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Design of Block Strength Adaptive Video Deblocking Filter

Y.Krishna Geethika¹, Tejo Navya Sri.B², R.Srikanth³, M.Ravi Kumar⁴, Dr.B.Naga Jyothi⁵

U.G. Student, Department of Electronics and Communication Engineering, DMS SVH College of Engineering,
Machilipatnam, Andhra Pradesh, India^{1 2 3 4}

Professor, Department of Electronics and Communication Engineering, DMS SVH College of Engineering,
Machilipatnam, Andhra Pradesh, India⁵

ABSTRACT: The main objective of this project is to remove the amount of blockiness and to improve the strength of the block present in a frame. It refers to the process of filtering a frame in the desired regions depending upon the requirement. In this paper, the technique is to filter and improve the strength of a block. The deblocking filtering detects and eliminates the amount of blockiness that is present in a frame. And then the filtered frames are then processed to form a video so that it aims to filter a video. So, in this project deblocking filter algorithm is used for video post processing implementation. In order to estimate block discontinuities, the strength of the boundary of the block is calculated by decision tree technique.

KEYWORDS: Vertical Filtering, Horizontal Filtering, Soft filtering, Strong Filtering, Block Strength Calculation, Filter Type, Threshold value

I. INTRODUCTION

Filtering is a technique that is done to emphasize certain features (or) remove other features to get the desired requirement. It is done only at the real edges. Real edges are calculated by the absolute difference on either side of a block and sharp edge difference will be high. Absolute difference will tell us about the decision making whether it is real edge or not. If there is too much blockiness then strong filtering will be done. In case if there is not much blockiness then soft filtering will be adopted. Strong filter affects more pixels on each side of the block boundary. The purpose of the filter decision is to 'switch off' of the filter when there is a significant change or gradient across the block boundary in the original image. A filter is applied to every decoded macroblock to reduce blocking distortion. The filter smooths block edges, improving the appearance of decoded frames. The filtered image is used for motion-compensated of future frames and this generally improves compression performance as the filtered image is a more faithful reproduction of the original frame than a blocky, unfiltered image. Generally when we observe blockiness in a frame or video we think it may be due to some frequency or signal disturbances but actually the original reason is that it is mainly caused due to compression of the video. Most of the videos we see over internet (YouTube, Facebook), television, and mobiles are compressed. Certain compression and decompression techniques that are currently available are H263, H264, MPEG-4[1]. These are widely used CODEC (Compression and Decompression) techniques for video. In our project the main concept is to remove blockiness and enhance the frame.

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II. RELATED WORK

Video is the collection of sequence of frames. Each frame in the video is partitioned into blocks called Macroblocks (MB). Discrete Cosine Transform is applied on the blocks to segregate the blocks into high frequency and low frequency components. The high frequency components are later removed by archiving compression. The output is achieved by using various filtering aspects to enhance the video and to eliminate blockiness. Image processing operations implemented with filtering that include smoothing, sharpening and edge enhancement. In general an image can be divided into blocks. In this work we are dividing an image into 4x4 blocks, and then filtering is done to each individual block.[1] Finally we filter the image in terms of blocks. There are various filtering aspects in our project so that the filtering is done completely on the entire frame.

NECESSITY OF COMPRESSION:

Standard video has 30 frames per second. So a High Definition (HD) video has a resolution of 1920x1080[5].

The size of one hour video can be computed as shown below:

Size of 1 frame = $1920 \times 1080 = 2073600$ bytes

Size of 30 frames = $2073600 \times 30 = 62208000$ bytes

Size of 1 minute video = $62208000 \times 60 = 3732480000$ bytes

Size of 1 hour video = $3732480000 \times 60 = 223948800000$ bytes

Each frame has Red(R), Green(G), Blue(B) planes taking them into consideration the size of 1 hour video is $223948800000 \times 3 = 671846400000 = 6.7 \times 10^{11}$ bytes.

INTER FRAMING:

Video is the collection of frames. The frames are in sequential order so that there will be similar data in second frame compared with its previous frame. Without directly encoding the present sub-block values of each block the encoder searches a similar block in the frame that is previously encoded. Many of the times the encoder finds the block that it matches but it is not an exact match. There will be minute differences between them and we need to transform these differences.[2]

INTRA FRAMING:

Intra framing is another feature that is used to reduce spatial redundancies. It predicts sub-block values by extrapolating neighbouring sub-blocks from adjacent reconstructed blocks. Intraframing performs lossy compression techniques relative to information that is contained only within the current frame, and related to any other frame in the video sequence.[2]

III. WHY DEBLOCKING FILTER IS PREFERRED

Blocking artifacts are the issues that occur in block-based video coding schemes. These are also sourced from imperfect motion compensation prediction. The purpose of the deblocking filter is to give a higher level of perceived quality by removing the blocking artifacts from the image. Deblocking filter takes in information regarding the boundary strength, certain threshold values and the block and the sub-block values are to be filtered. It is still having the capability to improve the subjective and objective quality.

IV. DEBLOCKING FILTER ASPECTS

There are three aspects regarding filtering:

- Horizontal Filtering
- Vertical Filtering
- Block Strength Calculation

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HORIZONTAL FILTERING

First the filtering is done horizontally i.e. in this filtering is done in horizontal direction. The horizontal filtering process is explained in figure 1. Consider two macro blocks. Each block is divided into 4 x 4 sub-blocks. Let the macro blocks be named as left & right. The left macro block has 4 x 4 sub-blocks and similarly right macro block has 4 x 4 sub-blocks as shown in the figure 1.

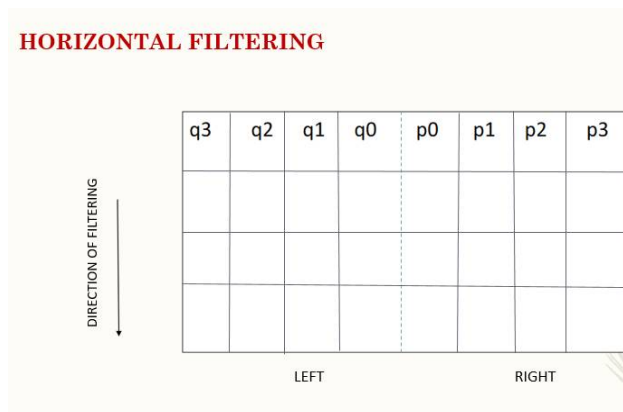


Fig 1: Horizontal Filtering

In the one-dimensional row the blocks present in left macro block are four in numbers named as (**q3, q2, q1, q0**) and right macro block also contain four sub-blocks (**p0, p1, p2, p3**). Here adjacent blocks (**q3 & q2**) are compared then the filtered right block i.e. **q2** will be the left block and the new block **q1** will become the right one. The compared block '**q3**' will be placed in the output image. Next (**q2 & q1**) will be compared for similarly and process goes on likewise till (**p2 & p3**). Process will be done along the columns and then they move on to the row. Later the horizontal filtering is done for next row. The same process happens to the entire frame.

VERTICAL FILTERING:

Vertical Filtering is done for horizontal edges and in this process the horizontal edges will be filtered. This process is also similar to horizontal filtering but here filtering process will be from top to bottom..

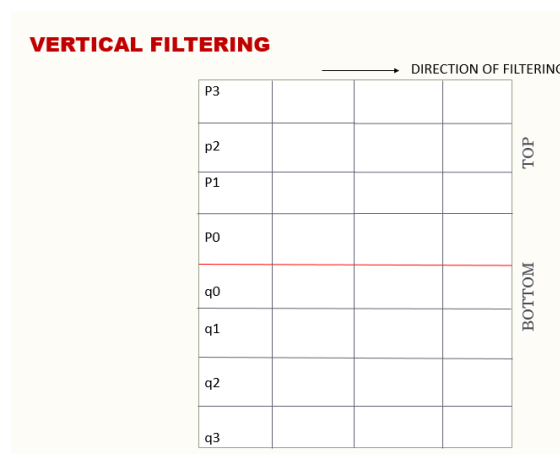


Fig 2: Vertical Filtering

In the above fig 2, one-dimensional column will be considered and then the blocks present in the top macro block are four namely (**p0, p1, p2, p3**) and coming to the bottom macro block are of (**q0, q1, q2, q3**). In this after filtering the top block p3 and

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bottom block p2, then this block p2 will become the top one and the new block p1 will become bottom one. The compared block 'p3' will be arranged in the output image. Next p3 & p2 will be compared similarly and process goes on likewise till q2 & q3. After completion of filtering of the desired block then it will be arranged in the output. Process will be done along the rows and then they move on to the column. Then the vertical filtering is done for next column. And process goes on through the entire frame

BLOCK STRENGTH CALCULATION:

Block strength is calculated to know the absolute difference between the blocks. Strength of the block will be calculated at the borders of the blocks. Depending upon the absolute difference, the type of filtering is decided and then applied.

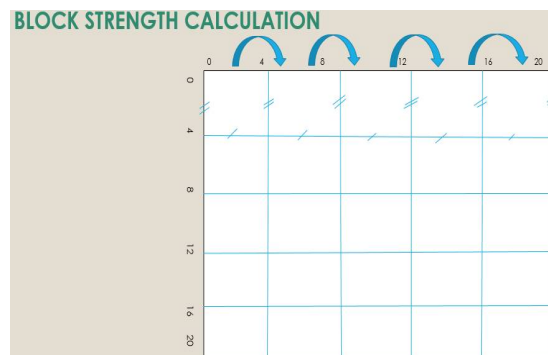


Fig 3 Block Strength Calculation

Consider fig 3, in that one-dimensional row will be there in that blocks present in left macro block are four in numbers named as (q3, q2, q1, q0) and right macro block also contain four sub-blocks (p0, p1, p2, p3). Here adjacent blocks (q3 & q2) are compared then the filtered right block i.e. q2 will be the left block and the new block q1 will become the right one. The compared block 'q3' will be placed in the output image. Next (q2 & q1) will be compared for similarly and process goes on like wise till (p2 & p3). Process will be done along the columns and then they move on to the row. Later the horizontal filtering is done for next row. The same process happens to the entire frame.

V. EXPERIMENTAL RESULTS

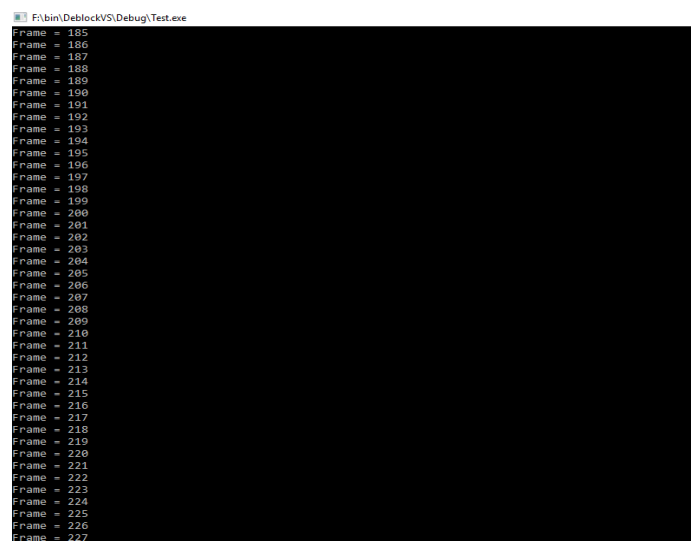


Fig 4 : Shows the frame count

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After debugging the code then the count of the frames will go like depending on the size of the video

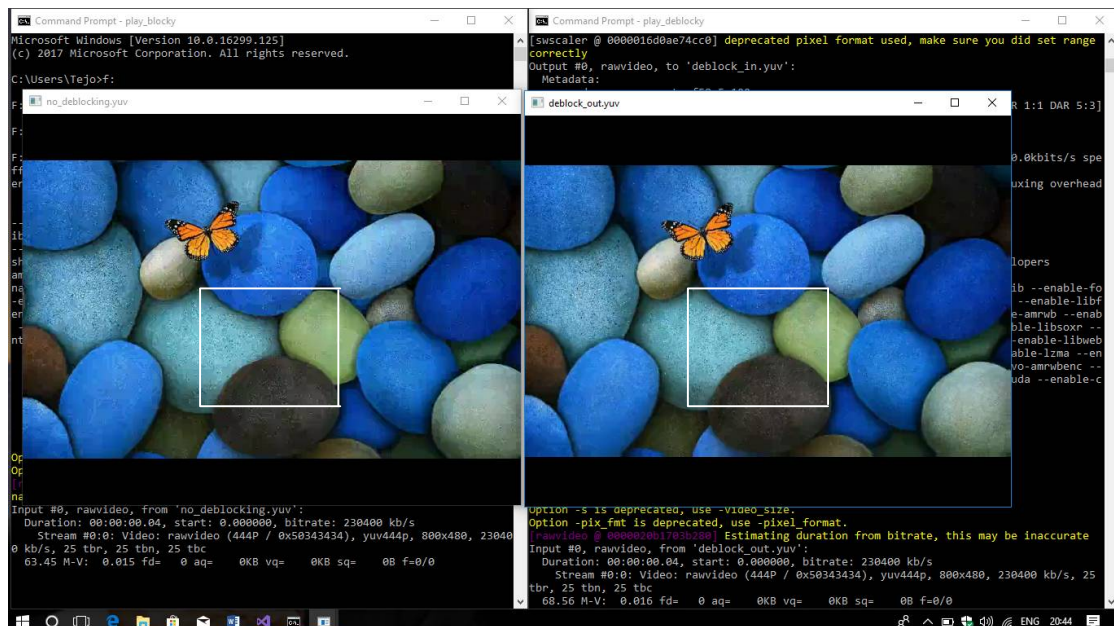


Fig 5

Filtering is applied on an image
Left side image is of blocky and Right side image is of deblocky

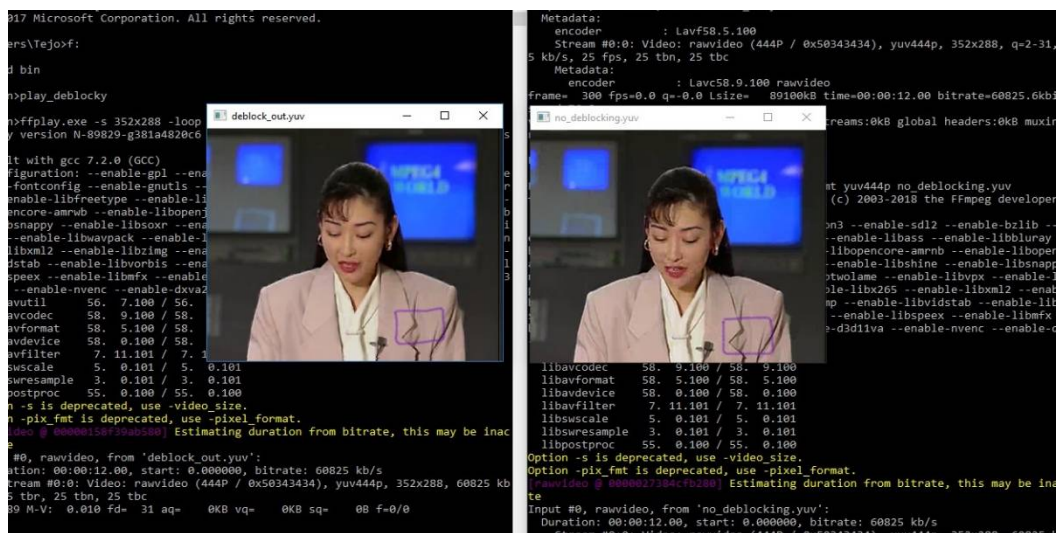


Fig 6

Standard bench mark video (AKIYO)
Filtering is applied on a video
Left one is of deblocky and Right one is of blocky

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Fig 7

Real Time Video

Filtering is applied on real time video which is captured in a mobile
Left one is of blocky and Right one is of deblocky

VI. CONCLUSION

We have implemented the concept of filtering on various aspects i.e. it is adaptive in nature. Our algorithm successfully increases the strength of block and removes the blockiness by using adaptive video deblocking filter. We have applied our algorithm on many images and applied it for a video. Actually if we apply a filtering technique on a frame then the filtering is applied on the entire frame but in this project it applies individually on a block without effecting the entire frame.

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