Adapting Video Transmission over the Internet for Distance Learning

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1. Introduction

With the recent rapid technological advances and development of the Internet, effective distance learning has become an increasingly plausible alternative to more traditional methods of study. Visual information (like video or slides) is proven to be the best way to transmit knowledge. Unfortunately, transmitting video over the Internet is still facing many difficulties, which make visual information transmission inefficient for practical applications. For distance learning it is even more important to always provide the learner with the requested information under all conditions. The main goal of this research is to optimize the transmission of visual information by implementing a new protocol that will consider the current status of the network and dynamically provide the requested information.

It is important for the users to have access to information when they are ready for it or when they need it regardless of whether the communication between user and server is good or bad. One of the most important aims of this research is to provide communciation with the end users. This needs to be achieved regardless of the levels of congestion experienced on the Internet which has adverse effects on the ability to transmit video. Therefore the challenge is to present not only visual information but visible information at any time.

The Internet is a network that works only base on “best effort”. It does not offer any guarantees for the arrival of the packets that are sent from host computer to end-user. This makes it difficult when sending multimedia data because during the transmission of video we cannot afford to lose too many packets, or the result will be transmission failure.

For learning purposes the most important point is to keep the learner provident with the information requested. This can be achieved by sacrificing the quality of the video. Only providing a high quality video when the network condition is very good. For this reason instead of focusing on how to improve the quality of video, the focus of this research will be on the importance of communicating information that will be relevant in the search

for knowledge. For example, when the connection between host and end-user has optimum speed the user will receive and optimum video quality. But, if the network is congested then the user will receive a video with a lower quality. And finally if the conditions on the network are to congested at any particular moment then the user will receive at minimum a document describing the information requested.

The difference this research and previous works is that in this research the protocol to be implemented focuses on the need to always provide the user with information even if we have to sacrifice the quality of the video, which is acceptable in applications like distance learning.

2. Video Transmission over the Internet

The transmission of video on the Internet can be accomplished in different ways. One is, to transmit the whole file to users. The problem comes or starts in this way; since video files are usually very big. The second way, instead of transmitting the whole file, streaming it. Streaming allows digital video and audio to be sent to a user's computer so that the user gets an uninterrupted flow of data. Video streaming involves the short-term storage of media files on the user's machine as compared to the downloading of large multimedia files. Streaming media is not a quality problem. The pictures may be fuzzy and the sound occasionally garbled. But the end user does not have to wait to download a whole file to start watching its contents. We will stream the videos to the end-users instead of sending them the whole file of a presentation. Thus the end-users do not have to wait a long period of time to start watching the requested and they will save space in their hard discs. And if the condition of the network is too bad at a particular moment instead of sending any video a written presentation of the material is send.

3. Adaptive Transmission of Video Image

The focus of this research will be on the importance of communicating information that will be relevant for distance learning. For example, when the connection between host and end-user has optimum speed the user will receive an optimum video quality. But, if the network is congested then the user will receive a video with a lower quality. And finally if the conditions on the network are too congested at any particular moment then the user will receive at least a document describing the information requested.
To realize the above strategy, the video transmitting protocol changes the quality of the video image according to the condition of the network. Instead of ensuring reliable transmission of video packets and improving the quality of the video using different mechanisms (e.g. forward error correction), the focus will be on the end to end adaptation to network congestion, which then can be used to complement error recovery methods.

4. The new protocol

To explain how the proposed protocol works it is necessary to describe Figure 1 below:
First a packet is sent from server to end-user and back, to determine how good or bad the communication between the two of them is. Then depending on the connection at that particular moment the appropriate video or information will be sent. This decision is made taking into consideration the amount of "*packet loss*" and the "*response time*" that it takes for the packet that is send from the end-user. Once the protocol has decided which

is the condition of the connection at that moment it will send a good quality video, or a medium quality video or a written presentation.

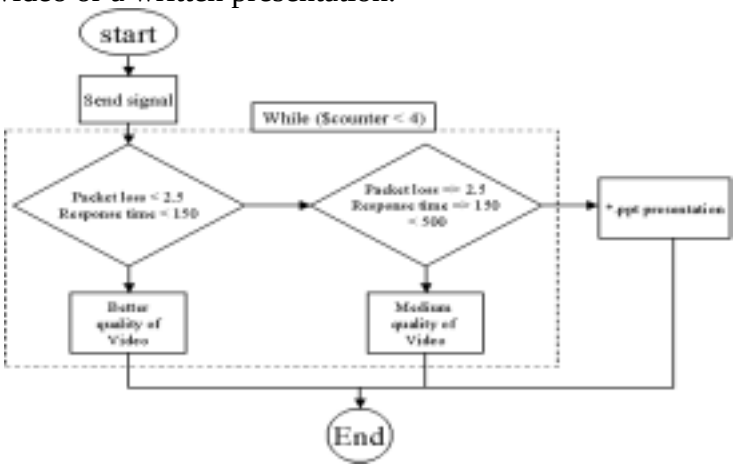

Figure 1: Flowchart of the proposed protocol

5. Experimental results

We design a prototype system of the proposed protocol and evaluated the transmitting time. Figure 2 shows one of the experiments made, that measures the time of buffering the first video image according to different bandwidth.

At smaller bandwidth it takes longer for the larger video (better resolution) to be uploaded. Thus, the smaller video (lower resolution) will be sent in that case. But at 151 bandwidth it takes the same time to upload the first image of each video. Therefore, the video with better quality and resolution can be sent.

These results support the decision of the protocol to send different videos with different resolutions depending on the bandwidth of the end-user at the time requested.

At a bandwidth of 8 Kbps there is a difference of about 10 seconds between the time taken to buffer each of the 2 videos. But at a bandwidth of 151 Kbps there is no difference in the time taken.

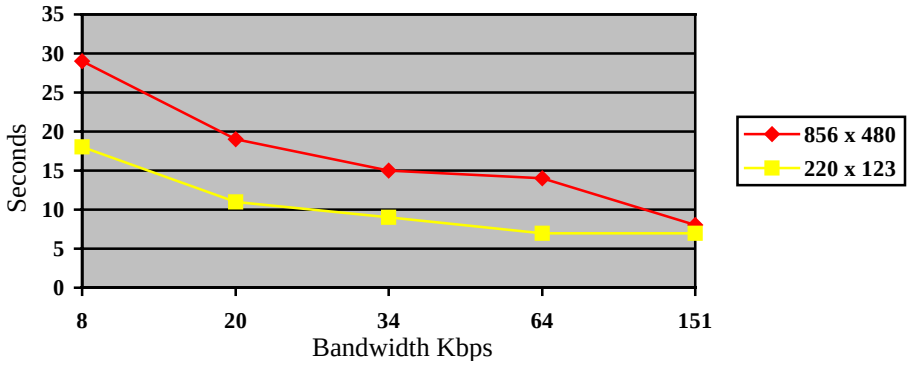

Figure 2: Initial time to buffer video depending on the quality of the video image

6. Conclusion

The proposed adapting transmission mechanism is able to ensure delivery of the requested information to the end-user under any network conditions. It will also keep the user constantly provided with information from the learning center. Consequently, the distance learning will become increasingly applicable and efficient.