

A review of surveillance security system using wireless video processing

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Abstract: In today's rapidly growing economy security is the key concern for any industry. Numerous solutions are available for the same. But they are not cost effective as far as small scale industries are concerned. So with the help of advanced technology, a cost effective, efficient and powerful security system can be developed. This can be of great use to small scale units. With the help of motion following camera, vibration detectors and panic switches, optimum security system can be designed. Same can be utilised for automatic theft detection in various industries, offices as well as home security. The paper proposes to develop a surveillance security system based on CCTV camera, PIR motion sensors, Servo motor, GSM module and micro-controller. Vedic processing, wireless and mobile communication fundamentals are used for the same. The system can also be modified for department of police in case of robbery, riots or other crimes by using machine learning fundamentals.

Keywords: Image processing, Video processing, Wireless communication, Mobile communication, Remote video surveillance, Machine Learning.

Introduction

In current scenario requirement of surveillance and use of security system is a must in the industries and organisations such as banks, hospitals, schools etc. These systems are normally equipped with latest equipment like CCTV camera, Wireless panic switches, wireless PIR sensor, and other sensors. But the security provided by such systems is not full proof. It provides a bit lower level of security in case of robbery. As it cannot deliver the sure shot information about the thief. In the case of robbery in the bank for example, the officials and police are informed immediately via some calls or SMS, but by the time they reach to the place it's too late.

For security of lockers only hammer attack protection is available, as the privacy of customers is much more important and the camera cannot be positioned in locker room. The alternative is to convert such security system in to advanced security system by using technology. With addition of time lapse video surveillance in current system this can be accomplished and no need to modify the whole security system. But it becomes crucial to monitor and maintain three different security systems at a time. [1]

The motion sensors are placed near the lockers and safety vaults. Passive IR (PIR) sensors are excellent devices for wireless sensor networks (WSN), being low-cost, low-power, and presenting a small form factor. PIR sensors are extensively used as simple, but reliable sensors. The concept of trigger for alarms, and automatic lighting systems are also used. However, the output of a PIR sensor depends on numerous aspects. For example, distance of the body from the sensor, direction of movement, and presence of multiple people. [2] The goal of monitoring an area for security often fights with the inhabitants' right to privacy. The paper claims that the technical choices can be made to balance the privacy security trade-off. The paper presents a privacy-sensitive surveillance security system which balances privacy and security by positioning cameras only in public areas and by distributing information about people's movements in private areas so that no single computer can track an individual. The paper also throws a light on how this distributed information can be utilized to correlate an interesting event such as a theft with an image taken by the cameras arranged at the public areas. [3] In bank due to customer privacy issues the CCTV camera cannot be placed on the door of lockers, but rotatable camera can be used which can move and record the lockers and safety vaults when the motion is detected but this can happen only in theft protection mode.

In this solution when theft protection mode is on all motion sensors are activated, and when ever the motion is detected the servo is energized and the camera is focused at the point of motion. The systems are controlled by main micro computing device like Raspberry Pi. The bank officials and police officials are notified and all doors are locked. So it becomes easier to catch the robbers after robbery.

In case if the robber runs away, the face is recorded in the camera and with the help of image processing and wireless communication, the image of thief can be instantly sent to police department for checking in old criminal database. Machine learning fundamentals can be of great help in this case. If the data is available, it becomes easy to catch robbers.

As a central processing device Raspberry Pi is preferred over other DSP, because DSP will not offer this kind of flexible system as the raspberry pi provides one stop solution. The RPi has on board connectivity module so it will reduce the requirement

of separate communication module. There by it provides a cost effective solution over DSP or any other microprocessor based minicomputer.

There are countless methods for face reorganization. Few of them are discussed later here. The raspberry pi can work on either openCV or Matlab. Matlab is well known digital signal processing tool which is very useful for image processing. It is compatible with python used in raspberry pi and it is simpler than open CV. For a good robust system, good and powerful software is also needed with high performance hardware.

Working

The system will use several components like motion sensors, fire sensors, CCTV camera, vibration sensor, communication module, servo controlled camera, hooters, and shock mechanism. The microcomputer device like Raspberry Pi or some other micro-processor based computer system is used for controlling whole device.

In case of unwanted movement in the locker room the motion is spotted and with reference to that the camera is focused on thief. Automatic recording starts and camera will follow the movement. Meanwhile all the bank and police officials are alerted via communication module.

Since the early 1990's servos used a de-facto standard pulse width modulation technique to control the position of the output shaft. The

pulse is fed to the servo via a control line. The control line does not supply power to the motor directly but it is an input to a control chip inside the servo. As such it does not have to supply much current to the servo. [4]

The image processing techniques can be used by developing programs either in the MATLAB or Open CV. First the finest frame of video is chosen from recording unit. And then after the process like face detection is accomplished. The image of thief is sent to police department via communication module to verify the same with the departmental criminal database, if the data is matched, the tracing of the thief becomes easy.

Recognition is obtained by comparing an analytical approximation of the skeleton function extracted from the analysed image with that obtained from model objects stored into a database. Tracking is performed by applying an extended Kalman filter to a set of observable quantities derived from the detected skeleton and other geometric characteristics of the moving object. [5]

Design

The system covers the bank environment with the help of two kind of sensors: cameras and motion detectors (passive infra-red sensors). Cameras are positioned only in public areas, and motion detectors are located throughout the building, approximately at every office doorway. Both types of sensors continuously record the movement and the readings are stored locally for fix duration of time.

The configuration of sensors provides two aspects of privacy. First, since sensed information is distributed, no single computer or sensor can track an individual. Presume that distributed access to multiple sensors must be more explicit and can be more easily controlled. Second, people already have reduced expectation of privacy in public areas. Many buildings have receptionists and guards witnessing who enters buildings. Thus use of cameras in such public areas should not be as onerous as in private areas.

Assume private areas are deployed densely enough with sensors so that a movement through the sensor field triggers multiple sensors. The limitation of the system is that it is designed for monitoring at times when the floor is sparsely populated, such as at night. Also presumed that the sensor nodes know their position in terms of a two-dimensional frame of reference. [3]



Fig 1. Placing of CCTV and PIR sensors

Comparison of the Security systems

Current security system

The current bank security system is very higher level of security in terms of its latest equipment's, technology used, banking becomes much secure than it was before few years.

It has very good capabilities for video monitoring 24 x 7 and 365 days, so it is very useful in terms of checking and detection of suspicious persons with help of old recordings.

It is enabled with fire alarms, hammer or drilling protection and motion sensing. So it becomes much secure in case of robbery protections.

Suppose a robber is trying to rob, first the motion of the robber is sensed and through communication medium bank officials are informed, now it goes to the locker and try to open it with either hammer or drilling machine, there will be some sock mechanism to prevent it. Now somehow they succeed in robbery, and run away it becomes very difficult to catch them.

This can be established with simple micro-controller and single DVR+HDD components but both will work independently. Both have no correlation with each other.

The CCTV recording is stored for several time periods into the hard disk installed there. The recording can be viewed on the monitors. But in case of fire or shock circuit the recorded video will be loss.

Block diagram

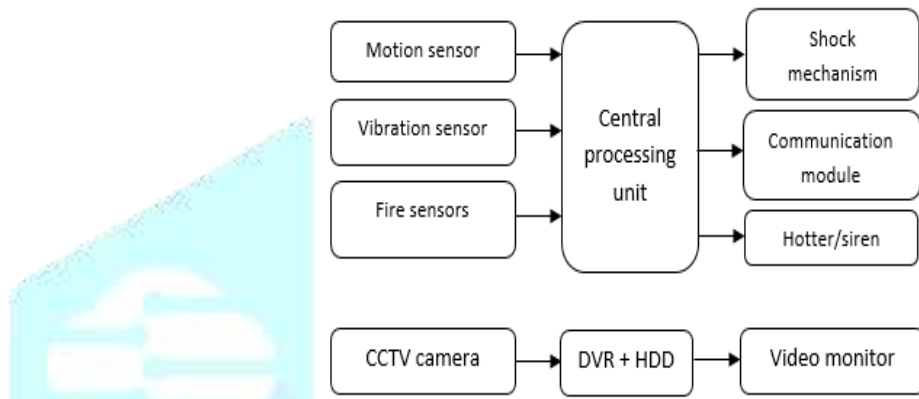


Fig.2 current security system

Proposed security system

The proposed security system is very very secure in terms of its working logic, techniques used and it also have latest equipment and technologies.

It has good capabilities of video processing from the recorded video of the CCTV camera, and is useful in terms of police department criminal record look-up.

It has one rotatable camera base which is controlled by motion sensor through the processing unit; it also supports the features of the older systems.

In previous case when robbery is happening the thief cannot be identified easily while in this case when robbers are trying to break locker their motions are detected and the camera is focused on them, meanwhile all the officials are alerted and the image of thief is sent for criminal database lookup, so it becomes very easy for police department to trace out the criminal.

In the proposed security system the CCTV is connected with main unit consisting micro-processor system also known as minicomputer system. This will serve as DVR and one storage device is connected with that minicomputer that will store the CCTV footages. Which will replace the DVR + HDD unit.

So there is only one main system and all components are interconnected with each other through main system. The system is little complicated but will performs as robust security system.

Block diagram

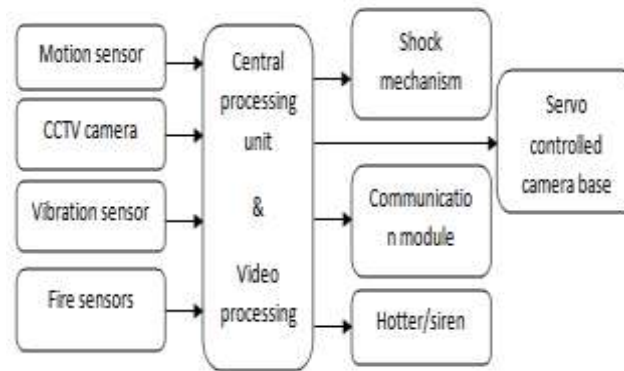


Fig.3 ultimate security system

Implementation

Raspberry pi based image processing is a new and advance technology which can open an era of computer vision. Other gestures and different types of image processing systems can be implemented in raspberry pi which will intensely reduce the price of the system.

The raspberry pi 3 is 3rd generation raspberry pi. which comes with 1.2 GHz 64-bit quad core ARMv8 CPU, 1 GB RAM, 4 USB ports, 802.11n WLAN, full HDMI port, Ethernet port. [6]

With MATLAB® Support Package for Raspberry Pi Hardware, computer can remotely communicate with the Raspberry Pi and use it to control peripheral devices. This support allows acquiring data from sensors and imaging devices connected to the Raspberry Pi. Specifically, libraries of MATLAB functions are provided for the following Raspberry Pi add-ons and interfaces:

- Raspberry Pi Sense HAT
- Raspberry Pi Camera Board
- I2C, SPI, and Serial interfaces
- PWM and servo motor control
- GPIO
- Linux system shell [7]

Simulink® Support Package for Raspberry Pi™ allows to develop algorithms that run standalone on Raspberry Pi. The support package extends Simulink with blocks to drive Raspberry Pi digital I/O and read and write data from them. After creating Simulink model, simulation can be done and the algorithm can be downloaded for standalone execution on the device. One particularly useful (and unique) capability offered by Simulink is the ability to tune parameters live from the Simulink model while the algorithm runs on the hardware. [8]

Conclusion

The deployment of privacy sensitive, cost effective and more reliable surveillance security systems using video processing is proposed. The design, implementation and analysis of the system have been discussed. The proposed system balances privacy with security by using motion sensors in private areas instead of cameras.

The proposed system can provide best quality security with several modifications in current security system. Thus it also fulfils the conditions of backward compatibilities.

The proposed system is discussed for banking security but it can be implemented anywhere in museum, libraries, schools, industries, historical places etc., as the system is mobile and wireless.

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