Streaming the Video Presentation Slides based on Frame Distance Technique

Hussein Muzahim Aziz
Department of Accounting and Banking Science, Al-Farabi University College, Baghdad, Iraq.
E-mail: hussein.muzahim@alfarabiuc.edu.iq

Abstract
The lockdown of the society that caused by COVID 19 couldn't affect the education sector as there is an alternative option that the students can take their education in online classes. Online classes start been widely used over the Internet as all the education sectors start using the e-learning system. E-learning system use the online tools to stream the contents of the lecture, such contents will increase the traffic load on the networks. The load of the networks will affect the smoothness of the online classes, as there is a possibility that the video frames could be lost or corrupted.
Frame distance technique is proposed to reduce the traffic on the networks, by dropping the redundancy slides that are related to the same display time segment. Three different frame distance technique are considered in this study (low, medium and high) to show the amount of bandwidth that are required to stream the video to a group of students. From the outcomes it can be found from that, adaption will be necessary to reduce the video traffic load on the networks that will have a positive effect on the online classes.

Keywords: E-learning, Presentation Slide, Display Time, Video Streaming, Frame Distance.

1. Introduction

COVID -19 pandemic, had a massive impact on human's lives that create a health crisis around the world that effects the social activities [**1**]. The governments around the world decided to lockdown all the education institutes to make sure that, the disease is not been spread among lecturers and students, which could affect the whole society. To avoid the collapse of the education sector, the governments administrative decided to shift the education system from traditional classes (Face-to-Face Teaching) to electronic learning (Online Teaching). Electronic learning (e-learning) is become a practical tool to meet the requirements of the educations system by transferring the lecture contents to the students [2]. Lecturers and students considered as direct partners that are interact with each other's in two-way communication with a

The presentation slides represent the lecture information that are combined with pictures, charts, tables etc., is to allow the students to connect through the Internet to view how the lecture are constructed [5,6]. The students will receive the lecturer presentation slides as a sequence of video frames and it will be displayed on the computer screen before the entire video stream has been transmitted [7].
In this situation, the students should attend the online lecture from the beginning until the end without any interruption. Google video streaming and YouTube used MPEG-4 codec, to stream the video application over the Internet [8,9].
Streaming video over the Internet will increase the load as it is counting more than half of the data traffic [10]. To provides a smooth service

to the end-users, an adaptive bit-rate (ABR) technique is used to adapt the video content to be transmitted by adjusting the number of video frames [11]. The adaptation to each video is partitioned into segments, where each segment corresponds to a time that are encoded according to the bitrates [1, 10, 11].

mechanism to handle the network traffic to provide a smooth playback. Rate adaptation mechanism is needed to adjust the transmission rate based on the network congestion level. In [12], they used the adaptation mechanism to the frames that are related to the same scene. The dropping frames will reduce the number of frames in the streaming video. The number of frames that are dropped will be different from one scene to another, as the scene duration are different. The propose idea of this study is to adapt the video frames of the lecture presentation slides that are streamed in real-time before they are encoded by MPEG-4. The frame distance technique is considered to drop the redundancy slides frames that are related to the same display time segments. In this case, the transmission will be based on selective frames that are chosen according to their distance in the frame sequence. At the receiver side, the frames that are received will be duplicated to fit the time segment to be played on the screen. As the presentation slides have dependencies that must satisfy the slides interval time.

2. The Proposed Technique

The time the lecturer start the online class, the connection is established between the lecturer computer and the student's computers to stream the video that contain the presentation slides. The lecturer's computer will broadcast the streaming lecture to all the student's computers. The estimated time for the lecture presentation is much different from one lecture to another and from one topic to another, therefore the display-time for each slide on the screen will be different. Since the slide that are

displayed on the lecture computer screen will have different display time, then the number of redundancies in the video that are transmitted will be also different, as shown in Figures 1 and 2 respectively. As longer the time the slides are displayed on the screen the more redundancy slides will be generated to represent the video frame sequence that are streamed.

Where; S : slide; sr : slide redundancy; t : interval time; T : display time

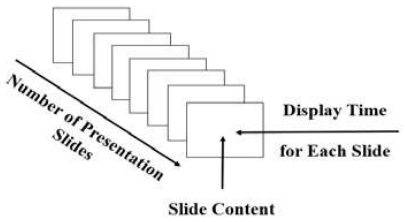


Fig 1. The Sequence of the Presentation

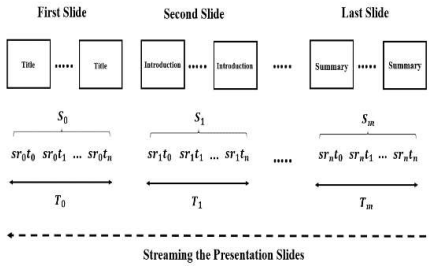


Fig 2. Streaming the Video Presentation Slides According to the Display Time.

The redundance slides that are streamed will depend on the amount of time of the slide that been viewed on the lecturer computer screen. If it is assumed that, the first slide S_0, is displayed on the screen according to the time T_0. It can be seen from that, there is a redundancy ***sr*** to the slides according to the time been displayed ***t***, therefore S_0 displayed at T_0 will be $\{sr_0t_0, sr_0t_1, sr_0t_2, sr_0t_3, \ldots, sr_0t_{n-1}, sr_0t_n\}$, where sr_0 is the first redundancy to the first slide and t_0 is the interval time for the redundancy slide. Since each slide been display have different contents, therefore ***T*** will be different and it will affect the redundancy slides in the video frame

sequence. To reduce the traffic load on the networks and to provide a smooth real-time lecturer to the students; a frame distance technique is proposed, as shown in Figure 3.

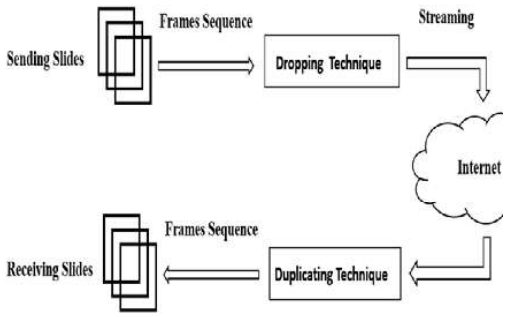


Fig 3. Streaming the Adaptive Video Presentation Slides over the Network.

The proposed technique is applied on the lecturer computer side, while the duplicate technique is applied on the student's computers side. From the lecturer computer side, the frame distance technique is applied before encoding the video presentation slides, the distance frame is selective frames that will be transmitted over the networks. The selective frames are fixed frames that are selected according to the distance that belong to the same displayed time segment, while the frames between the distance frames will be dropped. As an example if the frame distance is 2, and the first slides is S_0 and the display time on the screen is T_0 then the frame that are selected to represent the video sequence will be $\{sr_0t_0, sr_0t_2, sr_0t_4, \ldots, sr_0t_n\}$, while the frames that are dropped from the video sequence will be $\{sr_0t_1, sr_0t_3, sr_0t_5, \ldots, sr_0t_{n-1}\}$, as all of them are redundancy slides belong to the same slide segment that are displayed on the lecture screen.

Streaming the presentation slides have dependencies that must be meet according to the interval-time. The time the lecturer switched to the next slide, the same mechanism will be applied. In this situation, the number of frames that are streamed is going to be less than the actual frames.

The time the student's computer starts receiving the video stream that represent the lecturer slide, each frame will be checked, to identify weather the distance frames been received or not. The received distance frame will be duplicated to replace the drop ones from the sender side and it will be hold in the buffer. holding the frames in the buffer is to make sure that the slides will be available according to the playout time.

3. Results and Discussion

The number of presentation slides and the slides time duration will be different from one subject to another, as the presentation time it is depend on the contains of each slide. During the interactive mode the student's computers request to connect to the lecturer computer to accept the connection and to start stream the video that contains the presentation slides. One of the issues that are related to real time video streaming is the networks bandwidth variation. Networks condition could affect the follow of the frames with a possibility that the frames could be lost or delayed and can't meet their deadline. Therefore, adapting the video based on frame distance technique to transmit selective slides and drop the redundancy slides from the frame sequence. As the selective slides will be streamed while the lecture is displaying that particular slide. The selective slides that are streamed will be depended on the time that the slide is on online view.

The slide distance technique is based on transmitting selective slides based on a distance k, while the neighboring redundancy slides between the selective slides will be dropped. Three different frame distance (k) are considered in this study, where $k = 2$, for light dropping, $k = 3$, for medium dropping and $k =$

5 for high dropping. It is very hard to estimate the duration time for each slide as each slide will depend on the contents that have different time to be displayed or viewed on the lecturer ‘s computer screen.

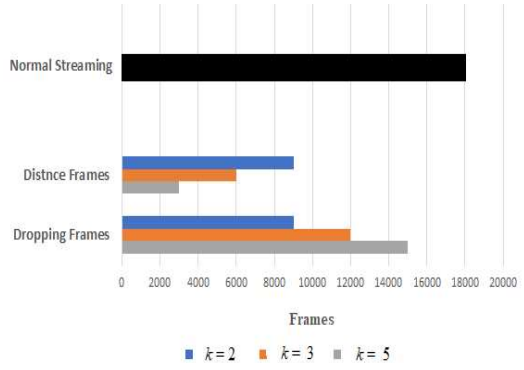
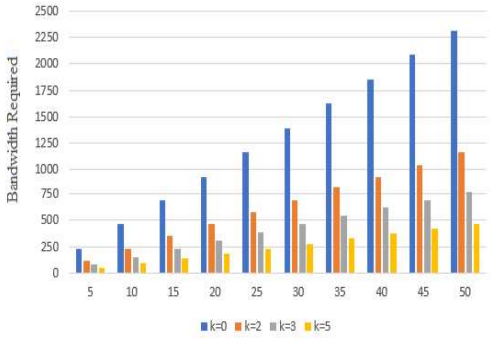


Fig4. The Effect of the Frame Distance on the Stream Length.

The presentation time will be considered in this study is fixed to 10 minutes and the resolution is 720p while the bandwidth required = video bandwidth * the number of users + 20% overhead. After analyzing the output of adapting the frame sequence according to the three different frame distance technique. It can be seen from that, the proposed adaption technique will reduce the streaming length of the video presentation slide, as shown in Figure 4. As the higher of frame distance (***k***), the shorter of the streamed length, while the dropping frames will be higher. The number of students that received the broadcast stream is set differently to check the required bandwidth for them, while the bitrate will set constant with a frame rate 30 fps, as shown in Figure 5.



Note: k=0; normal streaming

Fig 5. The Bandwidth Required for the Viewers.

It is been observed from that, as the number of students in the online class are increased the higher the bandwidth is required. While for the proposed technique, it shows less bandwidth are required than the actual streaming. The load on the networks will increase as the number of users are increased. Since the lecturer computer will broadcast the video contents in real time to all the student’s computers.

4. Conclusion

The pandemic caused by COVID-19 disease effect the global societies structure and especially the education sector. It is very hard to create a social distance to avoid the spreading of the disease among students and lecturers. The universities/colleges management decided to move from traditional learning system to online learning (e-learning) system. The e-learning system can be applicable since the Internet and computers devices are mostly available to everyone. The online classes are based on streaming the lecture presentation slides over the Internet through the web-based learning system. Streaming the video slides will generate a high-volume of data that will raise the networks traffic.

To reduce the networks traffic and to avoid the interruption to the online classes, an adapting technique is considered in this study, by adjusting the video frames. The proposed of frame distance technique, is to drop the redundancy slides from the video frames that are segment according to the time been displayed on the lecturer's computer screen.
The frame distance technique is based on selective frames (slides) in the frame sequence that are streamed, while the redundancy frames (slides) between them will be dropped. Streaming the selective frames based on their

The frame distance technique is based on selective frames (slides) in the frame sequence that are streamed, while the redundancy frames (slides) between them will be dropped. Streaming the selective frames based on their distance, is to make sure that, at least one of these frames that are related to the same segment will be received by the student's devices. The received slides will be duplicated according to the time-interval is to make sure that the quality of the video contents is played smoothly. Frame distance technique could be a promising technique to reduce the networks traffic, to provide a smooth real-time presentation that will improve the students perceived video quality that can cope with bandwidths changes over the peak-hour.

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