Research Paper on Edge Detection using Block Based Segmentation

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Abstract— Edge detection is an important image processing technique with wide range of applications. Several edge detection algorithms have been developed in the past few decades, however no single algorithm is suitable for all types of applications. Face recognition is one such important application in which edge detection plays a key role. Edge maps help in representing faces as a single unit. Here we survey the existing edge detection techniques and their suitability for extracting edges from facial images under noisy conditions. Then we introduce the proposed algorithm which is optimized for extracting edge maps from facial images under normal and noisy conditions. The proposed method is optimized for extracting edges from images corrupted by various types of noises. Performance of several existing edge detectors is severely degraded under noisy conditions. However, using the proposed method we are able to consistently detect good quality edge maps under various levels of noises.

Key words: Edge Detection, Soble Method, Canny Filtered Method and Block Matching Method etc

I. INTRODUCTION

An edge is generally defined as the boundary or contour at which a significant change occurs in some physical aspect of the image. Changes in physical aspect manifest themselves in a variety of ways such as changes in intensity, color and texture. The variations in physical aspect can be caused by discontinuities in depth, surface orientation, changes in texture (material properties), variations in illumination etc. Edge detection is the process of characterizing the intensity changes in an image in terms of the physical processes that have originated them. An edge detection system is dependent on a variety of factors like the application or context in which it is used, noise in the source image and level of edge details required. Face detection and localization is the task of checking whether the given input image contains any human face, and if so, returning the location of the human face in the image. Face detection is difficult mainly due to a large component of non-rigidity and textural differences among faces. The great challenge for the face detection problem is the large number of factors that govern the problem space. The long list of these factors include the pose, orientation, facial expressions, facial sizes found in the image, luminance conditions, occlusion, structural components, gender, ethnicity of the subject, the scene and complexity of images background. The scene in which the face is placed ranges from a simple uniform background to highly complex backgrounds. In the latter case it is obviously more difficult to detect a face. Faces appear totally different under different lighting conditions.

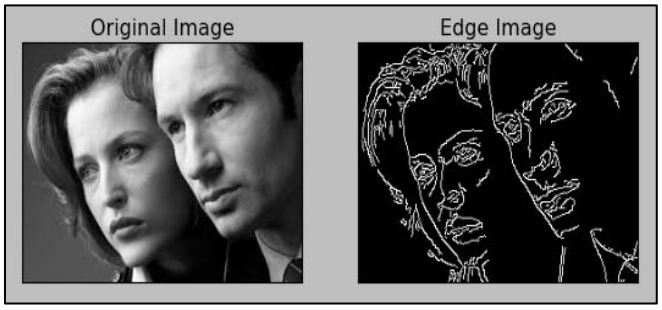

Fig.1.1: Edge detection of face image

Edge detection is one of the fundamental operations when we perform image processing. It helps us reduce the amount of data (pixels) to process and maintains the structural aspect of the image.

II. BASIC FUNDAMENTAL ALGORITHM USED

A. *Morphological Reconstruction Filters*

Reconstruction is a morphological transformation involving two images and a structuring element (instead of a single image and structuring element). One image, the marker, is the starting point for the transformation. The other image, the mask, constrains the transformation. The structuring element used defines connectivity. In morphological opening, erosion typically removes small objects, and the subsequent dilation tends to restore the shape of the objects that remain. However, the accuracy of this restoration depends on the similarity between the shapes and the structuring element. The method discussed in this section, opening by reconstruction, restores the original shapes of the objects that remain after erosion. The geodesic dilation represented by

$$D_B^i(f, f_r) = \min(f \oplus B, f_r)\ i = 1,2,3, \ldots \ldots \quad (1)$$

$$E_B^i(f, f_r) = \min(f \ominus B, f_r)\ i = 1,2,3, \ldots \ldots \quad (2)$$

Here a stopping criterion is denoted by:-

$$D_B^n(f, f_r) = D_B^{n-1}(f, f_r)\ and\ E_B^n(f, f_r) = E_B^{n-1}(f, f_r)$$

Output of the last iteration known as dilation and erosion both are termed as $D_{rcc}(f, f_r)$ and $E_{rcc}(f, f_r)$.

$$D_{rcc}(f, f_r) = D_B^n(f, f_r) \quad (3)$$

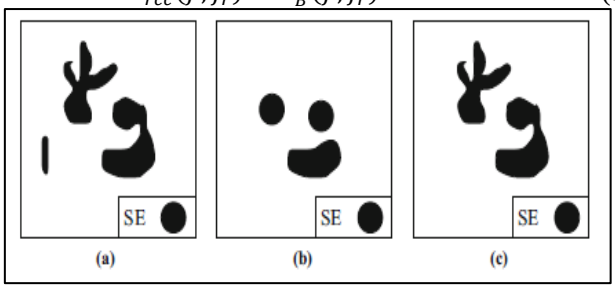

Fig. 2: a Original image b Result of conventional openingusing a disk SE c Result ofopening with reconstruction using the same SE

$$E_{rcc}(f, f_r) = E_B^n(f, f_r) \quad (4)$$

Open by reconstruction and close by reconstruction both are two most important filtering operations denoted by $(f \circ B)_{rcc}$ and $(f \cdot B)_{rcc}$

$$(f \circ B)_{rcc} = D_{rcc}(f \circ B, f) \quad (5)$$

$$(f \cdot B)_{rcc} = E_{rcc}(f \cdot B, f) \quad (6)$$

B. Coefficient of Variation

The coefficient of variation is a measure of spread that describes the amount of variability relative to the mean. Because the coefficient of variation is unit less, you can use it instead of the standard deviation to compare the spread of data sets that have different units or different means.CV is formulated as the ratio of the standard deviation σ to the mean μ:

$$\text{Coefficient of Variation (CV)} = \frac{\sigma}{\mu} \quad (7)$$

C. Region Shrink–Merge

Region developing and region splitting–merging, on the basis of a few predefined criteria, are famous techniques used for photo segmentation. First one is, in popular, evaluated pixel-smart, while the second splits or merges the picture regions block-by means of-block using a quad-tree structure. Similarly, we have used a method of place shrinking and merging based totally on the block traits (e.g., local CV, neighborhood imply) without changing the location size as is completed in region splitting-merging technique.

Let $f$be a$N \times N$ that contains a set of image block $R_{GB,}$this is known s background and other set $R_{FG,}$ this is known as foreground and Q be a predefined criterion.

$$R_{FG} = R_{FG} - \{R_{FG}^i\} \quad if\ R_{FG}^i \text{Does not satisfy Q} \quad (8)$$

$$R_{FG} = R_{FG} \cup \{R_{FG}^i\}\ if\ \exists R_{neb}^j \in R_{BG} \text{ Satisfy Q } i \neq j \quad (9)$$

Here $R_{FG}^j \in$ four or eight neighbor of R_{BG}^i

III. PROPOSED METHOD

This thesis presented a one consecutive passes: (i) pass-1 coarsely selects the region of interest on the basis of CV and morphological filters. We have considered two levels due to the fact, in coarse segmentation, there may be an excessive threat of misclassification as (a) some authentic ridges laid low with poor contrast won't get detected, at the same time as (b) some ultimate ridge regions with excessive contrast may additionally get detected erroneously. These misclassified regions are rectified inside the 2d segment of the algorithm wherein region cut back–merge operation based totally on CV measure looks after the areas with high contrast, and low-quality areas, alternatively, are taken care of by another cut back–merge operation based at the neighborhood average grey cost.

A. Segmentation: Pass 1

1) Selection of ROI Using CV

Selection of ROI is a block-wise operation by using CV. The fingerprint input image size $N \times N$, is

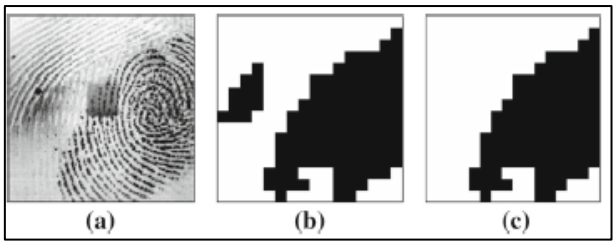

Fig. 3: aOriginal image b Primary selection of ROI using CV c ROI as the largest connected component

Segmented into different non -overlapping sub images blocks that must be an integer. Local CV is denoted by CV_L^i. Global CV is denoted byCV_G, that define the average of all the locally CV as;

$$CV_G = \sum_i^k i = 1\ CV_L^i \quad where, k = \frac{N \times N}{n \times n} \quad (10)$$

Each sub image block represented by

$$f_{sub} \in \begin{cases} R_{FG} if\ \left(\frac{CV_L^i}{CV_G}\right) \leq 1 \\ R_{BG}\ otherwise \end{cases} \quad (11)$$

Here $i = 1,2, \ldots\ldots, k$.

The choice manner of ROI based on CV, but, suffers from getting decided on some heritage areas as properly which have a high price of neighborhood CV. Therefore, we have included connected factor (CC) choice technique where the most important CC can be considered as the proper ROI. The filtering method is shown in Fig. 3.

2) Selection of ROI Using Morphology

Morphological filtering operations namely open and near with reconstruction are performed to figure out the ROI from an input image as a preliminary segmentation. The input fingerprint image is opened by a circular SE B1 with reconstruction followed by a closing with reconstruction using a circular SE B2. The output produces a blurred version of the input image in which (a) the noisy pixel in the background will be removed and (b) the regions with low contrast, removed by the CV-based filtering process, will be sustained. It is noted that $B1 > B2$.

After the morphologically filtered image is divided into *k*sub-image blocks,$\boldsymbol{f_{sub}(n \times n)}$, which calculate local average gray value

$$AGV_L^i = \frac{\sum_{p=0}^{n-1} \sum_{q=0}^{n-1} f_{sub}^i(x_p, y_q)}{n \times n}\ where\ i = 1, .. k \quad (12)$$

The set of local average gray values as:-\

$$ACV_G = \sum_{i=1}^k AGV_L^i \quad (13)$$

For removing ROI, threshold value T set as is the ratio of AGV_L^iandACV_G.

$$f_{sub} \in \begin{cases} R_{FG}\ if\ T \leq 1 \\ R_{BG}\ otherwise \end{cases} \quad (14)$$

3) Combining the Region of Interest

The two identified areas of interest obtained using specific filtering techniques, described formerly, are combined to obtain the overall ROI. The entire process is illustrated in Fig. 5 for a higher comprehension

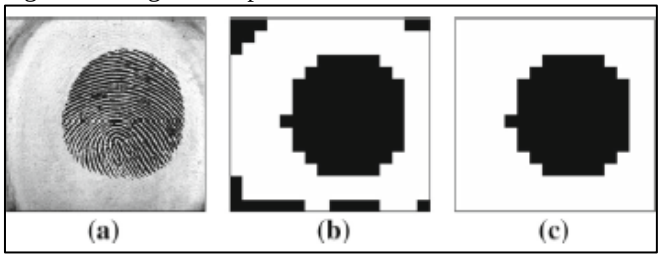

Fig. 3.1: aOriginal image b Primary selection of ROI using

morphological filters c ROI as the largest connected component

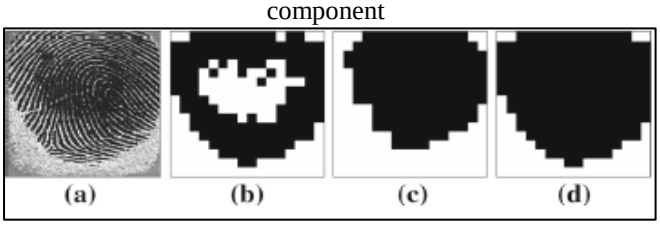

Fig. 3.2: a.Original image b.ROI selected by CV c.ROI selected by morphology d. Shows b ∪c

IV. RESULTS

This proposed method has block matching method for edge detection of the image. This method gives better results as compared to previous methods. The Canny operator was designed to be optimal edge detectors. It takes as input a gray scale image, and produces as output an image showing the positions of tracked intensity discontinuities. The Sobel operator performs a 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that correspond to edges. Salt and pepper this is also called "replacement" noise because some percentages of pixel values are just replaced by random numbers.

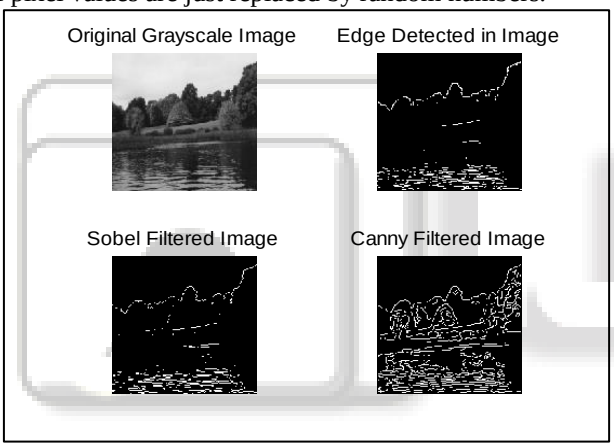

Fig. 4.1: a.Original grayscale image

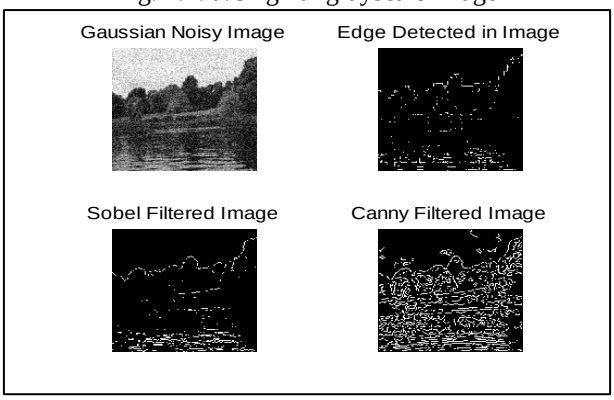

Fig. 4.1: b. Gaussian noisy image

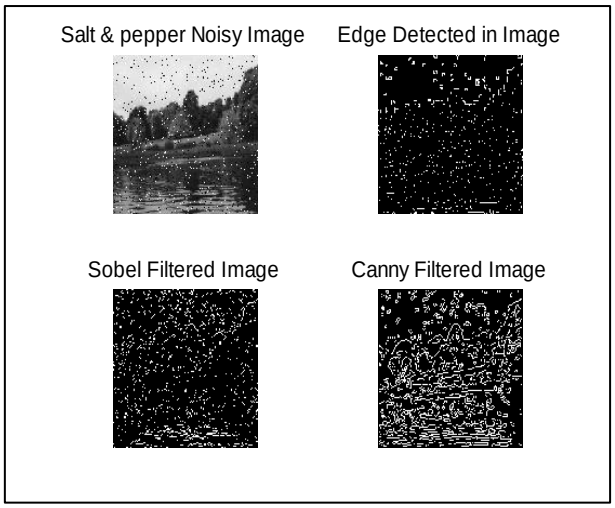

Fig.4.1.c. Canny filtered image

The above figure 4.1 shows original gray scale images, edge detection image, sobel filter image and canny filter image. In this figure original gray scale is an input image which is filtered by 3 methods. These methods give the better edge detection as compared to previous method.

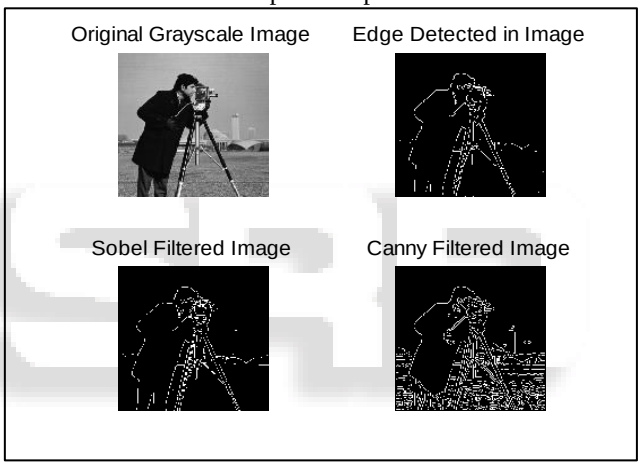

Fig. 4.2: a.Original grayscale image

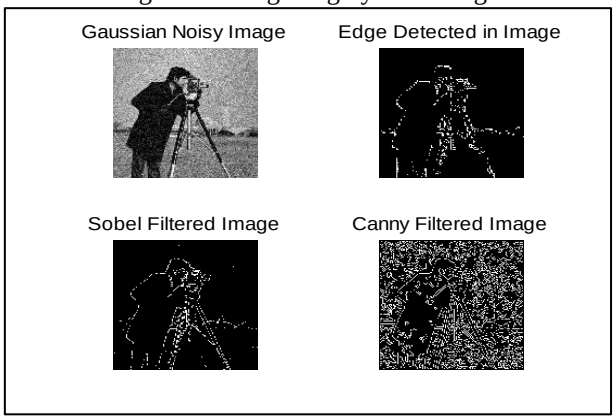

Fig. 4.2: b.Sobel filtered image

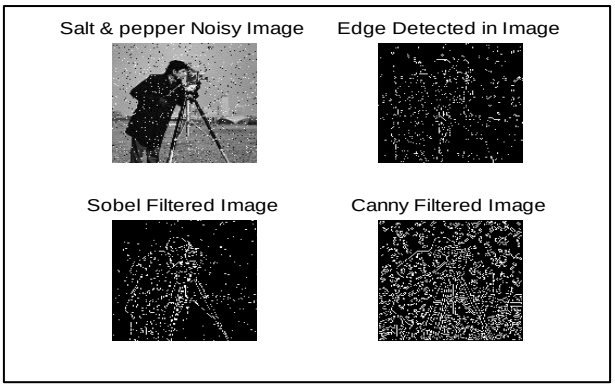

Fig. 4.3: c.Salt & pepper noisy image

In these above images Gaussian noisy image is used as an input which is converted into canny filtered image. But this conversion does not provide better edge detection as compared to block matching method. Same salt & pepper noisy image is used as an input; it also does not give better result.

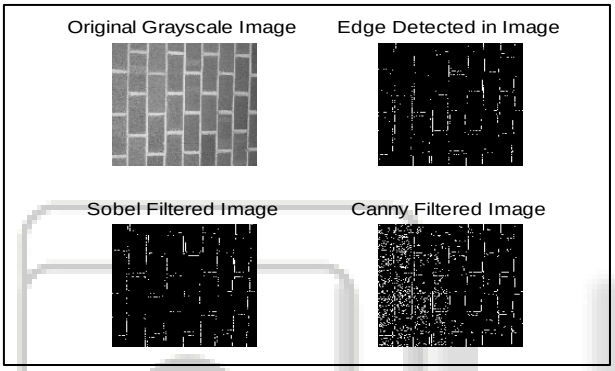

Fig. 4.4: a.Original gray scale image

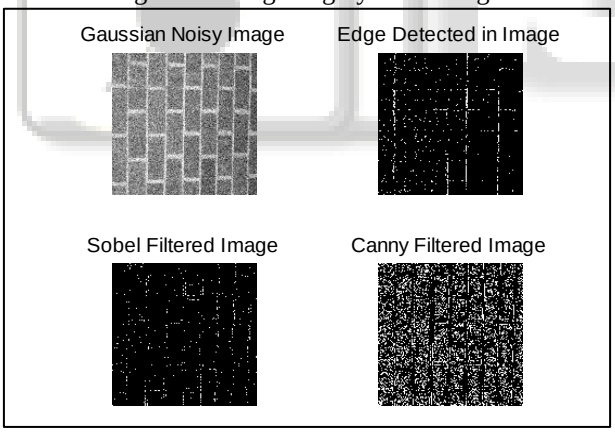

Fig. 4.4: b.Gaussian noisy image

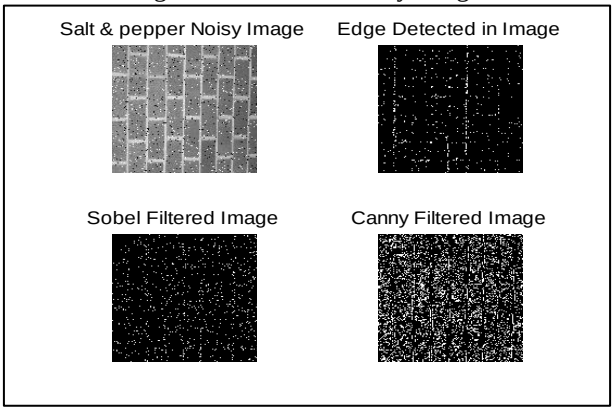

Fig. 4.4: c.Canny filtered image

In these above images original gray scale image which is used as an input and its edges are detected by edge detection method. But the output produced by this method does not provide efficient results. Same Gaussian noisy image is used as an input which is converted into canny filtered image. But this conversion does not produce better detection as compared to block matching method. Same salt & pepper noisy image is used as an input; it also does not give better result.

V. CONCLUSION

Since Edge detection is one of the most important techniques that have been commonly implemented in image processing. It is used in image segmentation, registration and identification of image processing. In this paper, we have studied block matching technique that provide better results for the image as compared to edge detection method, sobel method and canny filtered methods. The design of other methods has a very high robustness with respect to conventional block matching method effect, fast and accuracy.

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