

## **Anomaly Detection: An Application of Visual Surveillance**

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*Abstract: Recent advances in camera and video technologies have made it possible to network numerous video cameras together in order to provide visual coverage of extensive public spaces such as airports and train stations. As the size of the camera network grows and the level of activity in the public space increases, it becomes infeasible for human operators to monitor the multiple video streams and identify all events of possible interest. Consequently, a timely challenge for computer vision researchers is to design camera sensor networks capable of performing visual surveillance tasks automatically or at least with minimal human intervention. This paper presents with the technology of intelligence of the surveillance systems, while surveillance systems can provide many services, this paper describes the development of an application that uses cameras to detect the changes in the homes, buildings and offices etc. Basically the proposed system will detect the changes (whenever anybody enters) in a room with the help of the motion detection algorithm and it will automatically send an email to a computer in a security room.*

**Keywords: Motion Detection, Pattern Matching, .NET, Visual Studio 2010 and SQL.**

### **1. INTRODUCTION**

Recent advances in camera and video technologies have made it possible to network numerous video cameras together in order to provide visual coverage of extensive public spaces such as airports and train stations. As the size of the camera network grows and the level of activity in the public space increases, it becomes infeasible for human operators to monitor the multiple video streams and identify all events of possible interest. Consequently, a timely challenge for computer vision researchers is to design camera sensor networks capable of performing visual surveillance tasks automatically or at least with minimal human intervention [1].

A Visually Intelligent system could give people peace of mind, especially when they are at their office, or on vacation or out of town. The time when people are away from home for an extended period of time is the most dangerous for the security of their house. Such system is not only effective for protecting their home from burglary, it also reassures that everything they leave at home will remain safe and sound. Video Surveillance Software is the perfect solution to turn their home/office PC to a sophisticated home security system.

This project deals with the technology of intelligence of the surveillance systems. While these systems can provide many services, we will attempt to limit ourselves to the evaluation of the systems that use cameras to detect the changes in the

homes, buildings and offices that are given below. Basically our system will detect the changes (whenever anybody enters) in a room with the help of the motion detection algorithm and it will automatically send an email to a computer in the security room.

Good general purpose motion detection software should let the people to determine exactly what kind of motion to look for and then permit a range of responses, e.g. taking pictures, recording videos and sending e-mail notifications. The best software should also be able to analyze the movement itself[2]. Typical operations include:

**Motion Detection:** This is the simplest and most versatile technique. The software looks for anything that is different from one video frame to another. It compares pixel color and brightness (chrominescence and luminescence) without trying to identify anything. It can be trigged by moving objects, lights on/off, shadows, and even vibrations[3][4].

**Flow Control:** Using motion detection techniques, the software goes one step further and finds the general flow of motion within the video[3][4].

**Pattern Matching:** The software tries to match the input image to a reference image[3][4].

## 2. PROJECT DESIGN

The proposed application is a WEB based application which uses SMS service for sending notification after detection of some activities in the absence of owner. The general working of application is shown in Fig 1.

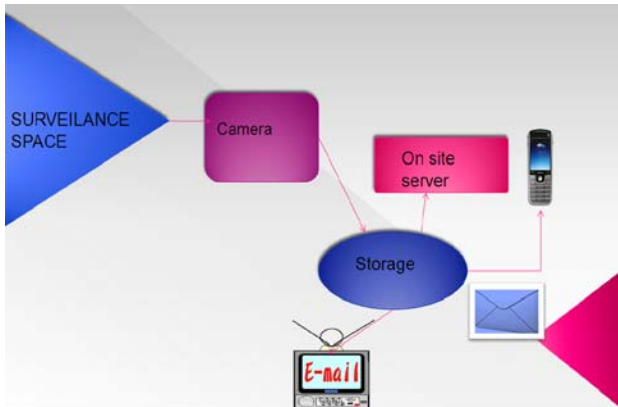


Figure 1. Basic design of system

### 2.1 System Requirements

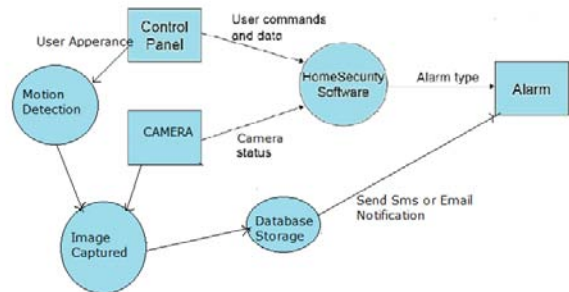
**2.1.1 Hardware Requirements :** Screen resolution of 800\*600 required for proper and complete viewing of the screens.

Resolution however should not exceed 1024\*768 and an Ethernet connection (LAN)

**2.1.2 Software requirements :** Windows XP based operating system, SQL Server 2005 as the DBMS-for the database and MS Word and notepad are used for the documentation.

### 2.2 Software System Attributes

Software system attributes are those which provide an internal and external view of complete project. A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system. DFDs can also be used for the visualization of data processing (structured design). On a DFD, data items flow from an external data source or an internal data store to an internal data store or an external data sink, via an internal process. DFD of proposed system is shown in Fig



2.

Figure 2: DFD of the proposed system

## 3. IMPLEMENTATION

### 3.1 Software Description

Languages Employed:

- ASP.NET- Active Server Pages .NET[7].
- SQL- Structured Query Language.
- C# Script

Software Packages Used:

- Microsoft Visual Studio .Net 2008
- MSSQL Server 2005 for SQL
- MSSQL Server 2005 for creating database for the system.

### 3.2 Modular Description

#### 3.2.1 Interfacing with Camera

The key approach to implement the idea is to create an interface which describes all the common functionality of all video sources. Then, a set of classes are created which implement the above interface and encapsulate all the routines for the communication with the particular video source and extracting image data from it. Each such class is fully responsible for all the work required to provide the application with images to display. To use the Microsoft functionality of video streaming, image capturing we need a dynamic link library i.e. DShowNet.dll . DShowNet is abbreviated as Direct Show Net. It is a library that can capture video stream and frame together[11].

Namespace that allows access to Microsoft's DirectShow functionality from within .Net. It works with any .Net language. Microsoft Direct Show is an Application Programming Interface is a media streaming architecture for MS windows. Using it your application can perform high-quality video and audio-playback or capture. DShowNet provides various classes and interfaces to be implemented in the device selection as and video as well as image capturing. DsDevice is a class defined in the DShowNet namespace acts as the device being interfaced with the application in other words it gives the camera being interfaced with the application. So using this class in the user-defined class DeviceSelector all the cameras can be connected to the proposed system and from that, one can select any particular camera. In this way interfacing with the camera is done[11].

### 3.2.2 Motion Detection

Conditions for Motion Detection: In the best conditions the system must have following: A well fixed camera - stability is key if anyone wants to isolate motion, stable light, no flickering, contrasting background - white objects against white background might not produce great results, high camera frame rate and resolution. The motion detection process can only be as good as the input images. If motion detection needs are simple, than a low-end webcam might be sufficient[4][11].

Algorithm has two images to understand whether there is considerable change that can be considered as a motion in the projected vision or not. These are the following steps:

- 1)The calculation is done in RGB format and the data of the images are stored in byte arrays.
- 2)Two images are firstly processed to see the general change in the projected vision. This general change must not affect the image difference calculation since this change is not from a motion. This difference is stored to use in pixel difference calculation part of the motion detection algorithm. This general difference will be called correction after here.
- 3)Two byte arrays are compared to see if there is considerable change in the pixels. Considerable change is determined by a threshold value which is called pixel threshold. If the difference between two pixels is greater than the pixel

threshold it is then compared with the correction value. Then according to the result the pixel is labeled as black if it has changed or labeled as white if it has not changed. This process of the motion detection algorithm is called blob calculation. The overall process of comparisons of frames is shown in Fig. 3.

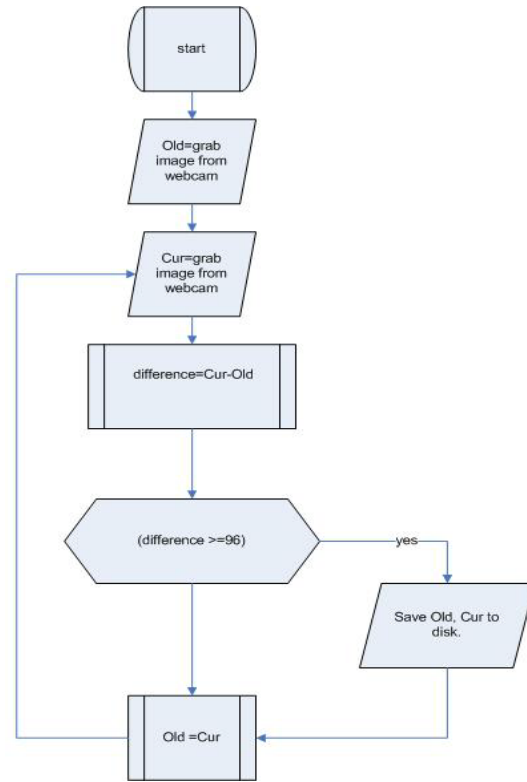


Figure 3. Flow chart for frame comparison

Blob method calculates the entire body of black blob size. This calculation is done by finding the radius of a blob. This radius of the blob is compared with another threshold value which is called blob threshold. In our proposed motion detection system, this sensitivity is defined by the user of the mobile phone and passed as an argument to the algorithm. Whenever a blob with a greater radius than blob threshold is found, the algorithm finishes the process telling the upper layer that there is a motion in the projected area[4][11].

Grab image from web cam called Old. Second, grab another image from web cam after a while, called Cur. Compare Cur & Old by comparing each pixel color. If difference is greater than tested value (according to the quality of your web cam & light system you are using is 60 or 50 Hz), then save the two pictures. Finally, make the old picture the Cur picture. Back to second step (infinite loop).

### 3.2.3 Image Capturing

Image Capture is also the name of the Application programming interface associated with the Image Capture Application. Drivers or software built to use this interface can also automatically interface many imaging systems and software that run on Mac OS X. A Software Development Kit for Image Capture is available on the Mac Developer website[10].

In this System an Image Processing class has been created, in which we have stored frames by comparing the corresponding pixels value in the consecutive frames.

Using the BufferCB function in the interface ISampleGrabberCB present in the DShowNet namespace we can grab the images and store them in the buffer. Image Capture is an application program that enables users to upload pictures from digital cameras or scanners which are either connected directly to the computer or the network[10].

The location of pixels are determined by using function named PixelAt(), which gives particular position in x,y coordinates.

LockedArray() is used to bound the rectangular portion of frames which is stored in memory. We have used Bitmap class for storing image in memory.

The parameters that are passed to the Bitmap constructor are width, height, stride, scan0,PixelFormat. Stride is the no. of bytes present in a row, scan0 is the pointer that points to the starting location of the locked array and PixelFormat is in Format24bpp that is 8bits per each color i.e. Red, Blue, Green, total 3bytes.

### 3.2.4 Storage of Image

This module helps in the storage of the image in the database SQL Server 2005. In this we use DataClient namespace which provides the SqlConnection using which we make our connection between the sql server and visual studio[9]. SqlCommand is used to write the command and transfer it to the sql server over the bridge being connected using SqlConnection class. A SqlCommand object allows us to query and send commands to a database. It has methods that are specialized for different commands. The ExecuteReader method returns a SqlDataReader object for viewing the results of a select query. For insert, update, and delete SQL commands, we use the ExecuteNonQuery method. If we need only a single aggregate value from a query, ExecuteScalar is the best choice. A SqlConnection is an object, just like any other C# object. Most of the time, we just declare and instantiate the SqlConnection all at the same time, as shown below: Various parameters of database connections are shown in Table 1.

```
SqlConnection conn = new SqlConnection ("Data
```

```
Source=(local);Initial Catalog=Northwind;Integrated Security=SSPI");
```

Table 1: Database connection table

The SqlConnection object instantiated in Table 1 uses a constructor with a single argument of type string. This

Connection String Parameter Name	Description
Data Source	Identifies the server. Could be local machine, machine domain name, or IP Address.
Initial Catalog	Database name.
Integrated Security	Set to SSPI to make connection with user's Windows login
User ID	Name of user configured in SQL Server.
Password	Password matching SQL Server User ID.

argument is called a connection string.

### 3.2.5 EMAIL

In the Fig 4. the email makes it past the hazards of the spam trap...er...filter, and is accepted for delivery by the receiver's MTA. The MTA calls a local MDA to deliver the mail to the correct mailbox, where it will sit until it is retrieved by the recipient's MUA[6].

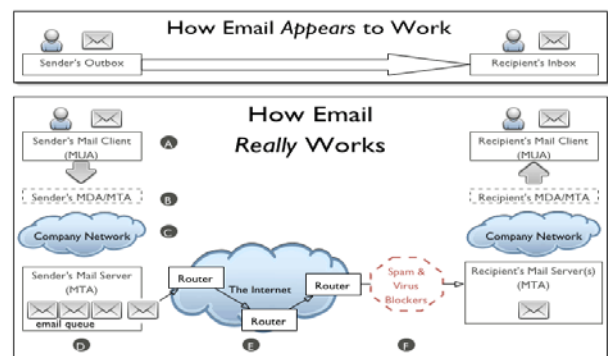


Figure 4. How Email works

There are following steps that are given below:

- Sender creates and sends an email.
- Sender's MDA/MTA routes the email.
- Network Cloud.
- Email Queue.

- MTA to MTA Transfer.
- Firewalls, Spam and Virus Filters etc.

#### 4. EXPERIMENTAL RESULTS

Below are some snapshots of the proposed system which shows that the motion has been detected and the email has been sent.

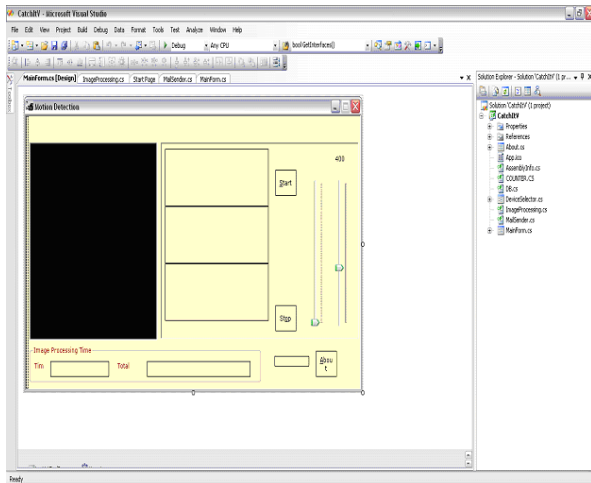


Figure 5. GUI of the application

5. GUI of the application

The Fig 5 shows the main outlook of the proposed system.

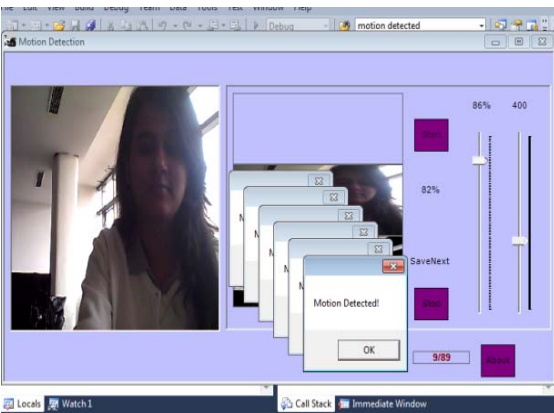


Figure 6. Motion Detection

Fig. 6 shows that motion has been detected by the camera.

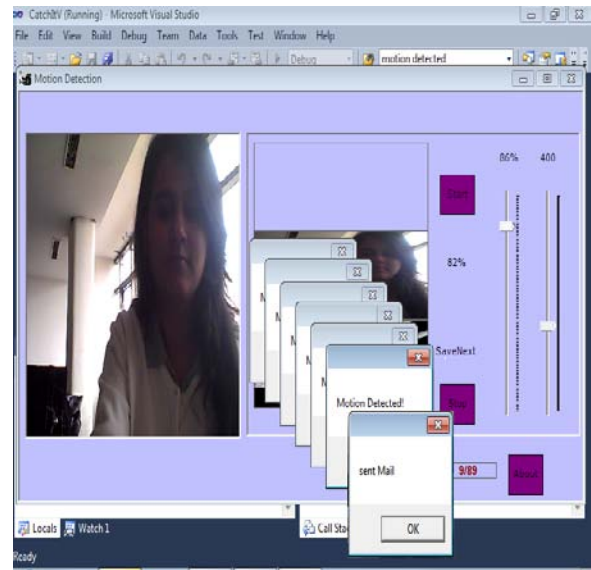


Figure 7. Email sending

The Fig 7 depicts that after the motion has been detected and the picture is taken, it is stored and sent via email to the specified user whose email id has been given.



Figure 8. Receiving of Email

Fig. 8 represents the mailbox of the user and that the email has been received by the user.

#### 5. CONCLUSION & FUTURE WORK

Our proposed virtual intelligent system efficiently keeps an eye over homes, offices etc. to keep them secure. The system configuration discussed here is simple, feasible and consists of easily accessible and inexpensive components. The feasibility of the proposed system has been illustrated on a real-life video sequence, taken under conditions similar to a real field situation. The system was able to efficiently determine various phases of the motion track the moving object (person) and notify the customer according to the embedded algorithm.

The project could be extended for future under following aspects : Fingerprint Recognition can be implemented as one of the modules for verifying the person, Online Real-life Video Transmission can be sent to specific e-mail id, Image can also be attached with the notification, Attendance Monitoring can be done.

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