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Electronic Eye for Home Security Using OpenCV with Raspberry PI 3

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ABSTRACT

In this project to open the door and closing the door was in the control of the owner and he can do that only from the web page after he get confirmation about the authorization of the person who want to entry into the house by getting his image by mail from the Raspberry Pi 3 processor. This was done by the PIR sensor, which senses the moment of the persons at the door and trigger the processor to take the photo by using the USB web camera. Whenever the PIR sensor detects then the owner of the house will get the instant alert message to his mobile, then he will check his mail for the authentication. The RF transmitter sends the signal to the receiver and vibrates the motor in the hand of the blind person in the home to let him know of the entry of the new person in the home.

INTRODUCTION

The demands on video surveillance systems are rapidly increasing in the present day. One of the first things people will want to know about their surveillance system is whether or not they have the ability to connect to it over the internet for remote viewing. In the past, security systems had to be monitored by a guard who was locked away in a room all day watching the monitors to make sure that nothing would happen. The other option was to come back and review the footage but damage could have happened.

Therefore, researchers and scientists had to come up with ways of overcoming that and thus improving security at large.

Commercial spaces, universities, hospitals, casinos and warehouses require video capturing systems that have the ability to alert and record beside live video streaming of the intruder. The advancements in video surveillance technology have made it possible to view your remote security camera from any internet-enabled PC or smart phone from anywhere in the word. This encompasses the use of CCTV (DVRs) systems and IP cameras. This technology is awesome but its cost of implementation has proven to be an impediment especially for a small home application.

Therefore, new innovative technology revolves around affordability of a product in terms of its cost and ease of implementation. The Raspberry Pi crosses both criteria in that it is a cheap, effective computer which can be interfaced with other modules to realize systems with immense functionality. A lot can be done on it ranging from motor speed control, automatic lighting, VPN server, security system etc. [1] [2]. The latter is of great interest in this project.

The Raspberry Pi microcomputer is capable of implementing a cost effective security system for various applications. This new arising technology related to security provides a comfortable and safe environment for small homes. The various objectives of the system are to detect an intruder, take an image of the intruder and also convey an alert message to the facility owner. In doing so it thus allows for remote monitoring of homes from anywhere in the world.

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The system to be designed cannot wholly replace the role of CCTV and IP surveillance cameras especially in large commercial set ups but will make it easy for low income home owners to monitor their homes at a very affordable price. In addition to the fact that the Raspberry Pi board is cheap, the camera to be used in this case is relatively cheap compared to the others. The whole security system circuitry is simple and easy to implement.

Image processing is a term which indicates the processing on image or video frame which is taken as an input and the result set of processing is may be a set of related parameters of an image. The purpose of image processing is visualization which is to observe the objects that are not visible. Analysis of human motion is one of the most recent and popular research topics in digital image processing. In which the movement of human is the important part of human detection and motion analysis, the aim is to detect the motions of human from the background image in a video sequence. It also includes detection and tracking [2]. The process of object 2 tracking is segmenting a region of interest from a video frames and keeping track of its motion and position.

OBJECTIVE OF THE PROJECT

The objective of the project is to facilitate the user with a simple and customized technology to effectively manage his/her visitors flowing to the premises.

AIM OF THE PROJECT

This project aims at controlling the doorbell in a smart way and to intimate the user with a picture and text message of the visitor at the door step. This project also includes the 'Eye-Secure' part which makes a blind person's life style more secured and comfortable in the absence of care takers.

EXISTING SYSTEM

In the existing system, there is no chance to know the information by the elder people already existed in the home about the entry of the new people. So they were facing the problems. And in the earlier system we get used the MSP430 microcontroller to implement the project. This controller does not have the internal Wi-Fi module so that we need to add the external one to communication over the web page and to the mail. To avoid these drawbacks we are developing the project by using the Raspberry Pi 3 processor.

PROPOSED SYSTEM

In the proposed system, we are using the Raspberry Pi 3 microprocessor to implement the project. It has the in-built Wi-Fi module so that there is no need of the external one and we are using RF technology to convey the information to the person in the house by vibrating the motor in the hand stick. Whenever the PIR sensor detects then the owner of the house will get the instant alert message to his mobile, then he will check his mail for the authentication.

BLOCK DIAGRAM

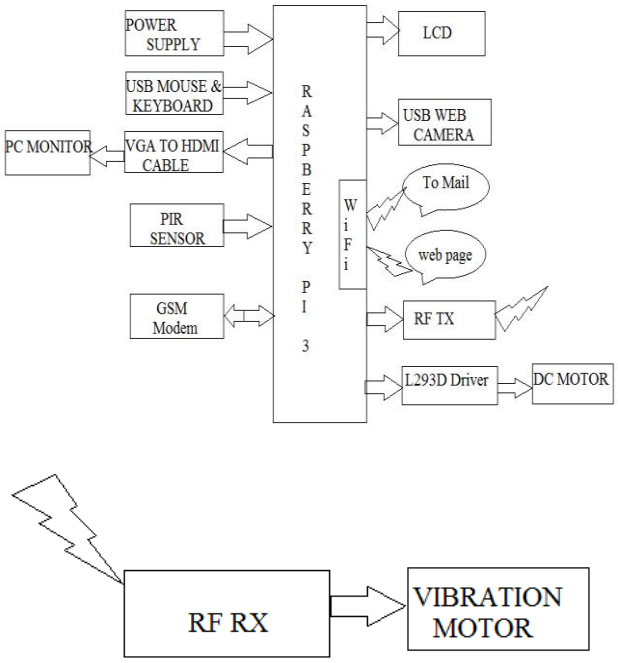

Fig 2.1: Block diagram of proposed system

Nowadays, people want one sole thing that is to make them feel safe and secure. The most commonly used security system is the CCTV (closed circuit

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Television). The cost of implementation of CCTV varies depending upon the size and use of the system. It is usually installed in hospitals, malls, parking lots etc… However, with the help of CCTV one can monitor the area 24/7, or the footage if stored in a location can be retrieved when required. Although, it can be used to deter crime and allows the authorities to identify and solve a crime, it doesn't detect neither recognize the person who is involved. We have implemented a system which provides both face detection and face recognition with the help of Raspberry pi 3 which is a credit card sized minicomputer and a Pi camera which is made especially for the raspberry pi 3.

Thus, when dealing with the real-time image processing, Open source computer vision (openCV) software, a powerful library of image processing tools, is a good choice. With the help of a smart surveillance system, we have achieved a system that can record the event, detect and recognize the person. A GSM module is used to send a message stating whether the person is an intruder or a visitor. If it is a visitor, then a command is sent by the user to perform some operation like- open the door (any type of automation is implemented) however if it is a stranger an alarm is generated to indicate that there is an intruder.

RASPBERRY PI 3

The Raspberry Pi is a credit-card sized computer that plugs into your TV and a keyboard. It is a capable little computer which can be used in electronics projects, and for many of the things that your desktop PC does, like spreadsheets, word-processing and games. It also plays high-definition video. We want to see it being used by kids all over the world to learn how computers work, how to manipulate the electronic world around them, and how to program.

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

What's more, the Raspberry Pi has the ability to interact with the outside world, and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras. We want to see the Raspberry Pi being used by kids all over the world to learn to program and understand how computers work.

There are currently four Raspberry Pi models. They are the Model A, the Model B, the Model B+ and the Compute Module. All models use the same CPU, the BCM2836, but other hardware features differ.

The Model B+

Released in July 2014, the Model B+ is a updated revision of the Model B. It increases the number of USB ports to 4 and the number of pins on the GPIO header to 40. In addition, it has improved power circuitry which allows higher powered USB devices to be attached and now hot plugged. The full size composite video connector has been removed and the functionality moved to the 3.5mm audio/video jack. The full size SD card slot has also been replaced with a much more robust micro SD slot.

The following list details some of the improvements over the Model B.

- Current monitors on the USB ports mean the B+ now supports hot plugging.
- Current limiter on the 5V for HDMI means HDMI cable powered VGA converters will now all work
- 14 more GPIO pins
- EEPROM readout support for the new HAT expansion boards
- Higher drive capacity for analog audio out, from a separate regulator, which means a better audio DAC quality.

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- No more back powering problems, due to the USB current limiters which also inhibit back flow, together with the "ideal power diode"
- Composite output moved to 3.5mm jack
- Connectors now moved to two sides of the board rather than the four of the original device.
- Ethernet LED's moved to the Ethernet connector
- 4 squarely positioned mounting holes for more rigid attachment to cases etc.

The power circuit changes also means a reduction in power requirements of between 0.5W and 1W.

General Purpose I/O (GPIO)

General Purpose Input/Output pins on the Raspberry Pi
This page expands on the technical features of the GPIO pins available on BCM2836 in general. For usage examples, see the GPIO Usage section. When reading this page, reference should be made to the BCM2836 ARM Peripherals Datasheet. GPIO pins can be configured as either general-purpose input, general-purpose output or as one of up to 6 special alternate settings, the functions of which are pin-dependant.

Power-On States

All GPIOs revert to general-purpose inputs on power-on reset. The default pull states are also applied, which are detailed in the alternate function table in the ARM peripherals datasheet. Most GPIOs have a default pull applied.

Interrupts

Each GPIO pin, when configured as a general-purpose input, can be configured as an interrupt source to the ARM. Several interrupt generation sources are configurable:

- Level-sensitive (high/low)
- Rising/falling edge
- Asynchronous rising/falling edge

Level interrupts maintain the interrupt status until the level has been cleared by system software (e.g. by servicing the attached peripheral generating the interrupt).

The normal rising/falling edge detection has a small amount of synchronisation built into the detection. At the system clock frequency, the pin is sampled with the criteria for generation of an interrupt being a stable transition within a 3-cycle window, i.e. a record of "1 0 0" or "0 1 1". Asynchronous detection bypasses this synchronisation to enable the detection of very narrow events.

Alternative Functions

Almost all of the GPIO pins have alternative functions. Peripheral blocks internal to BCM2836 can be selected to appear on one or more of a set of GPIO pins, for example the I2C busses can be configured to at least 3 separate locations. Pad control, such as drive strength or Schmitt filtering, still applies when the pin is configured as an alternate function.

The block diagram for an individual GPIO pin is given below:

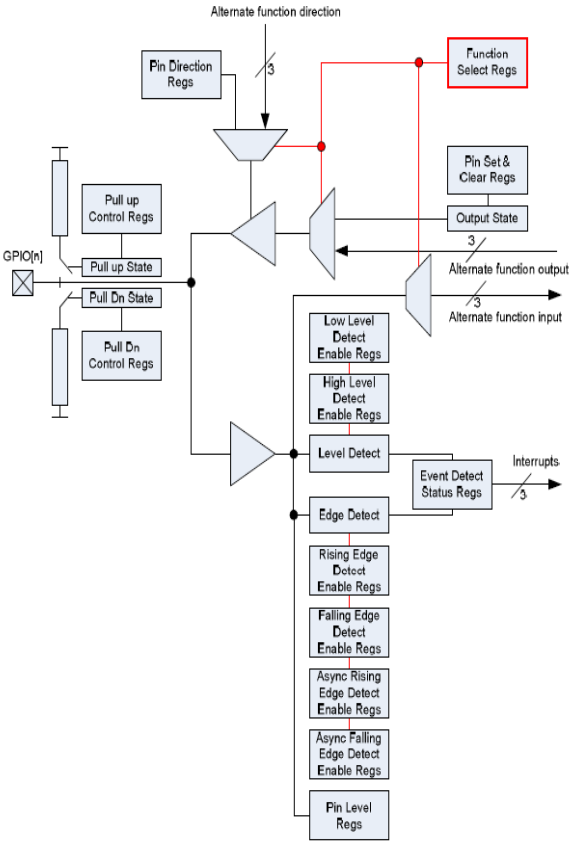

Fig 2.9: GPIO block diagram

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Raspberry Pi based Security Systems for Homes

Several criteria have been used to select a security system required to safeguard a facility. The chief among all these has been the cost of implementation of such a system. The Raspberry Pi is also a very versatile device whose functionality is not limited. It can be extended from being merely a security device to temperature control device, automatic lighting and proxy server. The following reasons explain the need to have your home security system based on Raspberry Pi:

An IP Camera system has the ability to distribute alarm messages over the internet as well as the Raspberry Pi based security system. However, the cost of an IP Camera makes it not easily affordable to small home owners.(insert cost plus citation) Thus they can be deployed in large industrial set ups, defence forces, police departments etc.

Arduino microcontroller based security system can be relatively cheaper to implement as compared to Raspberry Pi based system but its memory capacity renders it more ineffective especially when trying to interface with other modules e.g. camera, monitors, motion sensors, mouse and keyboard. Raspberry Pi has an extendable SD card storage and can be expanded to suit the needs of an individual. Moreover, Arduino 9 microcontroller requires a GSM modem to enable it transfer information through the internet. The Raspberry Pi has a port to connect it to the internet.

A CCTV surveillance system is expensive to purchase and install compared to the system in question. It requires a DVR system to connect it to the data networks through TNP/IP. A DVR on its own is very expensive. Hence such a system may not be afforded by low income home owners.

RESULTS

The implementation of realization of “Electronic EYE for Home security using OpenCV with Raspberry pi 3” is done successfully. The communication is properly done without any interference between different modules in the design. Design is done to meet all the specifications and requirements.

PROPOSED SYSTEM RESULTS

The main aim of this project is to provide the security to the home from the entry of the strangers and intimate the elder people in the house regarding the entry of the any person into the house. The project was done by using the Raspberry Pi 3 processor.

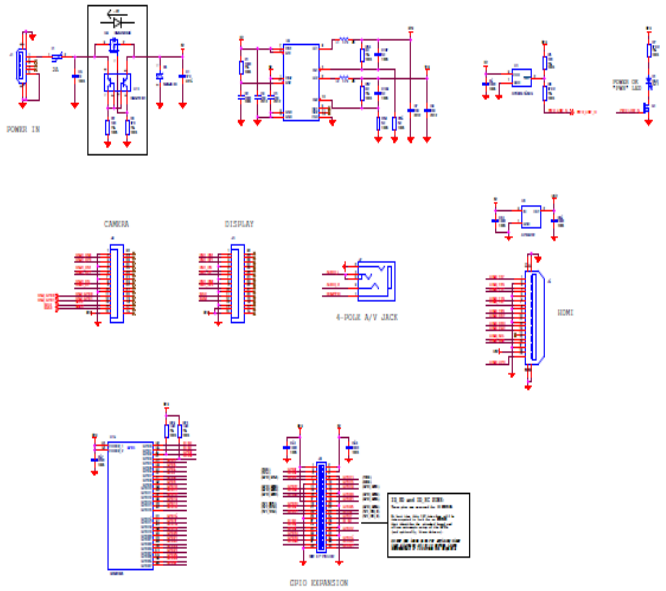

Fig 5.1: Schematic diagram of proposed system

Fig 5.2: Proposed transmitter

To PIR sensor was used to detect the human moments at the entrance door of the house. Whenever the PIR sensor detects any person moment, then it will send the signal to the Raspberry Pi 3 processor. Then the Pi 3 processor can trigger the USB camera to take the snapshot of that person and sent that to the Pi3.

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The Pi 3 processor in turn sends that photo to the predefined email ID given in the program. Then the user can get alert mail and if he wants to open the door of the house then the user can login into the predefined web page and send a predefined command button from that web page. Then the command will receive by the processor and open the door by rotating the DC motor by the L293 motor driver.

Whenever any person enters into the house then the RF transmitter connected to the Raspberry Pi 3 processor will get the high logic from the Pi and send that signal to the RF receiver side, which is placed at the hand stick of the elder/ blind person exist in the house. The RF Receiver will receive that data and trigger the vibration motor placed to the stick. Then the older person can get the information about the entry of the person into the house.

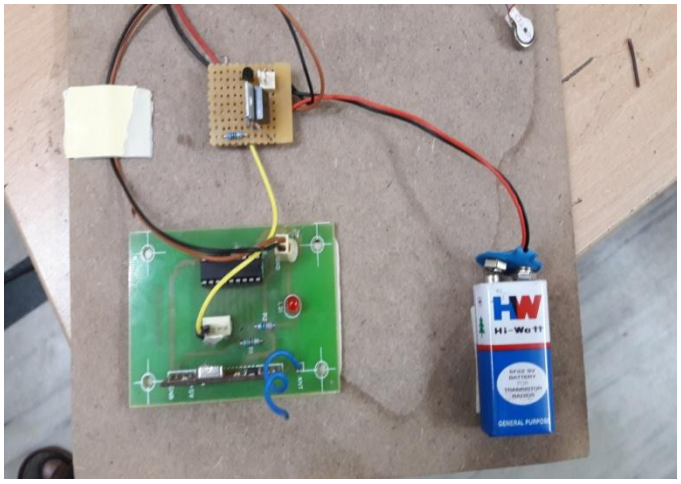

Fig 5.3: Proposed receiver

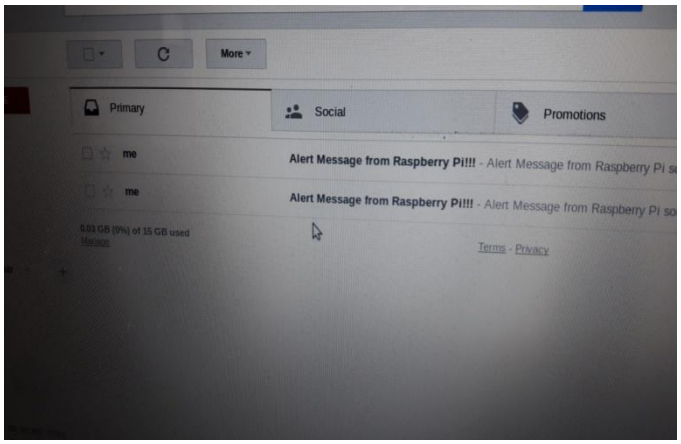

Fig 5.4: Alert message from raspberry pi

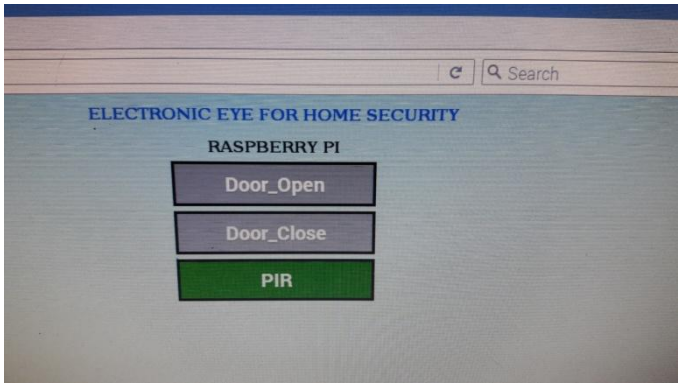

Fig 5.5: Alert message when Human (PIR) sensor detected

ADVANTAGES AND APPLICATIONS

ADVANTAGES

1. This system can monitor remote area ATM machines from theft.
2. It can avoid fire accidents
3. We can see status of ATM machine through web server
4. It can capture image of person who is trying to theft ATM machine
5. It can spray some kind of GASs on person who trying to theft ATM machine

APPLICATIONS

1. ATM Applications
2. Security applications
3. All security applications

CONCLUSION

Thus, we have developed electronic eye which is capable of providing both face detection and alarm system, rather than using different modules for performing the respective operations. Also the camera system is compact and can be implemented with low cost. The implemented face detection algorithm (Haar like cascade classifier) is very effective, with an accuracy of 88.9 % which can be increased further by effectively improving the illumination of the area. However, this system is connected with the help of Ethernet cable to the laptop to communicate with the raspberry pi. This can be overcome by making the system wireless.

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FUTURE SCOPE

In future we can embed the face recognition technology, by which we can recognize the face of the person at the door by compare the face of his with the already existed database and if it was compared then the door will be opened automatically without any command from the owner of the house.

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