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PROTOTYPE DESIGN USING INTERNET OF THINGS FOR MOTION DETECTION IN SECURITY ROOMS

¹J.L.DIVYA SHIVANI, ²RANJAN K.SENAPATI

¹Reaserch Scholar, K L University, A.P. India, ²Ranjan Senapathi, , Prof. Department of Electronics and Communication, K.L University, A.P. India, E-mail: ¹shivanidivya18@gmail.com, ²rksphd@gmail.com

ABSTRACT

Surveillancetechnique provides the capability of collecting exact and meaningful data and choosing appropriate decisions to optimize safety and security. In present surveillance technique, videos or images from any portable cameras or CCTV cameras are sent to a control centre, where actually all these huge amount of data is saved in database servers. Operators have to maintain and monitor these images or videos [1]. Mobile image surveillance represents a new paradigm that encompasses video acquisition on one side, and on the other side, especially at the same time image viewing and addresses both computerbased and mobile-based surveillance. [3] It is based on JPEG 2000 still image compression format. It is attractive because it supports flexible and progressive access to each individual image of the pre-stored content. It supports still image creation on the basis of motion detection technique which enables efficient utilization of resources.[3]It provides the software motion which enables the Pi's camera to detect motion and save the image as well as view live streaming from the camera. A python script, then directs the Pi to send email notifications every time when motion is detected. With these components, we designed a cost effective and efficient security camera system. The paper is concluded with concise summary and the future of surveillance systems for public safety.

Keywords:- *Raspberry Pi B+, Motion Detecting, Email, Notifications, Gsm, Python.*

I. INTRODUCTION

New innovative technology is related to how a product is capable of implementing along with its price. The Raspberry Pi crosses off both criteria because it is a cheap effective computer which is capable of much more. What makes it so convenient is that additional access can be done with it from a security system to a VPN server. The possibilities are endless! Like any other computer it can accept several programming languages including Python. Most importantly, security is necessary today and the Pi has the ability to become a camera security system with a low cost system. Normal security systems lead up to the price of thousands. Who would want to buy a single camera for over 100 dollars just to setup on their front door, when they can buy a 29 dollar camera which even notifies them via email?

1.1 Surveillance Systems: Surveillance means monitoring the behavior, activity, or any other related information changing about a situation,

normally it is for people to manage, influence, direct, or protect in certain cases. Word 'surveillance' is from French language which mean "watching over" any situation. This word surveillance may be referred as observing from remote distance with the help of electronic equipment's (just as CCTV camera).[6] Surveillance is very helpful to government& law enforcement for investigating, maintaining social control, recognizing and monitoring threats, thus to prevent criminal activity [1]. Personal or Home based security and surveillance system plays an important part of modern automated home. The basic design of a surveillance system starts with analysing the needs of the inhabitants, considering monitoring choices, reviewing system cost, surveying present technology and hardware, and planning for the installations. Further for interior protection given by a home security, a surveillance system monitoring has a feature that enables the system to monitor surrounding conditions in and out of the home, especially when we are away from home. The implementation of a surveillance system should provide for alerting the entire perimeter of a home as well as audio and video based surveillance

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monitoring system. These days various kinds of security system sensors are rightly available that are fabricated to detect sounds, door and window intrusions, air movements, human body radiations, motions around, and some other conditions that indicate an intruder if present. A proper security system implementation should consider an optimized plan for present homes as well as for new constructions. It must also consider the lifestyle, place or location of valuable items or any which have to be protected and also depends on how a system is to be controlled and protected, excess smoke and fire alerting, and the type of emergency response is required. The designing choices are various and which are varied with the advances in home surveillance technology and with wide availability of compact and low cost video surveillance systems [2].

1.2. Surveillance systems types: There are various kinds of home surveillance systems which can be very helpful in security systems. Some of such systems are explained below.

1.2.1. wireless security systems: Wireless home security networks (WSN)use battery powered radio transmitters and receivers which provide RF based communication to connect with various electronic components such as video cameras, smart sensors, environment motion sensors, alarms, centralized controllers, smoke and fire detectors, keypads, storage servers, and displays for monitoring. These kinds of surveillance systems are normally available in many hardware stores, on the Internet and are often available for do-it yourself kind of installation[10]. Wireless home security network has many advantages as they are very easy to install, they enablein-expensive and time taking task of installing new cables in the walls of existing architecture. Wireless sensor network are designed to transmit unique identification coded signals to a central controller, they enable us to reinstall all the components when we shift to any new locations. But these have some disadvantages as these Wireless system design specifications obviously has limited distance between sensors and cameras to the central controllers and they also require periodic replacement of battery source. [10]

1.2.2. hard-wired surveillance systems: The Hard-wired surveillance systems use wires as they are installed from the walls, spaces, roofs, and undergrounds in order to connect and pass the data from all the sensors to the central controller. Main elements of any hard-wired system includes a main

controller, smart sensors, keypad inputs, motion detecting sensors, fire, smoke and temperature sensors, cameras, displays, and alarm units. This kind of System has added advantages such as hardwired security systems which aremore reliable than many of the wireless sensor network systems. These hard-wired elements are usually not visible as they are installed from the walls and these are aesthetically reliable than other wireless elements and these Hard-wired components does not depend on battery source which may lead to energy failure, backup options. The only disadvantage of installing Hard-wired systems is that they are more expensive than wireless sensor systems. Some problems can invoke in the configuring sensors in existing homes where-in some parts in home are not convenient for pulling wires inside the walls, roofs or attics.[2]

1.2.3. remote accessing surveillance systems: A remote accessing surveillance system features the capability to monitor and control electronic components of home security systems from any location around the world. These systems can be developed with cellular or telephonic systems as they are spread around the world. A telephone call to the home GSM system or followed by a SMS key code allows the user to obtain status pertaining to environment, actuators and siren system conditions. These Remote surveillance systems can also be configured to call or text any specific person's phone number when certain conditions exceed their threshold. A preconfigured synthesized voice reply system also gives the caller with an audible report. The user, with proper coded text/sms inputs will have the same control functions from a distant location those which are available to control through keypad sitting inside home [1][2]. Disadvantage of these types of traditional systems are they suffer from an unnecessary waste of energy. These systems take a long time to detect and to wait for acknowledgment from user in case of any intruder. Furthermore the main failure arises if there is any problem in GSM network, as user can't control these electronic components and user won't get present status of home environment. This kind of systems turn even more hack able, if intruders get to know the key words and the home security operated mobile number as they can also operate and have overall control. These systems can't withstand to hackers if intruders uses signal jammer sand or other hacking techniques.

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2. PROPOSED SYSTEM

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From the security systems explained above we can state that all of these systems are working continuously at their position eventhough there is no intruder or any moving objects. Hence this consumes much energy and also require large amount of memory for storing the data of captured picture by the camera of the system which is also continuously kept for working. So to cut down the energy consumption of these traditional security systems, we propose a low cost embedded surveillance system using ultra low alert energy which consists of PIR sensor which is low energy



sensor.

Fig1: PIR Sensing Sent And Mail Result

With very low energy usage, security and safety it is the most discussed concept in most of the fields like surveillance, industry, offices, and in general applications and in smart environments. Previous security systems suffer from an unwanted waste of energy and the shortage of memory conditions in case of the absence of any intruder. In this paper we design a home based low cost embedded security system which evaluates with the introduction of a small PIR Pvro electric Infrared sensor which can be interfaced with any microcontroller with ultra-low alert energy consumption. This system can sense the signal generated by moving persons where there is change of radiation with PIR sensor i.e., by detecting the presence of any individuals or intruders at a relative change of thermal equilibrium by the surrounding environment. Thus by detecting, if there is any presence of intruder within a specific time intervals, then this sensor triggers a signal which initiates a function of the MCU to start the program of Web camera. This sensing experiment shows the reduction in memory usage requirement for saving the data and even systems energy consumption.

2.1 System Architecture:



Fig2: System Architecture

Above Fig2 shows the embedded surveillance system which has two groups of sensors, indoor and outdoor. The outdoor sensor group contains a number of PIR and pressure sensors placed near windows and doors of a home. When the outdoor sensors sense an intruder, the MCU rises up and turns on the energy for the indoor PIR and ultrasonic sensors. When this is completed, the decision signal passes to the embedded board GPIO (General purpose input and output). The software module of the energy efficient embedded board turns on the Web camera to capture images and user can view the images captured by the home surveillance system through the Internet.

3. DESIGN AND IMPLEMENTATION

In this paper the alerting sensors with lowenergy consumption are placed near the home windows and doors where an intruder could pass through.

Implementation is based on a PIR sensor security system for home applications where Passive Infrared PIR sensor has been installed to sense the motion of human through change of radiations due to release of heat radiations from the human body. PIR sensing device does not release any infrared waves but it passively receives

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incoming available infrared radiations. Figure above describes the block diagram of whole system. Whenever an intruder moves in the sensing region, these sensors activates the function of sleeping MCU (Micro Controller Unit) which enables the detection of the indoor sensors for signaling to the central embedded controller. This system analyzes the sensor info and then makes a programmed decision whether to initiate the camera to capture images or videos. We programmed feature of the controllers sleep mode to reduce energy consumption if there is no intruder so as to optimize the traditional surveillance system without wasting much of the energy. To secure the surveillance embedded system from theft, crime, fire, etc. a full security system is needed not only to detect but also to pre-empt hazards. Typical security systems use cameras and processes lot of information to extract features with high cost and hence requires significant infrastructure [4].

The main algorithm for the e-mail notifications is that an image is taken whenever motion is detected. Once that occurs we need to give a command that sends an e-mail to start. There is a particular part of the configuration file referred as "on picture save" where the user will enter a command to be performed once a picture is saved. The "on picture save" configuration is set to python camera because once a picture is saved this python script will run. The script camera.py is intended to use SSMTP and sends an e-mail alert for every time a picture is saved. Since it uses SSMTP it is necessary to enter the e-mail address and password of the account that notifications are to be sent to [3]. The content text can even be adjusted inside the program. In this particular script the user is alerted that there's a motion detected, the IP address and port of the location is also given. The context of the script is shown below for clarity.

4. SYSTEM HARDWARE:

A Raspberry Pi works like a computer, when it is plugged into an LCD with attachment of a keyboard and a mouse. It is able to complete the functions of any regular PC can. It is a thirty five dollar, credit card sized computer board. It has RAM, Hard Drive (SD Card), Audio and Video ports, USB port, HDMI port, and Ethernet port. With the Pi, users can create spread sheets, wordprocessing, internet browsing, play HD videos and much more. It was designed to be a cost effective computer for users who needed it. [4]There are two models, Model A and B. Model B is the faster containing 512MB of RAM as well as has the ability to over clock [1][2].

Raspberry Pi Camera V2.1: The Camera Board on the Raspberry Pi is a tiny printed circuit board with a camera on it. The PCB is connected to a ribbon cable which connects to the Pi itself on its own port. The ribbon can be extendable. The camera on the board is extremely tiny (5MP camera); and is comparable to those used on cell phones nowadays. As for now it is the only Camera made particularly for the Pi, therefore these specifications can't be updated. Since it uses 250mA, externally energizing the Pi should be enough for the camera.[5][10]

In order for the camera to be enabled it is necessary to go to the raspberry pi configuration settings and choosing Enable Camera.

raspistill –o imagename.jpg

The camera can be used as a regular camera as well as a motion detecting camera. In that case it is not necessary to download the configuration file. Commands in the terminal such as Take snapshots.

While other commands such as the one below can make a video.

raspivid –o videoname.h264

Outdoor Sensor group: To reduce the energy consumption of the alert state we combine pressure switches and PIR sensors [3]. The pressure switches which are used are thin and placed on the ground. When an intruder invades the area nearby the pressure switches, the PIR sensors wake up the MCU.

4.1.1. pyroelectric infrared sensor (pir): PIR sensor is essentially made of Pyroelectric sensors to develop an electrical signal in response to a change in the incident thermal radiation. Each living body emits some low level of radiations and the hotter the body the emitted radiation is more. Detection range of sensor is 3m to 12m approximately.



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In order to shape the Field Of View (FOV) of the sensor, the detector is equipped with lenses in front of it. The lens used here is of low cost and lightweight plastic material with transmission characteristics suited for the desired wavelength range. To cover much larger area, detection lens is split into multiple sections, each section have a Fresnel lens.



Fig4: Possible Detection Range

Here region of A zone is possible detection of object less than 12 meters in distance and 1.5 meters high, the region of B zone is detection of object less than 6meters in distance and 1.5meters high, and finally C zone is one with less than3 meters distance and 2.5 meters high.

Fresnel lens condenses light, providing a larger range of IR to the sensor and it will span over several tens of degree width. So total configuration improves immunity to changes in background temperature, noise or humidity and causes a shorter settling time of the output when a body moved in or out the FOV.

indoor sensor group: For indoor, we use multifrequency ultrasonic sensors. In the ultrasonic sensors we use a typical oscillator chip to design a square waveform generator and resistances and capacitance will be adjusted to generate a multifrequency ultrasonic transmission.

The ultrasonic transducer transforms the voltage waveform into an ultrasonic transmission and the transducer of the receiver transforms the ultrasonic transmission into the voltage waveform.

Since the receiver may experience external interference at several frequencies, it is necessary to screen the filter signals outside the receiving frequency and the signal input to the amplifier and the comparator, other ultrasonic sensors are also susceptible to refractive interference, so we use several ultrasonic sensors at the receiving end, the count of the total number of ultrasonic sensors, always being the majority of the sensors triggered, is after the message sent to the MCU.



Fig4: Ultrasonic Sensor

It is featured by different distances to moving objects that can discover little objects and measured by ultrasonic sensor. It also less affected by target materials and surfaces, and not affected by color. It can detect small objects over long operating distances. This sensor is immune to external disturbances like vibration, infrared radiation, and ambient noise and EMI radiation.

5. CONCLUSION:

Raspberry Pi exposes an entire new chapter when it comes to technology of nowadays, because of not only its size but also its capabilities. Its portable and can be used for anything. Even though it is Linux based and many individuals are not familiar with terminal commands, the web community for Pi is growing. There have been many inputs from completely different users along with tutorials online making everyone's life easy when it comes to Pi projects. This can be seen from this security camera project. The system can be made by anyone who follows these steps. The steps basically focus on installations which are done directly from the terminal. The program Motion and its configuration file perform 90% of the task required for the pictures to be taken and sent to the email. There is also minor programming involved to send an e-mail. To even modify the side of the script, the user will notice one command that might send associate e-mail directly from the configuration file using programs like "send Mail" or termination. These steps permit anyone's home to be secure and also the size of the camera permits it to be distinct as well. It is placed anywhere! If the user gets a notification they have to easily go to a Firefox browser and enter their IP address together with the stream port number. They'll be ready to see what's happening at that time. A price effective

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system that is user friendly and convenient, what more would you need?

6. RESULTS AND DISCUSSIONS:

In the early stage of this study, importance of surveillance system was discussed, which can be implemented using sensors and image processing. In this paper sensor based security system was demonstrated, and Image processing security system left for further study.



Fig5: Image Captured On Pir Event

In Fig1 a system connected setup is shown, where PIR sensor is connected at GPIO_26 when a moving objected is the pin status becomes high to low. This event is detected through python shell and through SMTP protocol and the captured image is attached using MIME in SMTP module. Here we used port number 587 for mail protocol in the server function as *smtplib.SMTP* ("*smtp.gmail.com*", 587).

We have to check the status of mail server connectivity that is mail server responding to send a mail or not, this status is shown on monitor and also we have connected a LED which turns on just to show status of communication. Fig6 shows the status of the connectivity.

 pi@raspberrypi; 	~/Downloads/New		
<u>File Edit Tabs H</u> elp			
<pre>File "rpicameramail.py", line 65, if(GPIO.input(26) == 0): KeyboardInterrupt</pre>	in <module></module>		
pi@raspberrypi / Downloads New S sud rpicameramal.py:21: RuntimeWarning: anyway. Use GPIO.setwarnings(False) GPIO.setup(12, GPIO.0UT)	o python rpicameramail.py This channel is already i to disable warnings.		
rpicameramail.py:22: RuntimeWarning: anyway. Use GPIO.setwarnings(False) GPIO.setup(16. GPIO.OUT)	This channel is already i to disable warnings.	n use,	continuing
rpicameramail.py:23: RuntimeWarning: anyway. Use GPIO.setwarnings(False) GPIO.setwarnings(False)	This channel is already i to disable warnings.	n use,	continuing
rpicameramail.py:24: RuntimeWarning: anyway. Use GPIO.setwarnings(False)	This channel is already i to disable warnings.	n use,	continuing
<pre>GPI0.setup(2), GPI0.cot) rpicameramail.py:25: RuntimeWarning: anyway. Use GPI0.setwarnings(False) GPI0.setup(25, GPI0.0UT)</pre>	This channel is already i to disable warnings.	n use,	continuing
ultrasonic detected successfully sent the mail pir detected successfully sent the mail			

Fig6: Connectivity Status Of Mail Server Any mail servers & clients which are configured with SMTP protocol normally communicate using plain text. These plain text are often passed through one or more routers. So for security reasons we have to use transport layer security. Here we are using *server.starttls()* function which encrypts user name and passwords which are accessed AUTH command.

Now client sends *EHLO* command to mail server & restarts communication from first, for this time communication is safe is it will be encrypted until QUIT command which is given by function *server.close()*.

7. FURTHER STUDY:

In this paper an IOT security has proposed and is been implemented to send a mail, further this paper is extended to explore more IOT applications as sending SMS through Internet and creating web server for home security system. Further to improve and extend the capabilities of sensing people Computer Vision based image processing with above mentioned IOT applications can a best home security system.

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