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Motion Detection and Tracking using Background Subtraction and Consecutive Frames Difference Method

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Abstract: *Recently security concerns have grown tremendously, it is important for all to be able to safeguard their property from worldly harms such as thefts, destruction of property etc. As the technology is widely growing in modern world, the methodologies used by thieves and robbers also equally improved in stealing. Therefore, it is necessary for the surveillance techniques also to be improved with the changing world. The latest technologies used against theft and destruction are the video surveillance and monitoring. A new methodology has been developed to detect the motion in a live video stream environment.*

The motion detection system is implemented for real time applications, background subtraction method and frame difference methods are used for detecting the motion from video frames. In this system, motion is detected from the real time video. Motion detection is usually a software-based monitoring system which, when it detects the motion will signal the surveillance camera to begin capturing the event or shows the motion detection using graphical method or by indicating an alarm. Background motion detection method is a simple method for motion detection by a fixed camera which compares the current image with a reference image or background image pixel by pixel. The values of pixels in difference image is compared with threshold value and if the pixel value is more than threshold value then it means there is motion in the area being monitored.

Keywords: *Background subtraction, consecutive frame difference, motion detection, motion tracking, and threshold comparison method.*

1. INTRODUCTION

The rapid development in the field of digital image processing, motion detection and tracking are attractive research topics. In recent years, real-time video applications were inapplicable due to the expense computational time. Where an intelligent method to analyze the motion in a video stream line using the methods of background subtraction, frame differencing, and optical flow, methods are proposed. This system is designed to detect and track any moving event in a frame automatically.

Organizations, commercial places and residential areas need to secure their facilities; this can be achieved by using security monitoring system with latest technology. An intelligent video sensor (Motion detector) was developed to support the monitoring security systems to detect unexpected movement without human intervention. The conventional systems are mostly human based, and it has its drawbacks. In order to eliminate this issues a technically enhanced security system need to be incorporated.

Therefore this gave raise to the need of the security system, where new techniques were used in these security systems which are based on event movement (Motion). Detection of the movement, location,

speed and any desired information of the event from the captured frames can be taken from the camera and can be transferred to the analysis part of the system. Motion detection is one of these intelligent systems which detect and track moving events. Where cameras capture the images of the securing area workspace; these images are processed to detect the event .Many algorithms and techniques have been used to perform this process and improve its outcome.

Motion detection system is one among the latest technologies used for security purpose. This is broadly used in many computer vision tasks like pose estimation, human tracking and face recognition, these are all the basic part of computer vision tasks. By using this technology, it is possible to monitor and capture every motion accurately/precisely in the area of interest.

Motion detection is a process of confirming a change in position of an object relative to its surroundings or the change in the surroundings relative to an object. It is applied to various domestic and commercial applications starting from simple motion detectors to high speed video surveillance systems. The main task of a motion detection system is to detect an motion present in an "area of environment being monitored".

2. OBJECTIVE

The main objective of this paper is to detect the present motion in an area of environment being monitored, motion detection works on the basis of frame differencing.

Background motion detection is a simple method for motion detection with the help of a fixed camera and it compares the current image with a reference image or background image pixel by pixel and counts the number of changes in the pixels. If the numbers of pixel changes are more than the threshold value then the motion is detected. Consecutive frame subtraction method simply compares the current image with previous image to find the change in value of pixels.

3. IMAGE PROCESSING

Image processing - a moving horizon! Walking towards a horizon is open ended. The horizon never gets any closer to us, but continually falls back to us. This results in the growth of image processing, as a technical condition, where constant progress is being made. Until years of image processing the concern was with basic phenomena, for example, making the models for compression of image data, restoration of image and image enhancement. Recently there is a great interest in moving beyond physical phenomena.

The research in the branch of image processing is the field of a digital-image processing that has experienced dramatic growth and increasingly widespread applicability. As advances in computer technology have kept pace with the rapid growth in volume of image data and other applications.

Digital-image processing has become economical in many fields of research and in industrial applications. Where each application had unique requirements from the others and all are much concerned with faster, cheaper, accurate, and much extensive computation. Now a days, trend is towards the real-time and interactive operations, where the user of the system obtains preliminary results within a short period of time and thus the next decision can be made by the human processor without loss of concentration on the task at hand.In imaging science image processing is any form of signal processing for which the input is an image, such as a photograph or video frame , the output of image processing may be either an image or a set of characteristics or parameters related to the image. Image processing generally refers to the digital image processing.

Image processing is a physical process which is used to convert an image signal, either digital or analog signal into a physical image. The actual output itself an actual physical image or the characteristics of an image. The most commonly used processing is photography, in which an image is captured by using an camera to create a digital or analog image. In order to obtain a physical picture, the image is processed by using the appropriate technology based on the input source type.

Image processing is also defined as a method to convert an image into digital form and perform some operations on image in order to get an enhanced image or to extract some useful information from the image. Now a day's image processing is widely used in varied field of applications. Recently, image processing is used in security sector with applied different methods.

3.1. Image Acquisition

Acquiring an image in real time from a web cam or any camera source is quite simple and it can be done with few lines of simple code. It is interesting to know about the camera before to use it and it is required to know about Image actualization hardware info.

>> **imaqhwinfo**

ans =

InstalledAdaptors: {'gentl' 'gige' 'matrox' 'winvideo'}

MATLABVersion: '8.1 (R2013a)'

ToolboxName: 'Image Acquisition Toolbox'

ToolboxVersion: '4.5 (R2013a)'

>> **imaqhwinfo('winvideo',1)**

ans =

DefaultFormat: 'MJPG_1280x720'

DeviceFileSupported: 0

DeviceName: 'HP Truevision HD'

DeviceID: 1

VideoInputConstructor: 'videoinput('winvideo', 1)'

VideoDeviceConstructor: 'imaq.VideoDevice('winvideo', 1)'

SupportedFormats: {1x10 cell}

4. Methodology

This section explains the motion detection method used to detect the motion.

4.1. Preprocessing

A new method is proposed which is a combination of both background subtraction method and consecutive frame subtraction method. In this method background image is formed by taking the mean value of previous consecutive frames and then current image is compared pixel wise with the background image to detect motion. The different approaches used in detection of motion are background subtraction method, consecutive frames and threshold comparison method.

For Motion detection, the steps followed in this process are mentioned in flow chart:

The main focus of this work is to obtain a background image from previous consecutive frames in real time by trigger method. Where the current image is compared pixel wise (pixel by pixel) or subtracted from background image to detect any motion. The image obtained after subtraction is called Difference Image. Values of pixels can be either positive or negative in difference image. Therefore implicit of difference image is taken and then values of pixels in difference image is compared with threshold value, then if the pixel value is more than threshold value then it means there is motion in the area being monitored and motion is detected. This method continuously keep making background image using previous frames in real time.

To make it practical and useful warning system, graphical method is used. This approach will also show the number of objects detected in motion and percentage area of total area in which motion is present. This method (background image formation and motion detection process) happens in while loop because it has to continuously detect the motion in real time, it will not stop until required. This method will bring some robustness in motion detection because previous background subtraction method is very sensitive to the very little motion that can be called noise.

A simple algorithm for motion detection is done by a fixed camera which compares the current image with a reference image and counts the number of different pixels. As images will naturally differ due to some factors such as light varying, flickering of camera , and dark currents in CCD is also used to reduce

the number of false positive alarms method has real-time detection speed and high detection accuracy, but needs long training time.

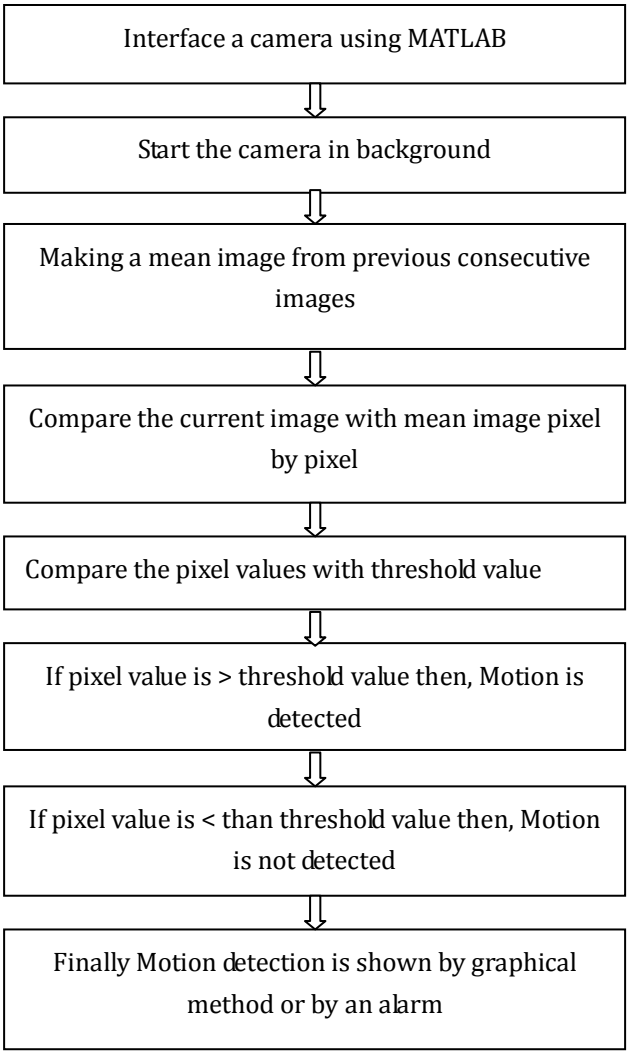

Figure 1. *Flow Chart of the System*

There are two possible approaches which is used for indication of motion detection, one is by blowing an alarm once motion is detected and second is by using graphical method.

4.2. Approach

4.2.1. Background Subtraction

Image subtraction is one of the popular techniques in image processing and computer vision technology. Generally image subtraction can be represented as:

$$\Delta I\ (i,\ j) = I_{Curr}(i,\ j) - I_{Prev}(i,\ j)$$

Where $\Delta I(i,j)$ is the difference in image intensity between two consecutive frames. $I_{Curr}(i,j)$ and $I_{Prev}(i,j)$ represent image intensities for current and previous frames respectively. Background subtraction, is also known as Foreground Detection. It is a technique in the fields of image processing and computer vision where in an image foreground is is extracted for further processing (object recognition etc.). Background subtraction is a widely used method for detecting the moving objects in videos from static cameras. The main task in this approach is that of detecting the moving objects from the difference between the current frame and a reference frame, often called "background image". This method (background subtraction) is most commonly used method for motion detection. In this technology it uses the difference of the current image and the background image to detect the motion region, and it is able to provide the data included object information.

4.2.1. Consecutive Frame Difference Method

Detection of moving object from a sequence of frames is captured from a static camera which is widely performed by frame difference method. The task of this approach is to detect the moving objects from the difference between the current frame and the reference frame. The frame difference method is commonly used method for detection of motion. This method adopts pixel by pixel based difference to find the moving object.

5. SOFTWARE REQUIREMENTS AND DESCRIPTION

5.1. Software Requirements

- Operating System: Windows 7
- Language: MATLAB programming language
- Software Packages: MATLAB R2010 & above

MATLAB is an integrated technical computing environment which combines numerical computation, advanced graphics and visualization, and an high level programming language. The MATLAB programming language is used to store the data in the form of matrices. MATLAB can provide an quick interface with the data matrices. This software provides an frame acquisition from hardware devices such as web cams or digital cameras as long as the devices are correctly initialized by the user. In order to allow quick setup with the image acquisition devices, MATLAB function directory will provides an host of predefined functions by which the user can enquire about the various different devices which are currently connected and then setup is made with the required device using MATLAB, so that it can acquire and store data at run time.

6. EXPERIMENTAL RESULT

To fulfill our proposed work, we have used computing software called MATLAB, because MATLAB provides Image Acquisition and Image Processing Toolboxes which facilitate us in creating a good GUI and an excellent code. Using a video input object, live data is acquired and analyzed to calculate any motion between two adjacent image frames. Any movements (motion detection) in the image stream are plotted in a MATLAB figure window. The result of the image sequences computed by proposed method here is shown in the following figures.

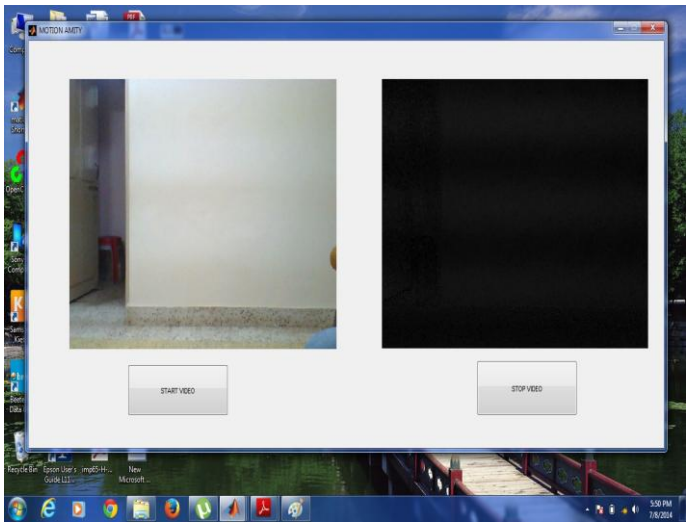

Figure 2. *Input first frame when there is no movements in the frames*

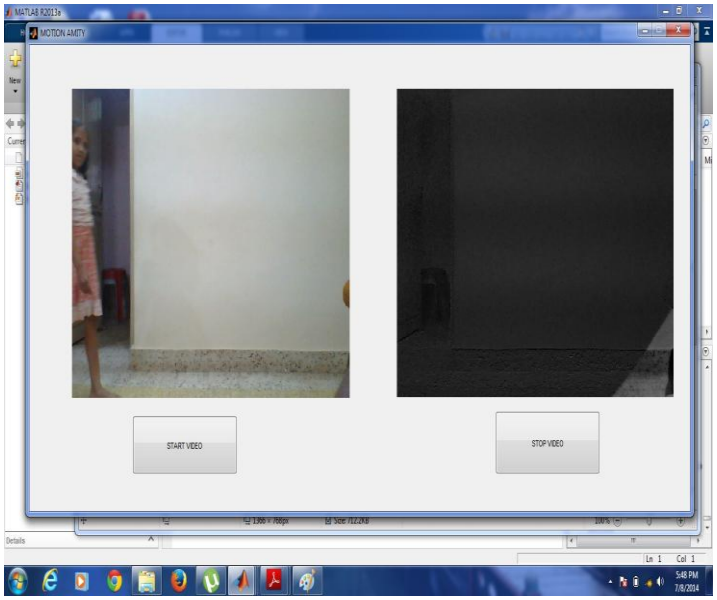

Figure 3. *Input first frame when there is movements in the frames*

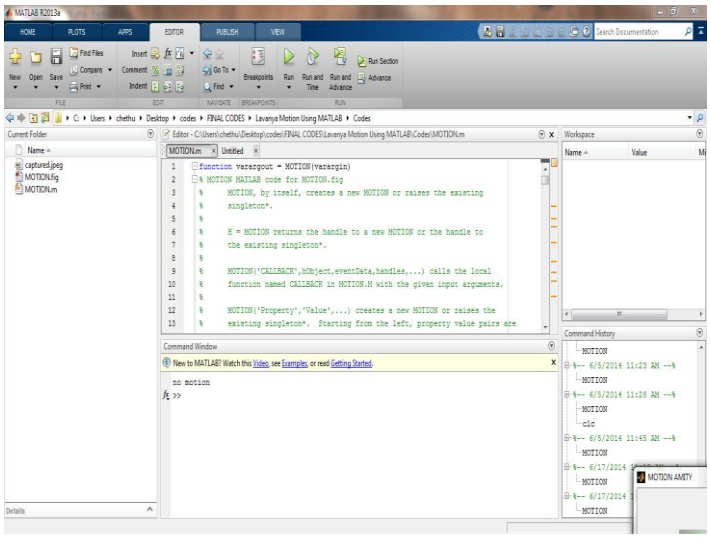

Figure 4. *Indication of no motion*

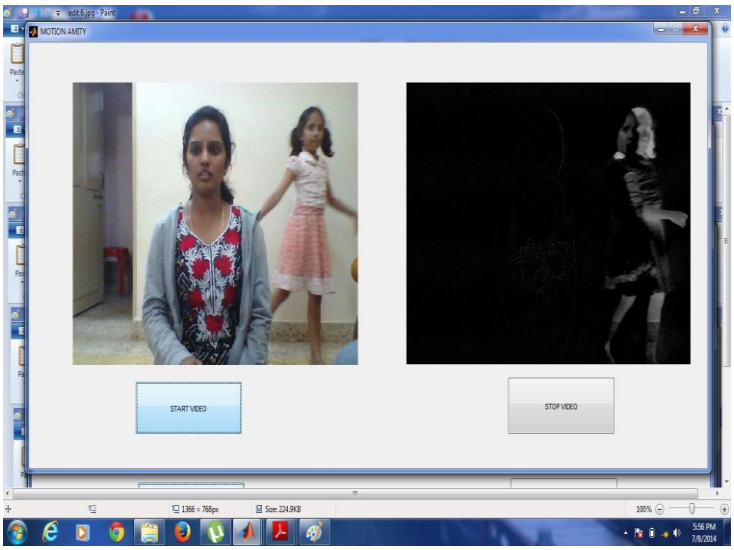

Figure 5. *Difference between two frames showing moving object with binary image of difference image*

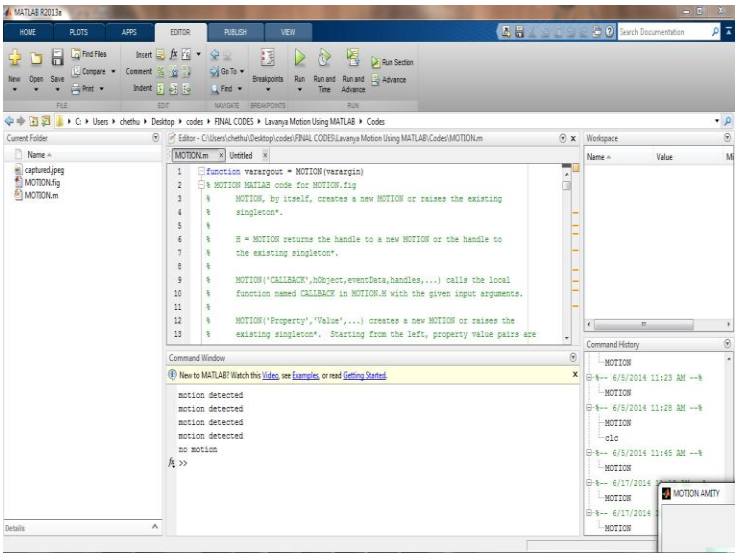

Figure 6. *Indication of motion Detected*

7. CONCLUSION

In our paper, a new approach is proposed to detect the motion using background subtraction and frame difference method. An video monitoring and detection system is developed successfully, which provides an efficient method for surveillance purposes and it is aimed to be highly beneficial for any person or organization. The system is adjustable to the camera movements which were shown as detected motion in other approaches because of their over sensitivity. Experimental results showed that the proposed method is more robust in nature as it can avoid the noise in motion detection. Therefore this method is useful to reduce the number of false positive alarms.

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