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Identification and Analysis of the Quality of Transmitted Video

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***Abstract*— Wireless sensor network is widely emerging technology from past recent years. It has gained lots of attention in recent years because of reduction in the complex wire infrastructure. Video streaming in wireless networks is a promising but difficult application. It is very difficult to enable continuous real time video streaming wirelessly due to various challenges in wireless networks. The main challenge is that the quality of wireless link fluctuates significantly because of the various interferences. In such a situation the number of information contained in each video frame must be preserved as much as possible and should be received at the other end that is at the user end. In the proposed system video is obtained from the camera then through the use of proper wireless protocol video will be sent wirelessly to the receiver .At the receiver, the video will be displayed and various parameters of video will be read like peak signal to noise ratio(PSNR),mean squared error(MSE), packet jitter and packet loss to identify the quality of video .**

Keywords*— Peak peak signal to noise ratio(PSNR),mean squared error(MSE), packet jitter and packet loss.

I. INTRODUCTION

Wireless sensor network is widely emerging technology from past recent years. It has gained lots of attention in recent years because of reduction in the complex wire infrastructure. WSN have been applied to variety of fields like industrial monitoring, health care monitoring, home automation, video surveillance. Video streaming in wireless networks is a promising and difficult application. Now days the use of video communication is becoming very popular among variety of fields like social and industrial. With rapid growth of this wireless technology and great success of internet videos, the wireless video streaming are expected to be widely deployed in the near future.

In many areas like monitoring, health care monitoring, home automation continuous monitoring is required. That is, in these areas continuous real time video streaming over wireless link is required.

But it is very difficult to enable continuous real time video streaming wirelessly due to various challenges in wireless networks. The main challenge is that the quality of wireless link fluctuates significantly because of the various interferences. Various other problems in wireless video streaming are radio interference, packet collisions, low transmission data rates, packet jitter, unknown and varying bandwidths, packet losses due to corruption in packets, much longer packet delivery time. In such a situation the number of information contained in each video frame must be preserved as much as possible and should be received at the other end that is at the user end.

II. LITERATURE ON RELATED WORKS

There are many methods for analysis and identification of wirelessly transmitted video. In [1] a cross layered optimized system for improving the user perceived video quality of real time video transmission at the receiver end under the constraint of packet delay have proposed. For this network functions such as encoder behavior, cognitive MAC scheduling, transmission, modulation and coding into a distortion delay optimization network have formulated. Then important system parameters of different network layers are jointly optimized to achieve best user perceived video quality. Further, the proposed problem has formulated in MIN-MAX problem and then this problem is solved by using dynamic programming. Fully integrated multi layer architecture of wireless network [2] is designed for digital video transmission in which developments are done in the Application layer, MAC layer and Physical layer. All these joint considerations of APP-MAC-PHY multi layered architecture are used to improve end to end performance of wireless network design for live video transmission. An innovative multi layer design of wireless system has developed where information among layers is exchanged and parameters are jointly optimized for richer interfaces among the layers of protocol stack. The optimal video streaming process over multiple links has designed which is formulated as Markov Decision Process (MDP) [3] for each streaming step. Then to achieve high quality video streaming, reward functions such as interruption rate, average playback quality, playback smoothness and service costs have carefully designed. Then to obtain sub optimal solution of MDP in real time, an adaptive best action search algorithm has proposed. The prototype design and analysis for wireless video streaming in ISM band makes the system very low power and of much lower cost for perimeter control. The proposed system captures pictures through vision sensor. Controller receives image information from this vision sensor. This information is transmitted through zigbee, 2.4 GHz (ISM) to transceiver and deployed in any highly sensitive defense area for perimeter control. Conventional bandwidth problem is removed by this system. But system has only used low quality images [4].Adaptive forward error control (AFEC) technique [5] used to provide intermediate solution for more reliability in transmission. In this mechanism, an adaptive

amount of redundant packets are injected in every sent block to achieve a desired recovery rate at receiver. Network simulator NS-2 is to evaluate AFEC. A compressed sensing based video encoder [6] is designed to encode and transmit video in wireless multimedia sensor networks. A novel energy distortion analysis is used to compare the video transmission over wireless links with a limited energy budget for low complexity sensing devices. Compressive video sensing (CVS) encoder is compared with two common video encoders. CVS performs well than these encoders when the encoding energy is high compared to the video transmission energy. In [7] the modeling, simulation and analysis of errors inherent in video streams over wireless broadband access networks have presented by presenting results of investigation of the effect of single bit error and bit packets error on the quality of H.264/AVC standard bursty video streams. A software hardware composite system that is developed [8] specifically for this purpose is employed in the investigation. Forward error correction (FEC) is used to achieve reliable video multicast over Wi-Fi networks with co-ordinated multiple access points (APs) to enhance video quality. This proposed scheme can increase the video multicast region by exploiting the AP diversity, thus it can serve more multicast end receivers with satisfactory video quality. A resource allocation algorithm for FEC code rate adaptation has also proposed which utilizes limited wireless resources more efficiently while enhancing video quality. A method for estimating the video packet delivery ratio after FEC decoding is also introduced. A context aware mechanism has presented in [9], over wireless networks. They have proposed resolution scaled Quality adaption architecture which is low complex, appropriate for real time systems and cost effective. It ensures video availability even when the bandwidth is low. This RSQA system can be used in heterogeneous environment because it is independent of wireless technology. In this system whenever a user experiences a packet loss or a delay in receiving video, the server will be notified about the congestion and decreases the video quality to make the video available at low bandwidth. The results of recent large scale subjective study of video quality on a collection of videos distorted by application relevant processes have presented in [10]. This study included 150 videos derived from 10 reference videos using four distortion types and evaluated by 38 subjects. They have presented an evaluation of performance of several publicly available objective video quality assessment models.

To summarize, this paper presents quality identification and analysis of wirelessly transmitted video. For this four parameters of video are considered which are mean squared error, peak signal to noise ratio, packet jitter and packet loss. These four parameters will be read at the receiver side for the identification and analysis of the quality of video.

III. PROPOSED SYSTEM ARCHITECTURE

In this proposed system quality of wirelessly transmitted video is identified by checking four parameters peak signal to noise ratio (PSNR), mean squared error (MSE), packet jitter, and packet loss with the help of MATLAB.

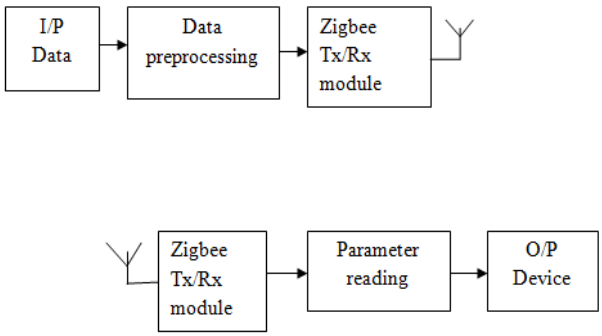


Fig. 1 Proposed system

Video will be aquired with the help of camera.The video will be stored and then used as a database for further processing. Next step is preprocessing of video that is video will be compressed for wireless transmission. Then proper wireless protocol will be developed at Zigbee module for fast transmission and reception of data.

At the receiver side, video will be displayed and various parameters of video will be read for checking the quality of video. The traditional quality metrics for identifying the quality of video are mean squared error (MSE) and peak signal to noise ratio. Other two parameters packet jitter and packet loss are also considered here for identifying the quality of video.

A. Mean Squared Error-

- The MSE is cumulative squared error between the compressed and the original image.
- If x_i and y_i are the i-th pixels in the original and distorted video signals respectively and N is the number of pixels in the video signal, MSE is defined as:

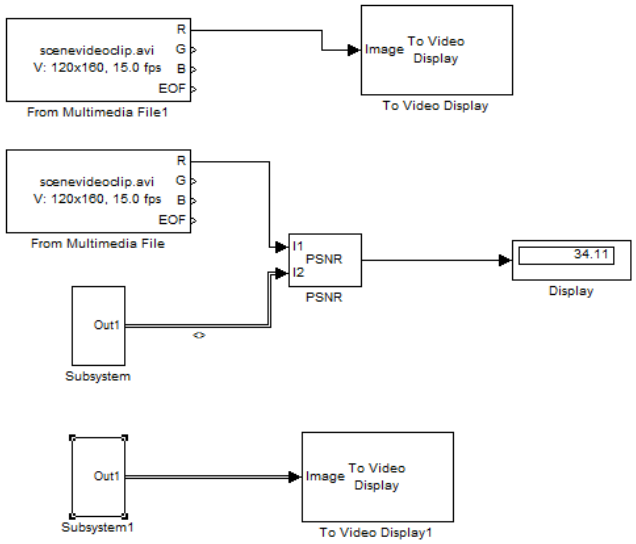
$$MSE = \frac{1}{N}\sum_{i=1}^{N}(x_i - y_i)^2$$

B. peak signal to noise ratio-

- The PSNR is most commonly used and traditional objective quality metric to measure of the quality of video. A higher PSNR would normally indicate higher quality.
- There are three methods for calculating the PSNR-full reference method (FR), reduced reference method(RR) and No reference method(NR).
- Here we use full reference method for calculating PSNR. In this method quality difference is measured by comparing each pixel of the distorted video to its corresponding pixel in the original video.
- The Peak Signal-to-Noise Ratio (PSNR) is defined as:

$$PSNR = 10\log_{10}\frac{L^2}{MSE}$$

  - Where L is the dynamic range of the pixel values or the maximum possible reference intensity value.

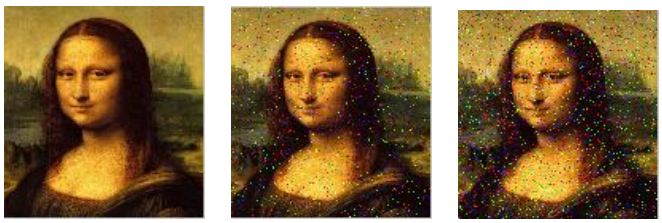


Transmitted video Received video

Fig. 2 MATLAB simulation for PSNR calculation of video

- If the value of PSNR is higher then it indicates higher quality of video. For low quality video value of PSNR is small.

Original Data | Less Distorted PSNR=25.86 dB MSE=168.45 | More Distorted PSNR=21.64 dB MSE=445.11



Original Data | Less Distorted PSNR=19.66 dB MSE=702.39 | More Distorted PSNR=16.64 dB MSE=1.408e+03

Original Data | Less Distorted PSNR=20.83 dB MSE=536.42 | More Distorted PSNR=18.05 dB MSE=1.0171e+03

Fig. 3 PSNR calculation of various images

C. Packet jitter-

- Packet Jitter is the variation in the delay of received packets. At the sender they are sent evenly spaced intervals, but due to traffic congestion, improper queuing or configuration errors they come at unequal intervals.

D. Packet losses-

- Packet loss occurs when one or more packets of data travelling across a network fail to reach their destination.

IV. RESULTS & OBSERVATIONS

With this system the quality of video will be identified with the help of four parameters. Most important parameter for quality identification of video is peak signal to noise ratio. Here we calculate PSNR in dB. Higher value of PSNR indicates higher quality video and less value of PSNR indicates poor quality video. PSNR is most commonly defined by mean squared error. The MSE is cumulative squared error between the compressed and the original image. In the absence of noise since two videos are identical MSE is zero and PSNR is infinite.

Packet jitter and packet losses are also considered for identifying the quality of video. When these two are absent or very small the quality of video is high.

IV.CONCLUSION AND FUTURE IMPROVEMENT

The proposed system is for identifying the quality of wirelessly transmitted video. Video is transmitted wirelessly through Zigbee module. Quality of video is measured by considering four parameters which are peak signal to noise ratio, mean squared error, packet loss and packet jitter. This system uses wireless protocol at Zigbee module for fast wireless transmission and reception of video. Peak signal to noise ratio is most important metric for identifying the quality of video. Higher value of PSNR indicates higher quality of video. This system identifies the quality of video as well as improves the video quality.

Currently we are working with small duration videos, in future we will try to analyze and indentify the quality of long duration videos.

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