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Address: -North Asian International Research Journal Consortium (NAIRJC) 221 Gangoo, Pulwama, Jammu and Kashmir, India - 192301, Cell: 09086405302, 09906662570, Ph. No: 01933-212815, Email: nairjc5@gmail.com, nairjc@nairjc.com, info@nairjc.com Website: www.nairjc.com

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SUB STREAM SELECTION OF SCALABLE VIDEO STREAMS USING HILL CLIMBING ALGORITHM

DR. P.S.MUNDRA [1] & ER. SHELLY KALRA [2]

[1] Ph.D, Professor of Electronics and Communication Department at Chandigarh Engineering College, Landran, Mohali, Punjab

[2] Pursuing M.tech in Electronics and Communication, Chandigarh Engineering College, Landran, Mohali, Punjab

ABSTRACT:

Video services are foreseen as a noteworthy revenue generator for next-generation wireless systems. The major issue is to find the most effective method to proficiently bolster video streaming over wireless systems. Recently, Worldwide Interoperability for Microwave Access (WiMAX) likewise called as IEEE 802.16 has been considered for assisting broadband wireless access over large separation along with great Quality-of-Service (QoS). WiMAX helps in developing last-mile innovation for giving ensured data transfer capacity as well as good scope for the remote locations. In this research, work has been done on scalable video transmission. The scalable video coding is an augmentation of H.264 (MPEG- 4, AVC) encoding. A framework has been developed, in which three factors analysis has been done to build a new qualifying quality metric. The quality parameter is function of both PSNR and SSIM. Hill climbing algorithm has been applied which is a better performer in terms of finding optimal solution. This helps in assigning the frame to proper sub-stream selection process. The results show better savings metric in terms of energy

Keywords: ***WiMAX, Multicast, QoS, PSNR, SSIM, MSE.***

1. INTRODUCTION

There is an increasing demand of high-speed data rate, quality of service with mobility in the world of technology. Using wire medium like DSL (Digital Subscriber Line), fibre optic and cable networks, although providing high-speed data rate and good quality of service but fails to provide mobility [1]. Also wire medium adds an extra burden of managing the cable architecture thus increasing the cost. The solution for the problem is to use wireless as a medium to provide the broadband services to users. However, wireless medium is always vulnerable to errors and security threats. With advancement of technology, researchers are able to discover techniques in order to utilize wireless in the best possible manner.

Multimedia communications, audio and video, are highly bandwidth demanding and error sensitive applications. Providing multimedia communication on broadband wireless technology like WiMAX (Worldwide Interoperability for Microwave Access) is a big challenge, due to time sensitivity issues [2, 3]. Additional security features increase packet size, and as a result delay increases and throughput decreases. A standout amongst the most prevalent of these services is video streaming, in which one can begin playing (i.e., watching) the video without downloading the whole content. WiMAX is a wireless digital communication framework based on the IEEE 802.16 standard which gives broadband wireless Internet access at very high rates [4]. WiMAX guarantees as to be one of the wireless access advancements equipped for assisting real time accomplishments such as video and voice process in a low price. The transmission range permits utilizing a base station to fulfil large separations [4]. WiMAX works in indoor as well as outdoor environments and assists data, voice, and video services [10, 11].

2. QUALITY OF VIDEOS

Videos are sequences of images displayed at a constant rate. The moving picture in all its fields whether it is cinema, television and video is a standout amongst the best creation of twentieth century [5]. In the late years, the improvement of compression algorithms and video processing apparatus has encouraged the move from analog to digital domain. Thus reducing the bandwidth and storage requirement and providing better video quality has become a priority for all content providers [6]. Video characteristic is a feature of video send via video handling framework, a regular or irregular means of acquainted video debasement (regularly contrasted with original video). Video handling framework might present some measure of distortion in the video information [9].

- **Video Quality Measurement:** Video quality assessment is accomplished to portray the characteristics of video successions. Video characteristics can be assessed objectively i.e. by computerized algorithms and subjectively i.e. by approaching users for their rating.

- **Objective Video Quality**: Objective video quality plans are mathematical frameworks. They depend on the standards which can be assessed objectively, i.e. free for human translation and it can be calculated spontaneously by computer program.

3. CLASSIFICATION OF OBJECTIVE VIDEO QUALITY METRICS

Objective strategy thus characterized from the measure of data accessible from the original signal, received signal or whether there is a signal exist by any means [7, 8].

- **Full Reference Methods (FR):** In this metric quality difference is computed by equating both the original video and received video signal. Normally, each pixel from the sender is equated upon relating pixel at the received video, with no learning in the middle of encoding or transmission procedure. FR measurements are typically the most exact to the detriment of higher computational exertion.
- **Reduced Reference Methods (RR):** This measurement extricates few components and contrasts those with given characteristic value by calculating the level of distortion that has occurred. This method do this by comparing only certain parameters from "before" and "after" streams, which helps to minimize the difficulty of the calculations and the time/processing power, required to obtain results.
- **No-Reference Methods (NR):** This measurements attempt to examine the characteristics of a distorted video with no reference to the original signal because of nonappearance of an original signal, this might be little precise than FR or RR methods, yet are high proficient to calculate.
- **Subjective Video Quality**: It is traditional, well proven method of measuring video quality that provides good results. In this strategy the fundamental thought is like in Mean Opinion Score for audio: video successions are appeared to a batch of observers and afterward this assessment is reported and modested to assess characteristic for every video succession. Thus, this testing technique might shift contingent upon which sort of framework being tested.

4. PROBLEM FORMULATION

For real success of multimedia services to be streamed and to be based on the advantages of scalable video encoding standards like (H.264 SVC), there is need for focusing on quality structure/ content of video frames when transmitted. Hence, qualities in terms of like PSNR, SNR, MSE and structural SSIM similarity measures. The methodology implemented intends to evaluate the scalable video delivery in scenarios where assignment of frames is done by Knapsack Algorithm and Hill Climbing Algorithm. The methodology explains below how different layers of quality (in terms of spatial, temporal and picture similarity to master copy of video frame) affect the overall transmission process in terms of energy.

5. PROPOSED WORK

As video streaming is an essential part of today's technology used in broadcasting of different services. For this trace based video repository from Arizona State University has been used. The java application reads these video traces and videos for transmission and then break the videos into frames so that gain level selection of the frames can be done and each frame is assigned a quality metric values based on Quality parameters mentioned in block diagram as the transmission occurs over WiMAX and energy consumption is consumed and monitored over a period of time.

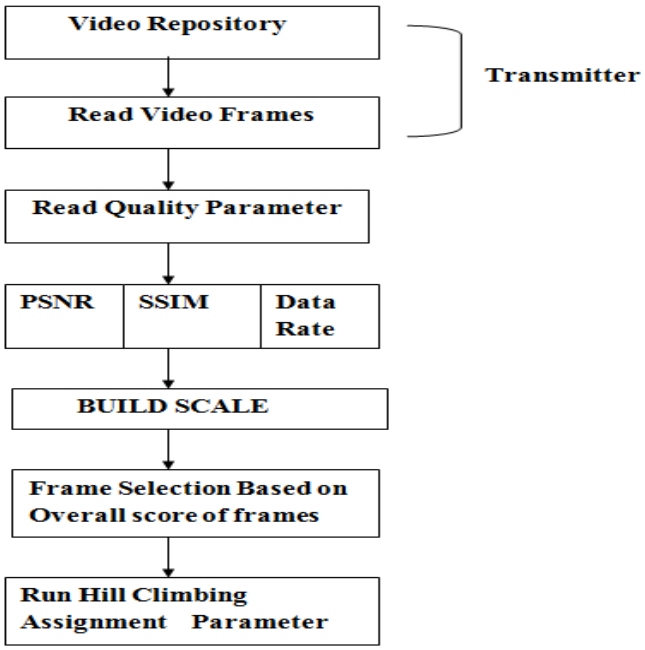


Figure 1.1: Block Diagram of Proposed Work

The implementation steps discuss that the transmission of video stream across the WiMAX is an assignment problem where large number of frames are to be aggregated for building streams into sub-streams. This can be easily understood by figure 1.1 as shown above. The way these streams are transmitted over WiMAX is really point of interest for this research work. Here, the quality of signal is in reference to the streamed frames of videos, which must have higher preposition of signal to noise and lowest possible MSE, in fact ideally, lowest possible cyclic prefix, BER and dispersion errors.

6. ALGORITHMS USED

6.1 Knapsack Algorithm:

In this context of research work and with reference to the previous work, it can be seen that this algorithms provides ways and means to find an aggregation of frames assignment such that they help to select the best possible combination based on two quality metrics (PSNR and Data Rate). Basically, it is combinatorial optimization problem solving that can be seen as hunting down the best component of some arrangement of discrete items (video frames for this case); subsequently, on a basic level, any kind of hunt methods or met heuristic can be utilized to fathom them. But generic search methods are neither ensured to locate an ideal arrangement, nor do they ensure to run rapidly (in polynomial time). But the previous work suggest that it work fairly well and still has potential to improve in terms adding more constrains or parameters that can help to choose and assign optimal combination of frame sets .

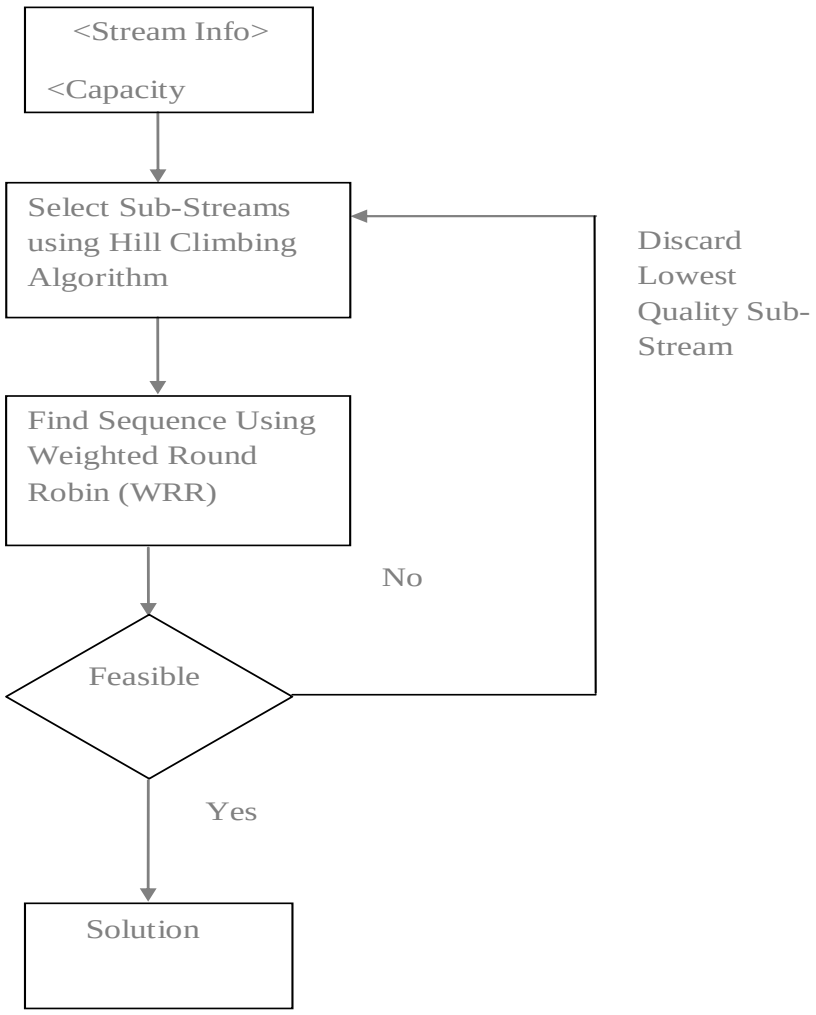
6.2 Hill Climbing Algorithm:

Since, the decision as to which dimensions to scale depend on the nature of video content being viewed and each content type is expected to have one or more optimal adaptation trajectories through adaptation space where selection frame based on some qualifying parameter is done.

In this research there are three qualifying parameters. Higher PSNR (full reference), Data Rate and SSIM (full reference)**.** The evaluation of each frame for selection or to be part for selection or to be part of stream is done based on video quality when variations in all three dimensions occur and is mix approach of using reference and no reference quality measures.

A metric is developed so as to act as guiding parameter for performing analysis of the network/view stream in order to extract data that can be used for impact to Knapsack and Hill Climbing algorithms which do frame selection and minimization of energy.

FLOW CHART:



The inputs of algorithms are picked from trace files of Arizona State University. The working of the proposed algorithm can be clearly understand from the above flow chart.

7. RESULTS

The experiment design for this research distribution of PSNR, MSE and SSIM allowed evaluating multiple scenarios. These experiments were designed to the robustness of proposed algorithm for building an optimal solution for both high quality and low energy consumption video sequencing. Since, the inherent nature of scalable videos concept is scale as per the available condition of channel. In presence of congestion, the layers approach helps to avoid blocking, pause or loss of playback by replacing the video sequence with lower quality version of frames with reduced bandwidth requirement.

The above step is achieved by the sub-stream selection algorithm by reducing signal- to-noise ratio (SNR), frame rate, or the spatial resolution. Therefore choosing which frame to stream or as to produce optimal video quality was a real objective.

The results show that as PSNR increases, the value of data rate also increases. As data rate increases, there is increase in SSIM value towards the positive value of 1 which shows that the quality improves due to greater flow of streams and thus not congestion leading to less energy consumption.

7.1 Mathematical illustration:

Table 1: Factor Rate of PSNR, SSIM and DATA RATES

Number of Frames	PSNR (dB)	SSIM	Data Rate (mb)
1	30	1.778687	10.3
2	31	1.295841	38.3
5	34	0.448463	166.3
10	39	0.711353	469.8
12	39	0.485242	637.1
15	42	0.678908	859.2
18	44	0.989144	952
20	45	1.835426	965.3
22	45	2.750607	946.9
25	45	1.78047	931.9
27	45	0.344373	914
29	45	1.146011	1012.1
32	45	1.676328	1222.1
35	45	0.736854	1500.3
40	45	0.75865	2000.3

Table 1 shows the values for PSNR, SSIM and Data Rate. The following values are the output for the mentioned frame numbers. As PSNR is directly proportional to higher quality and lower energy consumption, hence, higher PSNR values means better or higher quality of images/frames sequence consequently better video streaming. The value of SSIM remains between decimal value of -1 and +1. The quality of frame will be higher when the value of SSIM is closer to +1 and when the value of SSIM will be -1 than it means that structurally the quality of image has dropped. If quality is less, than extra operations are required to improve upon selection process to build stream, hence more energy consumption, therefore lower values of SSIM means more energy consumption. Thus, SSIM is directly proportional to image quality and inversely proportional to energy consumption. Higher SSIM will provide higher image Quality and lower energy consumption. Next, Higher data rate means large number of frames pass through stream faster thus, more exchange of bits and bytes and higher energy consumption, less buffering, blurring hence, less number of errors. PSNR as metric is one the best indicator of quality of frames as it is influencing the quality with respect to the data rate also, it can be seen from the above table that as the values of the Data rate increases, there is increase in PSNR also as more data is flowing as stream at any given time.

8. CONCLUSION

WiMAX (IEEE 802.16) is a developing broadband wireless innovation for residential and commercial users. The characteristic assessment of a video is a major issue and hence need a measuring system that works on the concept of multiple factor evaluation which influences the energy consumption as well as the quality of the video as this video handling framework might present little volume of deformation in the video itself.

The better quality video streams are obtained by using Hill Climbing (Simulated Annealing) Algorithm. The experiment design for this research distribution of PSNR, Data Rate and SSIM allowed evaluating multiple scenarios. These experiments were designed to the robustness of proposed algorithm for building an optimal solution for both high quality and low energy consumption video sequencing.

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