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Video Surveillance System for Home and Border Security

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Abstract:
In today's world where crime rate is increasing day by day, the security concerns have grown. Security of home and border areas is very important. Increasing military conflicts between nations, illegal immigrants, terrorist activities, burglary and theft, etc. Monitoring such areas is very important and is currently mostly done by using man power and a bit of technology. The purpose of this project is to eliminate the man power and introduce technology in the process completely. The system can detect motion from live video, and alert the user when a motion is detected.

Keywords: Motion Detection, Video Surveillance, Security.

I. INTRODUCTION

Security has always been an issue to the mankind. Especially in today's world where crimes are increasing, security becomes a major concern to us. Security of both our homes and borders of our nation is important. With significant increase in crimes like theft, burglaries in our homes and military conflicts between nations over the borders, illegal migrants and border infringements, terrorism, strict actions need to be taken. Video surveillance is a good option. And various systems are available today for the same. Earlier to video surveillance, personnel were deployed for surveillance of home areas, borders and no-man zones. But it requires a lot of manpower and money and is not that efficient. Video surveillance overcomes various problems like this. It require very less manpower and is also economical. It enables us to monitor our homes, borders and areas where deploying a person is not possible. Such areas can be monitored from distant location. Video surveillance systems earlier used CCTVs and the storage media were tapes, VCR, CDs. The problem with these storage devices is limited space. But advancement in technology has given us other storage devices like HDD, SSD. They have huge storage capacity. Also compared to the earlier storage devices, they are cheap, fast and reliable. Tapes, VCR cassettes are expensive compared to the storage size they provide. Also the current systems store the entire recordings on the storage devices which is not actually necessary as it takes a lot of space. The recording of the moment of the when a motion is detected is enough. It saves a lot of space. Also the motion detection algorithms like Normalized Cross Correlation (NCC), Sum of Absolute Difference (SAD) are not that efficient. We propose a different approach of motion detection by using several different algorithms like Grayscale Algorithm, Frame Subtraction, and Blob Detection. Also using IR sensors, motion detection capability of the system is extended to low light conditions.

1) Image Processing

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modelled in the form of multidimensional systems. Image processing refers to quantitative analyses and/or algorithms applied to digital image data. Image processing methods are becoming increasingly sophisticated and the tendency is to develop as much automation as possible. A common goal of image processing techniques applied to neuroimaging is to improve detection of abnormal brain tissue, including abnormalities that may not be readily recognizable by visual analysis alone.

2) Problems

Low light conditions

Problem arises in a motion detection system especially in low light conditions. As not all the cameras have low light capability. Using IR sensors for motion detection is a good option.

Efficiency

When more than one object is present in the field of view of the camera, detecting multiple objects is very difficult. So a need for efficient object detection algorithm is needed.

II. SYSTEM FUNCTIONALITY

A. Previous Work

Motion Detection is one of the most important aspect in the world of modern security and monitoring. This paper is an extension to work proposed by Chandana S. Different we use different algorithms to detect and track motion from the video feed through the camera and also using IR sensor.

B. System Architecture

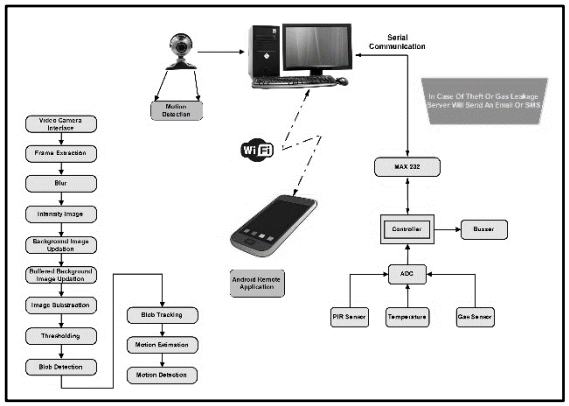

Figure.1. System Architecture

The system consists of a camera, IR sensor, Temperature sensor, Gas sensor, Microcontroller and Local server and a computer to run the software for motion detection. Algorithms used in the system are Grayscale Algorithm, Threshold Algorithm and Blob Detection Algorithm. The video input from the camera is given to the software. Then the algorithms are applied to the live video feed and motion is recognized. First a frame is extracted from the feed, then it is blurred and an intensity image is generated. After which is the background is image is updated which is used later for motion detection. The blurred image is set as the background image. Then the next frame is extracted and is compared with the background image, this is call image subtraction. After which the current frame is subjected to thresholding which is needed for blob detection. These same procedures are applied for every current frame which gives blob tracking which is later used for motion estimation and motion detection. When the motion is detected, the user app receives a notification alerting about the motion detection. The IR sensor comes into effect or are used for night conditions. The input data of the sensor is given to the microcontroller which then processes the data and gives it to the software. User can access the live feed wirelessly through the mobile app. The desktop software sends the live feed of the camera to the mobile application wirelessly through the local network or over the internet.

C. Proposed Algorithm

1. Take the video feed from the camera as input.
2. Extract a frame from it, and set the current frame as the Background image.
3. Take the next frame and compare it with the background frame using Image Subtraction and Blob Detection.
4. When the motion is detected, track the object comparing the consecutive frames. Alert the user through email.
5. Goto Step 1.

III. MOTION DETECTION FORMAT

We have used four algorithms to in our motion detection system. They are to be used together because each algorithm need result of some other algorithm for working.

1) Grayscale Algorithm

The grayscale algorithm uses the pixel separation formula. For a RGB image, a pixel contain RGB values storedin it, which are needed here.

Pixel Separation Formula:

$$R = (col >> 16)\ \&\ 0XFF$$
$$G = (col >> 08)\ \&\ 0XFF$$
$$B = (col\ \&\ 0XFF)$$
$$Avg = \frac{R+G+B}{3}$$
$$R = G = B = Avg$$

2) Threshold Algorithm

Image thresholding is a simple, yet effective, way of partitioning an image into a foreground and background.

```
if(Avg<Th)
col=black
else
col=white
```

3) Image Subtraction Algorithm

Image subtraction or pixel subtraction is a process whereby the digital numeric value of one pixel or whole image is subtracted from another image. The subtraction of two images is performed straightforwardly in a single pass. The output pixel values are given by:

$$Q(i,j) = P1(i,j) - P2(i,j)$$

Or if the operator computes absolute differences between the two input images then:

$$Q(i,j) = |P1(i,j) - P2(i,j)|$$

Or if it is simply desired to subtract a constant value C from a single image then:

$$Q(i,j) = P1(i,j) - C$$

IV. RESULT AND DISCUSSION

Using the above mentioned algorithms, motion detection system is implemented successfully. When an object comes in front of the camera feed, the frame is compared with the background frame. Then it undergoes blurring algorithm, image subtraction, thresholding algorithm and blob detection. The detected object is shown using a red box around it. And the moment an object is detected, the frame is saved to the local server and an email is sent to the registered email id. When the user logs in to the android app, the server sends the video feed to the android device through wireless network.

Now, many small and big objects can in front of the camera. Also grains in the video feed can fool the software. The software can consider these grains in the video to be an object and give false alerts to the user. The small objects can be birds or stones or any other inconsiderable object. So to avoid these, in the software, we set the thresholds like *min height, min width* for the objects to consider them as a threat.

Figure.2. Motion Detection Software

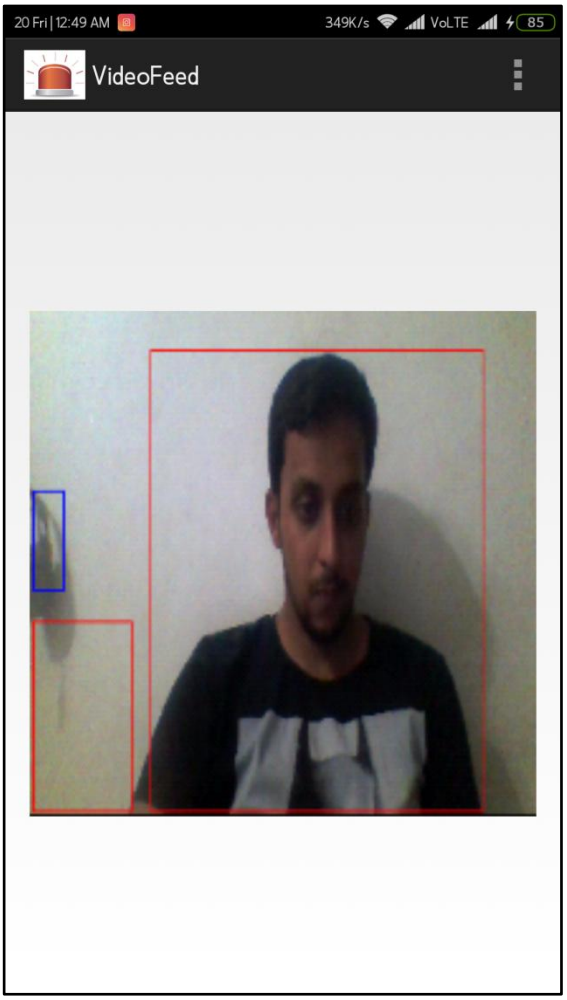

Figure.3. User Application

So as seen above, the system has been implemented successfully

Discussion:

Also we have studied previous algorithms and papers. A common thing that we observed was all of them are storing the footage from the video camera on to the storage devices. This increases the setup and maintenance cost of the system as you need to purchase a separate storage media for the same. Also the algorithms used are old and clumpsy and often slow. They lack in low light capabilities are inaccurate and also are less secure. Below is the graph of study of different algorithms and systems. We have compared all of them and tried to overcome the drawbacks in our proposed system. As seen in the graph, over the time the speed and accuracy of the systems have increased, but they particularly lack in security. Our system is secure, using the login credentials only registered user can access the system.

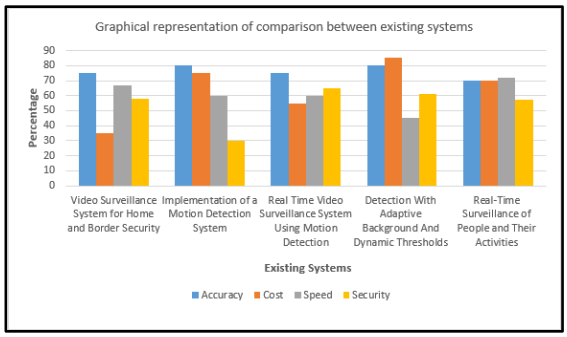

Figure. 1. Comparison Graph

Table.1. Comparison

Sr. No.	Paper name	Accuracy in percentage	Cost	Speed	Security
1	Video Surveillance System for Home and Border Security	75	Low	Medium	medium
2	Implementation of a Motion Detection System	80	High	Medium	low
3	Real Time Video Surveillance System Using Motion Detection	75	Medium	Medium	Medium
4	Detection With Adaptive Background And Dynamic Thresholds	80	High	Medium	Medium
5	Real-Time Surveillance of People and Their Activities	70	Low	High	Medium

V. COMPARISON

Thus a better surveillance system is developed that overcomes present problems. Motion detector, thermal sensor provide more support to the system. Also live feedback is provided with alerts to the user. The algorithm proposed provide better and effective motion detection.

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