IoT Based Home Intrusion Detection System

M. Kavitha, K Anvesh, P Arun Kumar, P Sravani

Abstract— Home security has become a significant and a major theme with the advancements made in IoT (Internet of Things). Different alarm systems are developed to minimize the intrusions, but there is very little outcome using alarm systems. There are many steps taken to improve the security and we are also trying to achieve. This paper explains mostly about how we can attain home security using sensors and webcam. Also explains various discussions that have undergone in this path. We mostly discuss what has already been discussed by others and we are going to propose some advancements to the existing one. Our home security system reacts if the person stands in front of the door and immediately sends an image of a person to the user email along with automated message to his mobile.

Keywords—Internet of Things (IoT), Raspberry pi, Security, Sensors, Smart Phone

1. INTRODUCTION

IoT is an organization of physical devices, home-based machineries, and diverse things fitted with hardware, software, and sensors which allows devices to connect and have a direct interaction between the physical world and digital world. IoT (Internet of Things) has made a revolutionary change to this world. Due to this mostly every object that has an Ip address (Internet Protocol) has been automated and can be controlled using our smartphones. There are many examples of this automation that we see in our everyday life a standout amongst the most common and useful ones is automation of electric devices in our homes that is the fans, lights that are present in our house automatically on and off by checking if there is anyone in that room or not. This can be achieved by using a sensor which detects the motion in the room and on the devices based on that. The sensor that is mostly used for demonstrations purpose is the PIR sensor (Passive Infrared Sensor). Not only PIR Sensor there are many motions detecting sensors in the market like Microwave Sensor, Ultra Sonic Sensor, Tomographic Motion Detector. These are some of the most used sensors out in the market that we found. Even among these sensors, the most popular one is Passive Infra-Red Sensor (PIR) which is being used mostly for small-scale projects.

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In this paper, we are going to connect the sensor to a WIFI module which in turn connects to the user's smartphone so that he/she can receive the alerts from the sensor to their smartphone either by text or by an email. The following fig.1 gives us an idea on how many devices are connected with IoT up until now and also on how many other will be connected by the year 2021. In fig. 2 we are showing the devices that are connected from different countries and also some expectations by the year 2021.
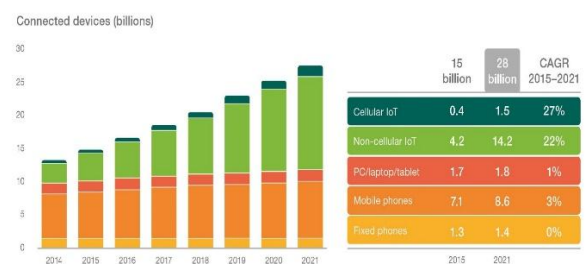

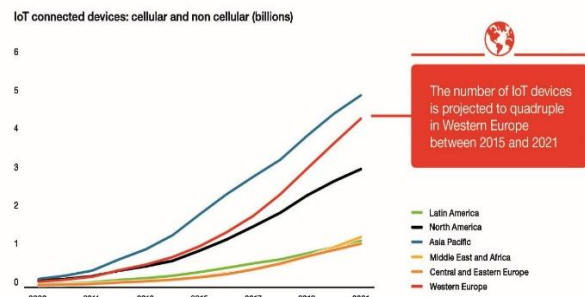**Fig. 1. Devices Connected and Future Expectations**

Fig. 2. Connected devices across certain countries

2. ASSOCIATED WORK

There are many kinds of works that we came across when we are writing this paper one of the papers the inspired us to go about choosing this home security is [1] "Home Security System using Internet of things." a paper presented in the IOP conference which discusses an inexpensive way of implementing a security system for both homes and industrial purpose. Before this paper came into existence there were different security methods proposed which can detect any person who stands in front of the door and send a text message to the person who created that program. That equipment used for setting up this project are Arduino Uno, ESP8266 WIFI Module, Reed Sensor Module. They even proposed the working model and showed the results of their implementation.

As discussed in [2] Improving home automation and security the focus was on fingerprinting how it stared what are the major drawbacks in the present systems and how can we overcome those drawbacks. Also, this paper improves the security system by not only improving the functionality of the fingerprint devices but also adding some login details so that the security level can be taken to next level. The fingerprinting system these people developed can also locate the geographical locations on where this has been accessed. Also, the total system is developed based on the javascript. The device they developed has an accuracy of around 97% which is pretty good.

When we talk about the IOT we need to discuss layers mainly security layers in IOT. Since there are many layers in IoT like perception layer, transportation, and architecture layer as discussed in [3] some of the security challenges that we will be facing are described in that paper. Fig.3. gives us an idea of how the security architecture is structured.
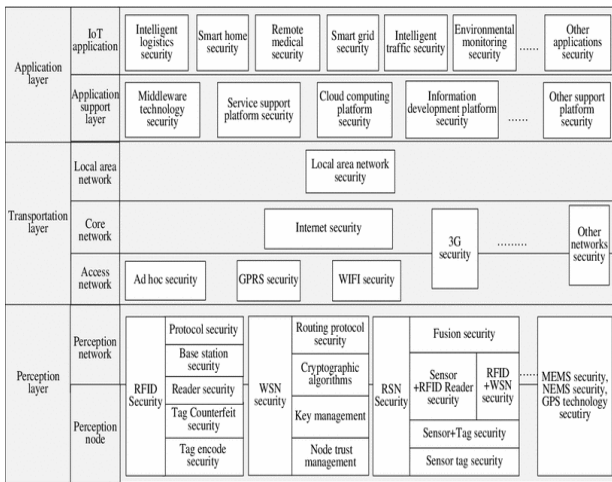

Fig. 3. Security Layers

As discussed in [4] we can try and improve the existing systems and take them to the next level to improve the security. This paper described and improved the existing security system. In the existing systems, the smartphone must be connected to that network for the alerts to reach the smartphones from the sensors, but this paper shows us a way to send alerts to the smartphone whether it is connected to the network or not. This is possible because of the microcontroller they used for developing those security systems. The microcontroller used here is TI-CC33200 Launchpad board that has an embedded microcontroller and a WIFI module which helps us to controlled and managed all the devices present in the house.

In [5] they proposed a study on smart door locking security system this can be mostly applied to ATM's, KIOSK and vending machines. Here they proposed the use of digital locks rather than the old physical locking system. This quite useful as the physical locks can be lost, stolen or can be re-made. Hence it can cause some major issues regarding data protection from an administrative point of view. During a conference, the security risks for the automatic teller machines have been pointed out and hence a need to improve the security system.

As discussed in [6] the importance and the necessity of

security system for our home and proposed a low-cost monitoring system using a webcam for live streaming on what is happening behind the doors without going out. These videos taken can also be viewed for any playback in the future. Here the webcam captures the live data and transmits it to our smartphones through a WIFI module so that we can view the data through a web application. In this project, they used a raspberry pi, raspberry pie camera, PIR sensor for any motion detection and EW-771UAN which is a type of WIFI module to receive data over the web.

When testing the water samples to find out the quality of water we manually gather samples and them to the lab to test and analyze. Here it takes some time to collect samples and send them to the lab. So, to reduce this time-consuming process and wastage of manpower and get the real-time values we can use various sensors. The Wi-Fi module that is present in the device transfers collected data to the microcontroller and transfers the data to our mobiles or pc. This helps to keep the water quality in check so we can provide safe drinking water.

SMTP Protocol

SMTP is application layer convention. The customer who needs to communicate something specific opens the TCP association with the SMTP server and sends letters in that association. The SMTP association will dependably be in the listening mode and at whatever point it tunes in to a TCP association from a customer it begins an interface an association with that port. In the wake of setting up the TCP association, the customer sends the mail.

The SMTP demonstrate has two sorts one is End to End strategy and the other is a Straight and forward strategy.

One association is used in straight and forward strategy where as two unique associations are used in end to end strategy. While sending an email, the client SMTP will initiate the session and contact the host SMTP. The collector or server SMTP will react and keep the mail until it reaches the beneficiary.

3. PROBLEM STATEMENT

By considering all the works done by many other we can identify many disadvantages and improvements that can be made to further improve security. We are not saying that the security system that came out is not good but can be further improved. In some projects, we have seen some proposals where they use live camera feed to the user smartphone directly and other projects where they send an alert message to the user's smartphone. Well, using a live feed is a better security option but requires a lot of space to store the recorded video for future reference. What if we try and combine these two features together?

4. METHODOLOGY

From all the related work discussed in the previous section, we can clearly see that there are many improvements that can

be done to improve the security system. There are many security solutions proposed by different people, but something more needs to be done to improve. In this project, we are going to try to implement a security system which consists of both alert systems and where we can see the image of a person who is at our house.

Here we will be using Raspberry Pi as our board for controlling all the sensors and the required devices for our project. Raspberry Pi is a micro-controller, or you can just say it is a mini-computer which can run a single program at a time. Here we can also use other boards like Arduino, but we are only using Raspberry Pi as it is easy to implement, and it consist many inbuilt components we require like Wi-Fi module. The next device we are going need to need is Passive Infrared (PIR) sensor. PIR sensor is a motion detecting sensor when a response to thermal heat it means it detects if any living thing enters in its range it senses its presence and we can add different types of alerts or commands to do when it happens.

5. COMPONENTS REQUIRED

1. Raspberry Pi
2. Webcam
3. PIR Sensor
4. Smartphone and PC

A. Raspberry pi

Raspberry pi is development of slight single panel PCs shaped to make computer science education a bit easier for the students. This was first developed in the United Kingdom. In a short time, this device has become more popular outside the targeted area and has become more popular with robotics. Even though it started as a charity foundation to teach basic computer science to students at schools this has become a revolution. Below in fig.4, we can see the parts of raspberry pi at some closer look.

Fig. 4. Raspberry Pi

As per the Raspberry Pi insights, there are in excess of 5 million gadgets that were sold by 2015 February, 11 million by 2016 November, 12.5 million by 2017 March and by 2017 June it became one of the bestselling general-purpose computers and by 2018 it reached around 19 million.

Raspberry Pi Models

The first-Generation Raspberry pi was released on February 2012.There different generation of models released where every model has a Broadcom system with the integrated ARM perfect focal preparing unit and an illustrations handling unit.

General processing speed goes between 700 MHz to 1.4 GHz and the memory runs between 256 MB to 1 GB RAM. There is an SD card slot which can be used to store the operating system. This board has four USB ports which can be used to connect the mouse, keyboard, pen drives etc. It also has an HDMI port for video output. It also has onboard Wi-Fi 802.11n and Bluetooth.

B. PIR Sensor

PIR Sensor otherwise called as the Passive Infrared sensor is a motion detecting sensor that can sense thermal heat in its radius. In fig.5 we can see the top portion of the PIR sensor, in fig.6 we can see the circuits in the PIR sensor and in fig.7 we can see the range of PIR Sensor how it is going to detect a heating body that passes through it, the heat signal and output signals are clearly shown to us in the figure.

The working of PIR sensor is simply as we already all the objects which have a temperature above absolute zero emit heat from their bodies that are called as radiation. This radiation is of a different wavelength to those that are visible to us invincible to the human eye and so we use a sensor to detect such radiations.

PIR sensor generally has three main pins one for input voltage which can take up to 5V, one for ground and the other for the output. We also have a repeatable and non-repeatable trigger.
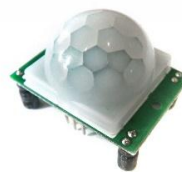

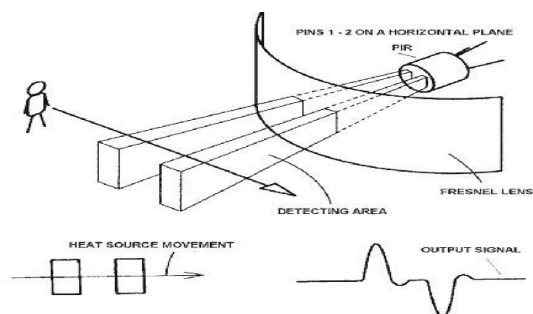**Fig. 5. PIR Sensor Top** **Fig. 6. PIR Sensor Bottom**

Fig. 7. PIR Sensor Range

C. Webcam

There nothing to discuss this cause each and every person who is reading this paper might have used this in their daily life. We don't need to use a high-quality camera where the image can be zoomed to an extreme level we can use something where can see a person's image clearly. For this

purpose, we can use some real chap webcams like Logitech c210, Logitech c270 in fig.8, Logitech c310. But for our needs, we will use even a cheaper device so as to make this system available to everyone.

Fig. 8 Logitech c270

D. Smartphone

Here we require a smartphone or any device which can connect to the internet to access the image captured by the webcam. Even we may use a low-resolution camera even that helps to find the person who does shady work at our homes.

6. IMPLEMENTATION

We already discussed the major use and working of PIR sensor in this system in the previous section so let's get down with the implementation part. We first started to make a connection to the Raspberry Pi and the PIR Sensor and now we need to boot OS into an SD can and insert it to the board.

We already gave a detailed explanation on all ports present on the board and how we will use them in previous sections. This board must be connected to the monitor for us to work on it. The OS used in raspberry pi is called Raspbian. There are many versions of this OS we use what suits our needs and support the board we are using.

First whenever we connect our Raspberry Pi to our system or monitor it powers up and starts the Linux operating system. Not only that our sensor which plays an important role here also gets powered up and starts picking up the signals. Whenever our PIR sensor picks up a heat source it will send a signal to Raspberry pi which will thusly respond and starts up the webcam or camera whatever we use in our project. Once the image captures our device will start to connect to the Wi-Fi or Ethernet which will, in turn, connect to the mail (Gmail or Yahoo or whatever it is) and try to send this image to our mail.

We also have a PHP site which can be opened through the IP address which is used to connect our device. This is a secure address which can be accessed only through this network. On opening this page, we will get a page displayed the recent image that our camera took and also along with two buttons named authorized and unauthorized which prints out two different texts on pressing them. Authorized prints allow this person and Unauthorized prints do not allow the person in the image.

The figure below shows us or gives us an idea of how the program or the code runs when it's run. This specifically shows us the running code when capturing an image.
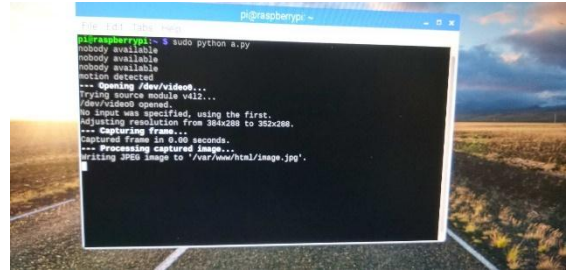

Fig. 8 Capturing Image

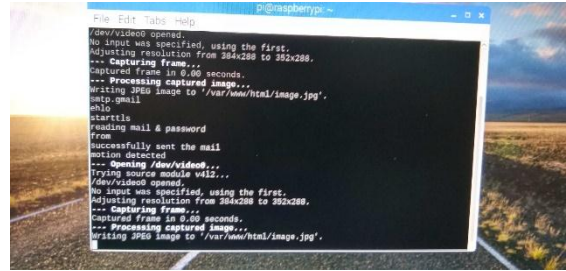The figure below shows the steps that take place when the image is being sent to the concerned mail.

Fig.9 Sending Mail

7. RESULTS DISCUSSION

There are there different outputs which are of different resolution and taken at different times to test the capacity of the low budget camera we are using here it seems that it cannot keep up with the fast movement of the person and as we can see the third output we used a different webcam than those which are used in the first two outputs. The first two outputs are bit clear when compare to the third output because the first two images were taken in the dark room with a little light focusing on me which is acceptable. The fourth image was our first shot after completion of our project it was a checkerboard type pattern on the wall and then later the third image was taken. We also need to keep in mind that we are using a very low budget camera and so is that detail but if we can afford for a better one the quality would be on another level.

Fig. 10. Sample Result 1

Fig. 11 Sample Result 2

8. CONCLUSION

Our security system helps us to have an additional layer along with pervious known systems. Hence by using this system we can provide a double layer security to our homes. As we are using camera with the PIR sensor this helps us identifying the intruder identity with less effort by accessing data anywhere from the home.

9. FUTURE SCOPE

The advancements that can be made to this project is limitless. Some of them are we can try and some biometric systems to detect the intrusion. We can also use image processing techniques where we can add a device which can find out if the person is really part of the family or a friend. We can even add an automation system which can work with this setup to further improve the possibilities. This can be a little tough, but the developments are being made to make it a possibility.

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