International Journal of Advanced Research Methodology in Engineering & Technology, ISSN 2456 6446
Volume 1, Issue 3, May 2017

Smart CCTV Image Enhancement with Multiple Filtering Techniques

Ganesh K.E, A.Suresh Kumar
Computer Science and Engineering
Mahendra Engineering College
Namakkal, India
ganes@live.in

R.Venkadesh, K.S.Manojee
Computer Science and Engineering
Mahendra Engineering College
Namakkal, India

***Abstract*— Automated means of video surveillance for public safety enhancement have existed for quite some time but have gained significant popularity only in recent years. Enhanced awareness for public safety is leading to innovative research by making use of multimedia information and telecommunications for disaster and crime prevention and management of secure environments. However, often the image quality in the video surveillance systems is low and do not fulfill the application requirements. There is a need for smart CCTV surveillance system, where the system is intelligent enough to detect the changes in the live video stream using Image Comparison technique and segregates only the motion detected image. The motion detected images are of low quality due to sunlight exposure and outside noise. To enhance the quality of the image using the Image Filtering techniques to make them more suitable for further processing. In our proposed system, the Comparison is done using covariance Tracking and quality of the image will be improved using Median Filter and Homomorphic Filter, the median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing. Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise. The Homomorphic Filter is used to improve appearance of an image by simultaneous brightness range compression and contrast enhancement. This system, will provide a complete security and smart image processing system saves only the detected images and reduces the overhead of saving the entire video in hard disk. The image filters improve the image quality by removing noise and correcting brightness and contrast parameters.**

Keywords*— *Homomorphic Filter; Median Filter; Covariance Tracking;

I. INTRODUCTION

Digital image processing deals with manipulation of digital images through a digital computer. It is a subfield of signals and systems but focus particularly on images. DIP focuses on developing a computer system that is able to perform processing on an image. The input of that system is a digital image and the system process that image using efficient algorithms, and gives an image as an output.

An image is nothing more than a two-dimensional signal. It is defined by the mathematical function f(x,y) where x and y are the two co-ordinates horizontally and vertically. Most images are affected to some extent by noise, that is unexplained variation in data disturbances in image intensity which are either uninterpretable or not of interest. Image analysis is often sampled if this noise can be altered out. In an analogous way filters are used in chemistry to free liquids from suspended impurities by passing them through a layer of sand or charcoal. Engineers working in signal processing have extended the meaning of the term filter to include operations which accentuate features of interest in data. Employing this broader dentition, image filters may be used to emphasize edges | that is, boundaries between objects or parts of objects in images. Filters provide an aid to visual interpretation of images. Filtering is a technique for modifying or enhancing an image. For example, you can filter an image to emphasize certain features or remove other features. Image processing operations implemented with filtering include smoothing, sharpening, and edge enhancement.

II. NOISE AND IMAGE PROCESSING

Noise in image, is any degradation in an image signal, caused by external disturbance while an image is being sent from one place to another place via satellite, wireless and network cable. There are several types of noises,

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

A. Salt and pepper noise

It known as shot noise, impulse noise or Spike noise. Its appearance is randomly scattered white or black or both pixel over the image.

B. Gaussian Noise

Gaussian noise is caused by random fluctuations in the signal; it’s modelled by random values added to an image. This noise has a probability density function [pdf] of the normal distribution. It is also known as Gaussian distribution.

C. Speckle noise

It can be modelled by random values multiplied by pixel values of an image.

There are some fundamental steps of image processing:

A. Image Acquisition:

This is the first step or process of the fundamental steps of digital image processing. Image acquisition could be as simple as being given an image that is already in digital form. Generally, the image acquisition stage involves pre-processing, such as scaling etc.

B. Image Enhancement:

Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image. Such as, changing brightness and contrast etc.

C. Image Restoration:

Image restoration is an area that also deals with improving the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to be based on mathematical or probabilistic models of image degradation.

D. Morphological Processing:

Morphological processing deals with tools for extracting image components that are useful in the representation and description of shape.

E. Segmentation:

Segmentation procedures partition an image into its constituent parts or objects.

F. Object recognition:

Recognition is the process that assigns a label, such as, vehicle to an object based on its descriptors.

III. IMAGE FILTERING TECHNIQUES

The broad classification of Image Filtering techniques is,

G. Linear Filtering

Several principles define a linear system. The first two are the basic definitions of linearity. If a system is defined to have an input as x[n] = ax[n1] + bx[n2], then the linear system response is y[n] = ay[n1] + by[n2]. This is known as the superposition property, and is fundamental to linear system design. The second property is shift invariance. If y[n] is the response to a linear, shift-invariant system with input x[n], then y[n-n0] is the response to the system with input x[n-n0]. In addition, two extra conditions are imposed, causal and stable. The causal condition is needed when considering systems in which future values are not known (for example, in video streaming). It is possible to consider a system that is not causal when looking at captured images with samples before and after the target location (for example, in a buffered version of an image frame). Stability is imposed to keep a filter's output from exceeding a finite limit, given an input that also does not exceed a finite limit. This is called the Bounded-Input Bounded-Output (BIBO) condition.

H. Nonlinear filters

Nonlinear filters have quite different behavior compared to linear filters. For nonlinear filters, the filter output or response of the filter does not obey the principles outlined earlier, particularly scaling and shift invariance. Moreover, a nonlinear filter can produce results that vary in a non-intuitive manner. The simplest nonlinear filter to consider is the median or rank-order filter. In the median filter, filter output depends on the ordering of input values, usually ranked from smallest to largest or vice versa. A filter support range with an odd number of values is used, making it easy to select the output. For example, suppose a filter was based on five values. In the region of interest, x0.x4, the values are ordered from smallest to largest. The value at position 2 is selected as the output. Consider the case at low frequency; all the values are the same or close to it. In this case, the value selected will be the original value ± some small error. In the case of high frequency, such as an edge, the values on one side of the edge will be low and the values on the other side will be high. When the ordering is done, the low values will still be in the low position and the high values will still be in the high position. A selection of the middle value will either be on the low side or the high side, but not in the middle, as would be the case using a linear low-pass filter. The median filter is sometimes called an edge-preserving filter due to this property. It is useful in removing outliers such as impulse noise.

I. Median Filter

At each pixel in a digital image we place a neighborhood around that point, analyze the values of all the pixels in the neighborhood according to some algorithm, and then replace the original pixel's value with one based on the analysis performed on the pixels in the neighborhood. The neighborhood then moves successively over every pixel in the image, repeating the process. The median filter is a sliding-window spatial filter. The median filter is normally used to reduce noise in an image, somewhat like the mean filter. However, it often does a better job than the mean filter of preserving useful detail in the image. This class of filter belongs to the class of edge preserving smoothing filters which are non-linear filters. Below example shows the illustration of Median Filter.

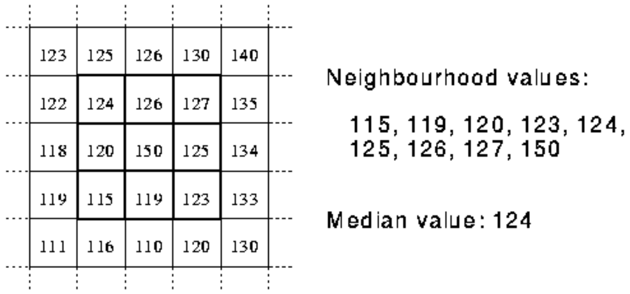

Fig. 1. Median Filter

The median is calculated by first sorting all the pixel values from the surrounding neighborhood into numerical order and then replacing the pixel being considered with the middle pixel value. (If the neighborhood under consideration contains an even number of pixels, the average of the two middle pixel values is used). A template of size 3x3, 5x5, 7x7, etc. is applies to each pixel. The values within this template are sorted and the middle of the sorted list is used to replace the templates central pixel.

J. Homomorphic Filter

If the image model is based on illumination-reflectance, then frequency domain procedures are not as easy to perform. The main reason is that illumination and reflectance components of the model are not separable. To be able to improve appearance of an image by simultaneous brightness range compression and contrast enhancement it is necessary to separate the two components. As you recall, an image can be modelled mathematically in terms of illumination and reflectance as follows,

$$\mathbf{F(x,y) = I(x,y)*R(x,y)}$$

where F is the images, I is scene illumination, and R is the scene reflectance. Illumination is the amount of source light incident on the scene being viewed and denoted as I(x,y). Reflectance is the amount of light reflected by the objects in the scene and denoted as R(x,y), where * is the multiplicative noise High Pass is one such technique for removing the multiplicative noise. Before applying high pass filtering we generally take the logarithmic values of the both the sides.

The Fourier transformed signal is processed by means of a filter function H(u,v) and the resulting function is inverse Fourier transformed. Finally, inverse exponential operation yields an enhanced image. This enhancement approach is termed as homomorphic filtering. The below figure shows the structure of Homomorphic Filter.

IV. NEEDS FOR CCTV VIDEO RECORDING

A Video surveillance is a rather broad concept. Apart from safety and security, video surveillance has a wide variety of applications in numerous other aspects of life. Digital video pays a pivotal role in a myriad of surveillance applications. Automated means of video surveillance for public safety enhancement have existed for quite some time but have gained significant popularity only in recent years.

Enhanced awareness for public safety is leading to innovative research by making use of multimedia information and telecommunications for disaster and crime prevention and management of secure environments. Because human beings are typically an important surveillance target, detecting humans, notably pedestrians, is a very relevant task which must be accomplished with a good performance.

V. SMART CCTV IMAGE AND VIDEO RECORDING

A new generation of video surveillance is emerging with innovative functionalities aided by new scientific rigor in areas such as communication, compression, data mining, content-based video retrieval, machine learning, and pattern recognition. Tracking humans, objects, and motion, for instance, can provide several assistive means in social environments, such as helping disabled people and enhancing manufacturing productivity. Identifying, tracking, and monitoring activities can lead to behavior analysis and understanding. All of this, in turn, is leading to new applications of surveillance in homeland security and crime prevention through indoor and outdoor monitoring and monitoring of critical infrastructures, highways, parking garages, and shopping malls.

Several research challenges arise in system design for collection and dissemination of video data as well as algorithms for processing the data collected, for its meaningful interpretation in the ongoing context and for carrying out automated security services accordingly.

VI. PROPOSED SYSTEM DESIGN

This paper proposes a Smart way of using CCTV security system with Image processing techniques such as, Covariance Tracking for Image comparison to identify intruders and to avoid redundancy. Then Filtering Techniques like Median Filtering and Homomorphic Filtering are used to enhance the image to the best. Median filter is the best filter to remove salt and pepper noise from CCTV image. Homomorphic filtering is to make corrections in illumination-reflectance parameter of the image. The following modules were developed.

A. CCTV RECORDING

CCTV camera or a Web camera video is connected to our application using Java Media Framework-JMF, which acts as an interface between System and video capturing devices. System is designed to show the real time video to the security person or the user. In the background system runs the image comparison algorithm to detect changes frames by frames from in main memory. If any changes identified, Then the motion detected frames is saved into hard disk and video if required.

B. *FRAME SEPERATION*

The image seperation is done in main memory using the Covariance Tracking algorithm, where at a given frame, System will calculate the Covariance Matrix and compared with the current frame with minimum covariance distance. Using FrameGrabbingControl class frame is grabbed. Frame is stored as image in separate folder. BufferToImage class is used to store image to secondary memory. Covariance Tracking comparison is the best and easy to implement with minimal hardware requirement.

C. *IMAGE FILTERING*

This proposed system uses Multiple filtering techniques as a part of image enhancement. Often, CCTV images are always noisy with visul defects caused by over brightness. System is using the Median Filter for removing the noise, which is the easy in implemetation and have good accuracy in output. Homomorphic filtering technique is applied to correct the luminance and reflectance parameter of the image. Filters are applied based on requirement. Filters are designed using MatLab library.

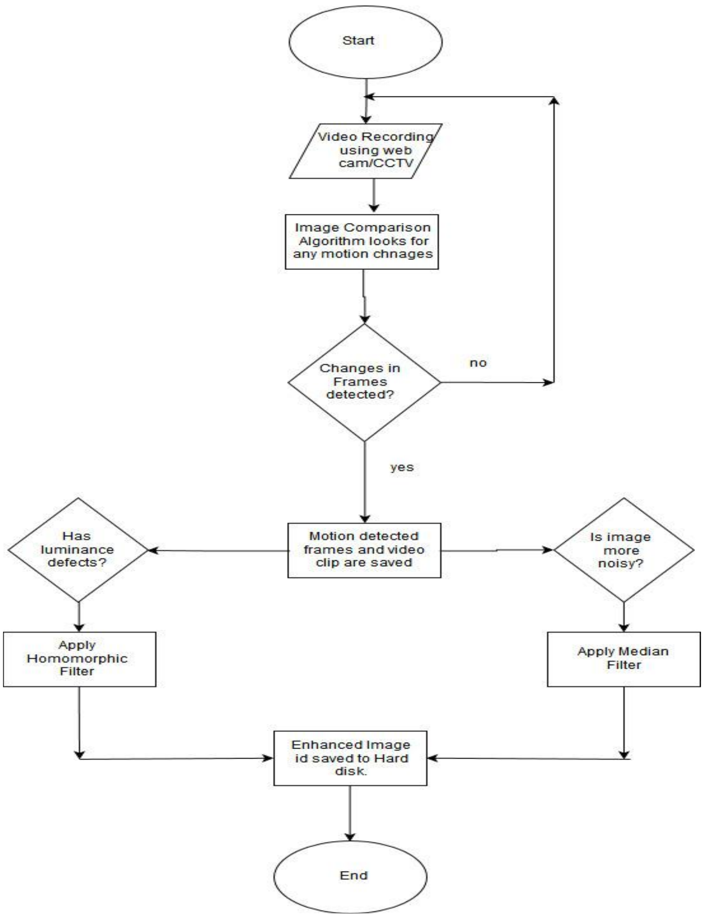

Fig. 2. System Flow chart

VII. EXPERIMENTAL AND RESULTS

In this System, all the motion detected frames are converted to images and are saved initially, then applied filter to compare the results,

a) No enhancement (NE), this process is the raw images obtained from CCTV using image comparison with no filtering process (Fig. 3a, Fig. 3b, Fig. 3c).

b) Median Filtering (MF), standard median filtering of raw images using standard median algorithm. (Fig. 4c.).

b) Homomorphic filtering (HM), standard homomorphic filtering of raw normalized images will be processed using Gaussian high-pass filter 0.25 (Fig. 4a. , Fig. 4b.).

NE:

Fig. 3.a. Sample1

NE:

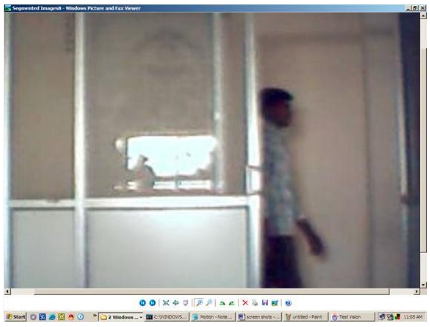

Fig. 3.b. Sample2

NE:

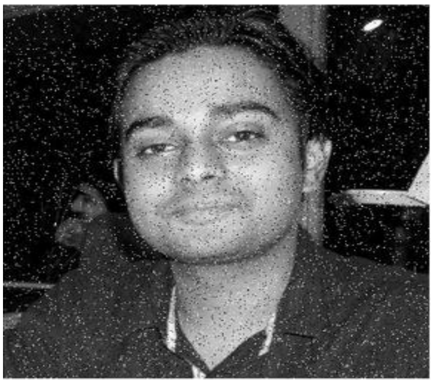

Fig. 3.c. Sample3

HM:

Fig. 4.a. Filtered image

HM:

Fig. 4.b. Filtered image

MF:

Fig. 4.c. Filtered image

VIII. CONCLUSION

There is a need of Smart CCTV system in our daily life. This paper proposed automatic means of video surveillance with image detection techniques to identify the intruder and image enhancement with multiple filtering techniques. The filtered image are noise free with enhanced brightness and contrast. The PSNR measurements shows that the proposed filtering techniques are having good performance in terms of quality.

IX. REFERENCES

[1] Sunil Khatri, Hemant Kasturiwale, “Quality Assessment Of Median Filtering Techniques For Impulse Noise Removal From Digital Images”, 2016

[2] Fan Liao, Ruichang Li, "An Improved Image Segmentation Algorithm Based On Rough Set", 2016

[3] Sanjib Das, Jonti Saikia, Soumita Das and Nural Goni "A Comparative Study Of Different Noise Filtering Techniques In Digital Images", 2015

[4] Maleerat Sodanil , Chalermpong Intarat, "A Development Of Image Enhancement For Cctv Images", 2015

[5] Youlian Zhu, Cheng Huang, "An Improved Median Filtering Algorithm For Image Noise Reduction", 2015

[6] Khaled M Mohamed, Russell C Hardie,"A Collaborative Adaptive Wiener Filter For Image Restoration Using A Spatial-Domain Multi-Patch Correlation Model Ifs", 2015

[7] Yi Lin, Michael D. McCool, Ali A. Ghorbani, "Enhancement Of Ir Images Using Homomorphic Filtering In Fast Discrete Curvelet Transform (Fdct)", 2014

[8] Boonthum Pathajarukul, Nima Bigdely-Shamlo, "Fundamentals Of Digital Image Processing", 2014

[9] I. Ahmad, Z. He, et al., “Special Issue on Video Surveillance,” IEEE Transactions on Circuits and Systems for Video Technology, 2012.