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Motion Estimation in Medical Video Sequences Using Gabor Filter

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ABSTRACT
Motion estimation is the process which determine motion vectors that describe the transformation from one 2D image to another from adjacent frames in a video sequence. It is the motion is in three dimensions but the images are a projection of the 3D scene onto a 2D plane. By motion estimation, we mean the estimation of the displacement or velocity of image structures from one frame to another in a time sequence of 2-D images. This projected motion is referred to as "apparent motion", "2-Dimage motion", or "optical flow". Optical flow estimation, motion estimation, 2-D motion estimation, or apparent motion estimation have same meanings. The motion vectors may relate to the whole image (global motion estimation) or specific parts, such as rectangular blocks, arbitrary shaped patches or even per pixel. The motion vectors may be described by a translational model or many other models that can approximate the motion of a real video camera, such as rotation and translation in all three dimensions and zoom. Here we are going to present a noble technique by means of what we can predict motion in medical video sequences using Gabor filter. Gabor filters are band pass filters which are used in image processing for feature extraction, texture analysis, and stereo disparity estimation.

Keywords:- Compression, Gabor filter, Motion estimation, Medical video, Quantization

I. INTRODUCTION

Video has huge redundant information which must be exploited to be stored and transmitted efficiently. The common technique to achieve this goal is known as motion estimation. In this technique, the current frame is predicted from a previous frame known as reference frame by using motion vectors. Two consecutive frames in a video sequence are highly correlated to each other so very high compression ratio is required due to limited transmission channel bandwidth. This objective may be achieved by exploiting the correlation between two consecutive frames. Exploiting the temporal correlation and reducing the temporal redundancy between two consecutive frames is achieved by motion estimation and compensation, which leads to compression.The NY Quist sampling limit can be broken by the sparsely of the signal being sampled.[3] If the signal is sparsely distributed in some basis, exact reconstruction is possible, even from fewer sampling measurements than the NY Quist sampling limit under particular conditions . This concept has already been used in dynamic MRI systems with the help of motion estimation and motion compensation techniques.[3]The motion estimation process is the most critical and demanding task in the video encoding process. It requires more memory space as compared to other operations in video encoding. To improve the motion estimation performance, a number of algorithms have been presented in the literature. Most of the previous research on motion estimation is based on the block search method. For this purpose, the block-based motion estimation (BBME) technique has been successfully applied in the video compression standards from H.261 to H.264. The most straightforward BBME method must be full search algorithm (FSA) that searches every candidate position within the search range.[8] Since FS consumes extremely high computational cost, development and refinement on ME algorithms have been fueled to archive better tradeoff between the computational cost and the ME speed. It include the low complexity ME algorithms and classify them into three categories, namely modeling the matching error surface, fast full search and reduction of searching candidate points. Generally, the optimal full search (FS) block matching algorithm results in the best performance with respect to the quality of decoded video sequences, however, it is computationally very intensive. Due to the huge demand of the computational requirement several fast search algorithms have been developed and introduced in recent years including the Affine based method. In this approach, it is block -dependent techniques and doesn't give the satisfactory results in capturing the motion discontinuities at object boundary also in the exiting techniques; we capture the motion at the same degree which caused increased in computational time. To overcome these problems, we propose Gabor filter based on motion estimation method that exploits the symmetry in the image. In the proposed method, Gabor filter works on the concept of orientations and we get different results at each orientation, here we use multi dimension orientation to predict motion for each frame in medical video sequences and enhancing the quality and precision for motion estimation. The proposed method can model a present frame more efficiently than existing Affine Transform, while requiring less complex hardware for computing the various parameters.

II. OVERVIEW OF MOTION ESTIMATION

The various techniques used in motion estimation are

A. Two Bit Transform from Second Derivative

Two- bit transform-second derivatives (2BT-SD) which improves the efficiency of image binarization and the accuracy of motion estimation by making use of the positive and negative second derivatives independently in the derivation of the second bit plane. The second derivative are also used to detect flat or background regions, avoiding expensive motion vector search operations for macro blocks in these areas, and deriving the motion vectors by prediction from neighbouring blocks. In applying the proposed 2BT-SD in the H.264/AVC standard, a further reduction of motion estimation complexity with a minor accuracy reduction is achieved by using 2BT-SD representation for secondary motion estimation while using the full resolution representation for the primary motion estimation. A hardware cost analysis shows that about 209K gates of hardware logics and 2.7K bytes of memory are reduced by 2BT-SD for motion estimation of 1280x720 size videos when compared with the full resolution motion estimation. Experiments show that the proposed 2BT-SD achieves better motion estimation accuracy than other binary motion estimations and provides faster processing time in flat or background regions with an acceptable bit-rate increase [1].

B. Robust Motion Estimation and Color Compensation

Video completion is used for repairing damaged or missing data in a video sequence. Video completion method using robust motion estimation and colour compensation. The previous techniques consist of three steps: motion estimation, source patch search, and colour assignment. If an input video contains brightness change, existing video completion methods give poor results. For overcoming this drawback, we apply two methods: colour normalization for motion estimation and source patch search, and colour compensation for colour assignment. In the first step, we estimate the motion using normalized input video. Then, we search the source patch using normalized colour information and motion information extracted in the first step. Finally, colour compensation using colour transform is used for colour assignment. Robust motion estimation method gives better visual results than conventional video completion methods [2].

C. Affine Transform

Affine Transform based on motion estimation method which can be used for medical video processing. This method provides sufficient parallelism in the implementation while giving good result in terms of motion estimation. An affine based motion estimation method using the parallel affine transform that exploits the symmetry in the image. In this method, a block- based gradient descent search algorithm is used to find the translation vectors, which are then used to find the affine parameters. This method can model a present frame more efficiently than existing fast BMA's, while requiring less complex hardware for computing the affine parameters. Due to the presence of complex motion in between consecutive frames, many video coding algorithms are forced to reduce video quality while maintaining a target bit rate. Though affine transform based algorithms give a good prediction, they are computationally intensive in nature. Parallel affine transform based motion estimation algorithm which reduces the time for computation of the affine parameters by taking a constant matrix during computation of the affine parameters. In addition, the algorithm takes less time to compute the predicted block by using the symmetry of the block to compute the affine transform of four locations simultaneously [3].

III. PROPOSED METHOD

We propose Gabor filter method based on Motion estimation in medical video sequences. Gabor filter is orientation sensitive filter, used for edge detection and texture analysis. Orientation representations of Gabor filters are similar to those of the human visual system, and they have been found to be particularly appropriate for texture representation and discrimination. Firsty we are applying histogram equalization on the original frame and then applying color quantization. And then applying energy density function on with or without enhanced image and Demonstration of a Gabor filter applied to different frames of medical video as shown below. Different orientation orientations are shown on the right at different angles.

Then logical image is obtained by combining all orientations. Calculate the motion estimation for each frame. The flow diagram is shown in Fig. 1

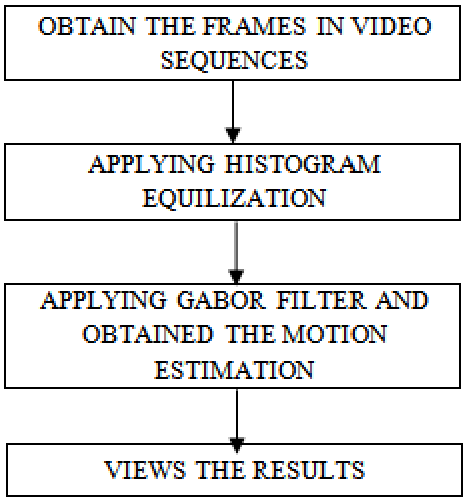

Fig. 1: Flow chart of proposed work

III. FIGURES AND TABLES

Firstly we are applying pre-processing step of histogram to the original frame of head MRI. Under this we are using histogram equalization. Histogram equalization used in image processing of contrast adjustment using the image's histogram. This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values and also removes the noise from background. The Fig. 2 shows Histogram equalization and Color quantization.

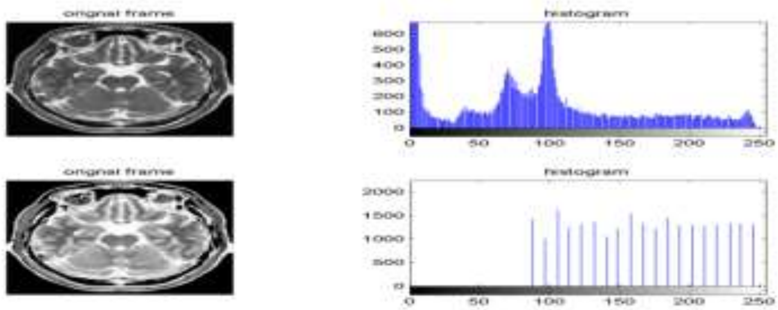

Fig 2.-Histogram equalization and Color quantization

Secondly applying the Energy density function on with enhanced frame and without enhanced frame. The Fig. 3 shows the application of Energy density function on enhanced frame and without enhanced frame.

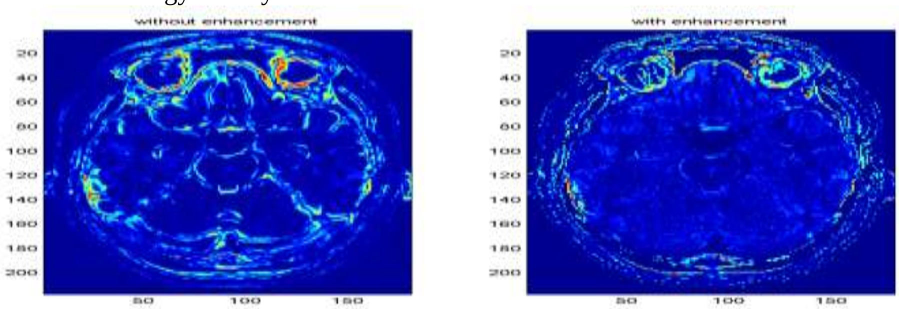

Fig 3.-Applying energy density functions on with and without enhanced image.

Applying the Gabor filter at seventeen different orientations and combined all the result of different orientations and obtained the logical image and applying the same process to next frames of medical video sequences.

The Fig 4 shows the different orientation and logical image. Logical image is obtained by combining all the orientation.

Fig 4.-Apply Gabor filter

Finally, obtain the motion estimation taken by each frame and calculate the total time taken by each frame. Fig. 5 shows Motion estimation using Gabor filter.

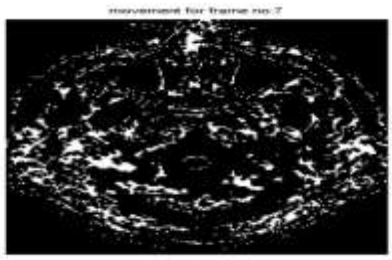

Fig 5.-Motion estimation

The Comparison of the total time taken by each frame is shown in the below given Table 1.

Table1. Comparison of the total time taken by each frame for Motion estimation

Prediction of frame i+1 from i frame	Affine transform based on existing technique	Gabor filter based on proposed technique
i=1	0.226887	0.16851
i=2	0.237845	0.14774
i=3	0.226877	0.13442
i=4	0.229419	0.17767
i=5	0.224942	0.14805
i=6	0.220726	0.13351
i=7	0.22249	0.14887
Average value	0.227026	0.151252

IV. CONCLUSION

With the increasing demand of multimedia applications, considerable efforts are needed for efficient video compressing and encoding algorithms. Motion estimation is effective technique for exploiting the temporal redundancy in video sequences and is therefore an essential part of MPEG based compression standards. Since motion estimation is the most computationally intensive portion of video encoding, efficient so Gabor filter techniques based on motion estimation are highly desired for video compressors subject to diverse requirement on average error rate, video sequences characteristics and delay. Simulation results show that the proposed method predicts the video frames more accurately in comparison to Affine transform based estimation methods. Gabor filter algorithm will take a much lower time than Affine Transform and thus can be used for real time video compression or dynamic medical imaging systems.

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