration play not a commercial oil discovery, although oil is present in Shiranish, Hartha/Mushora and Wajnah formations but not clear if it is recoverable.

Gas present in deeper formations, both the oil and gas traps are breaching traps. The best exploration targets should, therefore, be old structures, produced by Late shoulders of Sinjar basin contain many such leads as the prospective leads nominated A, B, C and D.

Second best are old structures which have been partially restructured and whose closure has been modified, but not breached. The prospective reservoirs will be at Late Cretaceous, Early Cretaceous and Late Triassic.

Keywords: Sasan Structure, Inversion, Breaching, Remigration, Prospective Leads

الخلاصة: يقع حقل ساسان ضمن محافضة نينوى ، على بعد 46 كم شمال غرب مدينة الموصل . أن تركيب ساسان الحالي تم اكتشافه من خلال المسح المسح السطحي والمسح الزلزالي الثنائي الابعاد لمكمن الطباشيري الأعلى ولكن بسبب رداءة نوعية المعطيات من المسح الزلزالي ونتائج الحفر جعل من أي تخمين للاحتياطي الهايدروكاربوني للحقل غير موثوق بدرجة كبيرة . أن المقطع الزلزالي لتركيب ساسان بين طية محدبة متفلقة كتليا تغطي مساحة صغيرة (تركيب ساسان الشرقي) . كما أشر المقطع الزلزالي وجود العديد من الفوالق الاعتيادية تفصل البئر ساسان واحد عن البئر ساسان اثنين وهذه الفوالق أثرت بدورها على النظام الهايدروكاربوني لهذين البئرين . أن التفسير الأكثر واقعية لمنطقة تركيب ساسان يدلل على وجود خسفة منقلبة وان سماكات تكوين الشيرانش لابار الحقل تدعم هذا التفسير . يوحي الانموذج المقترح بأن فوالق التمدد وفرت الفراغ اللازم (حوض سنجار) خلال فترة الطباشيري المتأخر وادى التضاغط في فترة الثلاثي الى رفع مركز الحوض الرسوبي منشأ منخفض طوبوغرافي فسر على انه طية زاحفة متفلقة . أن التراكيب المنضغطة الاقدم تم ملئها من خلال إعادة هجرة الهايدروكاربونات من مصائد قديمة متكسرة ، اما التراكيب الناشئة حديثا فقد تم ملئها من هجرة هايدروكاربونات من صخور مصدرية مولدة نشطة .أن القدرة الهايدروكاربونية لمكامن الجزء العلوي من تركيب ساسان القديم على الرغم من ايجابيته ولكنه لا يرتقي الى اكتشاف نفطي تجاري على الرغم من وجود النفط في تكاوين الشيرانش ، الهارثة/ المشورة والوجنة ووجود الغاز في المكامن العميقة ولكن يبقى من غير الواضح اذا كان بالإمكان استخراج هذه الهايدروكاربونات تجاريا .أن المصائد النفطية والغازية هي مصائد متكسرة (متهالكة) ولذلك فالخيار الاستكشافي الأول لهذه المنطقة يجب ان يكون بأتجاه التراكيب القديمة المتولدة على اكتاف حوض سنجار والحاوية على العديد من الفرص الاستكشافية الواعدة والتي تم تحديدها بالمواقع أ،ب،ج ، د . أما الخيار الثاني فهو التراكيب القديمة التي اعيد بناءها جزئيا والتي تغيرت انغلاقاتها التركيبية من غير ان يصيب التكسر مصائدها . أن اعمار هذه المكامن المهمة هي في فترات الطباشيري المتأخر والمبكر بالاضافة الى الترياسي المتأخر .

1. Introduction

The Field is in Nineveh Governorate, 46 km northwest of Mosul city. Topographically the area is hilly, dissected by m any deep wadies.

In 1938, the area of the field was covered by surface geological survey and showed that the Sasan Structure was an anticline trending East-West, with 11 km long and 6.4 wide. Dips measured on the Northern flank, range 20-35 degrees and the Southern flank from 7-16 degrees. A smaller anticlinal structure was identified to the southwest of the main Sasan Structure, having a structural size of about 8.0 X 2.5 km2, separated from the Sasan structure by synclinal saddle {1}. This dome was called Sasan West to separate it from the main Eastern dome.

In 1955 the first exploratory well was drilled at the crest of the Eastern dome and reached a total depth of 2950 m. in the Mus Formation. encountering oil shows which were discovered in the Shiranish, Hartha, Jawan / Mauddod of the Cretaceous. {2}.

In 1960 the area was covered by seismic surveys. Interpretation results was not conclusive. Another seismic survey was conducted, by Iraqi National Oil Company (INOC), through the period 1972-1974, covered mostly the western part of Sasan Structure. The results obtained were of bad quality. Nevertheless, the seismic maps showed that the Sasan Structure is represented by a domal structural shape complicated by many faults at deeper horizons {3,4}. In 1974, the second exploratory well (SA-2) was drilled to explore the hydrocarbon prospects and to clarify the structural configuration. The well reached a total depth of 2995 m in Baluti Formation (L. Jurassic). Results obtained from this well showed the existence of oil and gas at several horizons, proved from test results {5}.

In 1976, the area was again covered by seismic surveys. Interpretation results were also not conclusive. As a results, the structural picture of the field, in particular the deeper horizons remain unsolved, which might be due to the structural complexities of the area at deeper horizons (Fig-1).

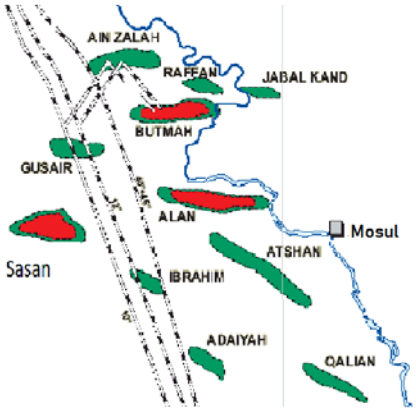


Fig.1. Location of Sasan (Recently nominated Sarjoon) Field.

2. The Main Objectives of the present Study:

2.1. Define the influence of structural inversion on the hydrocarbon system of Sasan oil field.

2.2. Suggest the most suitable promising location for the next well.

3. TECTONIC Setting

Sasan field is part of the Foot-hill Zone (Low Folded Zone). The geological terminology of Buday and Jassim has been used in the present work {6}. It is about 200 km wide, bound by the Mesopotamian Zone in the southwest and the High Folded Zone in the northeast (Fig. 2). South of Sinjar, the Foothill Zone is in contact with the Stable Shelf units {7,8}. Sinistral strike slip movement is postulated by Ameen {9}. The contact with the High Folded zone is delineated by the sudden elevation of the sequence exposing the Paleogene succession in the anticlines of the High Folded Zone in comparison with the deep Neogene filled depressed block of the Foothill Zone to the southwest. The Foothill Zone was the site of deposition of thick Neogene molasse; the

eastern half of the zone, known as the Butmah-Chemchemal subzone was elevated during the Paleogene as indicated by the development of Upper Paleocene to Eocene shoal deposits {10}. The Foothill zone is characterized by long anticlinal structures with very broad shallow synclines; upwards continuation of gravity field indicates that some anticlines are often associated with basement elevation. Some buried structures are (Fig. 2) also existed in the broad synclinal areas and are associated with diverging drainage system {11,12,13,14}. In the Mosul area where a thinner sedimentary column occurs above the basement and where carbonates associated with the thinning of the Jurassic and Cretaceous sequences are present. The folding style here is different. The folds are shorter (about 20-30 km), arranged in an en-echelon pattern and possess a simple harmonic character relative to those to the south of the high. Generally, most anticlinal structures of the Foothill Zone are asymmetrical to the southwest except in the area around Mosul where anticlines may have faced asymmetry, one to the north and the other to the south. The dominant fault system in the zone is the NW-SE system and is often found in association with the anticlinal structures {15,16,17}.

As indicated above, the main master fracture directions controlling the basin and swell patterns and distribution were NW-SE and NE-SE (i.e., longitudinal and transverse). Variation of as much as 20° in these main trends occurs frequently along the same lineament. The NW-SE trend is the original extensional trend which developed over a wide area as rifting and separation of the Cimmerian blocks occurred in the Early Mesozoic (Permian-Triassic into Early Jurassic) {18}. Along this trend compartmentalization of basins by up and down movements, separated from each other often by horizontal motion along the conjugate NE-SW trend, not infrequently occurred to form longitudinal subsided ridges, sometimes of a short-lived nature, or more evident and persistent horsts and grabens. Inversion of sectors of these "longitudinal basins" by transposition through wrench motion or vertical block uplift along the NE-SW fractures gave rise to such features as the Sinjar trough {19,20,21}.

This northern basinal area extended eastward into Laurestan province of western Iran. It is bounded to the north by the submerged Mosul High which also separates it form the Southeast Turkey Shelf. To the west is the submerged Rutbah Platform and the submerged Khleisia High. It appears that there was a narrow channel that existed between the Mosul and Khlesisia highs and this allowed a direct link between the northern basinal area and the Syrian Trough that occupied most of the central Syria and extended towards north-western Iraq (Sinjar Trough) {22,23,24}.

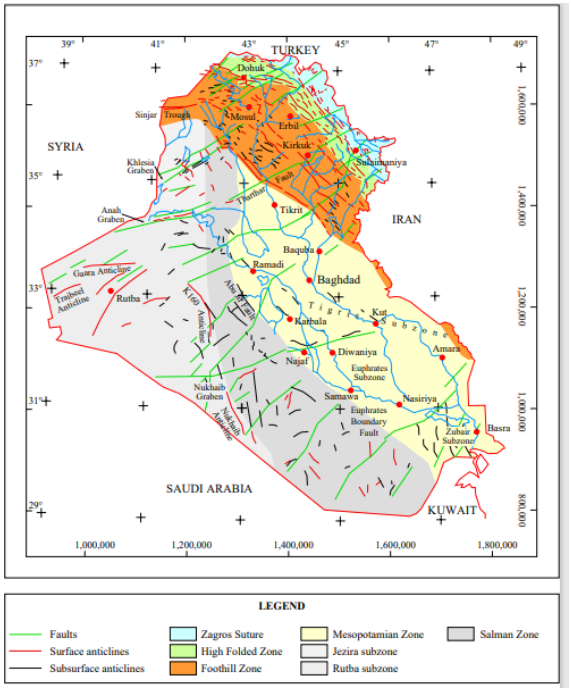


Fig.2. Tectonic map of Iraq (After Buday&Jassim,1984)

4. Geological Setting

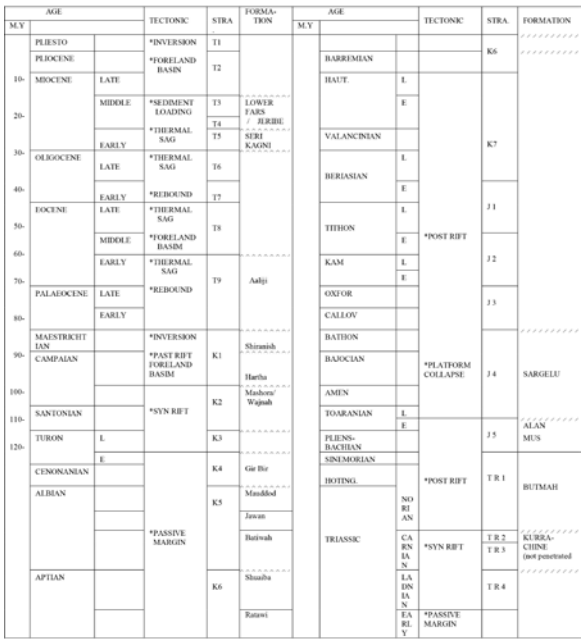
Two wells were drilled in Eastern dome. The first (SA-1) was drilled in 1955 to a depth of 2950 m and stopped in the Mus Formation. The second well (SA-2) was drilled to a depth of 2995m and terminated in Baluti formation {2,5}.

Stratigraphically, the Hydrocarbon potentials (oil & gas) are contained mainly with six pay zones of Mesozoic age. Four of these pay zones are housed within the U. and L. Cretaceous and the other two pay zones are within the Middle and Lower Jurassic. These pay zones consist of variable lithologic characteristics ranging from fractured Basinal rocks of Mud / Wackstone as for the pay zones of Shiranish, Mashora & Sargelu, to shoal facies of pack /Grainstone as for the pay zones of Mauddod, Mus & Butmah, to evaporitic facies as for Jawan pay zone.

The chronostratigraphic column of Sasan field, based on SA-1 & SA-2 data is shown in table (1). It must be noted that most of the lower Cretaceous and Upper Jurassic sequences were eroded not only in Sasan field but, in almost, in the whole region of Northwest Iraq {13}.

rifting west striking faults in the Sinjar-Abd el Aziz area causing substantial thicknesses of syn-extensional Late Campanian-Maastrichtian marly limestones to be deposited there. A latest Cretaceous collisional event along the northern Arabian Plate margin terminated the extension in the Sinjar-Abd el Aziz area. Eocene-Miocene suturing of Arabia to Eurasia had little effect on the structures of area, despite being the cause of significant uplift in the adjacent Palmy ride fold and thrust belt. Rather, the stress reorganization and northward Arabian Plate movement experienced since Pliocene time has caused reactivation of the normal faults in a reverse sense in northeast Syria-northwest Mosul {23,24,25}. Fault-propagation folding, and structural inversion have resulted in the topography that persists in the area today. This late-stage structural reactivation is critical to Cenozoic and Mesozoic anticlinal hydrocarbon trapping in the area. Paleozoic horizons remain to be fully explored {26,27}.

Table 1: Shows Chronostratigraphic events in Sasan Field.



5. Material and Methods

Data available suggest that present day structures in the Ninawa region are fault-propagation folds caused by the inversion of pre-existent normal faults {8}.
Sasan structure from surface mapping, identifies a domal closure aligned. WNW-ESE, known as Sasan East & a-3-way, dip closed (N, S &W) high to the West, "Sasan West" aligned WSW-ESE. Sasan East & West are separated by a saddle area, possibly faulted {1}. Sasan East was drilled by SA-1 & SA-2 located 1.1 Km updip to the East. Probable fault of the northern flank of Sasan East oriented along strike. 1200 Km of 2D seismic data is made, 305 Km of the re-processed lines are interpretable quality. Even after re-processing, the quality of this data varies from fair to very poor, only 77Km of these lines cover Sasan Field, the rest extend to the east towards Alan & Atshan Fields and show possible exploration prospects {3,4}. From

seismic sections in Sasan area, four seismic events are mapped, the first occur near top Alan Formation, the second is near top Butmah Formation and two deeper events below well TD. The two wells SA-1 and SA-2 show several faults which appear to separate SA-2 from SA-1. They are of extensional normal type (Fig-3).

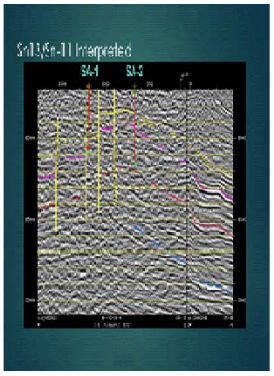


Fig-3: Show several faults appear to separate SA-2 from SA-1.

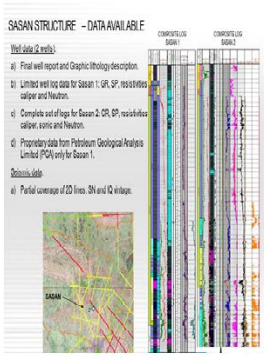


Fig-4: Shows the available data for Sasan structure.

The available data from the two wells SA-1 & SA-2 is shown in the Fig-4 and the Dipmeter log in the well SA-2 confirms the presence of probable fault cut the SA-2 well (Fig-5) besides the presence of subnormal formation pressure in the same interval (Fig-6).

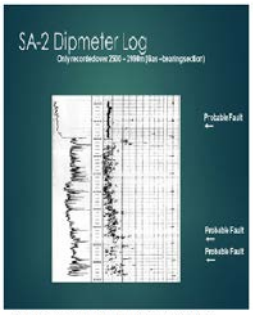


Fig-5: Shows dipmeter log for SA-2 recorded over 2500-2990 m confirm the presence of probable fault cut the well

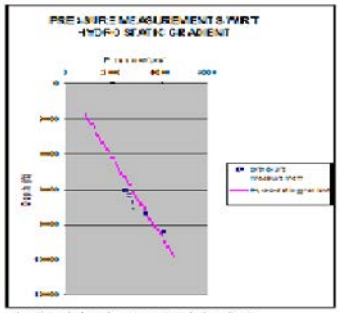


Fig-6: Shows the formation pressure system in the well SA-2.

6. Discussion

The Sinjar area of northeast Syria-northwest Mosul was part of the larger southwest-northeast trending Palmy ride/ Sinjar Basins from Late Paleozoic to Late Cretaceous time {23,24}. Although rifting took place in the Palmy rides/Sinjar in the Late Paleozoic, during the commenced along northwest-southeast trends in the Euphrates Fault System beginning in the Coniacian. In later Cretaceous time, extension began across east-Mesozoic most of the stratigraphic thickening was subsidence related. Following plate tectonic reorganization in Cretaceous time,

Structural inversion is a reversal of deformational processes must a commonly a depressed region is uplifted. Deposition occurs in the presence of normal faults such that a thick section is developed on the downthrown sides e.g., half graben or small rift basin. Low areas are then turned inside out into highs, usually by a combination of compression and wrenching. The final product is an anticlinal or structural high into which sedimentary unit thicken.

Structural inversion can strongly affect the petroleum prospectivness of an area in which it occurs {28, 29, 30, 31, 32}. To reach the above discussion a regional composite seismic sections were constructed to the area around Sasan structure nominated D-D′) (Fig-7) & (Fig-8) {29}. Only one strong reflection can be partially mapped across this composite line. Several interpretations (including different structural models) can be done with this data, and all can be completely valid (Fig-9). One possible interpretation (widely used by literature) is an inverted graben. Thick Shiranish Formation in Sasan wells support this interpretation. The model suggests that normal faults created the accommodation during Late Cretaceous (Sinjar Trough?) and subsequent tertiary compression uplifted the depocenter creating the topographic expression which is interpreted as a fault propagation fold (Fig-10). The regional seismic line also shows several other structural highs lie in the area between Sasan Field and Alan & Ibrahim Fields nominated as A, B, C and D and Sasan West structure may also be prospective (Figs-11 & 12).

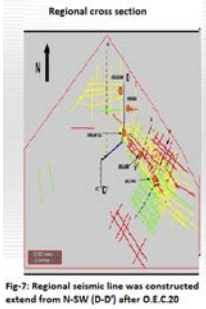


Fig-7: Regional seismic line was constructed extend from N-SW (D-D') after O.E.C.20

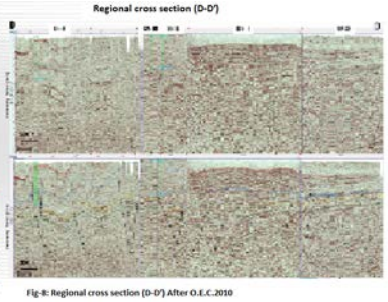
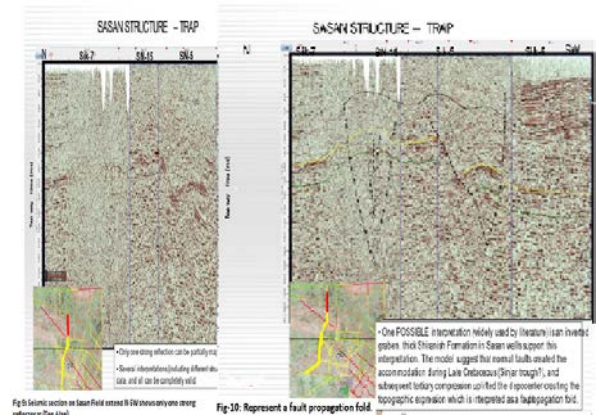
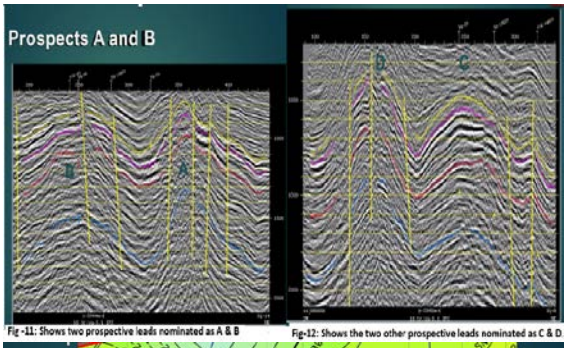


Fig-8: Regional cross section (D-D') After O.E.C.2010





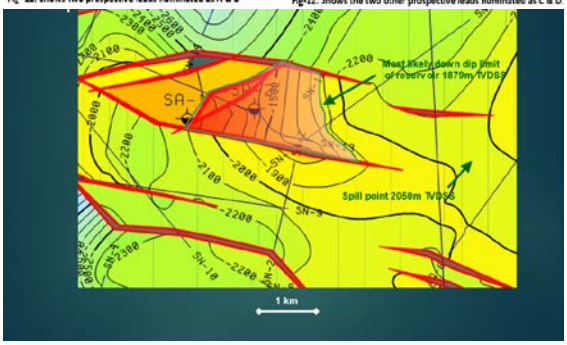


Fig.13. Shows Top Wajnah depth map within Sasan Area.

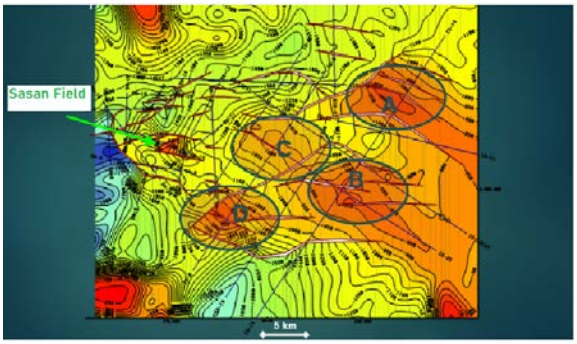


Fig.14. Top Wajnah depth map in the area between Sasan Field & Alan- Ibrahim Fields shows the four prospective leads nominated A, B, C & D.

The timing of formation of structural traps in the studied area shows that the potential structural traps were produced in three stages:
The first, during rifting episodes (mainly early Late Cretaceous). The main trap types are tilted fault blocks. The Earlier rifting in Mid-Late Triassic time may also have produced similar traps.
The second, The Early Tertiary phase of compression may have created more traps. The compression event only affected the NW part of the studied area.
The third, A phase of compression in the Late Pliocene to Recent produced the anticline seen at surface. This structure is above older extensional structure that has been inverted {33,34}.
As concerning, the timing of generation and migration, the potential source rocks has been identified. Generation from this is likely to have occurred during the periods of rapid burial.
Late Cretaceous in the Sinjar basin, several kilometers of Upper Cretaceous post-rift sediments were deposited. This may have been sufficient to cause generation from Triassic source rocks (Kurra Chine Formation) {8, 27}. The Early Tertiary inversion episode would have temporarily "switched off" generation within the basin. Trap breaching and remigration: many structural traps created by Late Cretaceous rifting and, possibly, by Early Tertiary compression, could have been petroleum-filled. In areas strongly affected by the Late Tertiary compression most of these traps were structurally modified,
probably leading to breaching or spillage. Some of this remigrated petroleum may have found its way into new traps. Similarly, the Early Tertiary compression may have liberated petroleum by breaching older extensional traps {33,34}.

7. Conclusion:

7.1. Potential traps were formed by Late Cretaceous extension, and by phases of compression in the Early and Late Tertiary. The last phase of compression ended petroleum generation.

7.2. The last compressional structures can only have been filled with remigrated petroleum from breached, older traps, earlier structures could have been filled by migration from an actively generating source rocks.
7.3. The exploration potential in the old Sasan structure configuration is good but it is still an exploration play not a commercial oil discovery, although oil is present in Shiranish, Hartha/Mushora and Wajnah formations but not clear if it is recoverable.
7.4. Gas present in deeper formations, both the oil and gas traps are breaching traps.
7.5. The best exploration targets should, therefore, be old structures, produced by Late Cretaceous extension or Early Tertiary compression, which have not been restructured by Late Tertiary compression. The faulted areas north and south shoulders of Sinjar basin contain many such leads as the prospective leads nominated A, B, C and D.
7.6. Second best are old structures which have been partially restructured and whose closure has been modified, but not breached.
7.7. The prospective reservoirs will be at Late Cretaceous, Early Cretaceous and Late Triassic.

8. Recommendation:

8.1. Several other structures highs have been shown by 2D seismic data.
8.2. These structures lie between Sasan Field and Alan & Ibrahim Fields.
8.3. Further mapping is recommended preferably 3D seismic.

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Geopolymer as a Green Concrete Alternative to Portland Cement Concrete: Article review

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Abstract .Concrete is the second most product in the world, this leads to Portland cement being the largest product on a global scale. The production of Portland cement process causes the emission of carbon dioxide into the atmosphere, contributing increased pollution and exacerbating the problem of global warming. In order to contribute the reducing of greenhouse gases emission to atmosphere and to encourage the use of environmentally friendly alternatives, geopolymer-cement has been traded as an alternative to Portland cement. Geopolymer-cement is produced from industrial residues rich in silicon and aluminium. Geopolymer-cement preserving the environment in two ways, first reducing the contribution to greenhouse gas emissions and secondly benefiting from industrial waste and preserving landfills. In this paper, the fresh properties, mechanical properties and performance of geopolymer concrete were reviewed from published research by some authors. Reviewing these properties of geopolymer as an alternative to Portland cement concrete. The bottom line of this paper is that geopolymer are similar in properties or even better in some of them than Portland cement concrete, and that geopolymer represents a promising possibility and an excellent choice in the future.

Keywords: Geopolymer, Global warming, Geopolymerization, Portland cement.

الخلاصة:
الخرسانة هي ثاني أكبر منتج في العالم، وهذا يؤدي إلى أن يكون أسمنت بورتلاند أكبر منتج على نطاق عالمي. يتسبب إنتاج عملية إسمنت بورتلاند في انبعاث ثاني أكسيد الكربون في الغلاف الجوي، مما يساهم في زيادة التلوث وتفاقم مشكلة الاحترار العالمي. وللمساهمة في خفض انبعاثات غازات الدفيئة في الغلاف الجوي وتشجيع استخدام بدائل صديقة للبيئة، جرى الاتجار بالأسمنت البوليمري الجغرافي كبديل لأسمنت بورتلاند. يتم إنتاج أسمنت البوليمر الجغرافي من المخلفات الصناعية الغنية بالسيليكون والألومنيوم. الأسمنت الجيوبوليمري الذي يحافظ على البيئة بطريقتين، ويقلل أولاً من المساهمة في انبعاثات غازات الدفيئة ويفيد ثانياً من النفايات الصناعية ويحافظ على مدافن النفايات. في هذه الورقة، تمت مراجعة الخصائص الجديدة والخصائص الميكانيكية وأداء خرسانة البوليمر الجغرافي من الأبحاث المنشورة من قبل بعض المؤلفين. مراجعة خصائص البوليمر الجغرافي كبديل لخرسانة أسمنت بورتلاند. خلاصة القول في هذه الورقة هي أن البوليمر الجغرافي متشابه في الخصائص أو حتى أفضل في بعضها من خرسانة أسمنت بورتلاند، وأن البوليمر الجغرافي يمثل إمكانية واعدة وخيارًا ممتازًا في المستقبل.

1. Introduction

Global warming become universal problem today and Portland cement which is the second biggest product wanted today response of carbon dioxide emission in the atmosphere [1]. To produce one ton of Portland cement there are 0.87 ton of CO2 which represent about 7% of total emitted greenhouse gas in the atmosphere [2]. So, to find cure for global warming there is a need to replace our demand for Portland cement with alternative meets the requirements [3]. On the other, many industrial wastes produce by product form burden on environment by consumption landfill, natural resource, and contributed and in environmental pollution. One of promising alternative is geopolymer which is inorganic polymer, this alternative requires to be helpful in energy conservation and reducing environment pollution, also mange waste issues . Portland cement known as a binder when water add to it, but alkali-activated play the binder component in geopolymer when it mixed with solid silica-alumina recourse which may found
in industrial waste as by-product like fly ash, silica fume, ground granulated blast furnace slag, palm oil fuel ash, etc.[4].

The process of geopolymerization depend on dissolving and reorganizing, condensing, and polymerizing aluminate and silicate components from oligomers to large forms of polymers, and when the end of grope meeting together, water will be formed as a free water [5].

2. Materials:

To product geopolymer it will need aluminosilicate resources and activated alkali binder, and there are different types of these as illustrated in (figure 4).

3. Factors affecting mix properties:

3.1. Influence of mix design

Ling, 2019 [9], they investigated the influence of mix method of fly ash based geopolymer on compressive strength, they concluded that SiO2/Na2O ratio arise the compressive strength increased. mole module (Module), concentration of solute in alkaline solution (Concentration), liquid-to-fly ash mass ratio (L/F), and curing temperature on the geopolymerization process, set time, and compressive strength. As activated alkali molarity increased, the set time was accelerated but the total heat generated from geopolymerization and the compressive strength of the geopolymer were reduced, while the total heat of geopolymerization and strength of these mixes were increased [10].

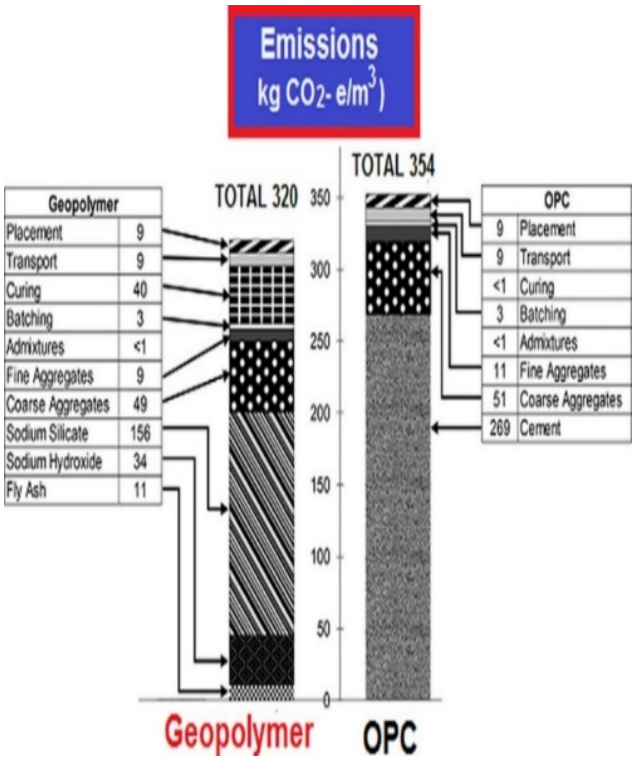


Fig. 1. the emission of carbon dioxide for ordinary Portland concrete and geopolymer concrete [6].

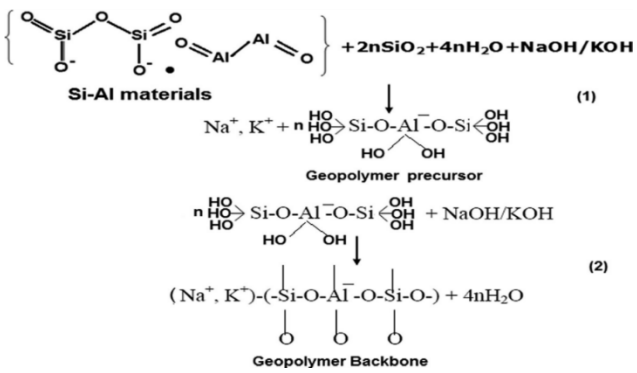


Fig. 2. Schematic representation of formation of geopolymer materials [7]

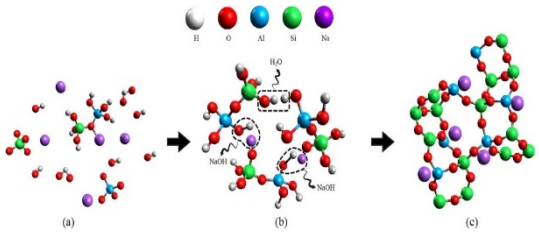
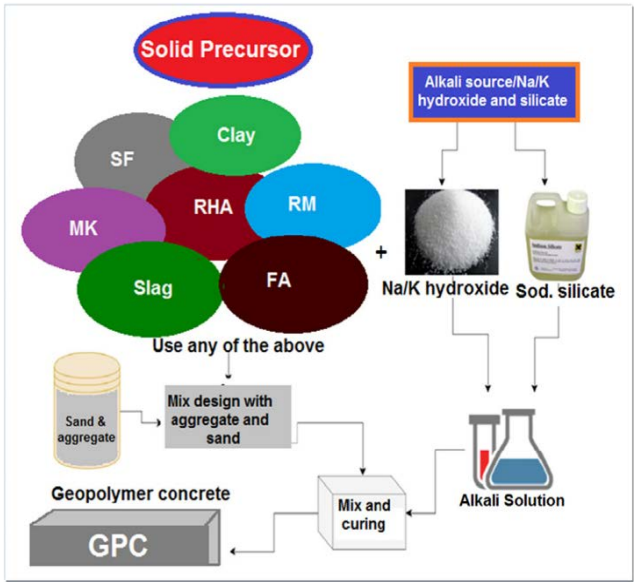


Fig.3. geopolymer production process: (a) aluminosilicate reorganizing, (b) condensing oligomers, and (c) polymerizing [5].

Fig. 4. Popular brand of foundation resources used in geopolymer composites [8].

increased the total heat of geopolymerisation, and improved the strength of the geopolymers. Concentrations of 20–25%, and L/F 0.40, and elevated curing (e.g., at 50 C) is preferred [9].



Fie. 5. production geopolymer process [11].

3.2. Influence of curing:

Gholampour et. al.[12], they investigated slag/ fly ash based Geopolymer concretes in Two different proportion the first 80% fly ash/20% ground granulated blast furnace slag (GGBS) and the second 50% FA/50% GGBS where Two dissimilar curing temperature are used, the ambient temperature at 23℃ and oven cured at 70℃. they study the effects of the curing temperature on compressive strength of the geopolymer. They conclude that 50/50 proportion mix show slightly improve stress and strain than 80/20 proportion mixes, and the oven-cured shows a slightly higher than ambient-cured for strength and a slightly lower for strain for the geopolymer. Also, *Zhao et. al.* [13], showed that specimen for good compressive strength should cured with 50℃ curing temperature.

4. Influence of some admixture and other addition:

4.1. Influence of superplasticizer:

Alrefaei et al. [14], examined the influence of three samples of different kind of high range water reduce agent, Polycarboxylate, Naphthalene and, Melamine on the compressive strength and the ability of flow for fly ash-slag based geopolymer activated by Ca $(OH)_2$/Na_2SO_4 fine particles blend., and they found an increased

in compressive strength and significantly improved in flow by using high range water reduce agent, by reducing the porosity and improved the compressive strength. Also, it found Na_2SO_4 activator exhibited significantly lower compressive strength compared to Na_2SiO_3 activator.

4.2. Influence of nano and micro silica fume:

Adak et al. [15], study the effect of nano-silica and micro-silica on the workability and mechanical properties of fly ash based geopolymer, containing variable proportions of nano and micro silica (up to 15%). The additives improve the compressive strength, splitting tensile strength, workability, and water absorption up to 5% and improve the durability of geopolymer . Nano silica addition up to 6% of fly ash will be affected in reducing sitting time[16], and the rate of reaction of the geopolymer constituted will enhances with presence of the nano silica.

4.3. Influence of Limestone:

Bayiha study the influence of limestone dust in metakaolin based geopolymer mortar cured at ambient temperature. Using alkaline activator were mixed (1:1 ratio) of sodium silicate and sodium hydroxide solution at different molarities (5, 8 and 10 M). they investigated the initial setting time, linear shrinkage, water absorption, compressive strength. Limestone played as setting retarder in mortar. As well as increasing the activator molarity the setting time will be accelerated. Also, they show that shrinkage will be increased in addition to increased limestone amount. For limestone addition up to 45%, water absorption, decrease by increasing limestone amount, with enhancement of compressive strength [17].

5. Fresh properties of geopolymers:

As pointed earlier, properties of geopolymer will depended on the nature of the resources. Authors illustrated to these differences, following paragraphs will show some of the effect of these resource materials. Slag based geopolymer displays low workability for geopolymer concrete , and the flowability will decrease with increasing the amount of slag [18]. The matrix will be high viscously due to hydration process of silicate in mixes [19]. Also, due to geopolymerisation process which will accelerate the chemical process and the setting time . Metakaolin clay will request more water to produce good flowability for the matrix due to high surface area [20]. Increasing metakaolin content in mixture will increasing the water amount, for constant water ratio the workability will decrease , and for high reactivity the geopolymerisation processes result in acceleration process and educing sitting time [21]. Silica fume noticeable as highly fine particle with high surface area which require high water proportion to produce good workability [22], and when it added to fly ash to product geopolymer concrete or geopolymer mortar showed great loss in slump, as well as increasing in silica fume content . The high reactive and high fineness of silica fume makes it able to accelerate the process of the reaction and decreasing sitting time [23].

6. Mechanical properties:

Ground Granulated Blast Furnace Slag based geopolymer showed good mechanical properties for geopolymer concrete like strength which depend on the amount of slag [19]. It had been found that with increasing the content of slag the compressive strength will be increased in geopolymer concrete and with geopolymer mortar compressive strength will increased with higher proportion . Due to increased silicate to aluminium ratio in the matrix which had affected in Ca-Si-Al hydration and improving mechanical properties [24].

As well as slag, research found that metakaolin add to fly ash based geopolymer concrete as a partial replacement had affected the mechanical properties of geopolymer mixture and improve the compressive strength depending on the metakaolin content in mixture, the compressive strength will increase with increasing the amount of metakaolin, due to accelerating the geopolymer hydration process [21]. Metakaolin as a micro unit in the mixture, which will allow it to act as fine filler constitute and occupy the empty pores and result in densify the matrix [25].

As reported by authors small addition of SF less than 1% to fly ash with low calcium based geopolymer concrete will increase the compressive strength about 80% at early age due to accelerated geopolymer hydration . Increasing amount of nano-silica above 2.5% in the geopolymer matrix is reported to drop the compressive strength was appointed to inadequate moistening and scattering of silica elements [23], and was suggested that silica ratio not above 2% to avoid unreacted nano-silica which will increased the microcracks in the matrix and lowering compressive strength due to a rising demand on water in mixture [26].

7. Durability properties:

Slag based geopolymer produce durable geopolymer due to reducing size of capillary pores and refine it, also, improve matrix density . Authors reported increasing slag content result in reducing absorbed water content compared with geopolymer without Ground Granulated Blast Furnace Slag . When slag react chemically will forms C-A-S hydrated gel which will be bonded with water and occupy pores volume comparing with fly ash based geopolymer which will procedure N-A-S hydrated gel with less able chemical bonded with water resulting more pores matrix [27]. Fly ash based geopolymer with addition of slag produce durable matrix to elevated temperature, firing, and sulphate attack [28].

Metakaolin with fine particle property would be helpful in packing and densify the geopolymer matrix . The humidity of the matrix will be reduced as the temperature a raise, water will be lost by evaporation from the surface of the spacemen and generating differences in pressure stress on empty void, this well be allowed development of microcracks [24].

Some research concludes in their study that silica fume helpful with transform amorphous phases to crystal phase for the matrix combinations, furthermore silica fume played significant role in increasing matrix density . Authors suggest that suitable dosage of silica fume will improve geopolymer in micro scale, reduced pore size and enhanced durability [29].

7.1. Resistance to acid attack:

S. Afridi et. al., examined the resistant to acid attack for Poly (Vinyl Alcohol) copolymer with polyacrylic acid was used as the superabsorbent polymer (SAP) based geopolymer. Also, they investigate the resistance to sulphate, and chloride attack. They used samples contain 0, 1, and 2% SAP content by weight of were prepared. Where the models cured at 80℃. The samples dunked in the compound liquids of hydrochloric acid sodium sulphate, calcium chloride with 5%(HCl), 5% (Na2SO4), and 5% (CaCl2) respectively for 180 days. There assessed of performance for geopolymer was centred on the alteration of weight and compressive strength for the models. They conclude that geopolymer had significant resistance to chemical attack [30].

7.2. Resistance to freeze-thaw cycles:

Y. Aygörmez et al., investigated the effect of freezing-thawing of 56 and 300 cycles, an improve for compressive strength was find out after 56 cycles but a reduce was noticed after 300 cycles [31]. S. Pilehvar et al., investigated the effect of frost conditions on the physical and mechanical properties of geopolymer concrete (GPC). Geopolymer concrete provided an excellent resistance against freeze-thaw cycles with minor reduction of the compressive strength [32]. M. Zhao et al., they confirmed that cycle of freezing and thawing for class F fly ash based geopolymer specimens show good durability [13].

7.3. Resistance to high elevated temperature:

Y. Aygörmez et al., studied the effects of exposure to high-temperature on compressive and flexural strengths, for metakaolin based geopolymer produced by silica fume addition as replacement of metakaolin and colemanite waste with and without polypropylene fibres, up to 20% at 300, 600, 900℃. the models preserved in stable condition. And Polypropylene improved flexural strength in elevated temperatures [31]. S.K. Shill et al., studies durability of fly ash based geopolymer mortar against both chemical fluids and elevated

temperature, they tested compressive strength of 3 and 28 old day. The samples had been suffered with loses in compressive strength, and the saturated geopolymer with hydrocarbon fluids decompose to soap and salt after 60 cycles of high temperature [33].

X. Jiang et al., investigated resistance of geopolymer concrete to fire condition more than 1200℃ temperature and comparing with ordinary Portland cement concrete. they conclude that conventional concrete showed more lose in compressive strength than geopolymer concrete [34]. Nazari et al., they examined the effect of cooling fly ash based geopolymer concrete to water and air after exposed to high temperature started from 400℃ and ending to 1000℃, they conclude that geopolymer concrete showed excellent mechanical performance [35]. Y. Aygörmez et al., pointed that specimen still show stable condition when they exposed to elevated temperature at 900 C, and fibres addition help in rising flexural strength for the specimen at elevated temperature [31]. F. Fan et al., examined fly ash based geopolymer heated to 500 C and they conclude that the proportion of water to fly ash and regimen of curing had significance role in determining mechanical and thermal properties for geopolymer [36].

H.Y. Zhang et al., they studied the influence on strength bond of geopolymer concrete reinforcement exposed to 100, 300, 500, and 700 C degree of temperature, and they result that the bonding force between geopolymer concrete and the reinforcement bar showed good bond strength until the temperature rich 300 C, after that strength will had reduction [37]. T. Kovář˘ík et al., they remarked that metakaolin based geopolymer concrete exposed to elevated temperature reach to 1000 C had durable mechanical strength when the aggregate to metakaolin ratio is (2.5) [38]. A.Z. Mohd Ali et al., experimented fly ash based geopolymer concrete by exposed to fire at tow hour range shows slightly weight loss due to evaporation the free water of the samples, and the thermal compatibility of geopolymer matrix and aggregate improve the resistant of spalling [39]. R.K. Preethi, B.V. Venkatarama Reddy, they showed that high compressive strength will be improved by using fly ash and ground furnace blast of slag as supply of alumina and silica based geopolymer concrete, and they improved that efflorescence caused by sodium salt unreacted moving to the surface do not influence on compressive strength [40]. W.G. Valencia Saavedra, R. Mejía de Gutiérrez, they pointed that ground furnace blast of slag/fly ash based geopolymer concrete will showed higher performance than normal concrete produced by ordinary Portland cement when exhibited to 1100 C [41].

8. Conclusion:

Geopolymer as a technology process represents a good solution to manage the waste of industrials produced by-product. The physical and chemical properties of the geopolymer resources determined the characters of geopolymer. Activators like alkali and curing regimen play significance role in geopolymer properties. Based on published research, it can be drawn the following assessed:

1. A wide range produced as industrial, agricultural waste as by-product may come as a source of silicate, aluminate for Geopolymer production.

2. Water content significant effect the mechanical properties.

3. Curing time and degree of heat curing related directly with compressive strength, so it directly related with engineering properties.

4. Geopolymer showed good resistance to aggressive environmental attack.

5. Using fineness rescores materials will be improving the mechanical properties and produce high compressive strength so as enhance the microstructure of the matrix. Also, fineness particles usefully in reducing permeability and accelerating the polymerization reaction which will improve the early strength.

6. Alkali activators concentration and its molarities significantly impact on fresh properties and setting time of the mixture.

7. Geopolymer have better resistance for sulphate attack, acid attack.

8. Geopolymer exhibits more durable performance in firing and had lower reduced in compressive strength rate from Portland cement concrete.

9. Geopolymer shows lower shrinkage issue from Portland cement concrete.

10. Curing for geopolymer need 50 to 90 C for 24 hr.,

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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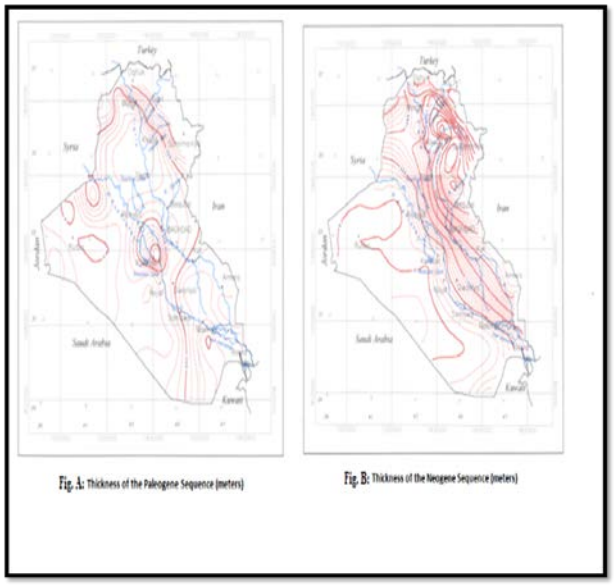

Plate.8. Shows thickness, maps (A, B)

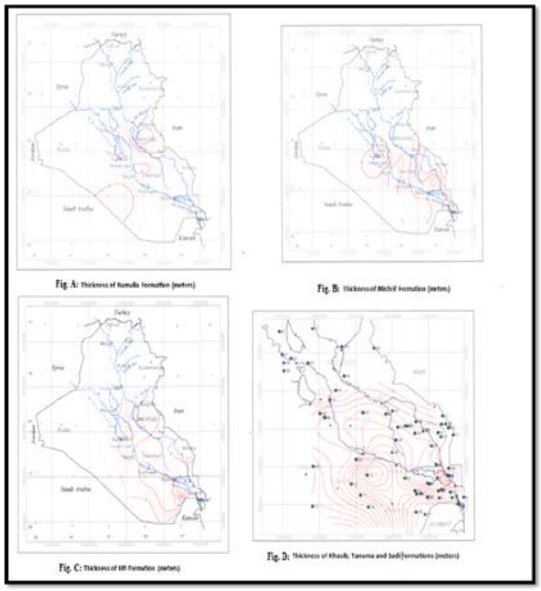

Plate.6. Shows thickness, maps (A, B, C, D)

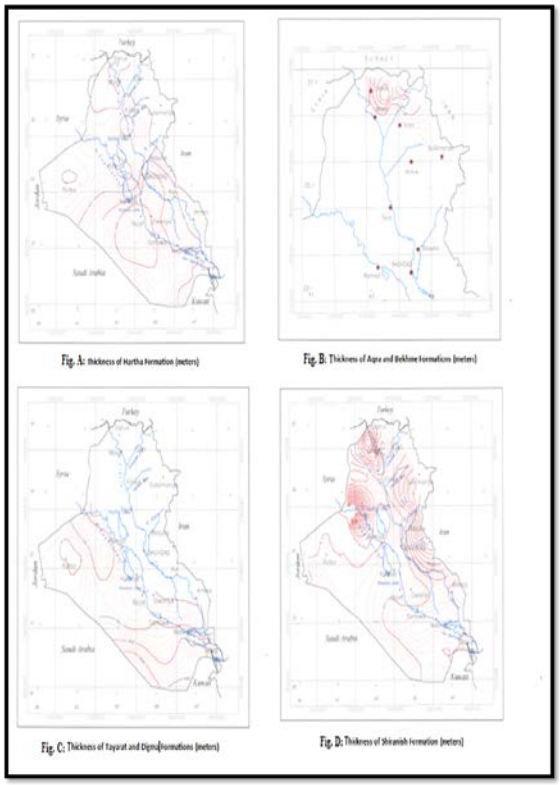

Plate.7. Shows thickness, maps (A, B, C, D)

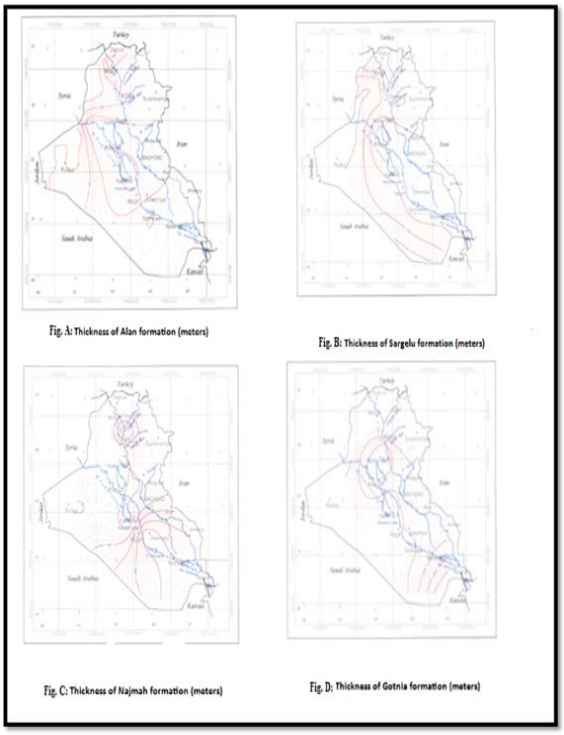

Plate.4. Shows thickness, maps(A,B,C,D)

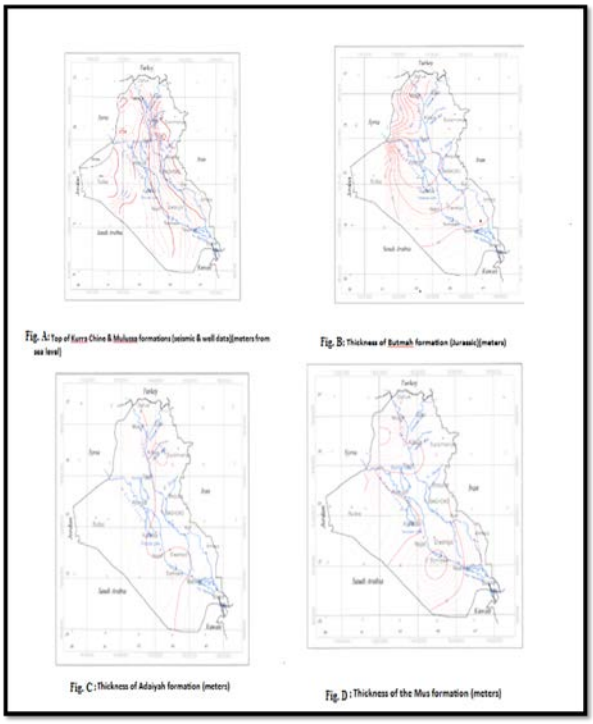

Plate.2. Shows tops and thickness, maps (E, F, G, H)

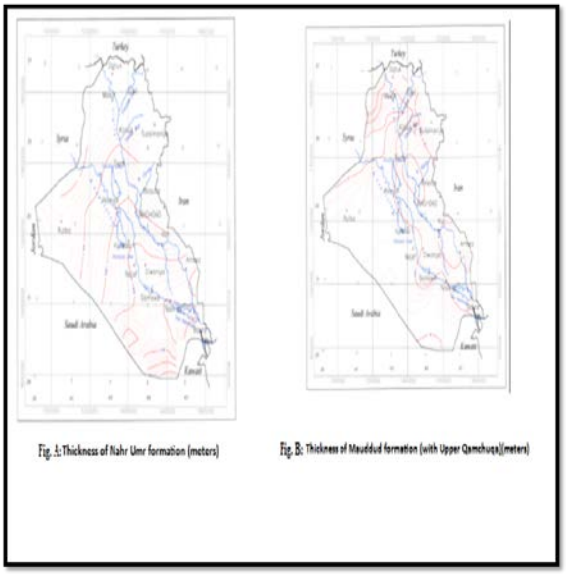

plate.5. Shows thickness, maps (A, B)

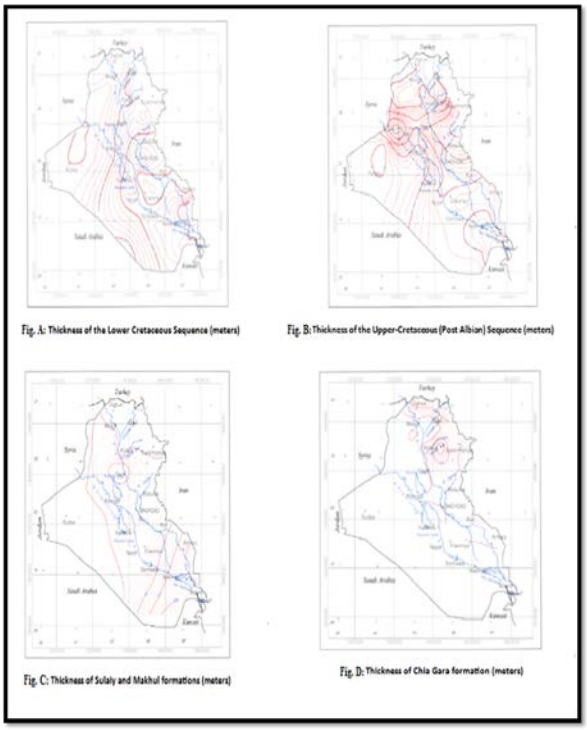

Plate.3. Shows thickness, maps (A, B, C, D)

جدول رقم (1ج): يمثل المكامن الرئيسية واعمارها وبيناتها الترسيبية وخواصها المكمنية والحقول الحاوية لها وانطقتها التكتونية

Tectonic Zone	Av. Permeability	Av. Porosity	Field Ex.	En.of deposition	Lithology	Age	Formation
FZ,MZ	1000 md	26%	29 Fields including Abu Gharab & W.Qurana	Rudist reefs	Entirely carbonates, including dense algal lst. highly porous &permeable organic detrital lst.	Cen.-E.Tur	Mishrif
FZ	70 md	Fractured 18%	7 Fields including Kirkuk & Chemchemal	Shallow-deep marine	Foraminiferal lst.	L.Turon.	Kometan
FZ	50 md	Fractured 15%	6 Fields including Ain Zalah	Shallow marine	Foraminiferal lst. & dolomite	U.Cret.	Mushorah
MZ	45 md	15%	10 Fields including Nahrawan & Halfaya	Open marine	Chalky,oligsteginal lst. marly in part with minor dark grey shale	L.Tur-E.Cam.	Khasib
MZ,SZ	20 md	23%	5 Fields including Ewst Baghdad	Shallow marine	Marly to chalky detrital lst.,interbedded with black shales	L.Tur-E.Cam	Tanuma
FZ,MZ,SZ	11 md	23%	8 Fields including Majnoon	Open marine shelf	White,chalky,marly, globegerinal lst.,organic detrital lst & marls	L.Tur-E.Cam	Sadi
JSZ,MZ	11-50 md	Fractured 17-23%	26 Fields including Kifl	Shallow marine	Organo-detrital, occasionaly dolomitic lst.	U.Cam-Maas	Hhartha
FZ	12 md	16%	23 Fields including Jambur	Deep marine	Marly,foraminiferal lst. & marl	U.Cam-Maas	Shiranish
FZ,MZ	50-125 md	Fractured 18-20%	13 Fields including Kirkuk	Back reef & fore reef	Reetal lst	Oligocene	Kirkuk Grou
FZ,MZ	100 md	Fractured 20%	3 Fields including Buzurgan	Shallow marine	Carbonates	Olig-L.Mio	Asmari
FZ	50 md	Fractured 20%	4 Fields including Tel Hajor	Deep marine	Marly,foraminiferal lst.	L.Miocene	Serikagni
FZ	35 md	Fractured 26%	18 Fields in Kor Mor	Shallow marine	Reetal,dolomite, sometimes chalky lst.	L.Miocene L.Miocene	Ghar Euphrates
FZ	22 md	18%	7 Fields including Khasham Ahmar	Evaporate-Lagoons	Interbedded lst. With anhyderite	L.Miocene	Dhiban
FZ	100 md	20%	32 Fields including Jambur	Shallow marine	Dolomitic lst.	M.Miocene	Jeribe
FZ,MZ	250 md	Fractured 21%	14 Fields including Rumaila & Kirkuk	Evaporate-lagoons	Lst. & sandstone	M.Miocene	Fatha
FZ	275 md	18%	4 Fields including Gilbat & Chia Surkh	Coastal areas & later fluviolacustrine system	Sandstone	U.Miocene	Injana

جدول رقم (2ب): يمثل المكامن الثانوية واعمارها وبيناتها الترسيبية وخواصها المكمنية والحقول الحاوية لها وانطقتها التكتونية

Tectonic Zone	Av.Permeability	Av.Porosity	Field Ex.	En.of deposition	Lithology	Age	Formation
FZ	0.5	5-19%	Bai Hassan tested minor oil & Jambur tested minor gas	Deep marine shelf	Foraminiferal,sometimes glaucomtic lst.	Ceno.	Dokan
FZ	200 md	15%	Sufaiyah	Shelf carbonate	Rudist reef	Ceno.	Gir Bir
FZ			Injani (minor oil)	Deep marine	Foraminiferal lst.	Ceno.-Tu	U.Balambo
FZ	50 md	18%	Demir Dagh	Carbonate ramp	Reef lst.with massive rudists,shoal facies & detrital forerreef lst. locally dolomitised silicinoes impregnated with bituman	U.Camp-Mae	Bekhma
FZ			Bai Hassan & Gellar	Outer shelf-besinal	Carbonates	U.Cret	Aaliji
SZ	100 md	22%	Ghalaisan	Carbonate inner shelf	Lst.	M-L.Eocene	Dammam
			Chemchemu	Lagoon &shoal	Well bedded,bituminous, chalky & crystalline ist. with chert nodules towards the top. The lower part well bedded hard,porous bituminous,white,poorly fossiliferous lst.	M-L.Eocene	Pila Spi
FZ							
FZ	100 md	Fractured 19%	Jaria Pika	Outer shelf-besinal	Marly,chalky lst.,& marls	M-L.Eocene	Jaddala
FZ			Demir Dagh	Hemai-Flyviosmarine	Molasse deposits	M-L.Eocene	Gercus
FZ	30 md	Fractured 13-20%	2 Fields including Nafl Khana	Shallow marine	Dolomitic,sometimes foraminiferal lst.	M.Miocene	Kalhur

جدول رقم (2أ): يمثل المكامن الثانوية واعمارها وبيناتها الترسيبية وخواصها المكمنية وامثلة على الحقول الحاوية لها وانطقتها التكتوني

Tectonic Zone	Av.Permeability	Av.Porosity	Field Example	En. Of Deposition	Lithology	Age	Fm.
JSZ			Well Khleesia-1	Terrestial & shallow marine	Quartzose sst.& shale	Ordovician	Khabour
RSZ	500 md	17%	Akkas	Glacial deposits	Sediments of 5-10m & shale	Silurian	Akkas
FZ	50 md	10%	Tested minor gas & condensate	Carbonate platform with locally developed lagoonal conditions & Sabkha	Evaporite,alternating thin beds of organic detrital l.st.,dark blue l.st. & massive ,silicified lst. With black shale beds near the base.	U.Perm	Chia Zaira
FZ			Akrakh & Akshan	Shallow marine-lagoonal	Dark massive dolomites overlying thick bedded l.st.with subordinate marl & shale with occasional chert nodules, in the lower part black, greenish,& yellowish shale & thin beds of l.st.	L.Perm-M.Tr	Geli Khana
FZ			Bai Hassan	Transitional-shallow marine	Oolitic,sometimes sandy & ferruginous lst.	L.Cret	Garagu
MZ	50 md	21%	Majnoon	Shallow marine	Grey green,brown & black silty shales interbedded with grey detrital lst.	Ceno.	Ahmadi
MZ	70 md	19%	Rumaila	Deep inner shelf	Fine grained,marly oligosteginal lst.	Ceno.	Rumaila

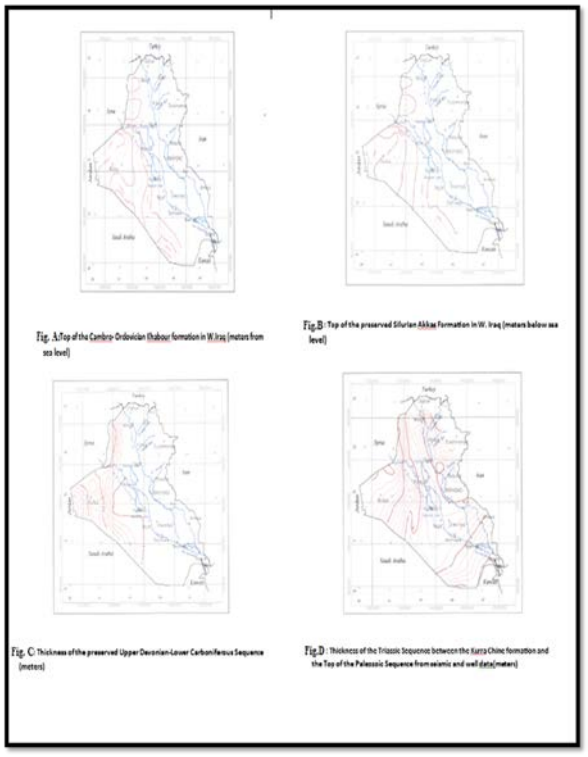

Plate.1. Shows Top and thickness, Maps (A, B, C, D)

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9.الملحقات :

جدول رقم (1أ): يمثل المكامن الرئيسية واعمارها وبيناتها الترسيبية وخواصها المكمنية وامثلة على الحقول الحاوية لها وانطقتها التكتونية

Tectonic Zone	Av.Permeability	Av.Porosity	Field example	En.of deposition	Lithology	Age
FZ	40 md	Fractured 20%	8 Fields including Abo & Butmah	Marine & transitional	Lst.,dolomite,anhydorite & shale	U.Traissac
FZ,JSZ,MZ,SZ	35 md	Fractured 11%	6 Fields including Makhul	Marine & transitional	Dolomite,l st occasionall argillaceous	L.Jurassic
			5 Fields including	Carbonate-evaporite	Anhydorite with sebordin	Liassic
FZ			Rafan	inner shelf	beds of brownish Lst. & black calcareous shales greenish marls both with anhydorite nodules	
FZ,MZ,JSZ	35 md	Fractured 11%	6 Fields including Dhiran	Supratidal & transitional marine &lagoonal setting	Evaporite sometimes anhydoritic & Lst.	L.Jurassic
			10 Fields including	Deep marine	Bituminoes dolomitic	M. Jurassic
FZ,MZ,SZ	100 md	19%	Kift		Lst.& shale	
FZ,MZ,SZ	100 md	19%	10 Fields including N.Rumaila & Khider Alma	Shallow-transitional mari (Lagoonal & shoali	Oolitic l st.,dolomite & anhydorite	M.-U.Juras
FZ,MZ,SZ	150 md	16%	8 Fields including Ajeel	Evaporite basin & Lagoonal setting	Evaporite,anhyorite, Oolitic Lst. & bituminous shale	M.-U.Juras
			4 Fields including Balad	Deep marine	Lst. & shale	U.Jurassic-L.Cret.
MZ,SZ	250 md	18%	4 Fields including Rumaila	Shallow mar	Detrital occasionally Oolitic Lst.	U.Jur-L.Cret

جدول رقم(1ب): يمثل المكامن الرئيسية واعمارها وبيناتها الترسيبية وخواصها المكمنية وامثلة على الحقول الحاوية لها مع انطقتها التكتونية.

Tectonic Zone	Av.Permeability	Av.Porosity	Field Example	En. Of deposition	Lithology	Age	Fm.
MZ	600 md	21%	10 Fields in southern Iraq	Reef	Oolitic shale with clean reefal Lst.facies	L.Cret.	Yamama
FZ,MZ	100 md	Fractured 20%	3 Fields including Sarjoor	Shallow- Deep marine	Dolomitic, argillaceous & marly Lst.	L.-M.Cret.	Sarmord
MZ,SZ	1000 md	Fractured 21%	9 Fields including Nasiriyah	Lagoon	Interbedded pseudo-oolit detrital Lst.& dark shale	L.Cret.	Ratawi
MZ	1000-2500 md	Range 20-25%	22 Fields including Rumaila & W.Qurna (major reservoir in southern & central part of Iraq	Deltaic-shallow marin	Alternating sequence of coarse to fine grained sandstone & shale	L.Cret.	Zubair
FZ	500 md	Fractured 18%	10 Fields including Bai Hassan & Majnoon	shallow marine	Oolitic Lst. Occasionally dolomitic Lst. &dolomite	L.Cret.	Shuaiba
FZ	40-65 md	Fractured 18-20%	6 Fields including Kirkuk (Major reservoir in Zagros basin)	Neritic setting	U.Qamchuqa dolomite & Lst. L.Qamchuqa black shales which are interbedded with dolomite	L.-M.Cret.	Qamchuqa
MZ,SZ	800 md	19%	33 Fields including Luhais & Noor	Deltaic-shallow marine	Medium-Fain grained sands & sandstone & Black shales which are interbedded	L.Cret.	Nahr Umr
FZ,SZ	11 md	Fractured 11%	3 Fields including Sarjoor	Shallow-transitional marine	Oolitic Lst.,dolomite & anhydorite	Albian	Jaisan
MZ,FZ	50 md	Fractured19%	19 Fields including Mansoor	Shallow marine	Dolomtised organic-detrital Lst.& non dolomtised detrital argillaceous Lst. & minor marls	Albian	Mauddud

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9.6- تتابع النيوجين (Neogene Sequence) المنطقة الواعدة (N.31-37، E.41.5-35).

7.التوصيات:

1- توصي الدراسة بالتوسع في الحفر الاستكشافي العميق لعصور الجوراسي والترياسي والدهر القديم بغية زيادة احتياطي العراق من النفوط الخفيفة والمكثفات والغاز.
2- توصي الدراسة بحفر بئر استكشافي في تركيب سنجار والذي من المؤمل ان يكون من الحقول العملاقة المضافة في المستقبل ومما يميز هذا التركيب تعدد مكامنه النفطية في العصور المختلفة
3- بعد الاكتشافات الهايدروكاربونية الحديثة في تراكيب شمال غرب الكويت بحقول جثاثيل – كراع المرو- كبد – رحبه – ام الروس – ركسه وكحلوله حيث انتجت هذه الحقول نفط وغاز من تكوين المارات ولذلك أصبح التركيز على العصر الجوراسي في المنطقة الواقعة بين حقل الرميلة الجنوبي وتركيب كثبان ضرورة ملحة.
4- الاخذ بنظر الاعتبار طبيعة التراكيب المنقلبة (Inverted structure) لحقول شمال غرب الموصل في حقول علان-عطشان – ابراهيم – سرجون – عداية- قليان والتي قد تمتد الى تراكيب جنوب غرب الموصل في حقول قصب – جوان –نجمة وقيارة عند تحديد مواقع لآبار استكشافية مستقبلية تخترق الطباشيري الاسفل نزولا الى الجوراسي والترياسي
5- اقتراح حفر ابار استكشافية في التراكيب التالية: -
1-Anbar 2-Ajnadin 3-A Shuriyah 4-Muthana 5- Nakheel 6- Najd 7-Rutba 8- Waha 9- Jabiriya 10- Ishtar.

6- ضرورة استعانة شركة الاستكشافات النفطية بشركات حفر لتنفيذ خططها المستقبلية الطموحة بما يعجل من وتيرة اكتشاف حقول جديدة ويعزز الاحتياطي الهايدروكاربوني العراقي.

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(E.40-43, N.31-35)

3.6 - المنطقة الواعدة لتتابع الكاربوني العلوي- البيرمي الاسفل
(Sequence U. Carboniferous-L. Permian) (E.39-42 ،N.32-34)

4.6 - المنطقة الواعدة لتكوين القره جيني التريـاسي (Kurra Chine)
هنالك ثلاث مناطق واعدة لتكوين القره جيني الاولى للمنطقة المحصورة بين
N.31-36 ، E.39-43 والثانية بين الخطوط (N.33-36 ، E.44-45) والثالثة بين
(E.45-47.5، N.29-32)

5.6- المنطقة الواعدة في تتابع الجوراسي: وتقسم الى ثلاث أنطقه ثانوية
الاولى(N.30-36، E.40-43) والثانية (N.32-36، E.43-45) والثالثة (N.29-31)
(E.44-46) واهميتها حسب التكوينات المكمنية الاتية

1.5.6- تكوين بطمة (Butmah Formation) بين الخطوط (N.33-37، E.41-43)

2.5.6- تكوين عداية (Adaiyah Formation) N.34-36، E.41-45)

3.5.6- تكوين المص (Mus Formation) ويقسم الى نطاقين ثانويين الاول بين الخطوط (N.35-36، E.42-44 والثانية (N.30-32، E.44-46)

4.5.6- تكوين علان (Alan Formation) (N.30-36، E.41-46)

5.5.6- تكوين ساركلو (Sargelu Formation) N.33-37 ، E.42-45)

6.5.6- تكوين نجمة (Najmah Formation) N.35-36) ، E.43-45)

7.5.6- تكوين القطنية (Gotnia Formation) N.33-36، E. 42-44)

6.6- تتابع الطباشيري المبكر (Early Cretaceous)
ويتضمن التكوينات والمناطق الواعدة التالية:

1.6.6- تداخل تكويني مكحول والسلي (Sulaiy & Makhul) ويقسم الى نطاقين الاول N.34-35، E.44-47 والثاني (N.29-32، E.45-47)

2.6.6- تكوين جياكارا (Chia Gara Formation) (N.35-37، E.43-45)

3.6.6- تكوين اليمامة مع تكويني كركو وزنكورة (Yamama Formation with with Garagu & Zanagura Formations) وتقسم المنطقة الواعدة الى نطاقين الاول N.31-36، E.42-45 والثاني (N.29-32، E.46-47.5)

4.6.6- تكوين الرطاوي ومكافئه سارمورد الاوسط (Ratawi Formation with Middle Sarmord) وقسمت المنطقة الواعدة الى ثلاث انطقه ثانوية الاولى
N.35-36، E.43-45.5 والثانية N.32.5-34.5 E.43-46 والثالثة N.29-31.5 E.46-47.5

5.6.6- تكوين الزبير (Zubair Formation) وتقسم المنطقة الواعدة الى ثلاث
أنطقه ثانوية الاولى N.33.5-35، E.42-44 والثانية N.31-33، E.43-46 والثالثة N.29-31، E.45-47.

6.6.6- تكوين شعيبة (Shuaiba Formation) وتقسم المنطقة الواعدة الى
نطاقين ثانويين الاول N.34.5-36.5، E.43-45 والثاني E.46-48 N.31-32.5

7.6.6- تكوين نهر عمر (Nahar Umr Formation) وتقسم المنطقة الواعدة
الى نطاقين ثانويين الاول (N.29-31، E.43-45) والثاني (N.30-31، E.46-48).

8.6.6- تكوين المودود مع مكافئه القمجوقة العلوي (Mauddud Formation With Upper Qamchuqa) وتقسم المنطقة الواعدة الى ثلاث انطقة ثانوية
الاولى(N.35-37، E.41.5-45.5)، الثانية(N.34.5-32.5 E.43-45.5) والثالثة (N.30.5-32.5، E.45-47.5)

7.6- تتابع الطباشيري المتأخر (Late Cretaceous)
ويتضمن التكوينات والمناطق الواعدة:

1.7.6- تكوين الرميلة (Rumaila Formation) ويشمل نطاقين الاول (N.32-34.5 E.44-46)والثاني (N.30-32 ، E.43-48)

2.7.6- تكوين المشرف (Mishrif Formation) ويشمل نطاقين الاول
(N.31-33، E.42.5-44.5) والثاني (N.30-32.5 ، E.45.5-48)

3.7.6- تكوين الكفل (Kifl Formation) ويشمل نطاقين الاول(N.32-34، E.43.5-46) والثاني (N.29-31، E.46-47)

4.7.6- تكوينات الخصيب، تنومة وسعدي (Khasib,Tanuma & Sadi Formation) والمنطقة الواعدة (N.29-32، E.44-48)

5.7.6- تكوين الهارثة (Hartha Formation) والمنطقة الواعدة (N.29-36) ، (E.40-48)

6.7.6- تكوين عقرة وبخمة في شمال العراق (Aqra & Bekhme Formation) (N.36-37 ، E.43-44.5)

7.7.6- تكويني طيارات ودكمة (Tayarat & Digma Formations)
ويشمل نطاقين الاول (N.32-35.5 ، E.40-43) والثاني (N.29-32، E.43-47.5)

8.7.6- تكوين الشيرانش ومكافئه تكوين القرنة (Shiranish & Qurna Formations) ويشمل نطاقين الاول N.33-37، E.41-46
والثاني N.29-32، E.44-47.5

8.6- تتابع الباليوجين (Paleogene Sequence) ويشمل نطاقين الاول (N.35-36 E.41.5-45) والثاني (N.29-34.5 ، E.43-47.5)

2.2.4.4. النظام البترولي الترياسي:

ان النظام البترولي الترياسي يتضمن تكوين القره جيني الجيري في الترياسي الاعلى والاسفل من صخور مصدرية ضمن الترياسي قد تكون تكوين القره جيني نفسه المصدر [9] او من تكوين مركا مير وليس هناك دليل حاسم بهذا الشأن المصادر [14،16]، ان الآبار في منطقة الموصل بينت وجود النفوط في تكوين القره جيني الجيري في الترياسي الاعلى والاسفل وكذلك الآبار المحفورة في اقليم كردستان كحقل شيخان على سبيل المثال لا الحصر والاعتقاد الواسع بان نفوط مكامن الترياسي ترجع اصولها الى تتابعات الترياسي نفسها والاستثناء من ذلك منطقة نهوض الخليصية في شمال غرب العراق حيث ان الهيدروكاربونات فيها كما تشير الدلائل تعود لأصول سلوريه وليس هناك صخور مصدرية أسفل الترياسي من الممكن ان تكون مصدراً لنفوط مكامن الترياسي على الرغم من هذا الاعتقاد لم يتم اثباته. أن الدراسة الجيوكيميائية لنفوط الترياسي في منخفض سنجار على الجانب السوري دعمت فرضية الصخور المصدرية لترياسي المصادر [11، 12] (Fig.4).

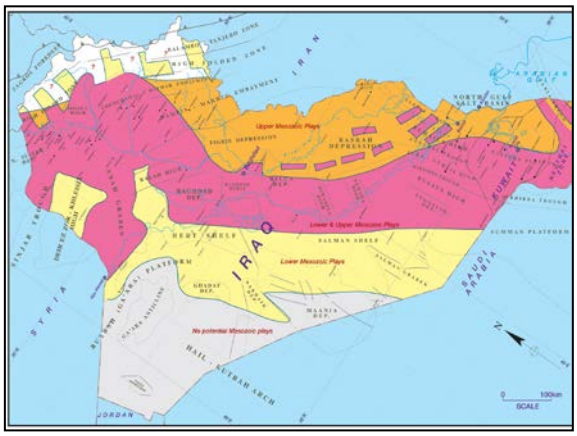

Fig.4. Possible & Proven Mesozoic after Al-Sharhan et al.,2003

3.2.4.4. النظام البترولي الباليوزويك: -

ان الصخور المصدرية لحقب الباليوزوي هي بشكل اساسي السجيل السلوري المتمثل بـ (Hot shale) لتكوين عكاز وكذلك السجيل الاوردفيشي لتكوين الخابور. ان الصخور المصدرية السلورية منتشرة بشكل واسع في نطاق الرطبة – حائل وبشكل جزئي في منطقة نهوض الخليصية في شمال غرب العراق المصادر [6،11، 12] والجزء الاعمق من نضوج هذه الصخور يقع على الحدود العراقية – السعودية لتصبح فوق النضوج الى غاز جاف في حقل ريشة الغازي في شرق الاردن وأكثر الى الشمال ، بالقرب من نهر الفرات المصادر [15, 17] وفي منطقة نهوض الخليصية فان صخور الباليوزوي في وقتنا الحاضر هي في قمة توليد نافذة النفط.

ان الوحدة المصدرية لتكوين عكاز في أعمق مستوياتها دخلت في نافذة النفط في زمن السلوري المتأخر وفي الديفوني عند ذروة الحركة الكالدونية (Caledonian movement)

ان المصائد المتفلقة والاكتاف (Horsts) المتجهة شمال شرق – جنوب غرب، على الاغلب تكونت خلال ذلك الزمن اما النفوط المتولدة في مراحل مبكرة فربما احتضنتها مكامن هذه التراكيب.

أن الحركات الهرسينية والثلاثية القارية ادت الى المحافظة على المصائد المتفلقة كما مبين بالنمط التركيبي لعكاز، أما الفوالق العميقة لسجيل السلوري فقد كانت في موقع مثالي لتزويد الحجر الرملي لتكوين الخابور الاوردوفيشي بالإضافة الى الوحدات الرملية النحيفة لمكمن عكاز السلوري. ان الغاز الجاف في مكامن حقل الريشة الغازي الاوردوفيشي في الاردن مصدره صخورا مصدرية شديدة النضوج من سجيل الاوردوفيشي او من سجيل السلوري الذي سبق بداية الرفع النهائي لمنطقة الرطبة – الريشة في منتصف المايوسين.

ان تتابعات البرمي العلوي فقيرة بالمحتوى الهايدروكاربوني ومن المحتمل انها ساهمت باصطياد جزء ضئيل من النفوط المنسلة من الصخور المصدرية السلورية وعلى وجه الخصوص عند الحدود الجنوبية (Fig.5).

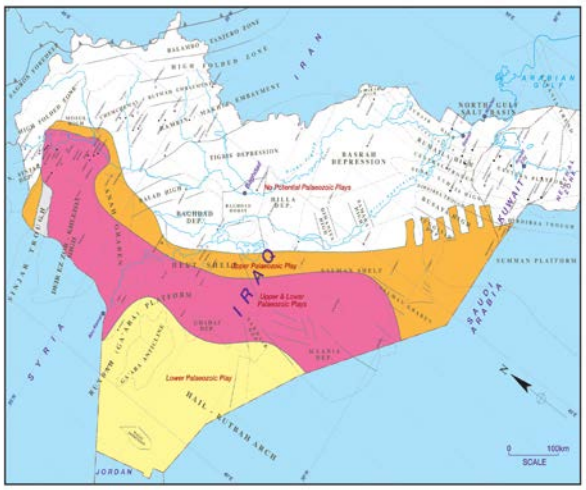

Fig.5. Possible & Proven Paleozoic Plays after Al-Sharhan et al.,2003

5. الانطقة والاعمار المقترحة لإنجاز حفر استكشافي ناجز: -

تم اعداد خرائط سماكة لجميع التكوينات المكمنية الرئيسية والثانوية بغية تحديد الانطقة ذات الاحتمالات الهايدروكاربونية العالية وحسب تسلسل الاعمار الجيولوجية المختلفة وكما مبين في الملحقات المرفقة بالبحث.

6- الاستنتاجات:

1.6- المنطقة الواعدة في تكوين الخابور (Khabur Formation) (الاوردوفيشي) بين الخطوط (E.40-43 ،N.32-36)

2.6 - المنطقة الواعدة في تكوين عكاز (Akkas Formation) (السلوري)

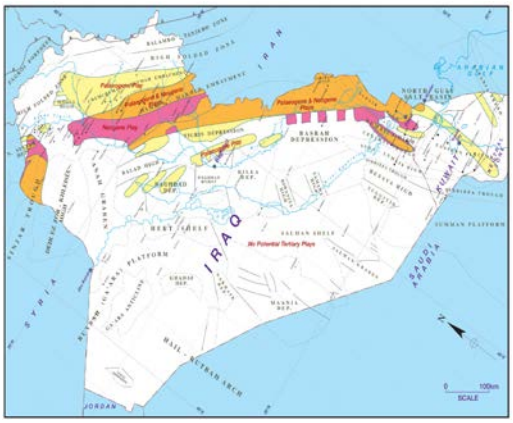

Fig.3. Potential & Proven Tertiary Plays after Al-Sharhan et al.,2003

2.1.4.4. النظام البترولي للعصر الطباشيري:

أن النظام البترولي للعصر الطباشيري في العراق هو السمة الغالبة لنطاقي حوض زاكروس وحوض وادي الرافدين ممثلة في المكامن الرملية لتكوينات الطباشيري الاسفل. اضافة الى المكامن الجيرية للطباشيري الاسفل والاوسط، ومكامن الطباشيري الاعلى المتشققة. ان الصخور المصدرية لنطاق حوض زاكروس متواجدة في الجزء الاوسط من الطباشيري ممثلة بالمارل الحوضي لتكوين البالمبو بالإضافة الى الجزء الاسفل من الطباشيري/ الجزء العلوي من الجوراسي لتكوين سلي الجيري السجيلي.

أن نفوط المكامن الرملية للطباشيري الاسفل في حوض وادي الرافدين والصفيحة العربية ممثلة بتكوينات الزبير ونهر عمر تولدت في تكوين سلي (الطباشيري الاسفل/الجوراسي الاعلى) ومن المحتمل تولدها من تكوين الرطاوي وسجيل تكوين الزبير (الطباشيري الاسفل) وربما كانت الصخور المصدرية الرئيسية لنفوط هذه المكامن الرملية المصدر [15].

أن معظم تراكيب هذا الجزء من العراق هي نتاج انبثاقات ملحية او نمو في القاعدة البلورية والتي رجحت حدوث الهجرة العمودية لكي تستطيع هذه النفوط الهجرة عبر التكسرات من الصخور المصدرية العميقة للجوراسي (ومن المحتمل الترياسي) الى مكامن الطباشيري المصدر [9].

ان البيئة البنائية لشعاب تكويني اليمامة والمشرف هي دليل ملموس على النمو المحتمل للتراكيب خلال الطباشيري المبكر. ان هذه النفوط العميقة قد نضجت خلال المراحل المبكرة من الحقبة الثلاثية ومن ثم هاجرت هذه النفوط الى مكامن الطباشيري عبر الفوالق على جوانب التقببات والطيات المحدبة الواسعة في زمن متأخر. ان العمليات التحويرية في الخزانات المائية أسفل جبهة تماس نفط – ماء ناتجة من عمليات سمنتة ثانوية والتي قيدت عملية اعادة الهجرة الى المكامن العلوية بسبب النمو التركيبي مما سبب اصطياد النفوط بمستويات أوطئ من المناطق الاخرى كما هي الحال في صخور الزبير المكمنية في حقول الروضتين والصابرية المجاورة في الكويت المصدر [10]. ان المكامن الجيرية الرصيفية في جنوب العراق امتطت حافات حوض وادي الرافدين مع النطاق الثانوي لمنطقة اقدام جبال زاكروس، اما في شمال العراق فقد امتطت النطاقين الثانويين لأقدام الجبال والطيات العالية لنطاق زاكروس. أما الى الشرق من الرصيف القاري فان هذه التتابعات تتشابه مع الترسبات البحرية وتتراوح في العمر بين التيثونين الى المايوسين المبكر ولهذه الترسبات قدرة توليدية ممتازة ومن المحتمل بان كميات كبيرة من النفوط والغازات قد تولدت الى الشرق من منطقة الرصيف وهاجرت اعلى الميل باتجاه تتابعات الرصيف حيث تم اصطيادها. ومن المحتمل ان تكون عملية الهجرة هذه قد بدأت في الباليوجين (Paleogene) وقبل عملية الطي في البلايوسين (Pliocene) ولذلك فان النفوط المتولدة توجهت مباشرة الى تراكيب الحقبة الثلاثية المتكونة بفعل الانبثاقات الملحية كما هي الحال في نفط خانة وجياسورخ على الحدود العراقية – الايرانية واستمرت عملية النضوج في فترة البلايوسين التي زادت من عمليات اصطياد النفوط في تراكيب طيات حزام زاكروس. ان المكامن المتشققة في الطباشيري الاعلى تمتاز بكونها صخور جيرية طينية (mudstone) ذات طبيعة صلدة مما تسبب بتشققها موضعيا مثل تكوينات الشيرانش، كوميتان، سعدي، تنومة والخصيب والثلاث الاخيرة هي الاكثر شيوعا وهي ذات مسامية عالية ونفاذية ضعيفة ومن المعتقد بأن نفوطها هاجرت من مستويات أعمق، جميعها وجدت في النطاق الثانوي لطيات زاكروس العالية وعلى حافة حوض وادي الرافدين مع النطاق الثانوي لإقدام الجبال، أما في شمال العراق فان لكثافة النفوط ومحتواها الكبريتي في مكمن الشيرانش النفطي في حقول بطمة وعين زالة قد سهل الاستنتاج بانها متماثلة مع مكمن القره جيني الترياسي. ويمثل (Fig.4) المناطق المحتملة لانتشار مكامن الحقبة المتوسطة المصادر [11،12] .

2.4.4. الانظمة البترولية الثانوية: -

1.2.4.4. النظام البترولي الجوراسي: -

ان النظام البترولي الجوراسي يتضمن مكامن النجمة والقطنية الحاوية على هيدروكربونات من الصخور المصدرية المولدة لتكوين ساركلو والذي قد يكون مكمنا في بعض المناطق بالإضافة الى النفوط المتولدة من التتابعات الجيرية – المتبخرات للجوراسي الاسفل وهي تكوينات بطمة، عداية، علان وتكوين جياكارا في الجوراسي الاعلى . ان المصائد ذات الاتجاه شمال – جنوب المقرونة بالشكل الاسفيني الكامل لحاجز القطنية سببت الاصطياد في تكوين النجمة او في مكامن الطباشيري التي تعلوها مثل تكوينات سولي، الزبير والرطاوي/ اليمامة. كما توفرت العديد من مصائد الفوالق في بداية عملية الهجرة اثناء الباليوجين والبعض من هذه النفوط تحركت باتجاه اعلى الميل غربا وباتجاه رصيف الصفيحة العربية وعلى اية حال ليس هناك دليل يسند بان هذه المصائد تكونت في هذا الحوض قبل المايوسين (fig.4) المصدر [13].

بينما وفر أنهايدرايت الجوراسي المتأخر صخرة حاجزة اقليمية لمكمن النجمة والى تكوينات أقدم عند فقدان تكوين الساركلو نتيجة التفلق او التعرية.
أن سجيل الطباشيري الاسفل لتكوين الزبير هي صخور حاجزية واسعة الانتشار تعلو الاعضاء الرملية المكمنية لتكوين الزبير بينما تمثل الصخور السجيلية في اعلى تكوين نهر عمر صخور حاجزية واسعة الانتشار للمكمن الرملي الاسفل لتكوين نهر عمر.
ان السجيل والحجر الجيري الاصم يمثل صخرة غطاء اقليمية لتكوين المشرف.
ان مارل فترة (Paleocene-Eocene) والحجر الجيري المارلي والسجيل يمثل صخرة حاجزية محلية لتكوين الشيرانش والهارثه في شمال العراق، ان المتبخرات المتواجدة في الجزء الاسفل لتكوين الفتحة (Miocene) تمثل صخرة غطاء ممتازة لمكمن الاسمري الجيري (Oligocene) والتكوينات المكافئة له في مجموعة كركوك، وكذلك لمكمن الجريبي الجيري (Lower Miocene) ومكمن الغار الرملي.
كما تمثل هذه المتبخرات ايضا صخور حاجزة موضعية متداخلة مع مكامن الفتحة الجيرية. كما ان الصخور السجيلية المتداخلة مع المكامن الرملية الثانوية في (Upper Miocene) تمثل صخور حاجزية موضعية في شمال شرق العراق.

4.4. الانظمة البترولية:

تم تحديد خمسة انظمة بترولية منفصلة في التتابع الطباقي العراقي والتي تتضمن نظامين بترولين رئيسيين وثلاثة انظمة بترولية ثانوية، النظام البترولي لحقبة الثلاثي يمثل خمس الاحتياطي المكتشف لوقتنا الحاضر بينما يمثل النظام البترولي الطباشيري بحدود ثلاثة ارباع الاحتياطي الكلي، بينما الانظمة البترولية الثانوية للجوراسي والترياسي والحقبة القديمة تمثل بحدود (1%) من الاحتياطي الكلي المثبت ليومنا هذا.

1.4.4. الانظمة البترولية الرئيسة:

1.1.4.4. النظام البترولي لحقبة الثلاثي:

ان ارتطام الصفيحة العربية بالصفيحة الايرانية اثناء فترة البلايوسين (Pliocene) وفي ذروة الحركة الالبية بحقبة الثلاثي ولدت طيات النطاق الثانوي لأقدام الجبال الز كروسية. ولقد ولدت هذه الاشكال الغير منتظمة في هامات التراكيب العالية التشقق ت بنفوط العصر الطباشيري نتيجة اعادة الهجرة المصادر [7،8]. أن النفوط الخفيفة (37°API) تدعم وجهة النظر القائلة بان هذه النفوط قد انتقلت من صخور مصدرية أعمق من الطباشيري الاعلى التي مازالت صخورها المصدرية دون مستوى النضوج او في مراحل النضوج المبكرة. ان معظم تراكيب تخلج كركوك (Kirkuk Embayment) لها تتابع غطائي متأثر بصدوع اندفاعية (thrust fault) تعلو تتابع من الصخور المكمنية تبعد (2-3) كم عن محور الطيات المكمنية. ان بعض النضوحات النفطية قد حدثت على طول الفوالق الانزلاقية كالنضوحات النفطية التي تسببت بالنار الازلية في حقل كركوك ونضوحات في حقول بلخانة، كلابات، جيا سورخ، نفط خانة وانجانة.

أن النفوط المستعصية موجودة في صخور مكامن حقب الثلاثي (أسفل تكوين انجانة) في منطقة الموصل ضمن النطاق الثانوي للطيات العالية زاكروس المصادر[11،12]. ومن امثلة النفوط الثقيلة ذات المحتوى الكبريتي العالي نفوط حقول منطقة القيارة. ولذلك وعلى اقل تقدير فان الهجرة العمودية والنضوحات النفطية الملاحظة على ضفة نهر دجلة من صخور مصدرية عميقة من العصر الجوراسي والصخور الاقدم لعبت دورا مهما في اعادة هجرة هذه النفوط، وعلى العكس من ذلك فأن فعاليات تكتونية قليلة في حوض وادي الرافدين على الارجح سبب قلة وصول هذه النفوط الى حقب الثلاثي عبر التكسرات العمودية من صخور مصدرية أعمق المصادر [8،9]. وفي الواقع فان متبخرات تكوين ديبان تمثل صخور حاجزة في الاجزاء الوسطى من هذا الحوض منعت الهجرة العمودية لنفوط الطباشيري الى مكمن المايوسين الاسفل. ان صخور الجزء الاسفل من حافات نهر الفرات المتفلقة ربما تشكل استثناءاً عن ذلك في جنوب العراق، حيث عثر على النفوط في مكامن تكوينات الدمام، الغار وانجانة. ونتيجة حدوث طيات مكثفة على الحدود الفاصلة بين حوض وادي الرافدين والنطاق الثانوي لإقدام جبال زاكروس التي ادت الى التواصل بين نفوط العصر الطباشيري ومكامن الثلاثي التي تعلوها وقد امتدت مكامن الحقبة الثلاثية من تخلج كركوك وعلى امتداد الحدود الشرقية للعراق وصولا الى جنوبه وقد ظهر نطاق ثانوي لمكامن الحقبة الثلاثية في منطقة سنجار على الحدود السورية العراقية (Fig.3) & (Fig.2) المصادر[13،14]

Fig.2. Low to moderate risk areas for exploring The Tertiary Plays of Iraq & Kuwait after Al-Sharhan et al, 2003

1.2.4. المكامن الرئيسة:

تتراوح اعمار المكامن الرئيسة من الترياسي العلوي الى المايوسين العلوي وتقع هذه المكامن ضمن (230) تجمع هايدروكاربوني المصادر [2، 7] والتي من خلالها تم تحديد (35) مكمن رئيسي منفصل وتميزت هذه المكامن بغزارة الاحتياطي والعاملين الجيولوجيين المهمين في غزارة هذه المكامن الهايدروكاربونية هي محافظة هذه المكامن على مساميتها الاولية وخاصة في المكامن الرملية وتحسن في مساميتها الثانوية في المكامن الجيرية.
وتم تحديد المكامن الرئيسة بضوء اعمارها في التتابع الطباقي العراقي مع بيان صخارياتها وبيئاتها الترسيبية والحقول او الآبار التي ثبت وجود الشواهد الهايدروكاربونية فيها وهي من الاقدم الى الاحدث: -
1- قره جيني 2- بطمة 3- عدايه 4- علان 5- سارکلو 6- نجمة 7- قطنية 8- جيكارا 9- سلي 10- يمامة 11- سارمورد 12- رطاوي 13- زبير 14- شعيبة 15- قمجوقة 16- نهر عمر 17- جوان 18- مودود 19- مشرف 20- كوميتان 21- مشورة 22- خصيب 23- تنومة 24- سعدي 25- هارثة 26- شيرانش 27- مجموعة كركوك 28- أسمري 29- سيري كآكني 30- الغار31 - الفرات 32- جريبي 33- دبان 34- الفتحة 35- أنجانة (الجداول 1أ، ب، ج).

2.2.4- المكامن الثانوية:

بالإضافة الى المكامن الرئيسة هناك العديد من المكامن الثانوية والتي ثبت تواجد الهيدروكاربونات فيها وعددها (17) وتتراوح اعمارها من الاوردوفيشي الى المايوسين المتوسط وهي من الاقدم الى الاحدث: -

1- الخابور 2- عكاز 3- جيا زيري 4- كلي خانة 5- كركو 6- أحمدي 7- رميلة 8- دوكان 9- كيربير 10- بالمبو العلوي 11- بخمة 12- عليجي 13- دمام 14- بلاسبي

15- جدالة 16- جيركس 17- كالهور (الجداول 2أ،2ب).

3.4. الصخور المصدرية والنضوج الهيدروكاربوني:
تناولت العديد من الدراسات الجيوكيميائية والبالونوجية السابقة الصخور المصدرية المولدة للهيدروكربونات ومن الدراسات التي اكدت هذه النتائج المصادر [3،4] حيث تم تحليل أكثر من (300) نموذج صخري من ابار في شمال وشمال شرق العراق جمعت من تكوين البامبو (طباشيري متأخر) وتكوينات جيا كارا، بارسيرين، قطنية، ناوكليكان وسارکلو في العصر الجوراسي، وخمنت نتائج هذه الدراسة بأن تكوين البالمبو قد

ولد (18) بليون برميل نفط قياسي بينما تكوينات الجوراسي ولدت ايضا بحدود (18) بليون برميل نفط قياسي وبقدرة توليد كلية تزيد على (31) بليون برميل نفط قياسي من مساحة (75000) كم مربع.

إن سجيل السلوري الاسفل لتكوين عكاز (Hot shale) هي الصخرة المصدرية الرئيسة لحقبة الباليوزويك في الصحراء الغربية ونهوض الخليصية في حوض وادي الرافدين في شمال غرب العراق، ان السجيل (Hot) وجد في البئر عكاز -1 والبئر خليصيه -1 بمعدل سماكة يصل (65) مترا والسجيل في هذين البئرين يحوي على نسبة عالية جدا من الكاربون العضوي الكلي (TOC) تراوحت من (0.96-16.62%) في البئر عكاز-1

و(1.0-9,94%) في البئر خليصية-1 وبقدرة نفطية (49) كغم / طن وبينت نتائج التحاليل الجيوكيميائية للبئر خليصيه - 1 خصائص مشابهة. والحجم المخمن للهايدروكاربونات المتولدة لمساحة (20.000) كم مربع واقعة بين منطقتي الخليجية –عكاز هي بحدود (16) بليون برميل نفط.

ان الصخور المصدرية السلورية في غرب العراق ربما كانت الاكثر غنى في المادة العضوية بالعالم.

المصادر [5, 6, 9, 10].

1.3.4. الهجرة:

ان نظرية هجرة النفوط الرئيسة في العراق تفترض بان الصخور المصدرية للجوراسي المتأخر والطباشيري المبكر زودت معظم المكامن العراقية وان عملية نضوج هذه الصخور المصدرية قد بدأت خلال ترسيب الاوليجوسين المبكر قبل (37) مليون سنة وبدأت عملية توليد الهايدروكاربونات من الصخور المصدرية للطباشيري المتوسط (الجزء الاسفل من تكوين بالمبو) خلال ترسيب المايوسين المتوسط (15) مليون سنة مضت وقد تم تسهيل عملية الهجرة لهذه الهيدروكاربونات من خلال النهوضات القديمة الموجودة (Paleo high) ومن خلال اختراق بعض المصائد القديمة كنتيجة لسلسلة من العمليات التكتونية النشطة عند ذلك الوقت.
وان هذه السلسلة التكتونية لم تمهد فقط لعملية هجرة الهيدروكاربونات بل ساهمت في تحسين المسامية الكلية للوحدات المكمنية.
أن الصخور المصدرية لحقبة الباليوزويك تعرضت لتأريخ مستمر من التوليد والطرد المختلفة عن الصخور المصدرية لحقبتي الجوراسي والطباشيري التي خضعت لعملية تدفق رئيسية واحدة للهايدروكاربونات المتولدة والمطرودة خلال ترسيب الحقب الثلاثية.

2.3.4. الصخور الغطائية:

ان الصخارية الحاجزة للحجر الرملي لتكوين عكاز السلوري هي السجيل الذي يعلوه بينما تكون صخارية الخابور الاوردفيشي سجيليه متداخلة مع حجره الرملي.
ان سجيل وأنهايدرايت الترياسي الاعلى تمثل الصخور الحاجزة لتكوين القره جيني وأنهايدرايت الجوراسي الاسفل يمثل صخور حاجزة موضعية لتكوين البطمة.

2.2.3. منطقة الفوالق المركزية:

تتصف هذه المنطقة بكثافة تواجد الظواهر التركيبية فيها والتراكيب موزعة بين ظاهر على السطح وماهو تحت سطحي وهي تراكيب غير متناظرة وتتعقد اطرافها الجنوبية الغربية عادة بالفوالق العكسية والمنطقة بصورة عامة ذات احتمالات نفطية عالية تتركز في ثلثها الجنوبي الشرقي في صخور العصر الثلاثي والطباشيري وفي ثلثها الاوسط كذلك اما في ثلثها الشمالي الغربي فتتركز احتمالاتها الهايدروكاربونات في صخور عصور الطباشيري ،الجوراسي والترياسي والمنطقة غنية بالحقول النفطية والغازية ومن أبرزها حقول القيارة ،النجمة ،جوان ،قصب ،باي حسن ،جمبور ،خباز ،حمرين ،قمر ،المنصورية،تل غزال ونفط خانة وتبلغ عدد التراكيب في هذه المنطقة (107) تركيبا.

3.2.3. السفح القريب من المنصة العربية:

تتميز هذه المنطقة بعدم ظهور تراكيبها الجيولوجية على السطح الا ما ندر وتتحدد نهايتها الجنوبية الغربية بنهر الفرات من الشمال الغربي والى الجنوب الشرقي من مدينة القائم وحتى مدينة هيت وبفوالق ابو جير ذات النضوح النفطي الوفير ومن ثم حقل مرجان فحقول الصبة، اللحيس، راجي وجريشان واما نهايتها الشمالية الشرقية فتمتد من جبل سنجار مرورا بالأطراف الجنوبية الغربية لجبال حمرين ومكحول ثم حقل بدرة فحقلي البزركان والحويزة ويعتبر العصر الطباشيري المنطقة ذات احتمالات نفطية عالية في معظمها ماعدا الثلث الشمالي الغربي منها حيث تعتبر صخور الحقبة المتوسطة ذات احتمالات نفطية متوسطة وتصبح في ثلثها الاوسط ذات احتمالات نفطية ضعيفة وتعتبر احتمالاتها معدومة في ثلثها الشمالي الغربي لصخور الحقبة المتوسطة المنكشفة على السطح عند منخفض الكعرة . غير ان هنالك احتمالات نفطية متفاوتة مازالت غير مقيمة ومجهولة في الصخور الرسوبية العائدة للحقبة القديمة باستثناء حقل عكاز النفطي.
ان جميع هذه الظواهر التركيبية مغطاة بمسوحات زلزالية وتختلف عن مثيلاتها الاخرى بصغر حجمها وقلة انغلاقها وعدم تناظر اشكالها، وتبلغ عدد التراكيب الجيولوجية في هذا النطاق (158) تركيبا.

4. جيولوجيا النفط:

هنالك (130) حقل مكتشف في هذه الدراسة وتمثل جميع الحقول المكتشفة في العراق لحين اعداد هذه الدراسة هذه الاكتشافات موزعة على مناطق جغرافية منها (78) اكتشاف. يقع في نطاق زاكروس و(45) حقلا ضمن نطاق حوض وادي الرافدين و(7) الحقول المتبقية في نطاق المنصة العربية.
ان النظام النفطي المتبع في هذه الدراسة يتضمن تحديد المكامن النفطية والصخور المصدرية وهجرة الهايدروكاربونات وتخلص الدراسة الى توصيف نظامين نفطيين رئيسيين وثلاثة انظمة ثانوية.

1.4. المكامن النفطية:

ان حجوم النفوط المثبتة هي بحدود (150) مليار برميل وحجم الغاز المثبت (270) تريليون قدم مكعب وان (30%) من هذه الاحتياطات النفطية موجودة ضمن نطاق زاكروس ومعظم المتبقي في نطاق حوض وادي الرافدين اما حجم الغاز الموجود في نطاق زاكروس فهو بحدود (40%) والمتبقي في نطاق حوض الرافدين.
وهنالك العديد من المكامن العميقة التي انتجت نفوطا خفيفة وغازا والاقدم عمرا فيها هو الاوردوفيشي والسلوري في المنصة العربية كما ويعتقد على نطاق واسع بان العمر البرميل قد يكون مكمن هامشي واعد مستقبلا.
وقد تم تأشير وجود الهيدروكاربونات في جنوب العراق في الصخور الجيرية لعصري الجوراسي والترياسي (البئر ديوان-1) كما تم تأشير وجود النفط في مكامن الجوراسي في (البئر الرميلة الجنوبي-120) كما اكدت الاكتشافات النفطية الاخيرة في نطاق زاكروس وجود العديد من المكامن الهايدروكاربونية لعصري الجوراسي والترياسي وكمثال على ذلك حقل شيخان في محافظة دهوك. ان معظم المكامن في حقول جنوب ووسط العراق تقع في الصخور الرملية الاوردوفيشي، الصخور الجيرية الجوراسية، الصخور الرملية والجيرية الطباشيرية وفي الصخور الرملية الجيرية والجيرية الرملية للمايوسين المتوسط. ان اعماق هذه المكامن تتراوح بين مكامن غازية في الحقبة القديمة في شمال وشمال غرب العراق (نهوض الخليصية) على عمق (3490) مترا وفي المنصة العربية (عكاز-1) على عمق (2327) مترا اما مكامن الجوراسي الاسفل فهي على عمق (3400) مترا بينما الجوراسي المتوسط والعلوي فيتراوح العمق بين (2700-3000) مترا.
في حين مكامن الطباشيري الاسفل تقع على اعماق تتراوح (2500-3850) مترا ومكامن الطباشيري المتوسط والعلوي على اعماق تتراوح بين (800-3000) مترا. أما مكامن المايوسين في الحقول الجنوبية فتقع على معدل عمق (300) مترا.

اما في نطاق زاكروس فان مكامن الترياسي تصل الى عمق (3050) مترا في شمال غرب العراق، ومكامن الجوراسي على اعماق تتراوح بين (1500-3000) مترا ومكامن الطباشيري على اعماق تتراوح بين (1250-3800) مترا تليها مكامن الثلاثي التي تتراوح في اعماقها بين (300-2900) مترا.

2.4. التوصيف المكمني:

تم تحديد المكامن بضوء اعمارها في التتابع الطباقي العراقي مع بيان صخارياتها وبيئاتها الترسيبية والحقول او الآبار التي ثبت وجود الشواهد الهايدروكاربونية فيها مع بيان خصائصها المكمنية وانطقتها التكتونية وتم تقسيمها الى صنفين مكامن رئيسة ومكامن ثانوية والمعيار في تحديد ذلك تواجد الهايدروكاربونات على الاقل في ثلاثة تجمعات هيدروكاربونية مختلفة حيث صنفت كمكامن رئيسة ومكامن ثانوية عند تواجد الهيدروكاربونات في تجمعين فما دون.

1. المقدمة:

ان معظم الحقول الهايدروكاربونية الحالية تقع في نطاقي حوض الرافدين (Mesopotamian Basin) واقدام الجبال (Foot Hill) من الجرف غير المستقر (Unstable Shelf) من المنصة العربية (Arabian Platform) كما ان معظم الهيدروكاربونات المكتشفة في العراق الى وقتنا الحاضر متأتية من عصري الثلاثي والطباشيري وما زال الحفر العميق لتتابعات عصري الجوراسي والترياسي والحقبة القديمة محدود للغاية وخاصة في حوض وادي الرافدين والصفيحة العربية.

هناك أكثر من (130) حقل نفطي تم اكتشافها في مختلف انحاء العراق منها (78) حقلا تقع في نطاق زاكروس (من ضمنها حقول اقليم كردستان المكتشفة بعد 2003) ومن (45) حقلا ضمن حوض وادي الرافدين و(7) الحقول المتبقية في منطقة المنصة العربية.

2. الهدف من الدراسة:

1.2. السعي الى تسليط الضوء الى اهمية زيادة وتيرة الحفر الاستكشافي في العراق بغية تعزيز الاحتياطي الهايدروكاربوني المثبت.

2.2. المفاضلة في تحديد اولويات الحفر الاستكشافي من خلال التركيز على التراكيب الواعدة من حيث انخفاض نسب المجازفة، ابعاد التراكيب، نوعية النفوط المحتملة وجسامة الاحتياطي فيها.

3.2. اقتراح حقول من المحتمل جدا ان تكون حاوية على مكامن مستقبلية عملاقة متميزة بنفوطها الخفيفة من خلال التوسع بالحفر العميق لبعض الحقول القائمة فعلا اخذين بنظر الاعتبار نتائج الحفر الاستكشافي الحديث في الدول المجاورة.

4.2. اقتراح اعادة تعين مواقع لآبار استكشافية للتحري عن المكامن العميقة في التراكيب المنقلبة.

3. الوحدات البنيوية المعتمدة في هذه الدراسة:

1.3. نطاق التقعر الاقليمي (Regional Foredeep):

يقع هذا النطاق في اقصى الشمال والشمال الشرقي من العراق ويمتد على شكل شريط ضيق مع امتداد الحدود الدولية ابتداء من شمال مدينة زاخو وحتى جنوب مدينة حلبجة

ويتصف بتعقيداته الجيولوجية الكبيرة حيث ادت الفوالق والتصدعات العكسية فيه الى ازاحة صخوره الرسوبية عن مواقعها الأصلية لتستقر في مناطق بعيدة.وقد عانت هذه الصخور من تغايرات عديدة نتيجة عملية الانزلاقات التي تقدر بعشرات الكيلومترات في بعض الاحيان ولذلك فالاحتمالات النفطية لهذا النطاق ضعيفة بشكل عام مع وجود بعض النضوحات النفطية في العصر الطباشيري وتتحسن الاحتمالات الهايدروكاربونية فيه خلال عصري الجوراسي والترياسي. عدد التراكيب الجيولوجية لهذا النطاق (104).

2.3. حوض وادي الرافدين (Mesopotamian Basin):

يؤلف هذا النطاق الجزء الاعظم من مساحة العراق وبحدود 60% من المساحة الكلية ويمتد بمحاذاة نطاق التقعر الاقليمي من جهته الشمالية والشمالية الشرقية وبمحاذاة المنحدر الشمالي الشرقي للمنصة العربية من الجهة الجنوبية الغربية ويتألف من ثلاث مناطق بنيوية رئيسية.

1.2.3. السفح القريب من التقعر الاقليمي:

تتصف هذه المنطقة بكثافة تواجد التراكيب الجيولوجية الطولية غير المتناظرة ولعبت الفوالق العكسية دورا مهما في تعقيد الكثير منها خاصة عند اطرافها الجنوبية الشرقية وهي في غالبيتها العظمى تراكيب ظاهرة على السطح وتتضاءل احتمالاتها النفطية كلما تقدمنا نحو الشمال الشرقي من المنطقة

وهي ممتازة عند طرفها الجنوبي الشرقي حيث تتواجد حقول صفية وعين زالة وبطمة وحقل كركوك وحقل كورمور الغازي وحقل جياسرخ ولتصبح عديمة الاحتمالات النفطية عند بلوغ التقعر الاقليمي لمكامن الطباشيري في اولا اعلاه. وتبلغ عدد التراكيب في هذه المنطقة (123) تركيبا.

Fig.1. Iraq- Major Structural Features after Beydoun et al, 1992

Aspects of Iraqi hydrocarbon explorations: obstacles and prospects upgrading

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Abstract: The goal of hydrocarbon exploration is to find hydrocarbon accumulation in commercial quantities. When studying the proven oil reserves in Iraq (150 billion barrels) and the probable oil reserves (130 billion barrels) and a proven gas reserves (127 trillion cubic feet) and a probable gas reserves (275) trillion cubic feet, we find that such figures put on a huge task on future exploration requirements. The conversion of a large portion of the probable reserve into a proven reserve is a significant support to firstly to maximize the proven reserve and secondly to further consolidate the financial and economic situation of Iraq. The only way to do this is through a steady increase in drilling exploration wells from (2-3) wells annually at present to (10) wells annually at the very least, noting that the total geological structures are (530) structures, of which only (130) have been drilled during the last decade. Therefore, the remaining (400) structures in the light of the current rate, Iraq needs more than (133) years to cover the required drilling .If the number of drilled wells is increased annually to (10) wells, the period will decrease to (40) years which seems a relatively reasonable period for significant strengthening of Iraqi hydrocarbon proven reserves before the possibility of finding alternatives to this energy in the future .This study focuses on selecting the preferred structures to be drilled depending on the different geological parameters such as minimum rate of risk, dimensions of structures, probable oil API and their total reserves. The study highlights some of the preferred structures for the location of exploratory wells by determining the different possible geological periods with high oil potential. according to tectonic division adapted by the Exploration Oil Company The study also suggests a few structures that are expected to be future giant reservoirs either by deeper drilling of the existing oil fields, taking into account the results of the latest exploration drilling in neighboring countries or in the deeper reservoirs of the inverted structures, besides revaluating some Iraq Oil Company (IPC) wells which suffer from the problem of old methods.

أفاق الاستكشافات الهيدروكاربونية في العراق، المعوقات وسبل الارتقاء

الخلاصة : أن الغاية من الاستكشاف الهايدروكاربوني هو العثور على تجمعات هايدروكاربونيه بكميات تجارية. فعند اجراء مقارنة للاحتياطي النفطي المثبت في العراق (150) مليار برميل واحتياطي نفطي محتمل (130) مليار برميل واحتياطي غازي مثبت (127) تريليون قدم مكعب واحتياطي غازي محتمل (275) تريليون قدم مكعب نجد أن هذه المقارنة تلقى على عاتق الاستكشاف مهام مستقبلية جسيمة تتمثل بضرورة سرعة تحويل جزء كبير من الاحتياطي المحتمل الى احتياطي مثبت لما يشكله ذلك من دعم كبير للاحتياطي المثبت اولا وزيادة ترسيخ الوضع المالي والاقتصادي للعراق ثانيا. ان السبيل الوحيد للقيام بذلك يتأتى من خلال زيادة مضطردة في حفر الآبار الاستكشافية من معدلها السنوي الحالي (2-3) أبار الى (10) أبار سنويا على اقل تقدير علما بأن مجموع التراكيب الجيولوجية الكلي في العراق (530) تركيبا حفر منها خلال العقد المنصرم (130) تركيبا فقط ولذلك فالمتبقي (400) تركيبا وعلى ضوء المعدل الحالي فان العراق يحتاج الى اكثر من (133) عاما لتغطية حفر جميع هذه التراكيب وعند رفع عدد الآبار الاستكشافية المحفورة سنويا الى (10) أبار فان الفترة تنخفض الى (40) عاما وهي فترة معقولة نسبيا لتعزيز مهم للخزين الهايدروكاربوني العراقي قبل احتمالية العثور على بدائل للطاقة مستقبلا. وتردف هذه الاستراتيجية الى المفاضلة في اختيار اوليات حفر هذه التراكيب من حيث انخفاض نسب المجازفة وأبعاد التراكيب ونوعية النفوط المحتملة وجسامة الاحتياطي وتسلط هذه الدراسة الضوء على بعض التراكيب المفضلة لتثبيت الآبار الاستكشافية عليها من خلال تحديد الحقب الجيولوجية المختلفة ذات الاحتمالية النفطية العالية بضوء التقسيم البنيوي المعتمد في شركة الاستكشافات النفطية كما تقترح الدراسة بعض التراكيب التي من المؤمل ان تكون مكامن نفطية مستقبلية عملاقة اما من خلال الحفر العميق لبعض الحقول القائمة الان مع الأخذ بنظر الاعتبار نتائج الحفر الاستكشافي الاخير في الدول المجاورة او تغاير الوضع التركيبي للمكامن العميقة عن المكامن الضحلة واعادة استكشاف بعض الحقول المحفورة من قبل شركة نفط العراق (IPC) التي عانت من مشاكل الحفر في حينها .

دليل المقيمين

ان المهمة الرئيسية للمقيم العلمي للبحوث المرسلة للنشر، هي أن يقرأ البحث الذي يقع ضمن تخصصه العلمي بعناية فائقة وتقييمه وفق رؤى ومنظور علمي أكاديمي لايخضع لأي آراء شخصية ، ومن ثم يقوم بتثبيت ملاحظاته والصادقة حول البحث المرسل اليه.

قبل البدء بعملية التقييم ، يرجى من المقيم التأكد فيما اذا كان البحث المرسل اليه يقع ضمن تخصصه العلمي أم لا، فإن كان البحث ضمن تخصصه العلمي ، فهل يمتلك المقيم الوقت الكافي لاتمام عملية التقييم ، إذ إن عملية التقييم يجب أن لاتتجاوز العشرة أيام .

بعد موافقة المقيم على اجراء عملية التقييم واتمامها خلال الفترة المحددة ، يرجى إجراء عملية التقييم وفق المحددات التالية :

1. هل ان البحث أصيلاً ومهم لدرجة يجب نشره في المجلة .
2. فيما اذا كان البحث يتفق مع السياسة العامة للمجلة وضوابط النشر فيها .
3. هل ان فكرة البحث متناولة في دراسات سابقة ؟ إذا كانت نعم ، يرجى الإشارة الى تلك الدراسات .
4. مدى تعبير عنوان البحث عن البحث نفسه ومحتواه .
5. بيان فيما إذا كان ملخص البحث يصف بشكل واضح مضمون البحث وفكرته .
6. هل تصف المقدمة في البحث مايريد المؤلف الوصول اليه وتوضيحه بشكل دقيق، وهل وضح فيها المؤلف ماهي المشكلة التي قام بدراستها .
7. مناقشة المؤلف للنتائج التي توصل اليها خلال بحثه بشكل علمي ومقنع .
8. يجب ان تُجرى عملية التقييم بشكل سري وعدم اطلاع المؤلف على أي جانب فيها.
9. اذا أراد المقيم مناقشة البحث مع مقيم آخر فيجب ابلاغ رئيس التحرير بذلك.
10. يجب ان لاتكون هنالك مخاطبات ومناقشات مباشرة بين المقيم والمؤلف فيما يتعلق ببحثه المرسل للنشر ويجب ان ترسل ملاحظات المقيم الى المؤلف من خلال مدير التحرير في المجلة.
11. إذا رأى المقيم بأن البحث مستلاً من دراسات سابقة ، توجب على المقيم بيان تلك الدراسات لرئيس التحرير في المجلة.
12. إن ملاحظات المقيم العلمية وتوصياته سيعتمد عليها وبشكل رئيسي في قرار قبول البحث للنشر من عدمه كما يرجى من المقيم الاشارة وبشكل دقيق الى الفقرات التي تحتاج الى تعديل بسيط ممكن ان تقوم بها هيأة التحرير وإلى تلك التي تحتاج الى تعديل جوهري من قبل المؤلف نفسه.

دليل المؤلفين

1. تستقبل المجلة البحوث والدراسات التي تكون ضمن تخصصها حصراً .
2. أن يكون البحث المقدم للنشر أصيلا ولم يسبق نشره في مجلة أو أي وسيلة نشر أخرى.
3. يعطي المؤلف حقوق حصرية للمجلة تتضمن النشر والتوزيع الورقي والالكتروني والخزن وإعادة الاستخدام للبحث .
4. لاتزيد عدد صفحات البحث المقدم للنشر عن خمسة عشر صفحات .
5. ترسل البحوث الى المجلة عبر بريدها الالكتروني .
6. يكتب البحث المرسل للنشر ببرنامج الـ (word) أو (Latex) وبحجم صفحة (A4) وبهيئة عمودين منفصلين مع ترك مسافة (2) سم من جوانب الصفحة الأربعة ويكتب متن البحث بنوع خط (Times New Roman) وبحجم (12).
7. يقدم ملخص للبحث باللغة الإنكليزية وان لايتجاوز (250) كلمة بحجم (12).
8. أن تحتوي الصفحة الأولى من البحث على المعلومات التالية :
   - عنوان البحث.
   - اسم المؤلف / المؤلفين وجهات الانتساب.
   - البريد الالكتروني للمؤلف / المؤلفين.
   - الملخص.
   - الكلمات الدلالية.
9. يكتب عنوان البحث متمركزاً في وسط الصفحة وبنوع خط (Times New Roman) وحجم (Bold 14) .
10. يكتب اسم المؤلف / المؤلفين متمركزاً في وسط الصفحة وتحت العنوان وبنوع خط Times New Roman وبحجم (Bold 12) .
11. تكتب جهات الانتساب للمؤلفين بنوع خط (Times New Roman) وبحجم (Bold 10) .
12. تكتب عناوين البريد الالكتروني بنوع خط (Times New Roman) وبحجم (Bold 10) .
13. يكتب ملخص البحث بنوع خط (Times New Roman) وبحجم (Bold 12) .
14. تكتب الكلمات الدلالية التي لايتجاوز عددها عن خمسة كلمات بنوع خط (Times New Roman) وبحجم (11) .
15. جهات الإنتساب تثبت كالآتي (القسم ، الكلية ، الجامعة ، المدينة ، البلد) وبدون مختصرات.
16. تجنب المختصرات والاستشهادات عند كتابة ملخص البحث.
17. عدم ذكر اسم المؤلف / المؤلفين في متن البحث على الاطلاق.
18. يكتب اسم الشكل تحته متمركزاً، أما الجدول فيكون عنوانه متمركزاً فوقه بحجم (Bold 10) .
19. تكون الرسوم والصور والمخططات ملونة وواضحة وذات دقة عالية مع مراعاة وضعها في مربع نص ويراعى عدم استعمال الاستنساخ في الاشكال البيانية.
20. تذكر المصادر في متن البحث بترقيمها وبحسب الأسبقية ، كما تكتب المصادر في نهاية البحث وترتب طبقاً لطريقة ترتيب المصادر العالمية المعروفة (IEEE), حيث يشار الى المصدر برقم في قوسين مربعة، على سبيل المثال [1]، ويكون في سطر النص مع مراعاة وجود مسافة قبل القوس الاول ويكون بحجم (10) بنوع خط (Times New Roman).
21. جميع الدراسات التي تم الإستشهاد بها خلال متن البحث أو الجداول أو الصور وغيرها يجب أن تثبت وبشكل دقيق في قائمة المصادر وبالعكس.
22. يلتزم المؤلف / المؤلفون ببيان فيما إذا كان البحث المقدم للنشر قد تم في ظل وجود أية علاقات شخصية أو مهنية أو مالية يمكن تفسيرها على أنها تضارب في المصالح.

تعليمات النشر

- يطبع البحث بأستخدام برنامج (Microsoft Word) , وعلى ورق حجم (A4) , وعلى هيئة عمودين (ماعدا الصفحة الاولى) , وتترك حاشية (2سم) من جوانب الصفحة الاربعة , ونوع الخط المستخدم في اللغة الانكليزية (Time New Roman) , والخط العربي (Simpfied Arabic) وحجم الحروف حسب الاتي :
ـ العنوان الرئيسي (16- غامق) , والعناوين الثانوية (12- غامق) , اسماء الباحثين (10) , طباعة النص والهوامش (10) .

- الصفحة الاولى من البحث تحتوي الاتي :
ـ عنوان البحث : يكون متمركزآ وسط الصفحة , وعلى ان يكون قصيرآ بقدر الامكان .
ـ اسماء الباحث والباحثين : يشار الى الاسم كامل , والمرتبة العلمية , والعنوان الالكتروني , وجهة الانتساب للباحث (المنفرد في الوسط , والمشترك على الجانبين) .
ـ الخلاصة : تدرج تباعاً باللغتين العربية والانكليزية , وضمن حدود الصفحة الاولى حصراً.

- البحث : ويشمل المقدمة والاطار النظري , والتحليل المقارن والاستنتاجات الختامية , وتراعى النقاط الاتية :
ـ الاشكال والصور والمخططات البيانية المقارنة : تحوي على ترقيم متسلسل , وعنوان ومصدر , تحتها مباشرة (متمركزة) , وعلى ان تكون ملونة وذات وضوحية عالية .
ـ الجداول : تحوي على ترقيم متسلسل , وعنوان متمركز في اعلى الجدول , ومصدر .
ـ المعادلات : ترقم تسلسلياً في اقصى اليمين بين قوسين اعتياديين , وتستعمل فيها وحدات القياس الخاصة بالنظام الدولي حصرآ وباللغة الانكليزية (Standard International Units Si Units).
- المصادر :
ـ تتم الاشارة الى المصادر داخل نصوص البحث , بأرقام غامقة حسب تسلسل ورودها ومابين اقواس مربعة [ ].
ـ تكتب المصادر في نهاية البحث , وترتب طبقآ لطريقة المصادر العالمية المعروفة (IEEE) ويراعى فيها الاتي:
  - الدوريات : لقب الباحث . الحرف الاول للاسم . الحرف الاول لاسم الاب , (سنة النشر) , عنوان البحث , جهة النشر , رقم المجلد والعدد والصفحات .
  - الكتب : لقب المؤلف , الحرف الاول للاسم , الحرف الاول لاسم الاب , (سنة النشر) , عنوان الكتاب , مكان النشر , دار النشر , الصفحات .
  - فصل من الكتاب : لقب المؤلف , الحرف الاول للاسم , الحرف الاول لاسم الاب , (سنة النشر) , عنوان الفصل , المؤلفون القائمون بتجميع فصول الكتاب , مكان النشر , دار النشر , الصفحات .

سياسة النشر في المجلة

1. يكون البحث المقدم للنشر ضمن تخصص المجلة وملتزم بمنهجية وأخلاقيات البحث العلمي وخطواته المتعارف عليها عالمياً.
2. ألا يكون البحث قد نشر سابقاً أو قدم للنشر في مجلة أخرى ويقوم المؤلف بتوقيع تعهد خاص بذلك.
3. لا تزيد عدد صفحات البحث المقدم للنشر عن خمسة عشر صفحات.
4. يتحمل المؤلف المسؤولية الكاملة عن محتويات البحث.
5. جميع البحوث المقدمة للنشر تخضع لعملية التقييم العلمي من قبل المختصين.
6. تخضع جميع البحوث المقدمة للنشر الى فحص الإستلال الالكتروني.
7. يُبلغ المؤلف بقرار نشر البحث أو عدم نشره خلال مدة لا تتجاوز 30 يوماً من تاريخ استلام المجلة للبحث.
8. يلتزم المؤلف بإجراء التعديلات اللازمة على بحثه وإعادته الى المجلة خلال فترة 7 أيام من تاريخ استلامه للتعديلات.
9. لاتُعاد البحوث الغير مقبولة للنشر للمؤلفين.
10. يحصل المؤلف الذي قُبل بحثه للنشر على ثلاثة مستلات إضافة الى نسخة من العدد الذي يُنشر فيه البحث، وبإمكان المؤلف شراء مستلات أو نسخ إضافية من المجلة.
11. تنقل حقوق النشر والطبع والتوزيع الورقي والالكتروني للبحوث الى المجلة ووفق صيغة تعهد يقوم المؤلف بتوقيعها.
12. جميع البحوث المنشورة في المجلة تكون مملوكة لها، ولا يحق لأية جهة أخرى إعادة نشر البحث أو ترجمته وإعادة نشره إلا بموافقة خطية من المؤلف ومن رئيس التحرير.
13. المؤلف مُلزم بالإفصاح عن الدعم المالي أو أي من أنواع الدعم الأخرى المقدمة له خلال إجراء البحث.
14. يتوجب على الباحث إبلاغ رئيس التحرير عند اكتشافه لوجود خطأ كبير في البحث أو عدم دقة بالمعلومات وأن يساهم في تصحيح الخطأ.

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