SMART HOME SECURITY SYSTEM USING ARDUINO AND IoT

by

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ABSTRACT

Security is the most fundamental aspect of our daily lives. Advancements in technologies such as IoT and cloud networks have assisted in making newer security systems more secure apart from becoming applicable and accessible for the common households. The ideas that were just mere concepts a decade ago are being practically implemented in households thanks to the technological advancements of our modern age.There are many different automation systems for smart homes. Our product is designed to detect intruders, leakage of water or any abnormal temperatures in our rooms. Any threats that are detected are immediately notified to the user using SMS. The user can also monitor the current parameters live from anywhere using the app. Smart devices that provide security in smart home systems have sensors, in our case- motion, temperature,water are some of the sensors.The sensor readings are fed to the Arduino where all the data conversions and calculations are performed and sent via ESP8266 Wifi module. This data sent by the Wifi module to the cloud can be accessed from anywhere. The system gives us notifications of intrusion or any other alerts to our phones regardless of our location.Since the system is connected to the cloud it always provides real time information without any delay through the app in the user's mobile phone, increasing the efficiency of the system. Also one of the key aspects of our project is the low cost of the equipment compared to other systems available in the market

1. INTRODUCTION

1.1 OBJECTIVES AND GOALS

Our objective is to design a Smart Home Security System Using Arduino And IoT that notifies an instant alert when there is any abnormality sensed by the sensors present in the security system. If there is an intruder detected by the PIR sensor or there is a rise in water level or rise in temperature detected by the water and temperature sensor respectively in any room, the user is notified through SMS in their phones immediately. The system gives us notifications of intrusion or any other alerts to the user's phones regardless of the user's location. Another goal of our project was to provide a robust and efficient system for a minimal cost so that it is affordable by most households.

1.2 APPLICATIONS

Our smart home security system can be used in residences, offices, hospitals, storage facilities and many other closed infrastructures to provide security as well as detect any incidents that could cause damage to the infrastructure or apparatus and minimize the destruction.

1.3 FEATURES

- Intruder detection

- Water leak/ overflow detection

- Fire detection

- Information can be accessed from anywhere anytime via cloud

- SMS notification in case of abnormalities

- Low power consumption

2. Low cost LITERATURE SURVEY

Juhi Jha et. Al. (2020) showed a modest implementation of a home security system. ZigBee modules usually consume less power as they power up using batteries and are used as a communication method at places where the proximity sensor is repeatedly sensing and is away from the power supply. Wi-Fi is placed inside the house where there is a scope to connect to the power supply. The Wi-Fi module uses relatively higher power in comparison to ZigBee. The Arduino senses the WIFI module and by using the ZigBee module it sends information to the module which is placed at home. For the person at home, an alert about an approaching object is obtained in the form of LED glow and also a ringing buzzer. An email alert is also sent to the registered user about the approaching object.

Shaik Anwar et Al. (2016) concluded that the said paper presents the design and the implementation of an interactive smart home security system with email alert, web enabled video streaming and remote control to access the door and voice alerts using smart phone. These are some of the trends in the automation field. With the help of the internet we can make administrators get parameters of different remote devices and send all the required information at any time.

Laxmi Jadhav et Al.(2018) proposed this home security system constructed using IOT which has proven to work efficiently through many practical experiments by connecting simple home appliances to it and controlling them remotely using the internet. This particular system not only follows the sensor data, but also drives the

process according to its requirements. It also registers the sensor data via the cloud at regular intervals. This will enable the user to monitor the conditions at any time from anywhere.

Anitha A(2017) has proposed a system to notify the user regarding any unauthorized entries / break ins or whenever the door is opened, by sending a push notification. On receiving the notification the user can take appropriate actions to secure their homes. This particular system uses Arduino Uno as the interface between various components, a magnetic Reed sensor which is used to monitor the current status, a buzzer used as the alarm, and a ESP8266 WiFi module to connect and operate the device through the Internet. The main advantage of this system is the seamless setup, easy maintenance and cost efficiency.

3. FIELD SURVEY

A survey was conducted using google forms asking various questions and inferences were made from hundred responses.
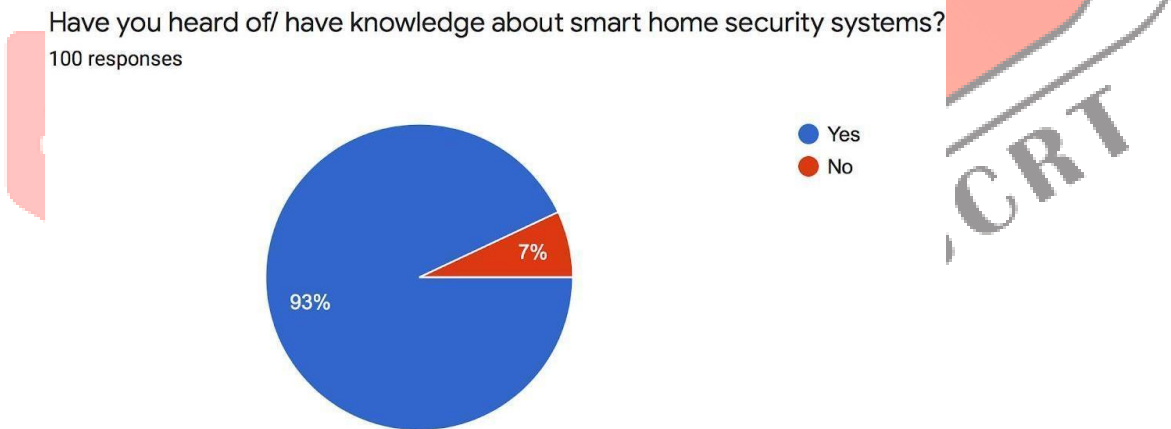

Fig 3.1 Response for Have you heard of/have knowledge about smart home security systems?

We found that 93% of the respondents are well aware of smart home security systems, and only 7% of the respondents have less knowledge about it.
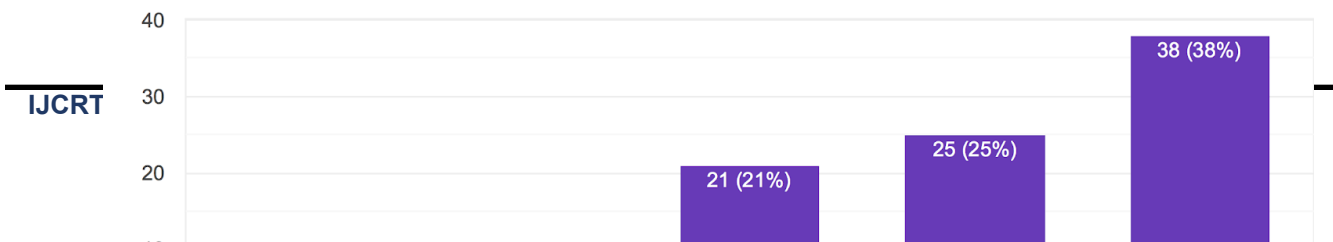
Fig 3.2 I live in a crowded neighbourhood.

About 84% of the respondents reside in moderately to extremely thickly populated areas, while the rest live in thinly populated areas.

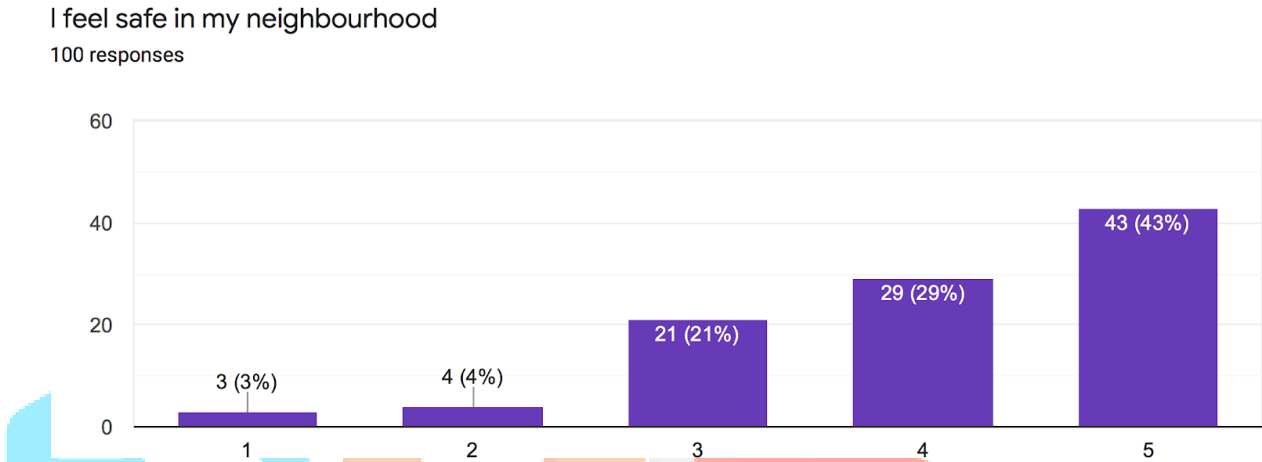**I feel safe in my neighbourhood**
100 responses

Fig 3.3 I feel safe in my neighbourhood

Around 72% of the respondents feel very safe in the neighbourhood they live in. The remaining 28% percent felt unsafe and might consider smart home security systems.

I am often far away from my house and if anything were to happen , I wouldn't be able to respond on time.
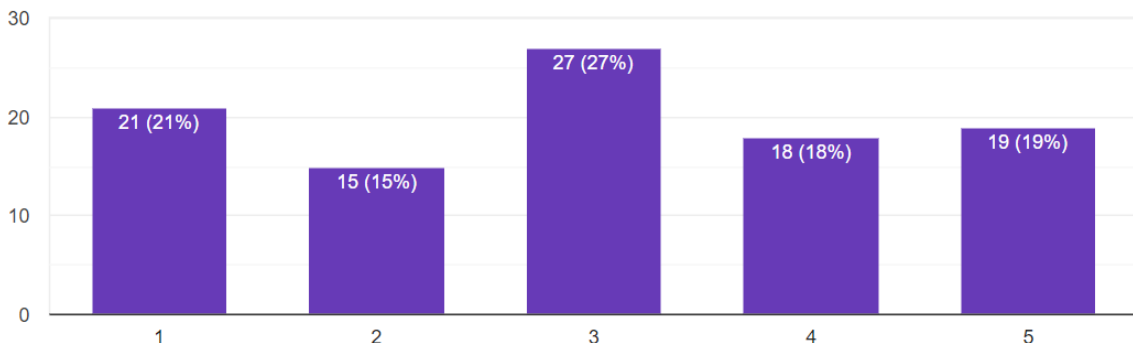100 responses

Fig 3.4 I am often far away from my house and if anything were to happen, I wouldn't be able to respond in time 27%(majority) went with a neutral answer and an almost

equal number of people lean towards strongly agree and strongly disagree.

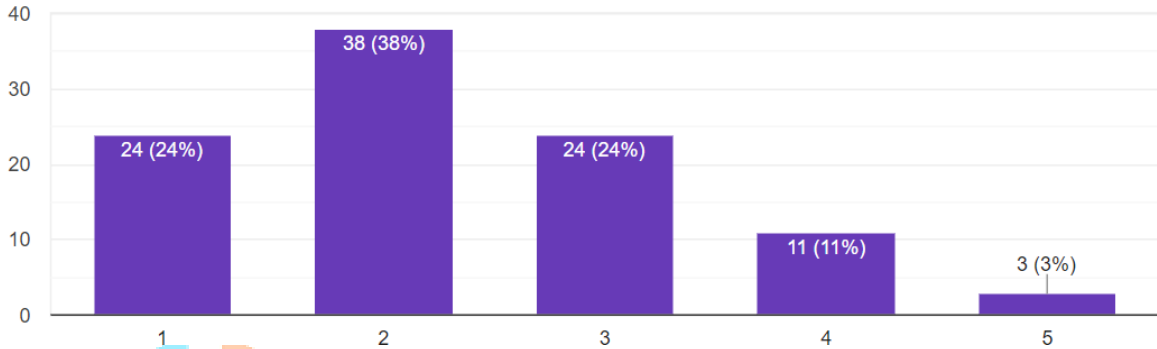How often do you hear about theft's in your locality?

100 responses

Fig 3.5 How often do you hear about the theft's in your locality?

58% disagree and 24% are neutral about it.

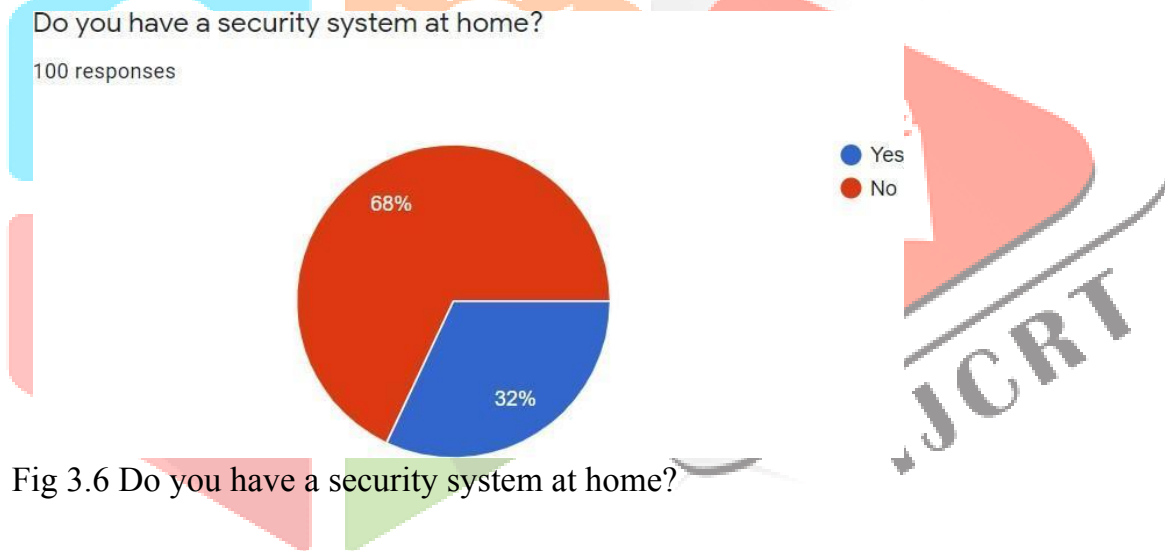Do you have a security system at home?

100 responses

Fig 3.6 Do you have a security system at home?

From the above chart we see that 68% of the people don't have a security system at their homes.

How many of your neighbours / acquaintances have a home security system that you know of?
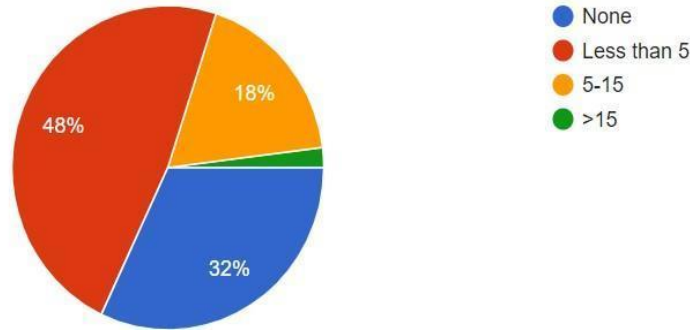
100 responses

Fig 3.7 How many of your neighbours/ acquaintances have a home security system that you know of?

80% of the people in general do not have any friends who have a security system at home and a small amount of them know of people with security systems installed.

I trust my neighbours well enough to take care of my home when i'm away.
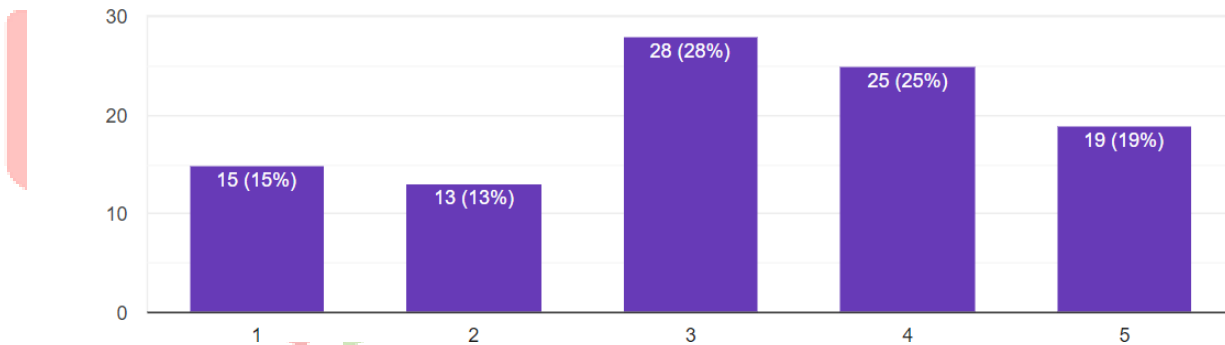
100 responses

Fig 3.8 I trust neighbours well enough to take care of my home when I'm away.

25% of them agreed that they trust their neighbours and 28% are half-minded about it.

It is important to get notified about things that happen in your locality or even at your own place when you're away.
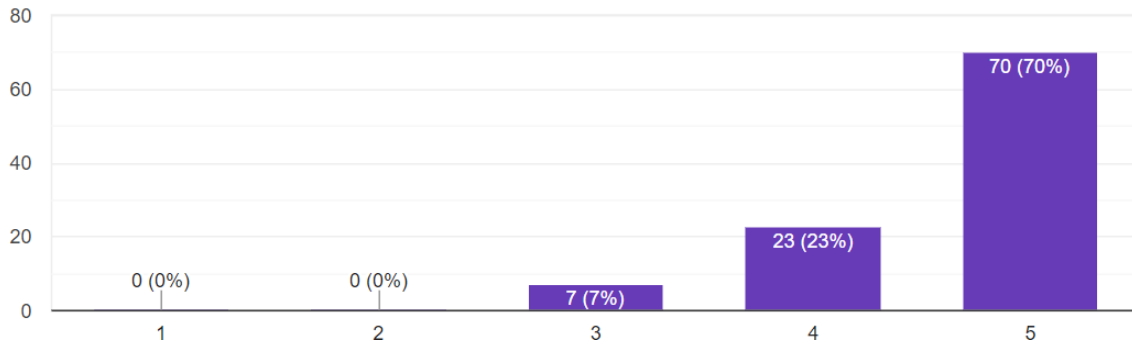
100 responses

Fig 3.9 it is important to get notified about things that happen in your locality or even at your own place when you're away

Majority of them strongly feel that they should be informed about all the events that take place in their locality.

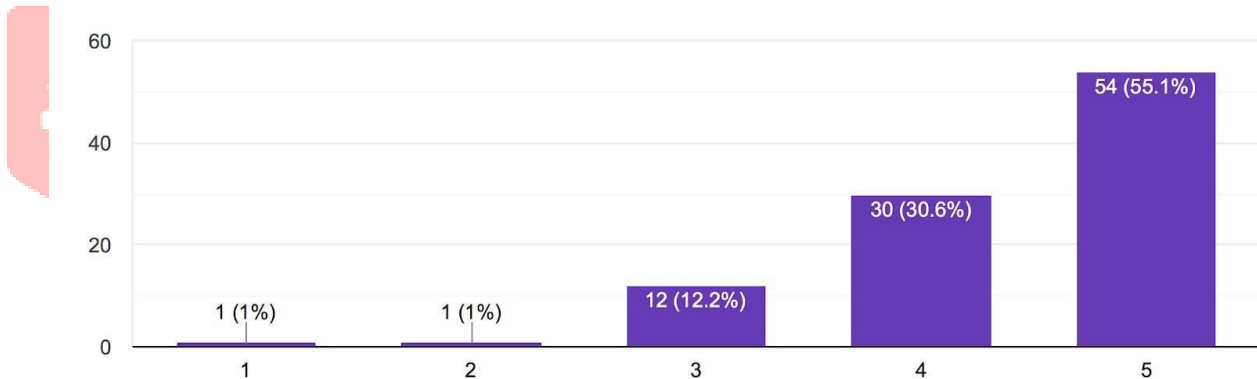How important do you think having a smart home security system is?

98 responses

Fig 3.10 How important do you thing having a smart home security system is?

Nearly 84 percent of people agree that having a smart home security system is important.

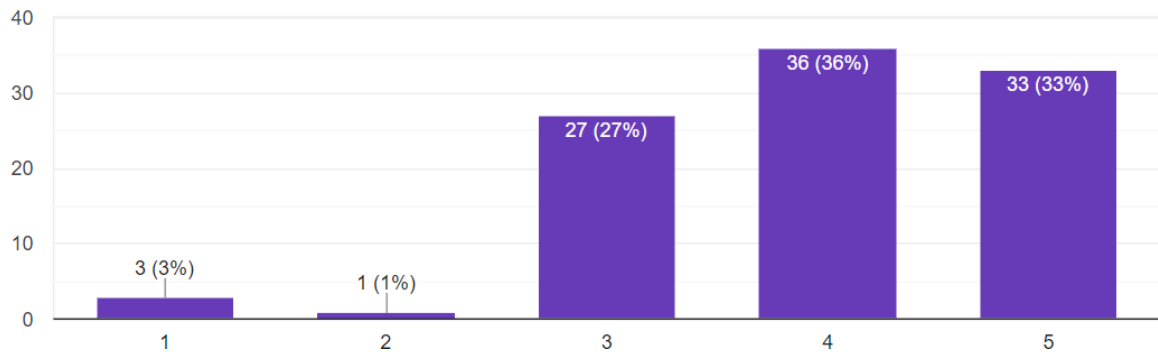Do you think smart home security system is expensive

100 responses

Fig 3.11 Do you think smart home security system is expensive?

Nearly 70% of them feel that a home security system is expensive. Only 27% feel neutral about it.

Do you consider purchasing / recommending others to purchase a smart home security system in the near future?
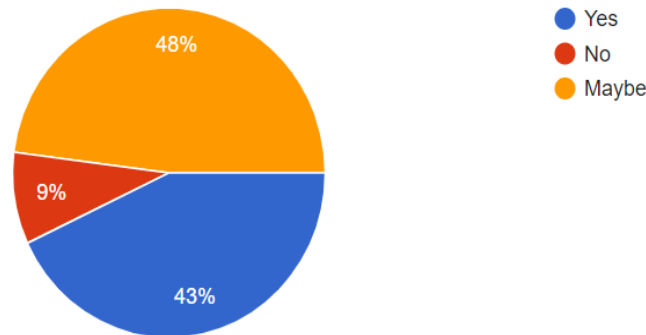
100 responses

Fig 3.12 Do you consider purchasing/recommending others to purchase a smart home security system in the near future?

Majority of the people who answered this survey are open to the idea of having a security system at home but nearly half of them do not plan on installing it immediately.

What are your expectations from the Smart Home security system?

Finally we asked people what are all the features or expectations from an ideal smart home security system. We received about 50 responses. Some of them are listed below:

User friendly and easy installation A good app with which monitoring is easier when far away or a sort of signal(like some kind of nudge or sound? to know if something is wrong.

The system should inform us through our mobile wherever we are.Also it has to operate an alarm to alert the neighbours and nearby police station .It has to send footage automatically to police and to the house owners.

It should notify us when there's some unnatural movement and a small alarm going off due to that. Secondly, take a screenshot of itself when the theft or break-in is happening, so that later on it'd be easy to identify the thiefs.It should be reliable, long-lasting so that it's a good monetary investment, and be able to effectively alert me when I am away ,It should work 24 hours round the clock.METHODOLOGIES AND IMPLEMENTATION
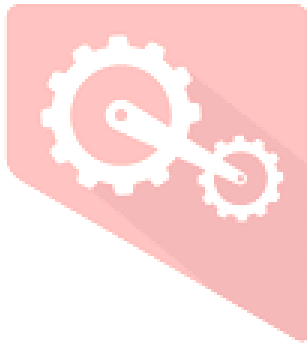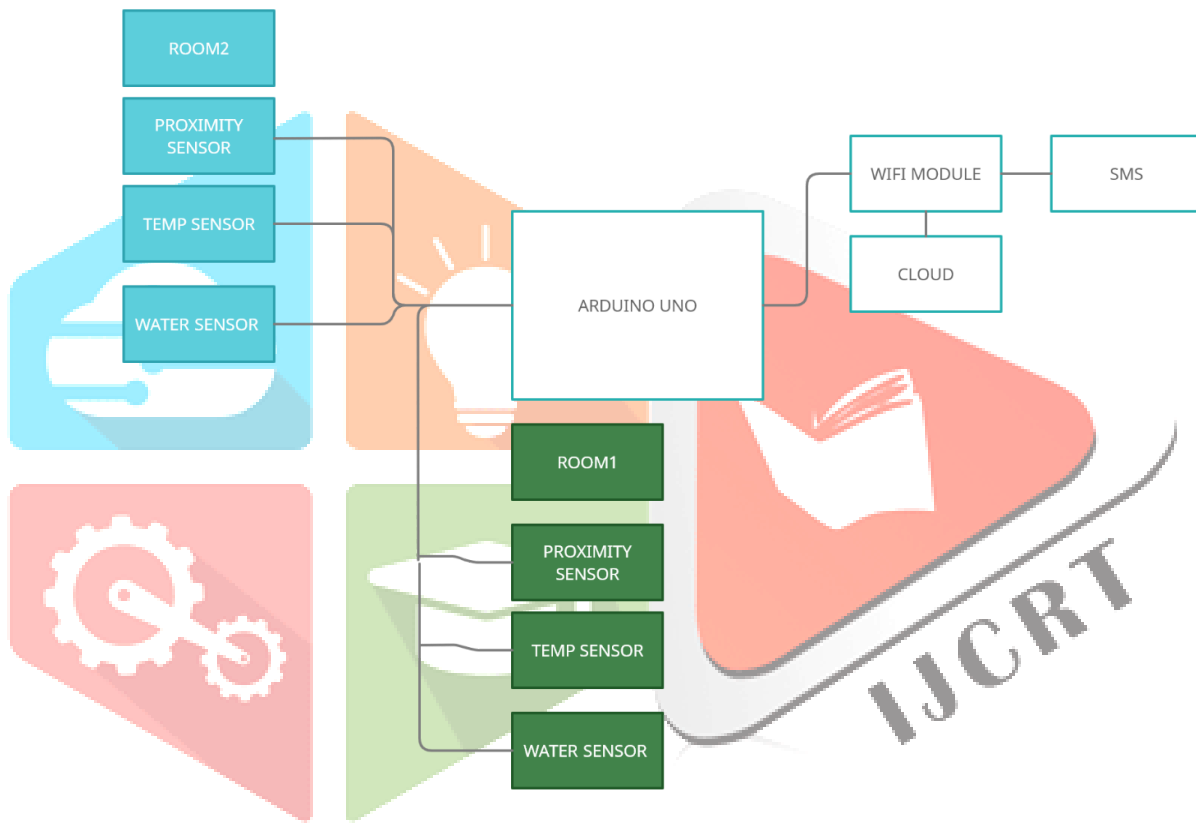
4.1 BLOCK DIAGRAM

Fig. 4.1.1 Block Diagram

Each room or location to be monitored consists of sensors. These sensors-proximity sensor,temperature sensor, water sensor feed the sensed values continuously. The Arduino uno, which is the microcontroller, performs various calculations and conversions. Firstly it converts the temperature sensor which is analog into a readable value. Then this value is converted to degree celsius. It also performs other calculations to determine if an intruder is present or if water level is above a particular limit. This data is then communicated via Wifi Protocol using ESP 8266 Wifi module. This data is sent to the cloud and in case an abnormality is detected- such as intruder present, or temperature too high or if water exceeds a particular limit, it alerts the user via SMS.

4.2 HARDWARE ANALYSIS

Components required:

- Arduino UNO
- Temperature sensor (DHT22)
- Water sensor (REES52)
- PIR sensor (HC-SR501)
- WiFi module (ESP 8266)
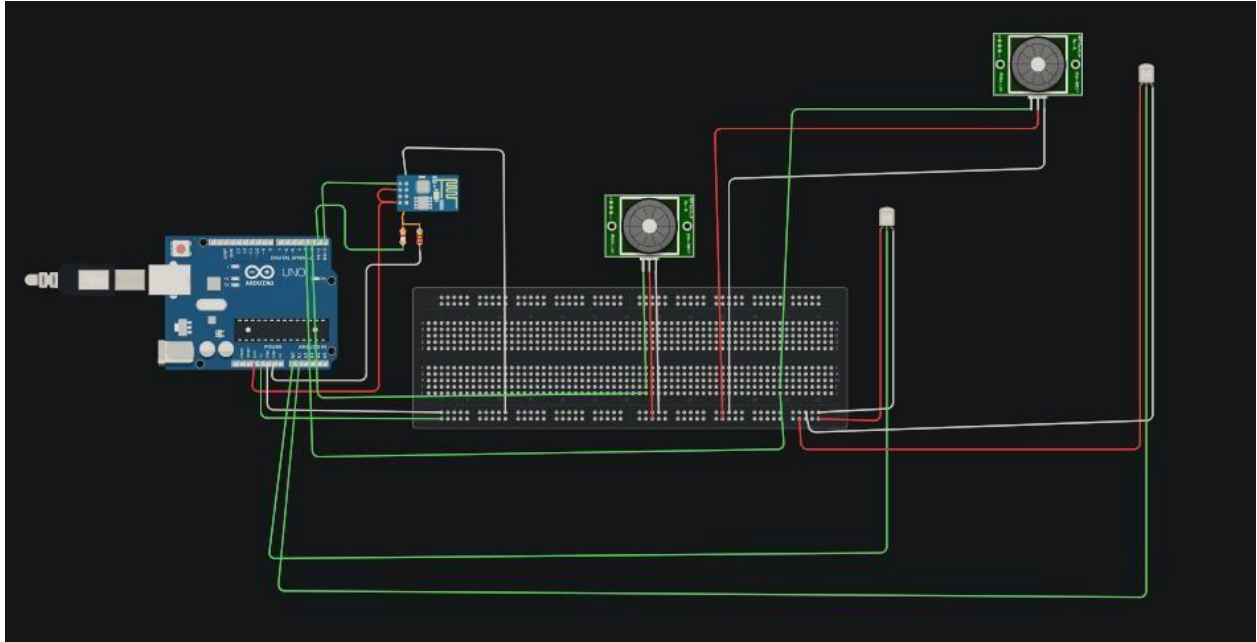- Resistors
- Connecting Wires
- Android Phone
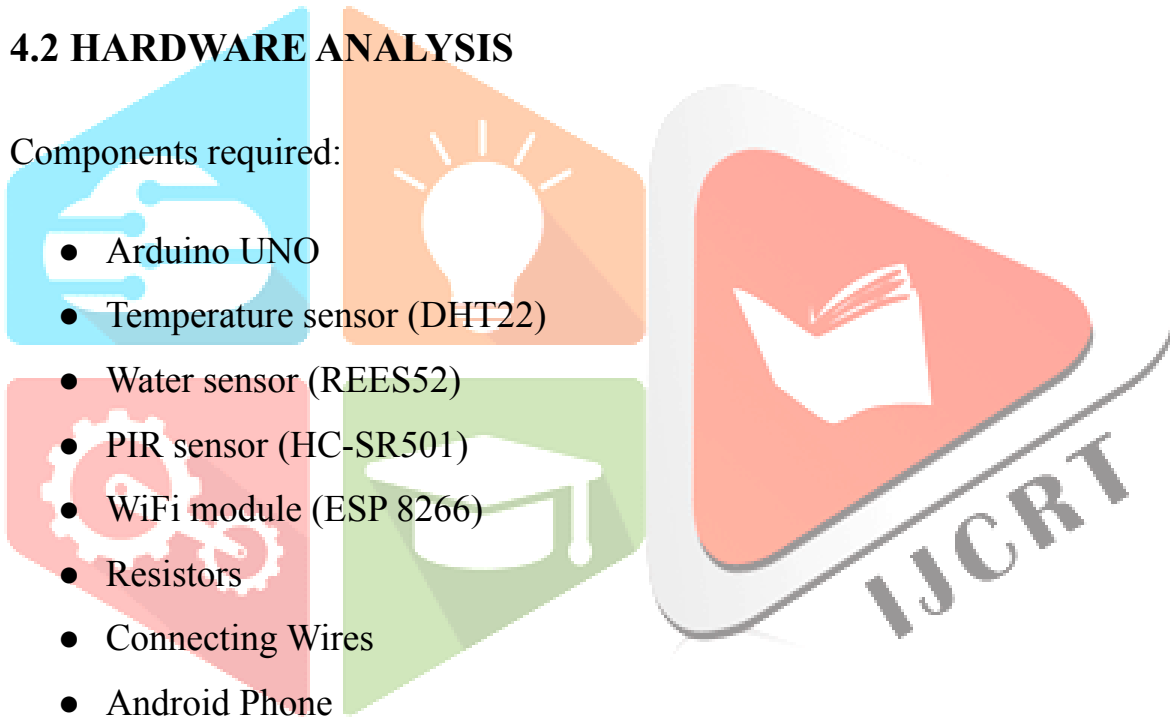
Figure 4.2. - Circuit used for simulation
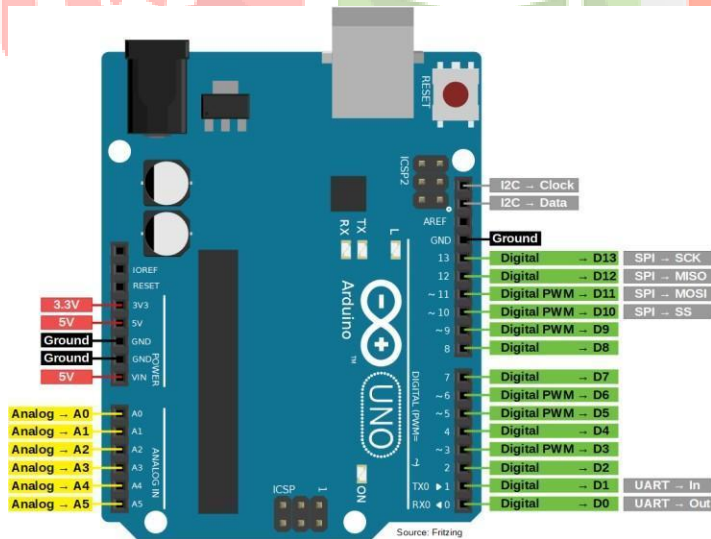
4.2.1 Arduino Uno

Fig. 4.2.1 Pin Diagram Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started

Technical Specification:

- Microcontroller: ATmega328P

- Operating Voltage: 5V

- Input Voltage (recommended): 7-12V

- Input Voltage (limit): 6-20V

- Digital I/O Pins: 14 (of which 6 provide PWM output)

- PWM Digital I/O Pins: 6

- Analog Input Pins: 6

- DC Current per I/O Pin: 20 mA

- DC current for 3.3V Pin: 50 mA

- Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader

- SRAM: 2 KB (ATmega328P)

- EEPROM: 1 KB (ATmega328P)

- Clock Speed: 16 MHz

- LED_BUILTIN: 13

- Length: 68.6 mm

- Width: 58.4 mm

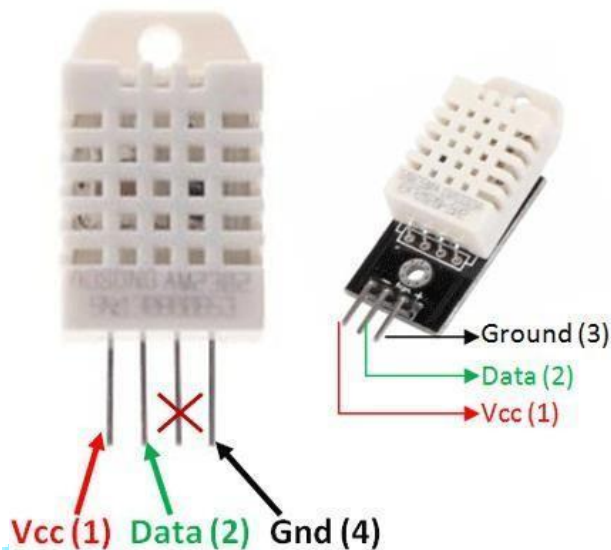- Weight: 25 g

4.2.2 TEMPERATURE SENSOR

Fig.4.2.2 Pin Diagram Temperature sensor DHT22

The DHT22 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers.

The sensor can measure temperature from -40°C to 80°C and humidity from 0% to 100% with an accuracy of ±1°C and ±1%. So if you are looking to measure in this range then this sensor might be the right choice for you.

Specifications:
    ○

- DHT22 Specifications
- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: -40°C to 80°C
- Humidity Range: 0% to 100%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±0.5°C and ±1%

4.2.3 WATER SENSOR

Signal/Out
Vcc
Gnd

Power Indicator LED

Fig. 4.2.3 Pin Diagram REES52 Water sensor

This sensor is supplied to 5V or 3.3V on VCC and GND pins. The pin S will give us an analog value between VCC and GND. So we will use the S pin as an analog input connecting Arduino, the value read will be higher depending on whether the sensor surface is covered with water. This is because the water acts as a conductor, given that the water we use in our deposits is not pure water (H_2O), since water is nonconductive. But rarely will we use this type of sensor to measure the water level in a tank of pure water.

Specifications:

Power supply	3,3V ~ 5V
Current	< 20mA
Humidity sensitivity range	10% ~ 90%
Pinout	+: VCC -: GND S: Analog output

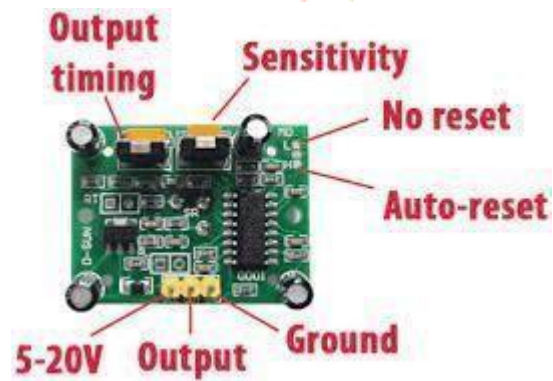Table 4.2.3 Water sensor specifications.

4.2.4 PIR SENSOR

Fig 4.2.4 Pir Sensor HC-SR501 Pin diagram

HC SR501 PIR motion sensor also called Pyroelectric, Passive infrared or IR motion sensor. As shown in above image these are small approximately 1.2 x 0.9 inch sized printed circuit board with the PIR motion sensor mounted on the front side and covered by a white fresnel lens that increases the performance of the lens and at the same time protect it. The backside of the PCB is the circuitry with chip and all the components require for processing the information received from the sensor.

Specifications

- Wide range on input voltage varying from 4.V to 12V (+5V recommended)
- Output voltage is High/Low (3.3V TTL)
- Can distinguish between object movement and human movement
- Has to operating modes - Repeatable(H) and Non- Repeatable(H)
- Cover distance of about 120° and 7 meters
- Low power consumption of 65mA
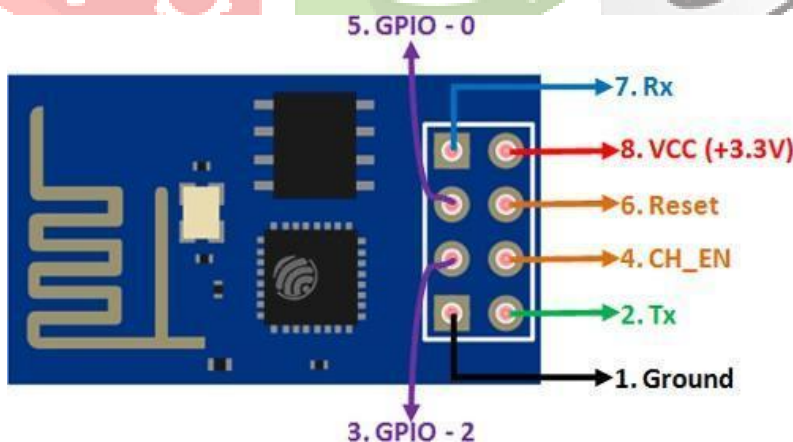- Operating temperature from -20° to +80° Celsius

4.2.5 WIFI MODULE

Fig. 4.2.5 ESP 8266 WiFi Module Pin Diagram

The ESP8266 is a very user friendly and low cost device to provide internet connectivity to your projects. The module can work both as an Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible. It can also fetch data from the internet using API's hence your project could access any information that is available in the internet, thus making it smarter. Another exciting feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user friendly.

Specifications:

- Low cost, compact and powerful Wi-Fi Module

- Power Supply: +3.3V only

- Current Consumption: 100mA

- I/O Voltage: 3.6V (max)

- I/O source current: 12mA (max)

- Built-in low power 32-bit MCU @ 80MHz

- 512kB Flash Memory

- Can be used as Station or Access Point or both combined

- Supports Deep sleep (<10uA)

- Supports serial communication hence compatible with many development platform like Arduino

- Can be programmed using Arduino IDE or AT-commands or Lua Script
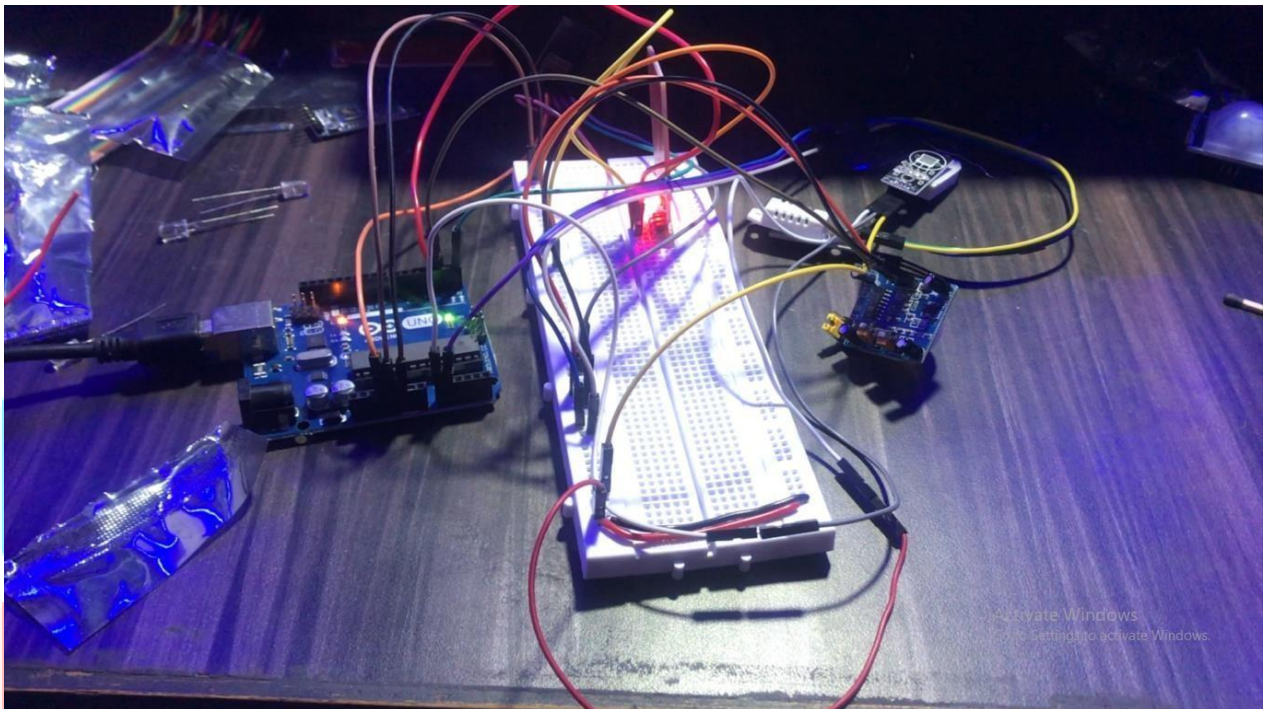
4.3 WORKING OF HARDWARE

Figure 4.3 Circuit

The Arduino Uno receives the signal from sensors. For the temperature sensor , it converts the analog to digital value. This is then converted to degree celsius. Similarly for water sensors, the sensed analog value is converted to digital value, and calculations are performed to determine if the water level is hazardous or not. The PIR sensor is calibrated for our use and as it gives a digital high signal for presence of intruder and low for safety, very few further calculations are required. These values are sent using the ESP 8266 WiFi module with its proper protocol. The data is sent in an infinite loop through the transmitter pin of the WiFi module to the cloud. Also an SMS is sent in case of hazards. The user can view these data at any time from anywhere through his mobile phone.

various calculations and conversions. Firstly it converts the temperature sensor which is analog into a readable value. Then this value is converted to degree celsius. It also performs other calculations to determine if an intruder is present or if water level is above a particular limit. This data is then communicated via Wifi Protocol using ESP 8266 Wifi module. This data is sent to the cloud and in case an abnormality is detected- such as intruder present, or temperature too high or if water exceeds a particular limit, it alerts the user via SMS.

4.4 COST ESTIMATION

Component	Quantity	Cost (Rs.)
Arduino uno	1	500
PIR sensor	3	220
Water sensor	2	150
Temperature sensor	3	855
Wifi module	1	115
Resistors and other extras	-	500
Total		2340

Table 4.4 Cost estimation

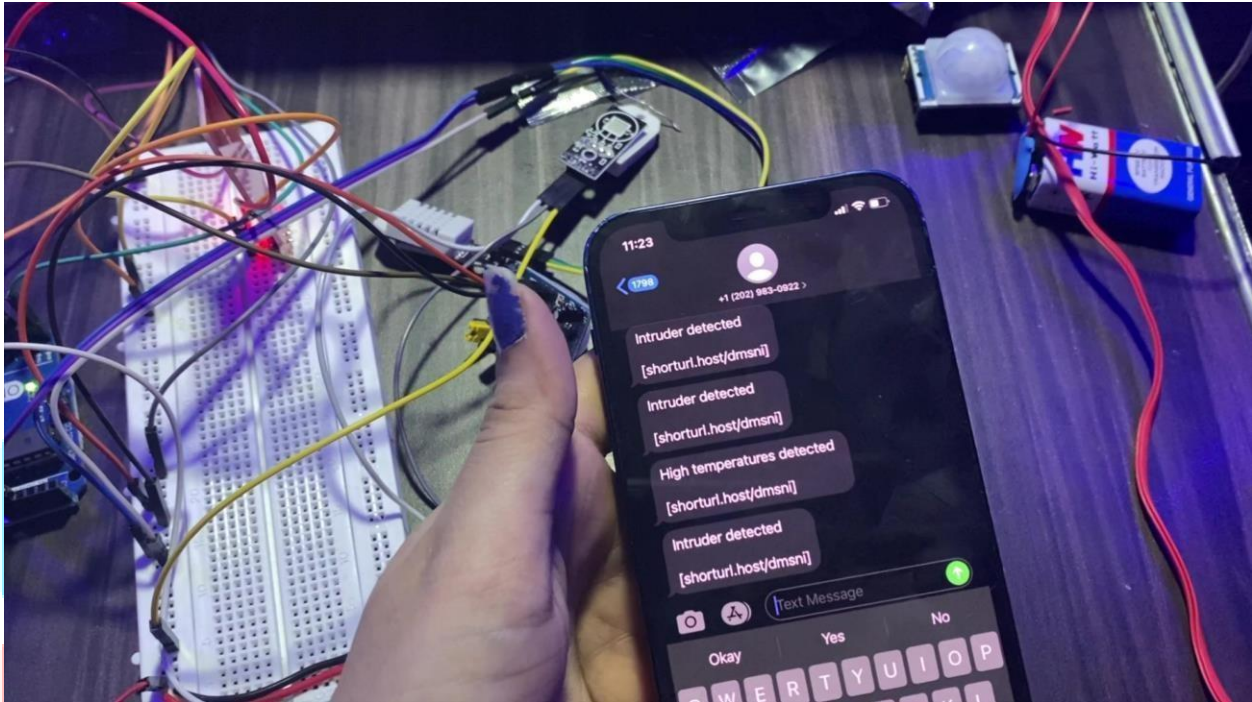## 4.   RESULTS

5.1 SMS ALERT

Fig. 7.1.1 SMS Notification when intruder is detected

The passive infrared sensor (PIR) is calibrated appropriately for the detection of intruders. When it detects any motion, the arduino sends the necessary data to twilio.com using an appropriate API key using the wifi module ESP8266. Twilio helps send an SMS to the user warning them of any intruders as shown in figure 7.1.1.

The temperature sensor reads the temperature of the room. This analog data is converted to degree celsius. When the temperature is above a particular value, in this case 70 degrees, it will send data to twilio.com using an appropriate API key. Twilio then sends the appropriate SMS to the user warning them of potential fire or any other accidents that result a high room temperature as shown in figure 7.1.2.
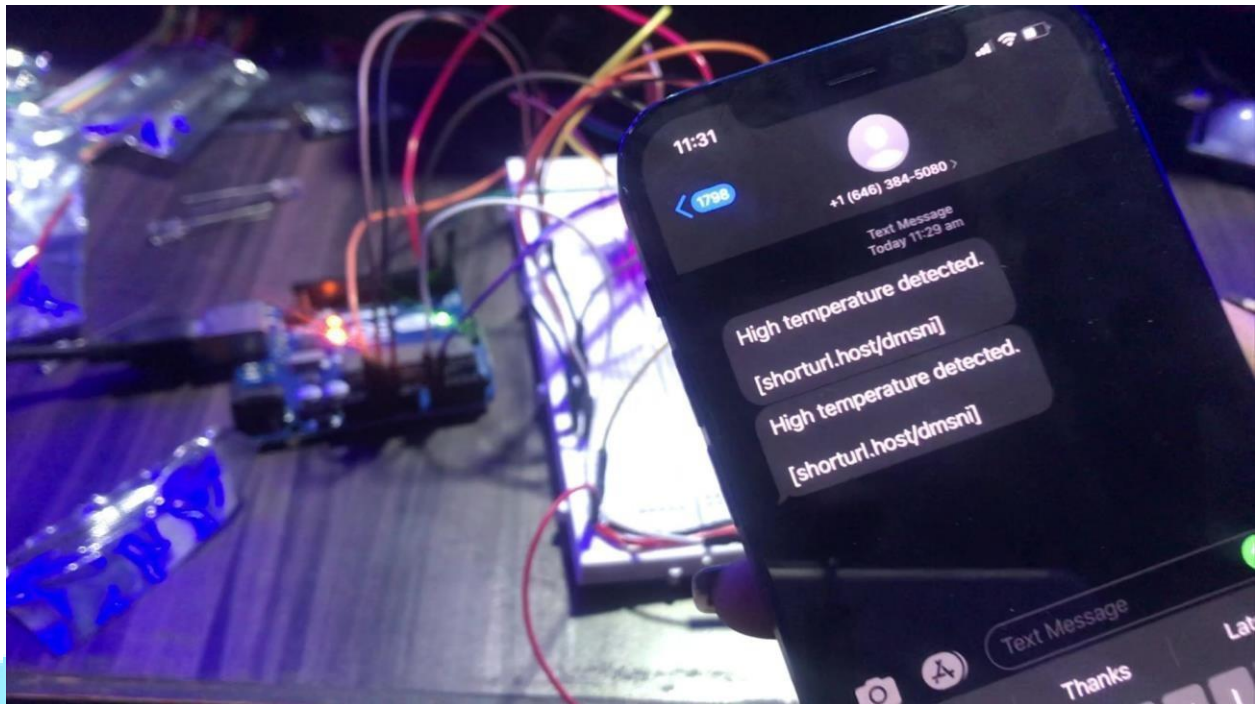
Fig.5.1.2 SMS Notification when high temperatures are detected.

5.2 REAL TIME DATA MONITORING

The Sensor data for each room is being sent to thingspeak for live monitoring. The user can view the current status at any time from anywhere. In the figure 7.1.2 given below, the sensor data is plotted along with time. The user can not only view the current values, but also the previous values to some extent. This data is being sent real time using the ESP8266 wifi module with appropriate API key. The data is saved in the cloud and is presented visually by thingspeak.

ThingSpeak is an IoT analytics platform service that allows us to aggregate, visualize, and analyze live data streams in the cloud. We can send data to

ThingSpeak from our devices, create instant visualization of live data, and send alerts.
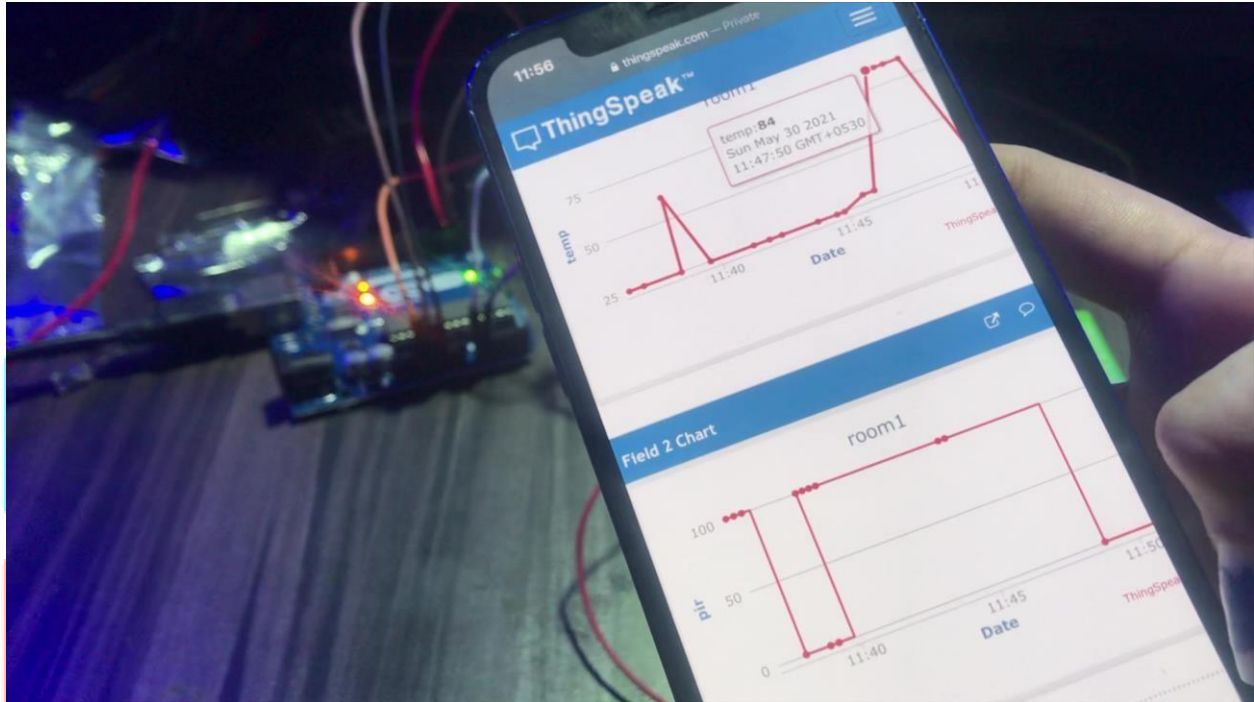

Fig.5.2 Temperature and pir always are plotted with time

5. CONCLUSION AND FUTURE WORK

6.1 CONCLUSION

A home security system has been built successfully using fast growing technology of IoT. We have analyzed the market for use case of our product and various other options of design. We finalized our design and built the device. We have concluded the results for the same. It is a reliable system which has 3 different sensors and real time monitoring. The devices can be set in various rooms. Due to real time monitoring, the damage which will be inflicted due to human negligence, fraud or natural causes can be prevented entirely or reduced considerably . There is scope for this product which offers various useful features and can be updated to implement potentially newer features if we wish to do so.

6.2 FUTURE SCOPES

Our system is pretty solid for its cost but there is always scope for betterment in the security world. Monitored alarm systems can be integrated with the very latest hi-tech lighting and automation facilities in order to provide even greater levels of security. Video monitoring could be the next big thing in security systems where the artificial intelligence is capable of recognising you to disarm the security system and of course peek the visitor via mobile. Our system can be upgraded to also add intelligent home bells where you can communicate with the person outside your door when you are not available too.

6. REFERENCES

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