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Medical Images Inter Frame Motion Analysis via Block Positioning Pixel Subtraction Technique

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Abstract— **This paper presents a study on image pixels using block positioning pixel subtraction technique to analyse the changes that occur in that region of interest. The changes that happen in the pixels represent the motion translation. Processing a whole video sequence in order to view a certain area of interest will increase the computational and processing time. In order to avoid this situation, the block positioning pixel subtraction technique is applied. The block-based positioning subtraction technique extracts the small block of interest to be processed. This small block of interest is processed individually without the need to process a full frame. This technique divides the frames into small 8×8 macro blocks and identifies the pixels of an area of interest in the small block as motion. Identified motion with changes of pixels value is extracted from the small 8 × 8 macro-block to further analyse the motion changes.**

Keywords-image pixel; subtraction technique; motion translation; block positioning; 8 × 8 macro-block

I. Introduction

Video sequences is a made up of frames that rapidly change from one frame to another frame. Each frame of an image conveys information. The changes of the information between the frames occur in low amount that allows motion to be detected at certain area. Motion estimation is a technique that is used to examine video sequences for block of objects that match with each other to reduce the temporal redundancy [1, 2]. Motion estimation identifies the blocks that match each other in a video sequence by detecting objects transformation which appears in each frame but at different locations [3]. The identified blocks are represented with a motion vector (x, y) to indicate the motion pixel displacement in a frame [4]. Difference pixels value indicates that there is a change occurs in the frames. Block Matching Algorithm (BMA) technique is widely used for motion estimation where a frame is divided into macro blocks of 8 × 8 pixels [5, 6]. The pixels value of the macro blocks which have been divided is used to compare between current macro block with the subsequent macro block [7, 8]. BMA technique is implemented into the video coding standards which are ITU-T [9], H.261 [9, 10], H.263 [10], MPEG-1[9], MPEG-2 [9] and MPEG-4 [9, 10].

The BMA concept is adopted, whereby the frames is divided into smaller block of equal size, a simple block-based pixel comparison via block positioning pixel subtraction technique is applied to detect the motion transformation. The advantage of adopting the BMA technique into our proposed technique is that the interested blocks in a frame can be processed without the need to involve the whole frame. The region of interest can be identified immediately and can be processed to obtain the results more efficient without processing the whole frame. This technique just involves the pixels value in macro block from current frame and subsequent frame which is compared and subtracted to detect the motion transformation. If no motion is detected during the subtraction process the results shows zero values. If the result shows nonzero values, then there is motion transformation detected.

II. Previous Related Work

A few approaches have adopted the use of the pixels value as a comparison tools to detect motion transformation. Benjamin et. al., used the pixels value to classify the skin color using the color histogram based approach [11]. Each pixel in an image is transformed to a color space and indexed into a table. These indexed values are the threshold value used to compare and detect the skin pixels. If the pixels are greater than the indexed values, then it recognized as skin, otherwise it is detected as non-skin. M. Sallam et. al. researched on the internal structure of the breast region [12]. M. Sallam et. al. proposed two-dimensional unwrapping technique to estimate the differences of pixels in the current image and reference image within the breast region while performing rotation, scaling and shearing as well. Robert et. al. researched on pixels based images using the object based classification method [11]. Two multi spectral satellite images are apply the component analysis and principle to reduce the redundancy in the image data field.

III. Proposed Experiment

In order to analyze and detect motion translation between targeted frames in a video sequences through the changes of pixels value, certain condition need to be constant to allow same environment is applied for each frames during the analysis process. The conditions that are set constant are the 8×8 macro block size and one brain MRI video sequences. The MRI video is processed to change the video sequence form into single standalone frames as shown in Fig. 1.

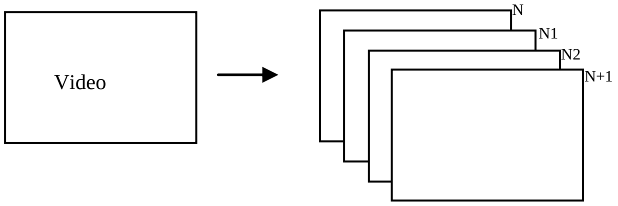


Figure 1. Video extraction into frames

These single standalone frames is extracted from the first frame which is the N frame to the last frame which is N+1. Two interested frames are selected to be processed into macro blocks. The two interested frames are selected by the user for comparing and analysis purposes. Each of the interested frames are divided into macro block of size 8×8 as illustrated in Fig. 2.

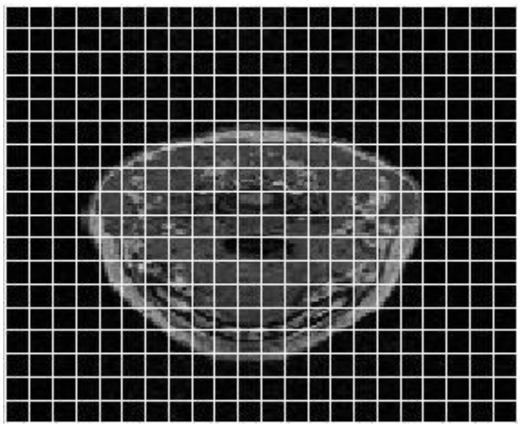


Figure 2. 8 × 8 small block size

Once the targeted frames are divided into macro blocks 8 × 8, the block of interest is selected to determine the position of the macro block using the coordinate (x, y) where x represents the column and y represents row. This is to simplify the process to detect motion transformation at selected interested block and need not to process the whole frame. Thus, this reduces the elapsed processing time and save processing memory that is used during the analyzing process. Equation (1) is used to select the location of the desired block of interest.

$$\text{Block} = \left\lfloor N\times(y-1)+1 : N\times(y-1)+8,\ N\times(x-1)+1 : N\times(x-1)+8 \right\rfloor \quad (1)$$

Where N = macro block size
x = column coordinate
y = row coordinate

The coordinate selected for the macro block in both frames (current frame and subsequent frame) should be the same to analysis the changes that occurs in the pixels value as illustrated in Fig.3, i.e. if in frame 1 block of interest is located at coordinate (10,2), then the subsequent frame i.e. frame 10, the block of interest should be also located at (10,2).

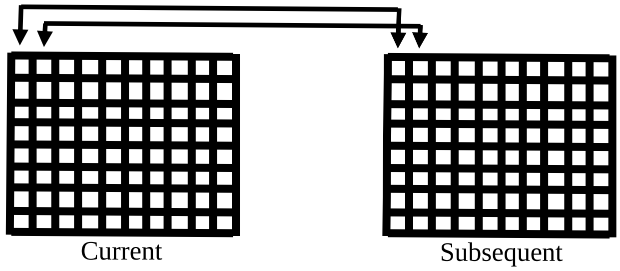


Figure 3. Block comparison

The block of interest from both of the frames which has been selected is extracted from the respective frames where it represents a single small macro block. The magnification of the extracted single small macro block is done in order to enhance the view of the extracted block due to the small block size. Equation (2) is used to magnify the single small macro block for analysis process purposes.

$$(\text{kron}(\text{Block},\text{uint8}(\text{ones}(16)))) \quad (2)$$

Once magnified, the pixels value of the single small macro block from both of the frames is analyzed by comparing and subtracting between the two blocks using (3).

$$Subtraction = \left| Block\,2 - Block \right| \quad (3)$$

The subtraction is done based on the each pixels in both macro block i.e. if pixel value in macro block (current frame) is located at (1, 1), then the subtraction pixel value in macro block (subsequent frame) should be from location (1, 1).

IV. EXPERIMENT AND RESULT ANALYSIS

In the proposed method, frame 1 and frame 10 are 2 different brain frames that are extracted from brain MRI video sequences. Fig. 5 (1a, 2a) represents frame 1, (1b, 2b) represents frame 10 and (1c, 2c) represents the block of interest.

In the first video sequences of the brain, the block of interest coordinate is chosen at coordinate (11, 11) as shown in Fig. 5 (1c). The chosen block of interest is shown in frame 1, the region of black color is small. In frame 10, the region of black color expends. The difference of pixels value shows that there is motion transformation detected. In the second video sequences, the chosen block of interest is coordinated at (4, 12). Fig. 5 (2a) shows the boundary of the brain in frame 1 is chosen whereas Fig. 5 (2b) shows the boundary of the brain in frame 10. Based on the two frames, the side of the brain in frame 10 expands. The difference of the pixels value is tabled when the pixels are subtracted and compared. The subtracted result of each pixels shows that there is motion present.

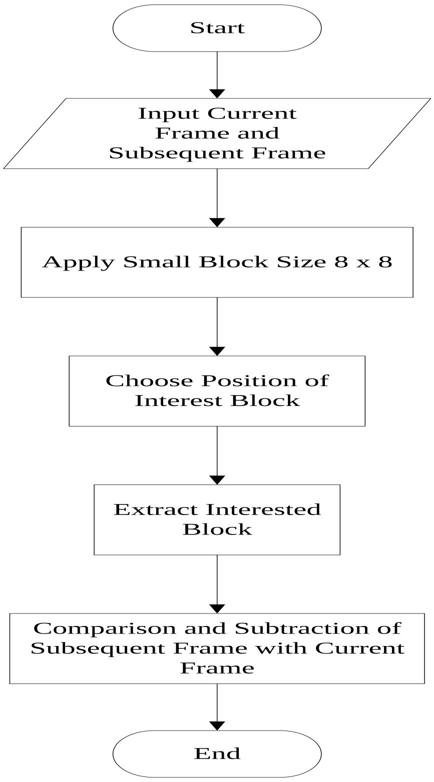
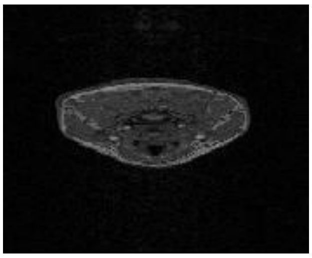
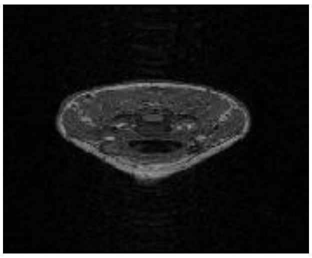


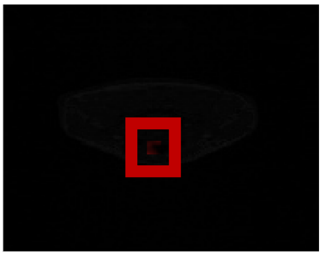
Figure 4. Block positioning subtraction technique



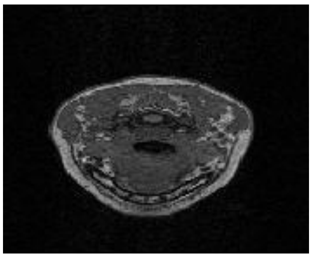
(1a)



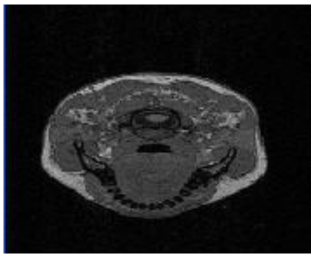
(1b)



(1c)



(2a)



(2b)

(2c)

Figure 5. (1a, 2a) Frame 1, (1b, 2b) Frame 10 and (1c, 2c) Block of Interest

V. DATA ANALYSIS

The block (3a, 3b) is the extracted block of interest from frame 1 and frame 10 respectively in the first video sequences of the brain as shown in Fig. 6.

(3a)

(3b)

35	37	37	36	43	52	53	48
47	46	40	31	29	33	33	30
49	46	35	20	10	9	9	8
41	39	30	17	5	0	0	2
39	37	33	25	14	6	4	5
45	41	37	32	22	10	3	2
62	54	46	41	31	16	5	2
81	70	59	53	43	27	15	11

(4a)

0	1	5	6	4	3	4	6
24	24	21	17	12	8	7	7
28	24	18	14	12	12	11	11
18	13	9	8	11	14	14	13
14	11	9	10	14	16	15	12
12	11	11	13	16	18	19	18
39	39	37	35	33	34	37	39
93	90	83	72	62	57	59	62

(4b)

Figure 6. (3a, 4a) Frame 1, (3b, 4b) Frame 10

The block (3c, 3d) is the extracted block of interest from the frame 1 and frame 10 respectively in the second video sequences of the brain as shown in Fig. 7.

(3c)

(3d)

$$\begin{Bmatrix} 7 & 5 & 14 & 14 & 4 & 6 & 20 & 2 \\ 2 & 0 & 0 & 0 & 2 & 2 & 11 & 10 \\ 4 & 0 & 7 & 7 & 3 & 0 & 9 & 15 \\ 6 & 4 & 3 & 3 & 5 & 1 & 9 & 12 \\ 0 & 4 & 3 & 3 & 1 & 7 & 2 & 2 \\ 5 & 6 & 1 & 1 & 11 & 0 & 0 & 0 \\ 0 & 4 & 10 & 10 & 9 & 0 & 7 & 3 \\ 5 & 11 & 0 & 0 & 1 & 9 & 0 & 5 \end{Bmatrix}$$

(4c)

$$\begin{Bmatrix} 149 & 83 & 59 & 59 & 58 & 65 & 69 & 58 \\ 142 & 97 & 79 & 79 & 42 & 67 & 76 & 57 \\ 147 & 124 & 115 & 115 & 53 & 73 & 76 & 54 \\ 126 & 133 & 101 & 101 & 71 & 48 & 68 & 63 \\ 133 & 159 & 106 & 106 & 108 & 121 & 55 & 61 \\ 152 & 163 & 137 & 137 & 118 & 92 & 132 & 45 \\ 150 & 164 & 137 & 137 & 141 & 121 & 118 & 81 \\ 102 & 158 & 142 & 142 & 168 & 139 & 124 & 110 \end{Bmatrix}$$

(4d)

Figure 7. (3a, 4a) Frame 1, (3b, 4b) Frame 10

Each of the blocks is magnified to analysed each of the pixels value. The differences in the pixels value which is extracted shows that motion transformation occurs between two difference frames in a video sequence. Different pixels value represents different shading color. Since the images are in grayscale, the values of the pixels are ranged between 0 to 255. The 0 value represents the black color and 255 represent white. The values in between represents many shades of gray. As the subtraction of pixels is carried out, the higher value will represents drastic motion whereas the lower value will represents less motion. The result which represents zero value shows that there is no motion happens.

VI. DISCUSSION

Motion translation represents or describes about the changes in the pixel values, it indicates that there is motion present or interferences have taken place. Each of the pixels value usually carries information which is varies between one another. If the pixels value is the same, then it will produce a zero value which indicates there is no motion translated or no changes happen in the area of interest. If there is motion translation, the pixels value is different and when the pixels produce a nonzero value when it is subtracted. Block Positioning Pixel Subtraction Technique is a way to detect motion translation at certain location in an image without the need to processing the whole frame. Adopting the BMA concept reduces the used of memory space during the mathematical functional calculation for pixels analysis between two successive targeted small macro blocks. Apart from that this technique also provides not only the ability to analyse the changes of the pixels but also allows users to choose the desired macro block to reduce the computational cost and time. The storage usage for processing and saving data also is minimized as only selected blocks in respective interested frames is processed and not all the frames in the video sequences.

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