INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION & MANAGEMENT

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AN EFFICIENT SMART SURVEILLANCE APPLICATION ON ANDROID DEVICE USING MESSAGING SERVICE AND EFFICIENT MOTION DETECTION MECHANISM

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ABSTRACT

Nowadays, surveillance applications has gained its importance globally in both public and private areas. These applications are developed with the motion detection task that will determine the motion detection region. The methods that exists for motion detection sometimes may not be applicable for areas where there are issues like changes in illumination, noise disturbances etc. The proposed system is facilitated to compensate the limitations with the high quality model as the background and it is applied to extract the moving objects that are captured in a video sequence. The proposed application is concentrated on the unmanned areas of surveillance especially during at night. Here, the video that are captured are stored on the server. If an unusual image is detected it notifies the incident to the user on his android device and the corresponding video, image can also be viewed on the android device. Thus, this application increases the flexibility, mobility and reduces the workload of continuous monitoring.

KEYWORDS

Android device, background model, motion detection, Surveillance application, unmanned areas.

1. INTRODUCTION

Many video surveillance applications that are also intelligent devices has become a part of day-to-day life to facilitate high security. In unmanned surveillance areas, detecting the motion and details about the detected motion is a challenging task [1]. Tracking and detecting the objects in video forms the basis for many surveillance applications ranging from video production to remote surveillance and from robotics to interactive games. Video forms the high end source of visual information than still image [2]. The proposed application can be deployed at various places such as ATMs, away from home spots, temples and museums to preserve valuable antiques.

2. PRELIMINARIES

The preliminaries used in this section are the prerequisite terms needed for the proposed application. The terms are cited as follows.

A. MOTION DETECTION AND ITS TASK IN VIDEO TRACKING

Video cameras assist in motion detection by capturing the objects of interest in the form of sets of image pixels where qualitative measurements such as recall and precision are used for assessment [14]. The video tracker estimates the location of the object over a time by modelling the relationship between the appearance of the target and its corresponding pixel values. Determination of the relationship between an object and its image projection is very complex that makes the video tracking task difficult.

Motion detection refers to the capability of the system to detect the motion and capturing the events. Motion detection is also called as activity detection, which is a software-based monitoring algorithm [14]. It implies that when the system detects any motions the event is captured. The major application areas of motion detection methods includes visualization of traffic flow, to classify the highway lanes, driving assistance, face detection, interaction of human-machine and remote image processing.

B. MECHANSIM OF EARLIER VIDEO SURVEILLANCE

Video surveillance is basically monitoring of an area with some form of video recording device, which would be primarily in location where security is of high importance. In the current scenario for surveillance applications, varieties of surveillance cameras have emerged. To list a few are infrared Day/night camera, dome security camera, bullet security camera, box security camera, Pan Tilt Zoom (PTZ) security camera and hidden camera.

In earlier scenarios of surveillance, Closed Circuit Television (CCTV) started video monitoring as a simple method of black and white video sequence from remote cameras to a central monitoring location [4]. The central monitoring location was manned, and recording of videos were analog. Historically, the quality of the recorded video was low in resolution, reflecting unrecognized objects that were transported over coaxial cables that were limited in bandwidth. The recorded video was stored as analog signal on magnetic tapes. Magnetic tapes have many operational problems like constant tape change, cumbersome information retrieval and very limited remote access. Traditional video surveillance had several technological limitations that have to be foreseen, and required adapting to new technologies in order to match the growing demands for video control by collecting and processing the monitored information.

Recent surveillance systems have efficiently replaced traditional surveillance systems. Digital technology emerged to facilitate the ultimate needs of surveillance [9]. To compensate the operational and technological limitations of earlier surveillance systems, Internet Protocol (IP) technology over Ethernet is combined with digital video [5]. IP/Digital surveillance uses IP camera that can send and receive data via a computer network and the internet. The IP camera can be centralized or decentralized. IP/Digital surveillance provides constant real-time operational information such as high-quality digital images which enables flexible, real-time, highly manageable and tunable solution. Besides the technical advancements it is affordable and cost-effective for customized deployment in large areas of surveillance. Thus, the overall motive of IP/Digital surveillance is to efficiently and effectively maintain security and intrusion detection at the monitored location.

C. RECENT TREND IN SURVEILLANCE USING SMART PHONE

Smart phone is a device that is built on mobile operating system that has the capability of more advanced computing and connectivity than a feature phone [3]. The rapid development of mobile applications and m-commerce has been the drivers of smartphone adoption that combines the Personal Digital Assistant (PDA) with the mobile phone. It also includes high resolution touch screen and web browser that displays the standard web page as well as mobile optimized sites. Wi-Fi and mobile broadband facilitates the high speed access to the internet on smartphones.

Some of the smartphone operating system includes android (Google), iOS (Apple), Symbian (Nokia), web OS (Hewlett – Packard); windows phone (Microsoft) etc. These technical advancements have assisted in monitoring the areas over a smart phone. Thus smart phone surveillance has improved the dynamism in monitoring, more flexible for remote access of surveillance areas.

3. RELATED WORK

The related work in this section describes the various methods of detecting motion and their discussion with respect to their pros and cons.

According to earlier research work, motion detection methods are classified into three major categories temporal difference, optical flow and back ground subtraction. In temporal difference methods the shapes of the moving object are incomplete because it readily accustom to sudden changes in the environment [8]. In optical flow methods the certain characteristics of flow vectors depict the projected motion on the image plane with appropriate approximation [10]. The computational complexity is too high to implement the motion task in video surveillance system because, streams of moving objects are indicated by flow

vectors and detected object region is sparse [11]. Background subtraction detects the moving objects by estimating the exact difference the current and previous frame. The previous frame is also called as reference frame or background image or background model [6] [7].

The basic criterion is that background image is a representation of the scene with static or constant objects that are updated regularly to avoid the frequent changes in luminance and coordinate settings [6]. Background subtraction method has proved to be the best out of the above mentioned categories due to the time complexity and the accurate detection of moving objects. The background model that is generated has specified limitations with respect to the region. The efficient background model must adapt to gradual increase of illumination changes, dynamic background movements, should exhibit noise tolerance, should not be responsive to repetitive motions from clutters, generated of proper video sequence at the beginning and implementation set up should be fast and reliable [12]. The each frame that is held can include moving objects. Using the single background model, several methods are used to generate more number of reference images that are applied for the calculation of mixture of background model, which also has a drawback of inaccuracy in detecting objects [13].

Numerous algorithms with background subtraction method have been facilitated to estimate the moving object. These algorithms range from simple to more complex approaches, aim to improve the speed and limit the memory requirements. The various algorithms that facilitate background subtraction are as follows.

- Russian Gaussian Average method uses the independent pixel location of the background model.
- Temporal median filter method proposes that to use the median values of the last n frames as the background model.
- Mixture of Gaussian method is used when each pixel can be represented as a mixture with particular to one or more distribution.
- Kernel Density Estimation (KDE) is a non-parametric method to calculate the probability density function on the buffer of last n background values.
- Sequential Kernel Density Approximation initially detects the background probability density function from initial sample set that is frequently updated.
- Eigen background method is applied to the whole image instead of a block that facilitates the extensive spatial correlation and avoids tiling effect on block partitioning.

Amongst the methods specified, simple algorithms such as Russian Gaussian Average and temporal median filter of an accuracy and frame rate is high with limited memory requirements. Kernel Density Estimation has higher requirements for memory that prevents easy implementation on low memory devices. Sequential Kernel Density approximation is an approximation of KDE that proved to be almost accurate but mitigate the memory requirements and time complexity is reduced [1].

4. PROPOSED SYSTEM

The proposed work describes the smart surveillance system for unmanned indoor environment by accurately detecting the motion and delivering the push notification to view the unusual image that is been detected in the areas of surveillance.

A. ESTIMATION OF THE FRAME DIFFERENCE

Frame is digitally coded image in a video technology. It is a matrix representation that comprises picture elements. Each picture consists of a horizontal set of elements that is referred to as line. Frame rate is the number of frames that are scanned per second in a moving picture.

The picture facilitates the determination of the background region. Here, the background model that is generated is subtracted with the each input frame to obtain the frame reference values. For better sense of motion, higher frame rate is used. The most commonly used frame rates are 59.94 fps, 50 fps, 29.97 fps, 25 fps and 23.976 fps. Historically, the frame rate was 24 fps. This frame rate is the minimum acceptable rate due to the high cost. The reference frame always contains the background region and the motion detection methods can easily generate the background model but with noise as a limitation.

Temporal resolution describes the ability of the frame rate to capture moving objects. For higher frame rate is said to have better temporal resolution than a lower one. Refresh rate is the difference in rates at which the video frames are captured and displayed. Refresh rate is generally expressed in cycles/sec called Hertz. In today's market, the accepted maximum display rate is of 60 fps.

The exact differencing image ($\Delta_t(x,y)$ is generated by calculating the modulus of the difference between background model ($B_t(x,y)$) and the incoming video frame $I_t(x,y)$ at each frame.

$$\Delta_t(x,y) = | B_t(x,y) - I_t(x,y) | \quad (1)$$

B. PIXEL CALCULATION BY RGB PROCESSING AND REPROCESSING

The accurate detection of the pixels at each frame is calculated by the Cauchy distribution model which uses the absolute frame differential estimation [15].

FIGURE 1: FLOW OF PIXEL CALCULATION

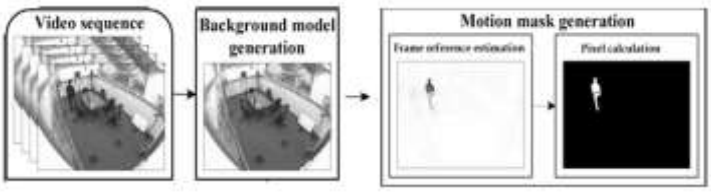


Fig. 1 depicts the flow of pixel calculation from video sequence where the background model that is generated is used for accurate motion detection. The model (f) is calculated as follows:

$$f(\Delta_t(x,y);a_2,b) = \frac{1}{\Pi}\left[\frac{b}{(\Delta_t(x,y)-a_2)^2+b^2}\right] \quad (2)$$

Finally, $D_t(x,y)$ is formulated as follows:

$$D_t(x,y) = \begin{cases} 0, if\ f_1 > f_2 \\ 1, otherwise \end{cases} \quad (3)$$

If $D_t(x,y)$ is equal to 0, then it belongs to the background region of $I_t(x,y)$ otherwise, it belongs to moving objects in $I_t(x,y)$.

C. OVERVIEW OF GCM

Google Cloud Messaging (GCM) is a free messaging service for android. It helps the developers to send data from servers to their applications on android supported devices. It also upstream messages from the user's device back to the cloud. This message is a lightweight message that indicates about the new data to be fetched from server to the android application.

The implementation of GCM is that GCM connection servers and 3rd party app server establishes communication with the android device through the unique registration ID that is been generated.

The primary characteristics of the messaging services are

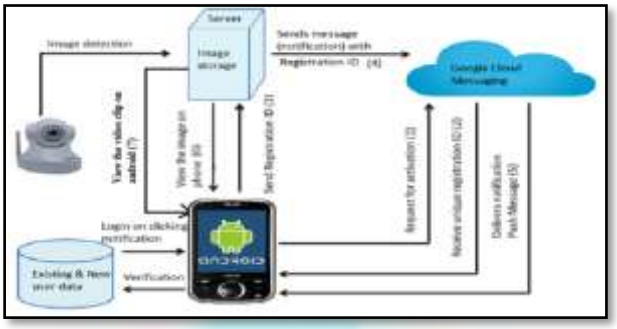
- It allows 3rd party application servers to send notification messages to the android application.
- The upstream messages from the user's device are received.

- To receive messages it is not necessary for the application to run.
- There are no built-in interfaces or other handling for message

5. SYSTEM MODEL

The implementation of the proposed work requires smartphone with the minimum required version of Android 3.0 and Internet Protocol camera. The software requirements are as follows. Eclipse is an Integrated Development Environment that supports multi-language. It consists of a base workspace and an extensible plug-ins for customizing the environment. Android Development Tool (ADT) is a plugin for eclipse IDE that facilitates the development of android applications.

FIGURE 2: SYSTEM ARCHITECTURE



The flow of the system model (fig. 2) is described as follows:

1. The surveillance camera is connected to the server and the area is continuously monitored. The monitored area is unmanned, i.e. it does not require any human intervention.
2. The current frame and the previous frames are compared. If there is any difference in the frame comparison, then it indicates that a motion is detected in the monitored area (i.e. the background model).
3. The difference in image that is been detected are captured and stored in the server and sent as an alert or notification message to the authenticated user.
4. Meanwhile, the video clip is also stored in the server. The application monitors the area and if any there is any detection of the motion, the recording starts from that point and it is stored in the server.
5. The authenticated user can view the notification and with the help of the notification message the user can the view the detected image with the Uniform Resource Locator (URL) from where the message was sent.
6. If the user wants to view the video source , he can view it using the Uniform Resource Locator, where the video and image is stored.

6. CONCLUSION

In today's market, various low cost IP cameras and smartphones are available. Surveillance system through smart phones ensures the flexibility, and enhances the mobility of the user that reduces the workload of continuous manned monitoring. The added advantage of the system is that the messaging service incorporated here allows the notifications to be sent to one or more authenticated users and also allows the users to view the video of the corresponding image. Thus the main motivation is to develop a society oriented application to control and prevent any suspicious activities in the public and private locations.

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