MOTION ESTIMATION SEARCH ALGORITHM USING NEW CROSS HEXAGON-DIAMOND SEARCH PATTERN

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Abstract: Motion estimation is the part of the most computational complexity and the greatest impact on the performance in H.264. Motion estimation is a very important part of video compression. H.264 Video coding standard provides improved bit rate reduction and coding efficiency when compared with other existing standards such as H.261, H.262/MPEG-2,H.263.Various algorithm have been developed for the process of motion estimation to improve better quality and reduce less number of computational time. Cross, hexagon, diamond are adaptive search techniques for motion estimation. Simulation results show that the proposed motion estimation scheme achieves reducing 19.99% motion estimation time and PSNR value is 24.67dB. Motion estimation algorithms are developed and analyzed using MATLAB environment.

Keywords: **H.264, PSNR, Video compression, Efficiency, motion estimation.**

1. INTRODUCTION

H.264 is one of the research highlights of video coding standard and it has provided higher coding efficiency.H.264 more accurate prediction than many existing video coding standards such as H.261/H.263 and MPEG-1/2/4. H.264 is implemented by multiple block mode prediction, multiple reference frames and search pattern. Three-step search (TSS) is one kind of search algorithm. It is a simple one and it is used in the low bit rate video compression standard. The Diamond Search (DS) is a successful algorithm that uses partial searching to achieve global optimization [1].

Motion estimation (ME) is one of the most important time consuming Part of h.264.block matching algorithm (BMA) is used to find motion estimation and its simplest effective algorithm for video compression standard. Fast motion estimation algorithms use fixed search pattern to reduce search points and good encoding speed but video quality decreases. Fixed pattern does not match the real time video. So proposed new combined method with many search patterns to achieve both fast encoding and high search accuracy. New fast motion estimation algorithms are Cross, Hexagon and diamond [2]-[7].

2. SEARCH ALGORITHM

2.1 Unsymmetrical-Cross Search Pattern

A circle shaped search pattern with a uniform distribution of a minimum number of search points is desired to achieve the fastest search speed. And it can be equally utilized with maximum efficiency. And it consist 7 check points marked as 1, show the figure as given and its performed when there is too much difference between obtained motion vector and start position. Cross search method uses a large computational time. Centre circle(0,0) represents current positions and above the centre point(0,1) represent to next search pattern of the centre position and its assume minimum cost of the search point[3].

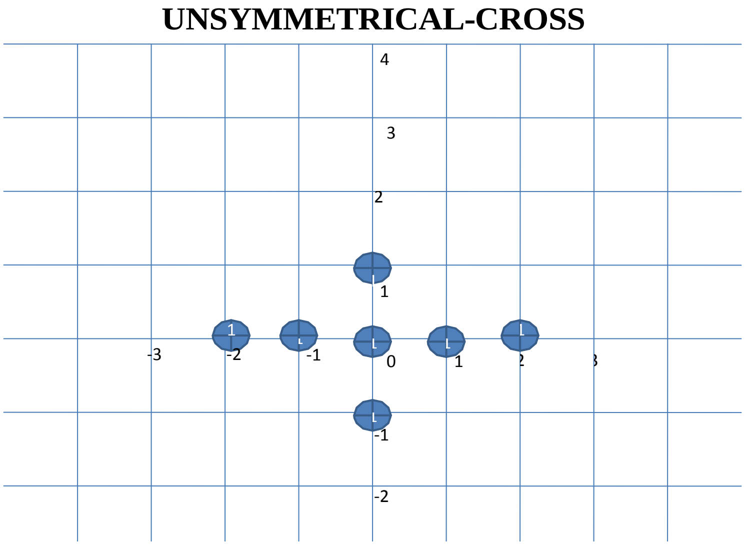

Fig:1. Unsymmetrical-cross search pattern

2.2 Multi-Hexagon Search Pattern

Multi hexagon figure shows the model of hexagon search patterns. It consist number of search points, and its performed when there is too much difference between obtained motion vector and start position. Hexagon search method uses a large computational time. (0,1) represents centre point of the first hexagon search pattern and its assume minimum cost of the search point of previous search pattern . (-1,2) represents centre point of the second hexagon search pattern and its assume minimum cost of the search point of previous search pattern [4].

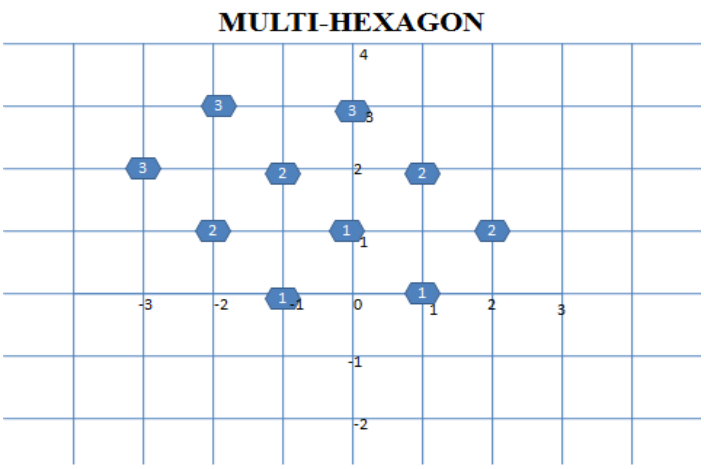

Fig. 2 multi-hexagon search pattern

2.3 Diamond Search Pattern

Diamond search figure shows the model of diamond search patterns. It consist number of search points, and its performed when there is too much difference between obtained motion vector and start position. Diamond search method uses a large computational time. (0,3) represents centre point of the diamond search pattern and its assume minimum cost of the search point of previous search pattern . (0,3) is the final optimum point.[5].

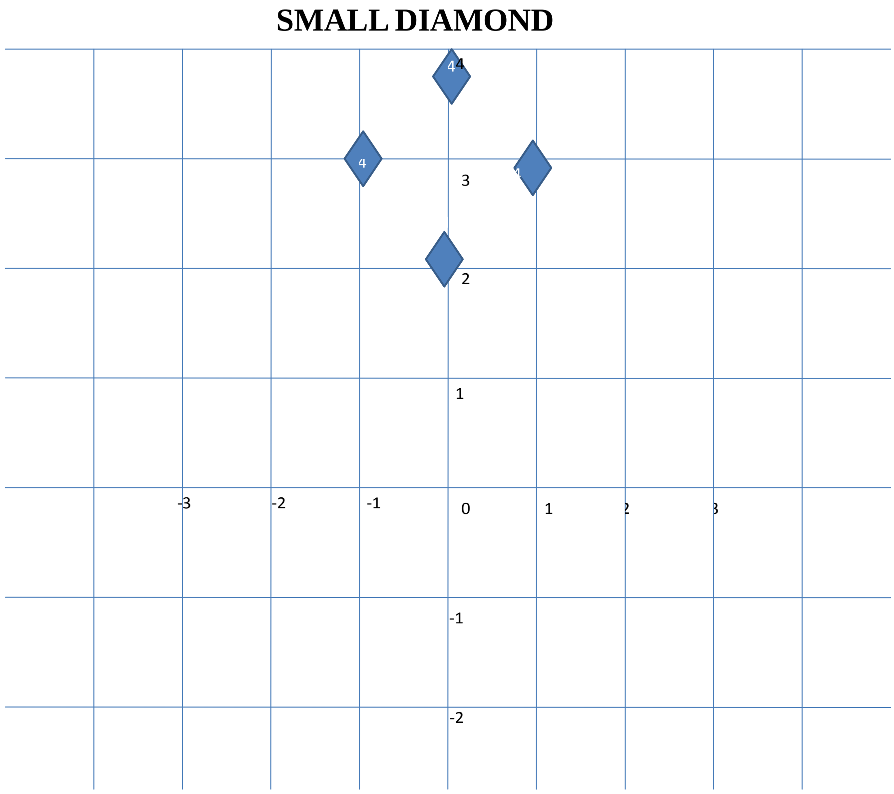

Fig.3 Diamond Search pattern

3. PROPOSED SEARCH PATTERN

Hybrid of cross, hexagon and diamond search patterns are very simplicity and also robust and near optimal performance. It searches for the best motion vectors in a coarse fine search pattern. This algorithm may be described as:

Step1: An initial step size is picked from the centre.

Step2: The centre point is moved to the point with the minimum distortion.

Step 1 and step 2 are repeated till the step size becomes smaller than one. A Particular path for convergence of this algorithm is shown in figure 4.

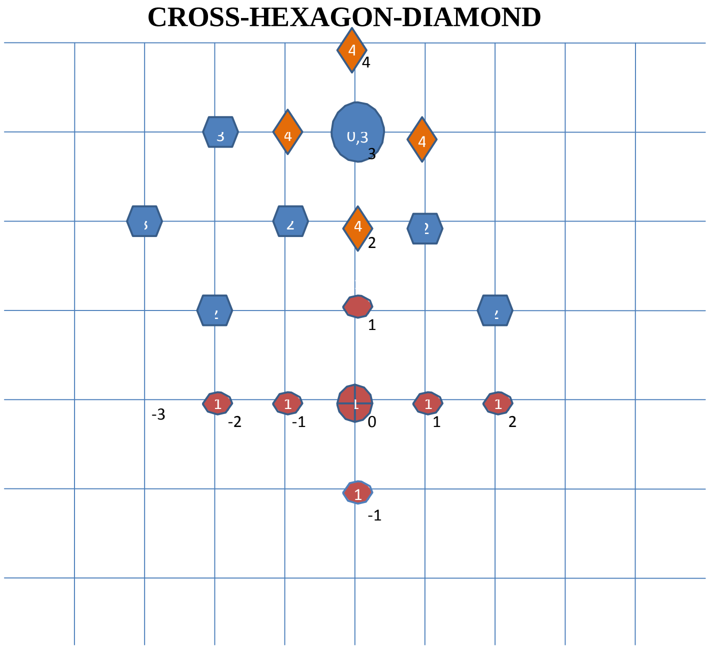

Fig.4 Cross-Hexagon-Diamond

3.1 ALGORITHOM STEPS

Step1: The algorithm first predicts the initial search point from the candidate motion vector list.

Step2: The algorithm searches for the point having minimum block distortion measure (BDM) in cross search pattern among all the seven points at a distance of step size around the center.

Step3: The search terminates when the minimum BDM point happens to be used as in next search pattern of the centre point.

Step4: The algorithm searches for the point having minimum block distortion measure (BDM) in hexagon search pattern among all the seven point at a distance of step size around the center.

Step5: Repeat the third step again.

Step 6: The algorithm searches for the point having minimum block distortion measure (BDM) in diamond search pattern among all the five points at a distance of step size around the center.

Step7: The point with minimum BDM in small diamond search pattern provides the motion vector of the best matching block.

4. SIMULATION RESULTS ANALYSIS

YUV test sequence named „Foreman" of resolution 832x480 is used for analysis. The YUV sequence is converted to sequence of frames and is read from storage location using

MATLAB. Motion Estimation is done for a total of ten frames and the average PSNR is calculated with different search patterns for the compensated and original frame.

Two test video sequences of different kinds are used in this simulation experimentation. They are foreman and BQmall.

The following table which shows the PSNR value, motion estimation time and number of computations in the foreman and BQmall sequence.

PATTERN	**MET(S)**	**PSNR(dB)**	**COMPUTATIONS**
CS	21.49	22.67	11.56
HEX	29.83	20.72	12.71
DS	28.60	22.16	16.83
PROPOSED	**22.59**	**24.67**	**12.08**

Table: 1 Comparison PSNR, MET, Computations – foremen

PATTERN	**MET(S)**	**PSNR(dB)**	**COMPUTATIONS**
CS	71.05	22.09	11.34
HEX	82.50	21.55	11.20
DS	90.69	21.93	15.51
PROPOSED	**71.03**	**22.23**	**11.03**

Table: 2 Comparison PSNR, MET, Computations – BQmall

SIMULATION OUTPUT- FOREMAN

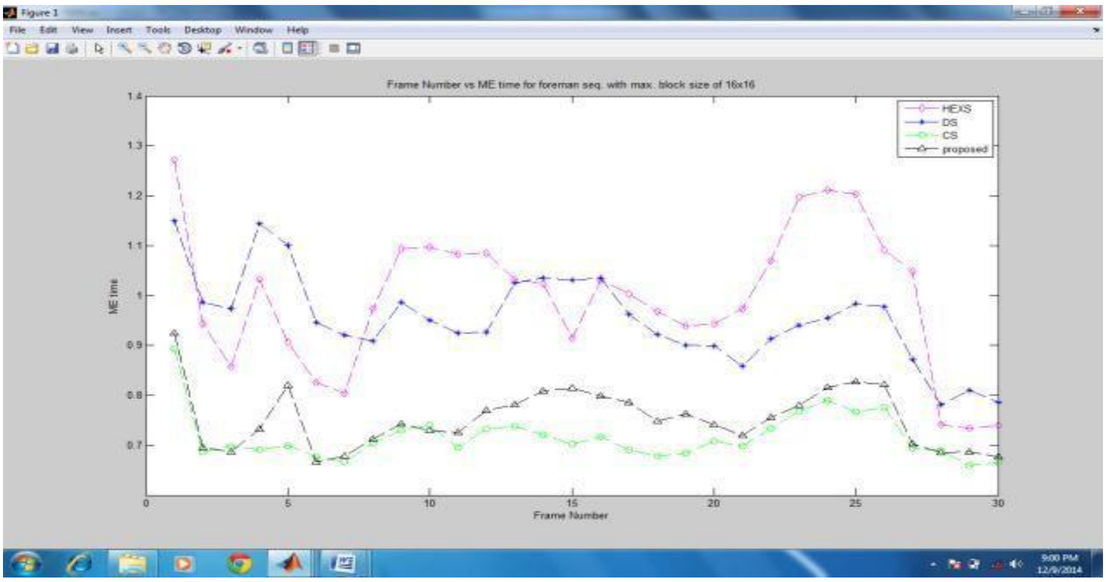

Fig 1: Motion Estimation Time

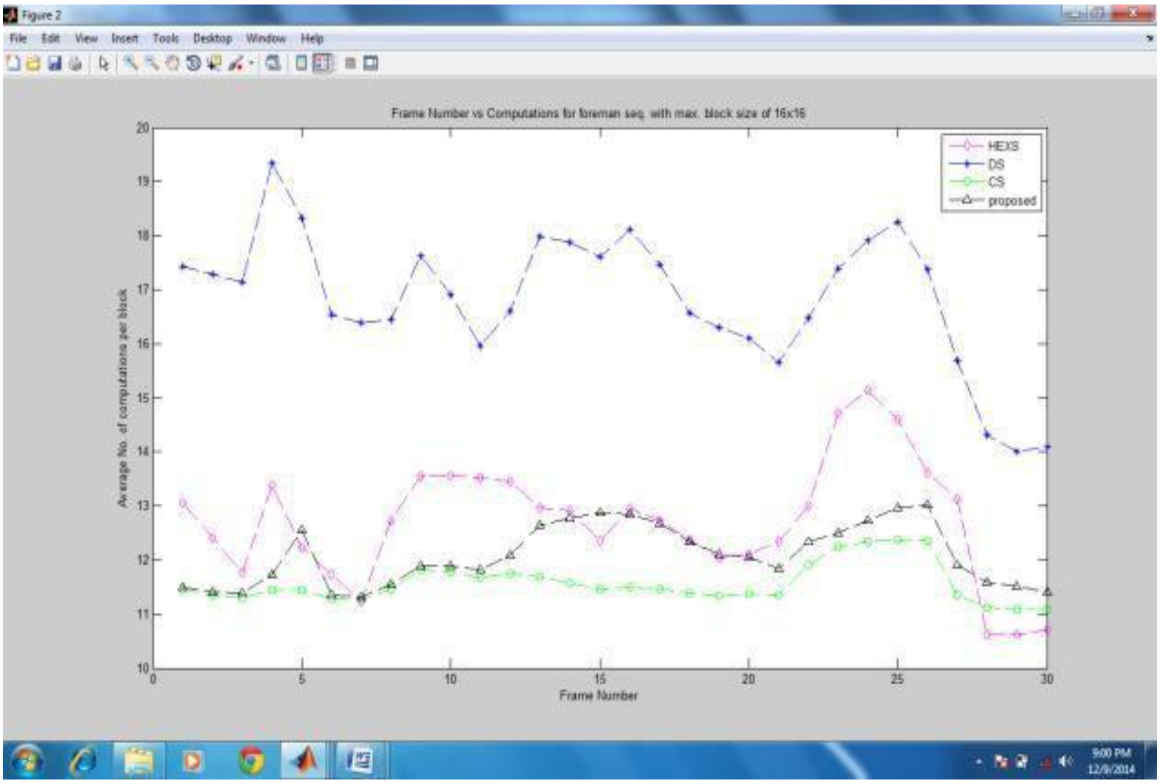

Fig 2: Number of Computations

Fig 3: Reconstructed Image

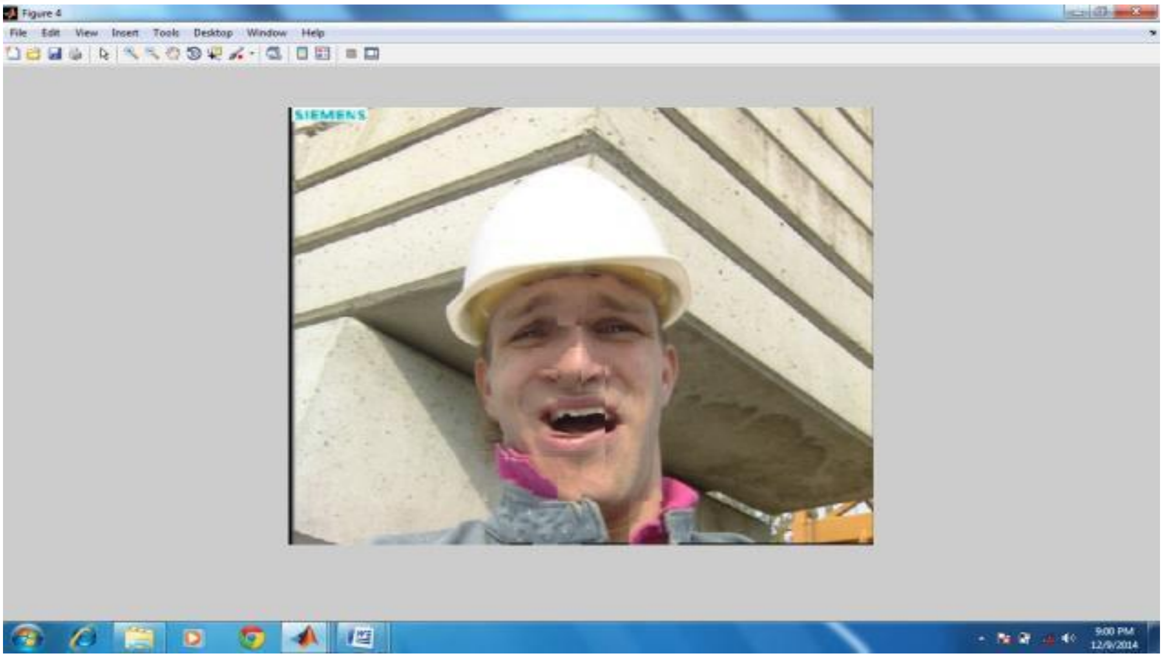

Fig 4: Reference Image

SIMULATION OUTPUT- BQMALL

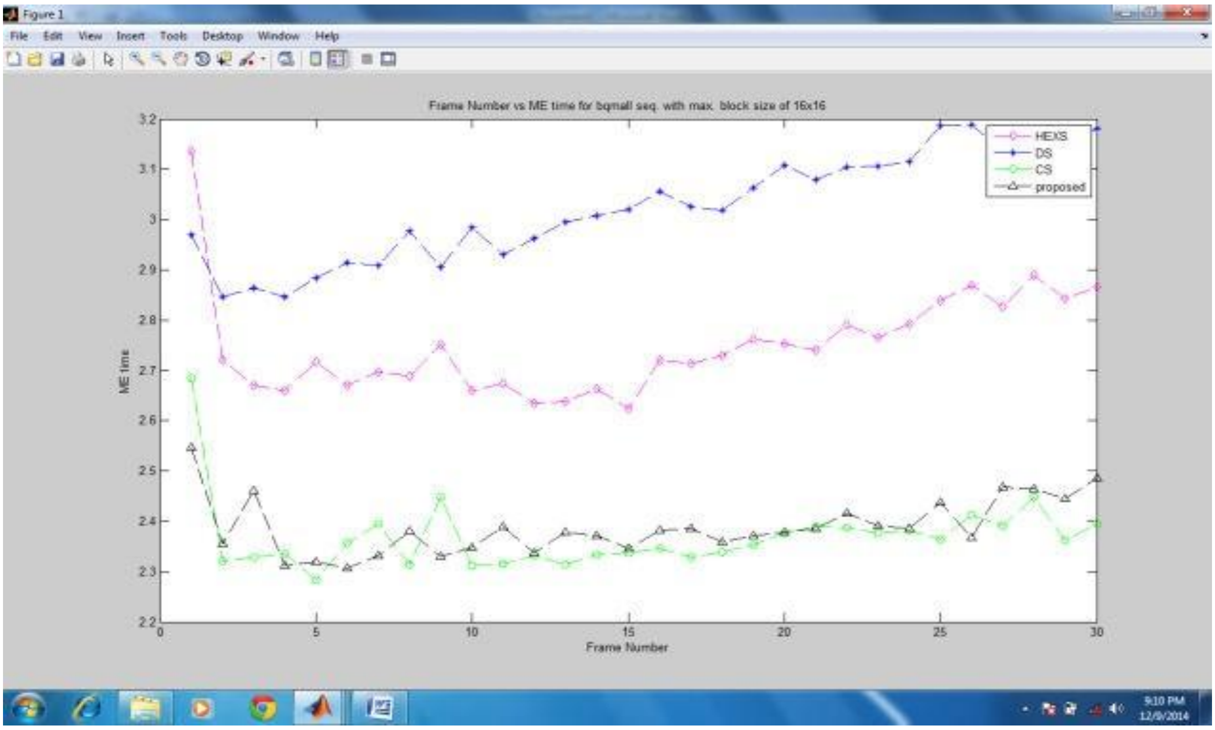

Fig 1: Motion Estimation Tim

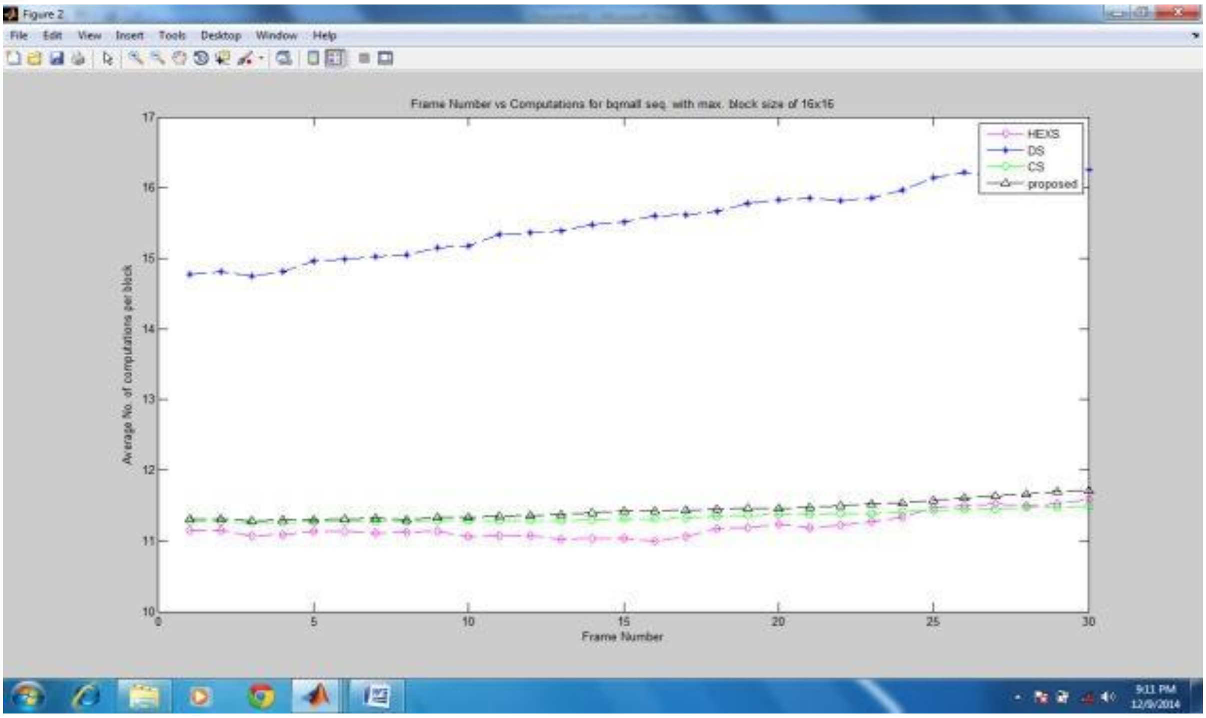

Fig 2: Number of Computations

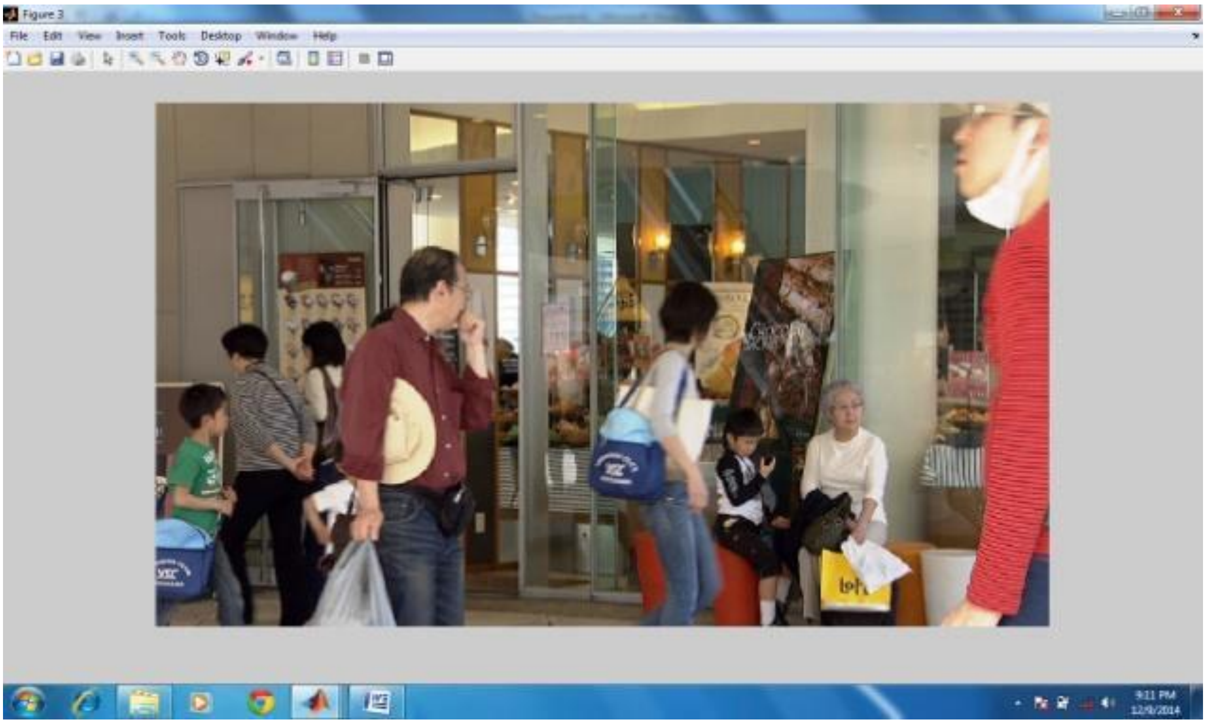

Fig 3: Reconstructed Image

Fig 4: Reference Image

5. CONCLUSION AND FUTURE WORK

In this paper, a comparative analysis is done for the motion estimation algorithms of optimal search techniques. The simulation results show that the proposed algorithm decreased by motion estimation time 19.99% and PSNR value is 24.67dB. A system is designed in Altera Cyclone IV FPGA using for further work focus on the development of High speed Low power Motion Estimation algorithm in NIOS II forH.264.

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