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A Real Time Video Streaming in Wireless Network using key frame extraction and Forward Error Correction Coding

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Abstract
Today video data is accessed using various wireless networks like Wi-Fi, cellular data, etc. Wireless networks are more error prone and bandwidth sensitive. The video consists of large number of frames, each consecutive frame having redundant data. So it is not feasible to send all frames having similar data. To challenge the issue of data redundancy and frame extraction time this paper proposes a key frame extraction in video transmission. Second this paper proposes a hamming coding for video encoding to recover lost bits in block of frame. The forward error correction using hamming codes provides high video quality and minimum bandwidth consumption. Using hamming codes for video streaming reduces the cost of computations that undergoes processing of video in wireless networks.

Keywords
Block Correlation, Hamming Codes, Key Frame Extraction, Video Decoding, Wireless Networks

I. Introduction

Today video streaming is massively used by everyone using mobile phone, i-pad, laptop, etc. Video streaming require more bandwidth to meet quality and reduce delay. The applications like hot star, YouTube are become very popular. Near about 70% of mobile data usage is due to video streaming.

For accessing video there are protocols like multipath tcp and sc-tcp. These protocols provide bandwidth aggregation such that we can use multiple wireless networks together[2]. These protocols provide bandwidth aggregation using transport layer, network layer topologies. While using multiple wireless networks there is problem of changing the network. There is always end to end connection between every wireless network. There are two approaches of using bandwidth aggregation adaptive and non adaptive. In adaptive bandwidth aggregation the link is select using parameters like link capacity, link quality, round trip time, end to end delay between every packet send. In adaptive network there is challenge to choose the network because every network has end to end connection with mobile device.

In real time video streaming video is encoded into number of decodable formats. The contents of video send, received in the form of streams so called video streaming[8][9]. The video quality depends on the bandwidth available for accessing the video. In past five years wireless video streaming is improved so much because wireless video streaming is much cheaper than wired. The new technologies for wireless networks became mature now such as 4g networks for mobile, wi-fi access is available widely. If video is accessed under 300 meter radio range then 802.11 radios are most preferable.

The fec coding used for recognized error without retransmission of packet. In fec coding send message in redundant way such that number of redundancy symbols should meet the path quality and bit code rate according to bandwidth available for video transmission. In fec coding there is encoding and decoding of video. The video is transmitted in the form of encoded symbols and receiver will decode it. The encoding is depending upon the bit rate. There are number of ways to detect an error in the fec coding by using hamming code, parity checker, etc. In fec coding for bit code rate there are different algorithms[7]. These algorithms manage traffic of packets according to the noise in the channel. The numbers of redundant symbols depend on the capacity of link[6].

II. Literature Survey

In motion videos, oftentimes the background is kept fixed only the moving object data is need to be changed. This is achieved by dividing frames into three types: intra frames (I-frames), predictive frames (P-frames), and bidirectional frames (B-frames). An I-frame contains all the data mandatory to display the frame, while P and B-frames both depend on previous data to display the frame[1][2]. P-frames hold the changes between a ancestor frame and the frame to be displayed, so less amount of data need to be transmitted. B-frames are extended from I/P-frames in that they hold changes from previous and future frames, which result in even less data being sent. Because of the dependencies from the different types of frame, frames must be encoded with I-frames first, followed by the P-frames that are required by B-frames.

Jiyan Wu proposes a priority aware fec coding in which frame level distortion is calculated based on bandwidth and delay constraints [1]. The frame scheduling is based on video traffic and frame priority. In fec coding the redundancy symbol size and packet size depend on control parameters. The packet loss rate, round trip time and network status is send to the sender by network status monitor. The distortion is calculated by using packet loss during transmission in network and packet loss in reconstructing the frame. The end to end delay is estimated using path propagation delay and path transmission delay [9].

Jiyan Wu, Chau Yuen and Ming Wang proposes concurrent multipath transfer using SCTP in content agnostic fashion. The data is distributed in wireless networks depend on total distortion. The author proposes a concurrent multipath transfer with markov decision process (MDP) and distortion analytical model. This paper investigates the challenging problem of content agnostic scheduling and frame level distortion.

Thomas Stockhammer proposes a bit rate allocation for video streaming in wireless network. Author presents analytical model which specify minimum initial delay and minimum buffer required for video streaming. In this paper author distribute bit rate according to the behavior of channel in addition to that encoding buffer size is depends on decoding buffer[2][10]. The content aware services such as resources are wired or wireless. In wireless content packet losses are due to link layer. The author proposes a mathematical treatment which gives deterministic curves for initial playout delay decoding buffer size for successful play out.

Jiyan Wu proposes priority aware forward error correction coding in wireless network video streaming. The author proposes priority aware TCP-oriented coding scheme (PATON) to challenge the issue of TCP throughput fluctuations and deadline violations. The author proposes frame level distortion model and dynamic fec coding based on sub group of group of pictures. The frame selection is based on priority due to bandwidth limitation. The high priority frames are selected and low weight video frames are dropped to improve overall streaming quality [3].

In this paper author presents data centric public layer approach for data distribution which address the issues like time varying bandwidth and fluctuating packet loss rate [4]. Frame must be delivered within packet decoding time [7]. In real time video streaming with wireless network traffic congestion is not same. The video traffic is unexpected in wireless networks and bandwidth is time varying. The video frame is decoded within the decoding time. In wireless networks different networks have different behavior such as delay and jitter is different, time varying bandwidth. The author presents Data Centric Publish Layer (DCPL) which delivers proper information of heterogeneous network towards packet delivery in video streaming. RTP-based video streaming wasn't able to protect packets of the lower enhancement layers from burst packet loss when the number of receivers and subscribers increased. On the other hand scalable RTPS-based video streaming approach was able to keep up a continuous but with a low quality video flow by intentionally dropping some enhancement packets to protect the lower and base temporal layer.

III. Architecture of the System

In the architecture diagram there are two main components sender and receiver. The sender sends video frame by frame. The sender encode video to detect and correct error caused by wireless networks. The receiver streamed video by using index frame number.

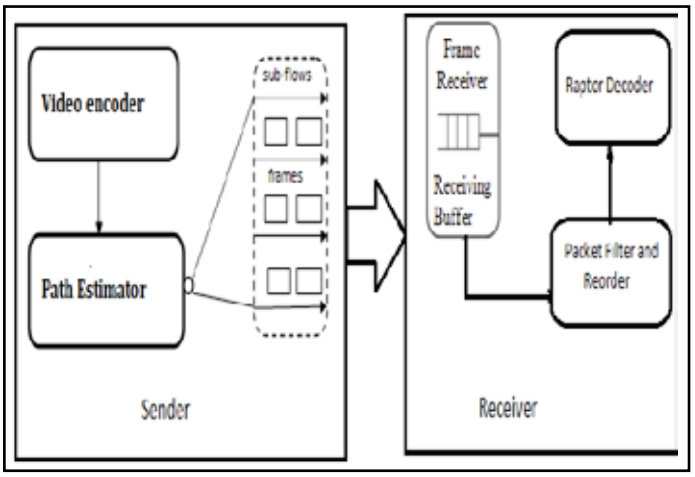

Fig 1. : Architecture diagram of the system

Fig. 1 presents the architecture diagram of the system. Sender encodes the video using hamming code. Hamming codes are used to detect and correct the single bit error. In wireless network communication there is high packet loss rate, the retransmission of packet take more time so it may increase delay in streaming the video. The hamming codes are used to correct those error bits without retransmission. At the receiver side there is packet filter and reorder which is used check the deadline of packet and packet reorder is done using the sequence number.

A. Sender

1) Frame Extraction: A whole video consists of sequence of images that is frames. Each frame consists of pixels. Every frame had redundant data. The key frame is used to reduce redundancy and represent whole video. The video is segmented into scenes, shots and frames. The key frame represents similar contents in the shot. The key frame is extracted using the parameters like colors, edges, optimal flow and motion descriptors. In this technique the difference between two frames is encoded. The main goal is to find beginning and end of each shot. In pixel wise comparison the pixel change in each frame is calculated.

The key frame is calculated using features like color histogram, edge detection and block correlation.

1. Color histogram: The frame is represented using color distribution. Color is important feature in frame extraction. The frame difference is calculated using color histogram. Color histogram of frame gives pixelwise color representation in frame. Every frame in the video have some similar content that may be object or background. The frame comparison calculate the frame difference as follows:
2. Edge detection: The edge detection is used make difference in frame from changing and unchanging object. In video there are 20 to 30 frames per second so there is huge redundant data in every frame. To define unchanging object in successive frame, the edges are calculated with respect to boundaries in the regions of image. The object having same gray scale value have no change in corresponding image. The edges compare with adjacent frame to eliminate redundancy.
3. Block correlation: Each frame is compare with reference frame with fixed block size of 16*16 pixels. The block correlation is used to detect moving objects in the consecutive frame. The car is moving in the race the block correlation is used to encode that object.

B. Receiver

1) Video Encoder and Decoder: In real time video streaming the quality of video is depend on distortion in frame. The video consist of Group of Pictures (GoP) having M frames showed by index m. Total number of frames given by : m (1<=m<=M). We consider only I- frame (Intra-coded-picture) and P (Predicted) frames. B- frame(Bidirectional) require prediction of many subsequent frames. This may not so efficient because delay increases.

IV. Conclusion

The frames are extracted using key frame extraction provides high efficiency, low processing time and minimum bandwidth consumption. Using key frame extraction the video is summarized satisfactorily. The video encoding and decoding using hamming codes reduces the error rate. In wireless networks while accessing video packet loss rate is reduces using hamming coding. The minimum bandwidth consumption is achieved using video encoding. The delay is reduces which is required for quality video streaming.

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