

## CHAPTER 1

### ABOUT THE COMPANY



# Karunadu Technologies Pvt. Ltd.

### COMPANY PROFILE

- **Business Name :** KarunaduTechnologiesPrivateLimited
- **Business Address :** #17, ATK complex, 4th Floor, Acharya College Main Road, Beside Karur Vysya Bank, Guttebasaveshwaranagar, Chikkabanvara, Bengaluru, Karnataka- 560090
- **Email :** support@karunadutechnologies.com
- **Tel :** 09902913646/09964823646
- **Website :** [www.karunadutechnologies.com](http://www.karunadutechnologies.com)
- **Based in :** Chikkabanvara
- **Area of Operations :** Bengaluru.

## 1.1 Introduction

Karunadu Technologies Pvt. Ltd. is a leading IT software solutions and services industry focusing on quality standards and customer values. They offer broad range of customized software applications powered by concrete technology and industry expertise.

Karunadu Technologies Pvt. Ltd. Offers end to end embedded solutions to its customers that entail all stages of product life cycle. Their proficient and dedicated embedded application development team helps you to build embedded application solutions that will ensure the best customer satisfaction. They will match customer requirements with our strong experience and in depth expertise of the market.

Karunadu Technologies Pvt. Ltd. is also a leading Skills and Talent Development company that is building a manpower pool for global industry requirements. They empower individual with knowledge, skills and competencies that assist them to escalate as integrated individuals with a sense of commitment and dedication towards the society.

Karunadu Technologies Pvt. Ltd. empower individual with knowledge, skills and competencies that assist them to escalate as integrated individuals with a sense of commitment and dedication.

Karunadu Technologies Pvt. Ltd. also helps companies to find right individuals matching the requirements. They engage in Outsourcing of talented candidates. They find you the best talent of pre-screened, interested candidates to our recruiters and/or hiring managers.

Karunadu Technologies Pvt. Ltd. helps students to transform their own ideas to project. They provide assistance to individuals for their IEEE Academic project. They have a large collection of projects on latest technologies. They have world class innovative ideas on Embedded, IOT, Mat lab, VLSI, Android, Big Data, Dot net, Java and much more.

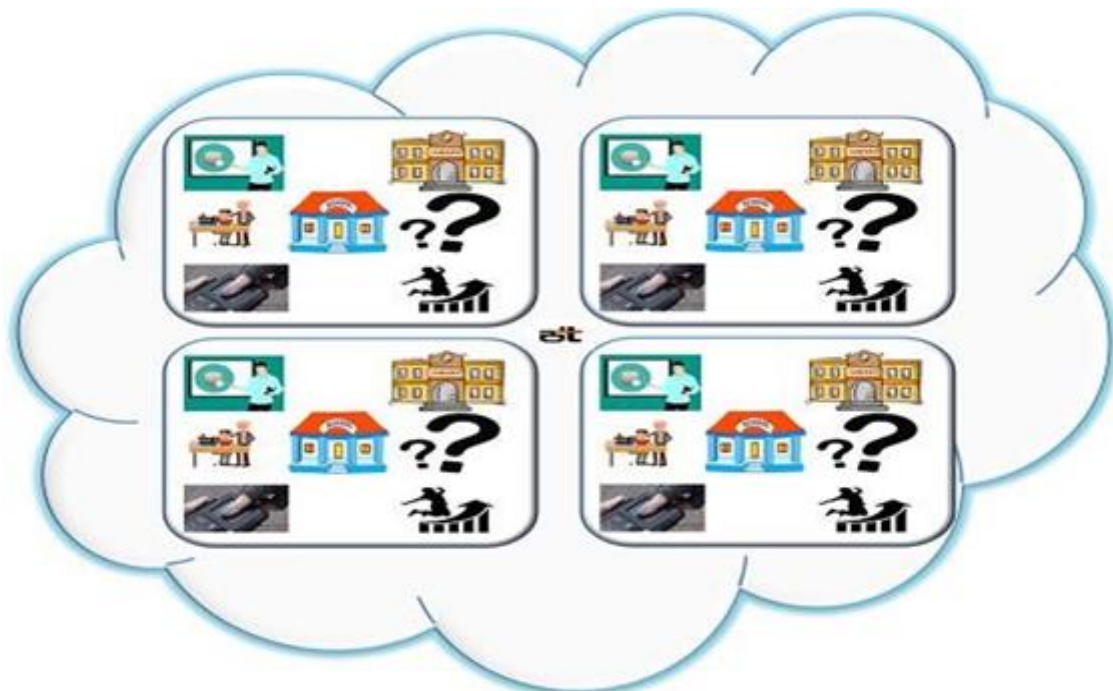
## 1.2 Company Products

### 1.2.1 KECMS – Karunadu Enterprise Content Management System

Karunadu Enterprise Content Management System is a one stop solution for all our enterprise content management System relating to digital asset management , document imaging, workflow systems and records management systems. Increasing digitalization has led to an exponential growth in business content and managing this sea of unstructured data is tedious work. KECMS enables you to create, capture, manage, distribute, archive different forms of content and has much more features.

### 1.2.2 KEMS – Karunadu Education Management System

Manage diversified data relating to education management on cloud. Educational data including students and staff is gathered over years which contain information from admission/appointment until leaving the Education. Statistical reports for the College/school can be generated along with admission Tracking and result analysis to keep track of progressive improvements of both student and staff. Many more features adds on to our product features.



### **1.2.3 KASS – Karunadu Advanced Security System**

A Complete one stop embedded solution for large apartments. Security system which monitors door breakage, window breakage, gas leakage, motion detection and various other features which can be operated and maintained by centralized monitored system. This Embedded solution enhances the security measures of apartment/building and enhances the security of individuals may be from unintended intervention or from unauthorized access.

## **1.3 Services Offered**

### **1.3.1 IT Solutions and Services**

Karunadu Technologies is a Bangalore based IT Training and Software Development center with an exclusive expertise in the area of IT Services and Solutions. Karunadu Technologies Pvt. Ltd. Is Also Expertise In Web Designing And Consulting Services.

### **1.3.2 Embedded Design and Development**

Karunadu Technologies Pvt. Ltd. has expertise in Design and development of embedded products and offers solutions and services in field of Electronics.

### **1.3.3 Academic Projects**

Karunadu Technologies Pvt. Ltd. helps students in their academics by imparting industrial experience into projects to strive excellence of students. Karunadu Technologies Pvt. Ltd. encourages students to implement their own ideas to projects keeping in mind "A small seed sown upfront will be nourished to become a large tree one day", thereby focusing the future entrepreneurs. They have a wide range of IEEE projects for B.E, M.Tech, MCA, BCA, DIPLOMA students for all branches in each and every domain.

### **1.3.4 Inplant Training**

Karunadu Technologies Pvt. Ltd. provides Inplant training for students according to the interest of students keeping in mind the current technology and academic benefit one obtains after completing the training. Students will be nourished and will be trained throughout with practical experience. Students will be exposed to industrial standards which boost their carrier. Students will become Acquaint to various structural partitions such as labs, workshops, assembly units, stores, and administrative unit and machinery units. They help students to understand their functions, applications and maintenance. Students will be trained from initial stage that is from collection of Project Requirements, Project Planning, Designing, implementation, testing, deployment and maintenance there by helping to understand the business model of the industry. Entire project life cycle will be demonstrated

with hands on experience. Students will also be trained about management skills and team building activities. They assure that by end of implant training students will Enhance communication skills and acquire technical skills, employability skills, start-up skills, and will be aware of risks in industry, management skills and many other skills which are helpful to professional engagement.

### **1.3.5 Software Courses**

Karunadu Technologies Pvt. Ltd. provides courses for students according to the interest of students keeping in mind the current technology and assist them for their further Employment. Company provides various courses such as C, C++, VB, DBMS, Dot Net, Core Java and J2EE along with live projects.

### **1.4 IT Services and Solutions**

- Application development and Management
- Product development and Maintenance
- WebDesigning
- Digital marketing and SEO
- Be-spoke Development
- Maintenance and support
- Application/Software Outsourcing
- Legacy Systems Maintenance & Migration
- Data warehousing
- Enterprise Business Solutions
- ITES and KPO

Karunadu Technologies Pvt. Ltd. is rapid emerging IT development and Service Company engrossed on providing cost effective and reliable solutions to customers across various latest technologies. They offer scalable end-to-end application development and management solutions from requirement analysis to deployment and rollout.

Karunadu Technologies Pvt. Ltd. offers cost effective highly scalable products for varied verticals. They focus on creating sustainable value growth through innovative solutions and unique partnerships. They create, design and deliver business solutions with high value and innovation by leveraging technology expertise and innovative business

models to address long-term business objectives. They keep their products and services updated with the latest innovations in the respective requirement and technology.

They make our dream come true. They design websites that look professional, easy to update which in turn build their online business. They develop our websites using latest technologies and tools which help to enhance user experience and security on the websites.

They have A Dynamic Team with Innovative Ideas and Exposure to the Industry who create dynamic responsive Websites and Mobile Applications. Adding on they have A Skilled Group of People Managing Their Digital Marketing and SEO to make their presence available worldwide.

### **1.5 Embedded Services and Solutions**

- Product development and Maintenance.
- PCB design services.
- Solution Research Consultancy.
- Electronic Manufacturing service.
- Quality assurance services.
- Be-spoke Development.
- Software and Firmware development.
- Prototyping embedded solutions and Consultancy.
- Driver development for Windows and Linux

Karunadu Technologies Pvt. Ltd offers end to end embedded solutions to its customers that entail all stages of product life cycle. They cover all projects that include conceptualization, requirement engineering, system architecture design, hardware, firmware design and support engineering.

In the last couple of decades, Embedded Systems has become an integral part of our day-to-day lives. Its presence in industries ranging from Power, Automobiles, Healthcare and Analytical to Medical Instrumentation is evident. Moreover, embedded systems cater to consumer needs such as electronic appliances, transportation, communication, mobility and so on.

Karunadu Technologies Pvt. Ltd. understand the ubiquity and inevitability of embedded systems. With diverse knowledge pools and hands on experience they later to all such industries with solutions covering everything from tiny Chip to gigantic Cloud.

Karunadu Technologies Pvt. Ltd. understands that custom / bespoke development is an implicit requirement for any solution in embedded systems. This forms the backbone that provides customers an apt solution to their requirement/problem.

Their proficient and dedicated embedded application development team helps us to build embedded application solutions with greater design and at most customer satisfaction.

### **1.6 Skill Development and Internship**

Identifying and training of manpower pool for global industry requirements. Training and development of talents on all leading technologies. Skill set includes: IoT, Embedded, Arduino, Mat lab, Lab View, Wireless Technology, Raspberry-Pi , Robotics, Dot Net, Java/J2EE, Android, Angular, Python, Artificial Intelligence, AWS Ethical Hacking, C/C++, etc.

Internship is provided for all academic courses to encourage upcoming global talents. They conduct wide range of Training programs which includes courses, workshops, internship, Industrial talks for students and professionals on all latest technologies and trends.

### **1.7 Industrial Training**

Karunadu Technologies Pvt. Ltd. is also a leading Skills and Talent Development company that is building a manpower pool for global industry requirements.

Karunadu Technologies Pvt. Ltd. bridges the gap between Industry requirements and curriculum of educational institutions and also to meet the ever increasing demand for Quality professionals.

Karunadu Technologies Pvt. Ltd. enables professional with latest technologies essential for global engineering organizations. They Offer wide range of Training programs for students and industry professionals.

They conduct wide range of Training programs which includes courses, workshops, internship, Industrial talks for students and professionals on all latest technologies and trends.

Karunadu Technologies Pvt. Ltd. provides young job aspirants the perfect Launchpad to build an excellent rewarding career in the industry. They enable candidates from all the places to outperform the competition and stay ahead of the innovation curve.

## CHAPTER 2

# INTRODUCTION

In the present situation, ensuring safety and security has become an inevitable essentiality. Since it is well known that influence of modern technology has reached its peak, demand for security systems are going up progressively. Modern home needs intelligent systems with minimum human effort. With the advent of digital and wireless technologies, automated security systems becomes more intelligent. Surveillance camera helps the user to get a remote view of his home. Surveillance is the monitoring of the location, behavior or activities for the purpose of directing, managing and detecting intrusion. IOT refers to system of interrelated computing devices and it plays a major role in surveillance. Android phone helps user to view the location from the remote area without human intervention.

The Internet of Things (IoT) is a revolutionary new concept that has the potential to turn virtually anything “smart” .This extraordinary event has captured the attention of millions. Why is this so big today? So imagine a world where machines function without any notion of human interaction. The IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, smart phones and tablets, to any range of traditionally dumb or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled. A future where machines communicate with other machines and make decisions based on the data collected and all independent of an end user. It might be difficult to see the significance of the IoT but every advancement made is to make everyday life simpler and safer.

The future of IoT is virtually unlimited due to advances in technology and consumers’ desire to integrate devices such as smart phones with household machines. Wi-Fi has made it possible to connect people and machines on land, in the air and at sea. It is critical that both companies and governments keep in ethics in mind as we approach the fourth Industrial Revolution. With so much data traveling from device to device, security in technology will be required to grow just as fast as connectivity in order to keep up with demands. Governments will undoubtable face tough decisions as to how far the private



sector is allowed to go in terms of robotics and information sharing. The possibilities are exciting, productivity will increase and amazing things will come by connecting the world.

With the growth of technology immensely, most of the social problems are being resolved. The main objective of this project is to serve in the field of trade and commerce, particularly with the problem of theft & misuse of the absence of an authorized person in a particular area.

ESP8266 is a 3V Wi-Fi module very popular for its Internet of Things applications. ESP 8266 maximum working Voltage is 3.6V and its very important to note. You must know how to power it, how to serial-connect it with Arduino safely, how to ping and many other things. You should use software like Circuito.io, Tinkercad, Fritzing to simulate and work with the board safely. You should also use Logic Level Controller to use with ESP8266 module.

## CHAPTER 3

## TASK PERFORMED IN THE COMPANY

DATE	TITLE AND DESCRIPTION
11-01	Learned about Introduction of Embedded Systems, its benefits and various kinds of applications.
12-01	Studied about basics of HTML and c programming language.
14-01	Learn to operate LED and vary its brightness.
16-01	Studied about Serial Communication and also learned to operate the buzzer.
17-01	Studied about the “Relay” switch and program to operate the relay with push button. Learned to operate “DC Motor”.
18-01	Studied about displaying String in LED and also about HEX keypad.
19-01	Learned to operate Hex keypad using user defined function and interfacing it with Arduino.
20-01	Studied about GSM and GPS. Learned to send a message, receive a message and to make a call manually.
21-01	Learned to operate GSM and GPS and interfacing it with Arduino.
22-01	Studied about Sensors and their interfacing with Arduino. Learned about IR sensors, Light Dependent sensors, etc.
23-01	Studied about Soil Moisture Sensors, Accelerometer and interfacing it with Arduino.
24-01	Studied about Ultrasonic Sensor and connection with Arduino. Also studied about DHT11 sensor used for reading the temperature and Humidity.
26-01	Studied about Internet of Things (IOT), wifi and hotspot devices, communication between PC and UART device, connecting with wifi and also creating hotspot from it.
28-01	Revision of previous class.
29-01	Started doing project on Internet of Things. Taken abstract

	about the project with title: Critical Room Temperature monitoring System.
31-01	Did the part of the project which was calculating the humidity and temperature and sending the data to the cloud.
01-02	Did some part of the project which was connecting the GPS sensor and calculating the position. Also sent the GPS data to the cloud.
04-02	Completed with the project and also did the revision of the project. Revised the connections of the various devices used.
05-02	Did two more topics similar to the project and got better idea about the project.
06-02	Started with the report in the institute.
07-02	Studied about the sensors and revised the connection of sensor. Also finished with the report.

Table 3.1: Task Performed In Company

### **3.1 Sensors and devices used during the course:**

#### **3.1.1 Arduino**

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

The Arduino is a microcontroller board based on the ATmega8. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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 a AC-to-DC adapter or battery to get started.



Fig 3.1:Arduino UNO

### 3.1.2 LED Interfacing

LCD (Liquid Crystal Display) is made of nematic liquid crystals sandwiched between layers of filter glass, electrodes and polarizing film kept in front of mirror. Normally this crystal are in twisted state and allow light to pass through them so when there is no current, light entering through the front of the LCD will simply hit the mirror and bounce right back out. But when the circuit supplies current to the electrodes, the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle untwist and block the light in that region from passing through. That makes the LCD show the rectangle as a black area.

16 X 2 lines LCD are Common-plane-based LCD which is simplest LCD in market and most of them are backlit by LED. To control the functioning of LCD there is a onboard

controller. H44780 Character LCD is a industry standard liquid crystal display (LCD) display device designed for interfacing with embedded systems. These screens come in a variety of configurations including 8x1, which is one row of eight characters, 16x2, and 20x4. These LCD screens are limited to text only and are often used in copiers, fax machines, laser printers, industrial test equipment, networking equipment such as routers and storage devices.

Character LCDs can come with or without backlights, which may be LED, fluorescent, or electroluminescent. Character LCDs use a standard 14-pin interface and those with backlights have 16 pins. The pinouts are as follows:

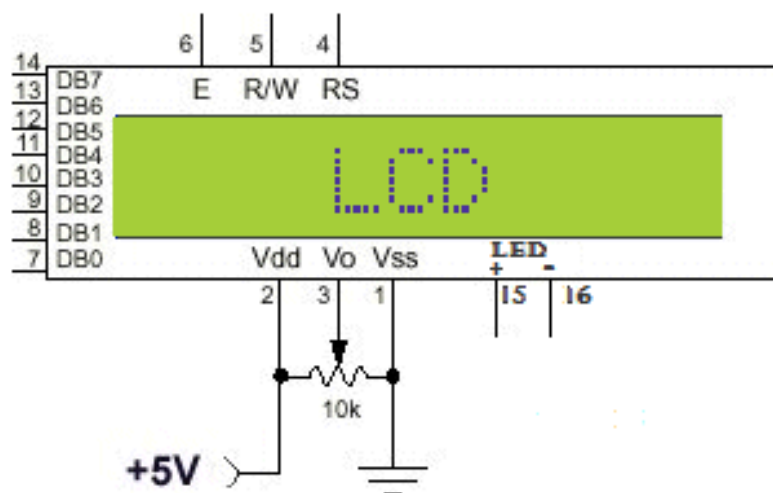


Fig 3.2:lcd pinout

<b>Pin No.</b>	<b>Name</b>	<b>Description</b>
Pin no. 1	<b>VSS</b>	Power supply (GND)
Pin no. 2	<b>VCC</b>	Power supply (+5V)
Pin no. 3	<b>VEE</b>	Contrast adjust
Pin no. 4	<b>RS</b>	0 = Instruction input 1 = Data input
Pin no. 5	<b>R/W</b>	0 = Write to LCD module 1 = Read from LCD module
Pin no. 6	<b>EN</b>	Enable signal
Pin no. 7	<b>D0</b>	Data bus line 0 (LSB)
Pin no. 8	<b>D1</b>	Data bus line 1
Pin no. 9	<b>D2</b>	Data bus line 2
Pin no. 10	<b>D3</b>	Data bus line 3
Pin no. 11	<b>D4</b>	Data bus line 4
Pin no. 12	<b>D5</b>	Data bus line 5
Pin no. 13	<b>D6</b>	Data bus line 6
Pin no. 14	<b>D7</b>	Data bus line 7 (MSB)
Pin no. 15	<b>LED+</b>	Anode of LED for Backlit
Pin no. 16	<b>LED-</b>	Cathode of LED for Backlit

Table 3.2: LCD Description

### 3.1.3 Accelerometer:

An accelerometer is a device that measures the vibration, or acceleration of motion of a structure. The force caused by vibration or a change in motion (acceleration) causes the mass to "squeeze" the piezoelectric material which produces an electrical charge that is proportional to the force exerted upon it. Since the charge is proportional to the force, and the mass is a constant, then the charge is also proportional to the acceleration.

There are two types of piezoelectric accelerometers (vibration sensors). The first type is a "high impedance" charge output accelerometer. In this type of accelerometer the piezoelectric crystal produces an electrical charge which is connected directly to the measurement instruments. The charge output requires special accommodations and instrumentation most commonly found in research facilities. This type of accelerometer is also used in high temperature applications ( $>120^{\circ}\text{C}$ ) where low impedance models can not be used.

The second type of accelerometer is a low impedance output accelerometer. A low impedance accelerometer has a charge accelerometer as its front end but has a tiny built-in micro-circuit and FET transistor that converts that charge into a low impedance voltage that can easily interface with standard instrumentation.

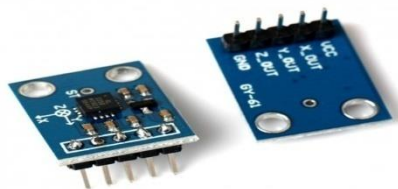


Fig 3.3: Accelerometer sensor

### 3.1.4 IR SENSOR

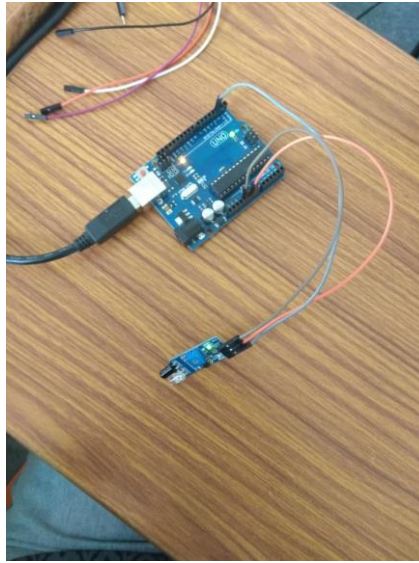


Fig 3.4: IR SENSOR

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion. Infrared waves are not visible to the human eye. In the electromagnetic spectrum, infrared radiation can be found between the visible and microwave regions. The infrared waves typically have wavelengths between 0.75 and 1000 $\mu\text{m}$ .

The infrared spectrum can be split into near IR, mid IR and far IR. The wavelength region from 0.75 to 3 $\mu\text{m}$  is known as the near infrared region. The region between 3 and 6 $\mu\text{m}$  is known as the mid-infrared region, and infrared radiation which has a wavelength greater higher than 6 $\mu\text{m}$  is known as far infrared.

**Specification:**

- Operating Voltage: 3.0V – 5.0V
- Detection range: 2cm – 30cm (Adjustable using potentiometer)
- Current Consumption: at 3.3V : ~23 mA, at 5.0V: ~43 mA
- Active output level: Outputs Low logic level when obstacle is detected
- On board Obstacle Detection LED indicator



### 3.1.5 GSM MODULE SIM800



Fig 3.5: GSM MODULE SIM800

The GSM system is the most widely used cellular technology in use in the world today. It has been a particularly successful cellular phone technology for a variety of reasons including the ability to roam worldwide with the certainty of being able to be able to operate on GSM networks in exactly the same way - provided billing agreements are in place.

The letters GSM originally stood for the words Groupe Speciale Mobile, but as it became clear this cellular technology was being used world -wide the meaning of GSM was changed to Global System for Mobile Communications. Since this cellular technology was first deployed in 1991, the use of GSM has grown steadily, and it is now the most widely cell phone system in the world. GSM reached the 1 billion subscriber point in February 2004, and is now well over the 3 billion subscriber mark and still steadily increasing

The GSM system was designed as a second generation (2G) cellular phone technology. One of the basic aims was to provide a system that would enable greater capacity to be achieved than the previous first generation analogue systems.

Parameters	Description
Multiple access technology	FDMA / TDMA
Duplex technique	FDD
Uplink frequency band	933 - 960 MHz (basic 900 MHz band only)
Downlink frequency band	890 - 915 MHz (basic 900 MHz band only)
Channel spacing	200 kHz
Modulation	GMSK
Speech coding	Various - original was RPE-LTP/13
Speech channels per RF channel	8
Channel data rate	270.833 kbps
Frame duration	4.615 ms

Table3.3: GSM module specification

### 3.1.6 ESP-01 MODULE

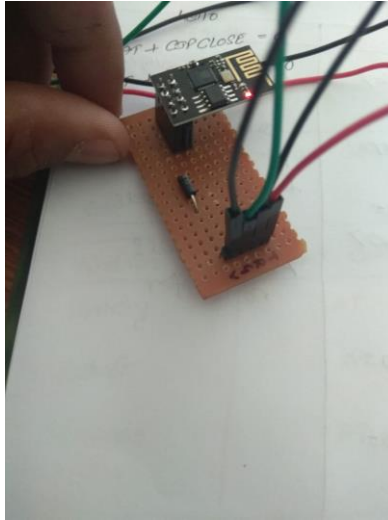


Fig 3.6: ESP-01 module

The ESP8266 is designed by a Chinese company Espressif .It is a simple application and they easy add a connectivity to another microcontroller, which is very limited number of exposed pins. The chip first came to the attention of western makers in August 2014 with the **ESP-01** module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted.The ESP-01 is one of the smallest units available. Two general GPIOs are available and if you need more you can use the two serial ports (1, 3 / RX, TX).

#### Specification:

- ESP chip version: ESP8266
- Flash size: 1M
- Onboard USB-TTL converter: No
- GPIO's broken out/available to free use: 0, 2
- Power supply information: 3.3VDC

- Antenna: onboard PCB antenna

### 3.1.7 PUSH BUTTON



Fig 3.7: Push Button

A push-button or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, although many un-biased buttons (due to their physical nature) still require a spring to return to their un-pushed state. Terms for the "pushing" of a button include pressing, depressing, mashing, slapping, hitting, and punching.

### 3.1.8 BUZZER

The **piezo buzzer** produces sound based on reverse of the piezoelectric effect. These buzzers can be used alert a user of an event corresponding to a switching action, counter signal or sensor input. The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range of 2 to 4 kHz. The Red lead is connected to the Input and the Black lead is connected to Ground.



Fig 3.8: Buzzer

### 3.1.9 DC Motors

DC motors are widely used, inexpensive, small and powerful for their size. Reduction gearboxes are often required to reduce the speed and increase the torque output of the motor. Unfortunately more sophisticated control algorithms are required to achieve accurate control over the axial rotation of these motors. Although recent developments in stepper motor technologies have come a long way, the benefits offered by smooth control and high levels of acceleration with DC motors far outweigh any disadvantages. Several characteristics are important when selecting DC motors and these can be split into two specific categories. The first category is associated with the input ratings of the motor and specifies its electrical requirements, like operating voltage and current. The second category is related to the motor's output characteristics and specifies the physical limitations of the motor in terms of speed, torque and power.

Specifications of the motors used are given below:

- Operating Voltage: 6-12V
- Operating Current; 2A max
- Speed: 2400 rpm
- Torque: 30 gm-cm

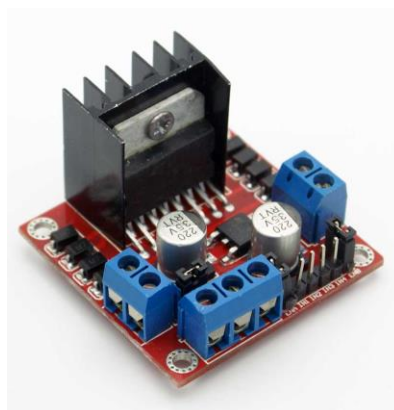


Fig 3.9: DC Motor

### 3.1.10 GPS (Global Positioning System)

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver. The GPS program provides critical capabilities to military, civil and commercial users around the world. In addition, GPS is the backbone for modernizing the global air traffic system.

When people talk about "a GPS," they usually mean a **GPS receiver**. The **Global Positioning System** (GPS) is actually a **constellation** of 27 Earth-orbiting satellites (24 in operation and three extras in case one fails). The U.S. military developed and implemented this satellite network as a military navigation system, but soon opened it up to everybody else. Each of these 3,000- to 4,000-pound solar-powered satellites circles the globe at about 12,000 miles (19,300 km), making two complete rotations every day. The orbits are arranged so that at anytime, anywhere on Earth, there are at least four satellites "visible" in the sky.



Fig 3.9: GPS Receiver

### 3.1.11 Relay and its working

A relay is a simple electromechanical switch made up of an electromagnet and a set of contacts. Relays are found hidden in all sorts of devices. In fact, some of the first computers ever built used relays to implement Boolean gates. A relay can be defined as a switch.

Switches are generally used to close or open the circuit manually. Relay is also a switch that connects or disconnects two circuits. But instead of manual operation a relay is applied with electrical signal, which in turn connects or disconnects another circuit.

There are only four main parts in a relay. They are

- Electromagnet
- Movable Armature
- Switch point contacts
- Spring

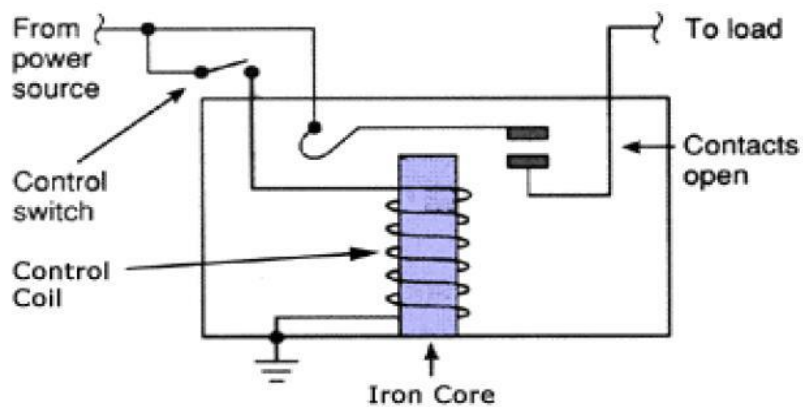


Fig 3.10:Relay

## CHAPTER 4

# LITERATURE SURVEY

### 4.1. Internet of Things (IOT) Based Weather Monitoring system:

Present innovations in technology mainly focus on controlling and monitoring of different activities. These are increasingly emerging to reach the human needs. Most of this technology is focused on efficient monitoring and controlling different activities. An efficient environmental monitoring system is required to monitor and assess the conditions in case of exceeding the prescribed level of parameters (e.g., noise, CO and radiation levels). When the objects like environment equipped with sensor devices, microcontroller and various software applications becomes a self-protecting and self-monitoring environment and it is also called as smart environment. In such environment when some event occurs the alarm or LED alerts automatically. The effects due to the environmental changes on animals, plants and human beings can be monitored and controlled by smart environmental monitoring system. By using embedded intelligence into the environment makes the environment interactive with other objectives, this is one of the application that smart environment targets.

### 4.2. IoT-based Temperature and Humidity Monitoring System using

#### Arduino UNO:

Almost all the activities surrounding us have impact on Temperature [1]. An accurate calculation of temperature and humidity is a important factor in many fields and industries of science. The constant observation of temperature is crucial in lot of applications like food industry, the manufacturing factory and pharmaceutical industry. For commercial purpose of temperature sensing we have analog and digital Temperature sensors. Temperature sensors which have temperature-dependent functions can be measured using resistors, semiconductors like diodes, thermocouples and thermistors. The main objective of the project is overseeing the live temperature and humidity in a less cost. The observational node is Arduino. The programming language used for Arduino is Arduino programming. The Sensor used is DHT11 temperature sensor. This sensor



consists of temperature calculating function and main advantage of using DHT11 sensor is it is inexpensive and has less weight. Sensor is connected with the raspberry pi using jumper wires. The temperature is perceived using the sensor DHT11 and is read, stored and displayed by the raspberry pi kit.

### **4.3. Designing Of An Intelligent Temperature-Cum-Humidity Monitoring**

#### **Device:**

The major industries in India include biomedical, agricultural and pharmaceutical which forms backbone of countries economy. The continuous monitoring of temperature and humidity is a major criteria in all the above mentioned industries. The controlled environment forms foremost criteria in all of the above industries. Any kind of deviation in the environmental conditions or the preset parameters can cost heavy financial losses due to alterations in productivity in the pharmaceutical and agricultural industries. A precise monitoring of humidity and temperature is required in biomedical industry sue to the screening of drugs and use of various cell culture methods. Arduino is used to take the inputs from the sensors that have been used. A DHT11 sensor is used to measure the humidity and temperature for the particular area. It senses the humidith and temperature and humidity at each and every time and give the information to the Arduino as input.

## CHAPTER 5

# SOFTWARE REQUIREMENTS SPECIFICATION

### 5.1 Hardware Specification:

- **Microcontroller** : ATmega328P Operating
- **Voltage** : 5V
- **Clock Speed** : 16 MHz
- **Input Voltage(recommended)** : 7-12V
- **Input Voltage(limit)** : 6-20V
- **Flash Memory** : 32 KB (ATmega328P) , 0.5 KB used by bootloader
- **EEPROM** : 1 KB (ATmega328P)
- **Wifi module**: ESP-01
- **Temperature sensor**: DHT11

### 5.2 Software Specification:

- **Editor** : Arduino Editor, Hercules
- **BackEnd** : Thingspeak

## CHAPTER 6

# SYSTEM ANALYSIS

### 6.1 Hardware Requirement:

This project is based on both hardware and software. The hardware requirements are as follows:

#### 6.1.1 Arduino

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

The Arduino is a microcontroller board based on the ATmega8. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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 a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Revision of the board has the following new features:

- pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be

compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin, that is reserved for future purposes.

- Stronger RESET circuit.
- ATmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

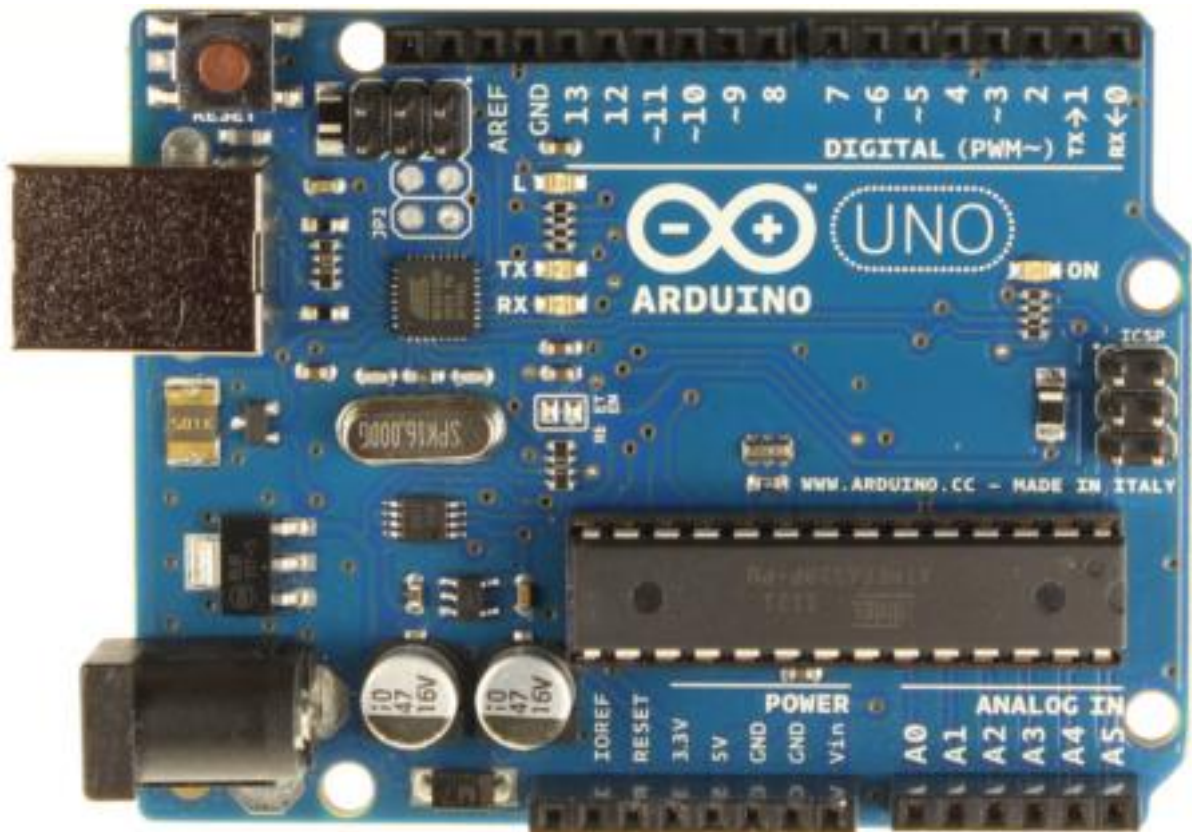


Fig. 6.1 : Real Arduino UNO board

Parameters For Arduino UNO	Description
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Table 6.1 : Specifications of Arduino

### 6.1.2 DHT11

The DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long term stability.

This sensor include a resistive type humidity measurement component and a NTC temperature measurement component, and connect to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interface ability and cost effectiveness.

It's of small size, low power consumption and up-to 20 meter signal transmission makes it a best choice for various applications. Some of the features of this sensor are as follows:

- DHT series digital temperature and humidity sensor.
- Full range of calibration, in-line digital output.
- Humidity measuring range : 20% ~ 90% RH (0-50 temperature compensation).
- Temperature measuring range : 0 ~ +50.
- Humidity measurement accuracy :  $\pm 5.0\%$  RH.
- Temperature measurement accuracy :  $\pm 2.0$ .
- Response time : < 5s.
- Low power consumption.
- Power : 3-5.5V.

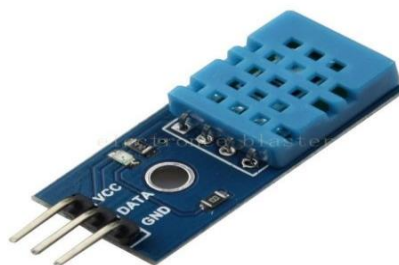


Fig. 6.2 : DHT11 Sensor

Models	Description
Output Signal	Digital Signal via single-bus
Sensing element	Polymer resistor
Measuring range Humidity	20-90% RH
Temperature	0-50 Celsius
Accuracy	Humidity $\pm 4\%$ RH (Max $\pm 5\%$ RH), temperature $\pm 2.0$ Celsius
Resolution or sensitivity	Humidity 1% RH
Repeatability	Humidity $\pm 1\%$ RH
Humidity	Hysteresis $\pm 1\%$ RH
Long term Stability	$\pm 0.5\%$ RH/year
Sensing period	Average: 2s
Dimensions Size	12*15.5*5.5mm

Table 6.2 : Specification of DHT11

### 6.1.3 ESP8266 Wi-Fi Module

ESP8266 is a complete and self-contained Wi-Fi network solutions that can carry software applications, or through Another application processor uninstall all Wi-Fi networking capabilities. ESP8266 when the device is mounted and as the only application of the application processor, the flash memory can be started directly from an external Move. Built-in cache memory will help improve system performance and reduce memory requirements. Another situation is when wireless Internet access assume the task of Wi-Fi adapter, you can add it to any microcontroller-based design, the connection is simple, just by SPI / SDIO interface or central processor AHB bridge interface. Processing and storage capacity on ESP8266 powerful piece, it can be integrated via GPIO ports sensors and other applications specific equipment to achieve the lowest early in the development and operation of at least occupy system resources.

The ESP8266 highly integrated chip, including antenna switch balun, power management converter, so with minimal external circuitry, and includes front-end module, including the entire solution designed to minimize the space occupied by PCB. The system is equipped with ESP8266 manifested leading features are: energy saving VoIP quickly switch between the sleep / wake patterns, with low-power operation adaptive radio bias, front-end signal processing functions, troubleshooting and radio systems coexist characteristics eliminate cellular / Bluetooth / DDR / LVDS / LCD interference.

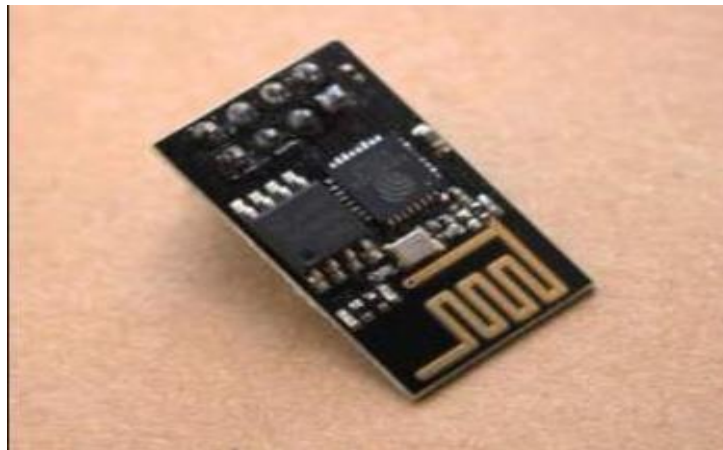


Fig. 6.3: ESP8266

### Characteristics:

- 802.11 b / g / n
- Wi-Fi Direct (P2P), soft-AP
- Built-in TCP / IP protocol stack
- Built-in TR switch, balun, LNA, power amplifier and matching network
- Built-in PLL, voltage regulator and power management components
- 802.11b mode + 19.5dBm output power
- Built-in temperature sensor
- Support antenna diversity
- off leakage current is less than 10uA
- Built-in low-power 32-bit CPU: can double as an application processor
- SDIO 2.0, SPI, UART
- STBC, 1x1 MIMO, 2x1 MIMO



- A-MPDU, A-MSDU aggregation and the 0.4 Within wake
- 2ms, connect and transfer data packets
- standby power consumption of less than 1.0mW (DTIM3)

### ESP8266 AT Command Set

- AT – Attention
- AT+RST - Reset the board
- AT+CWMODE\* - Operating Mode
  - 1.Client
  - 2.AccessPoint
  3. Client and Access Point
- AT+CWJAP\*=<ssid>,<pwd> - Join network
- AT+CIPSTART=<type>,<addr>,<port> - Connect to socket server
- AT+CIPSEND=<length> Send TCP/IP data follows TCP/IP DATA

### 6.1.4 GPS (Global Positioning System)

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver. The GPS program provides critical capabilities to military, civil and commercial users around the world. In addition, GPS is the backbone for modernizing the global air traffic system.

When people talk about "a GPS," they usually mean a **GPS receiver**. The **Global Positioning System (GPS)** is actually a **constellation** of 27 Earth-orbiting satellites (24 in operation and three extras in case one fails). The U.S. military developed and implemented this satellite network as a military navigation system, but soon opened it up to everybody else. Each of these 3,000- to 4,000-pound solar-powered satellites circles the globe at about 12,000 miles (19,300 km), making two complete rotations every day.

The orbits are arranged so that at anytime, anywhere on Earth, there are at least four satellites "visible" in the sky.



Fig 6.4 : GPS Receiver

### How it works?

GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time and signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map

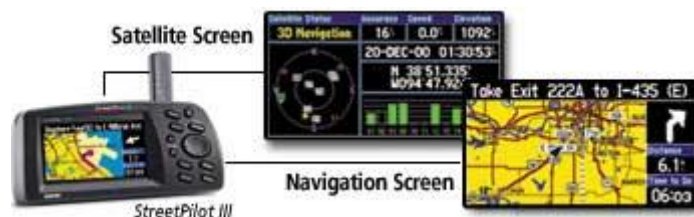


Fig. 6.5 : GPS Working

A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and more.

## CHAPTER 7

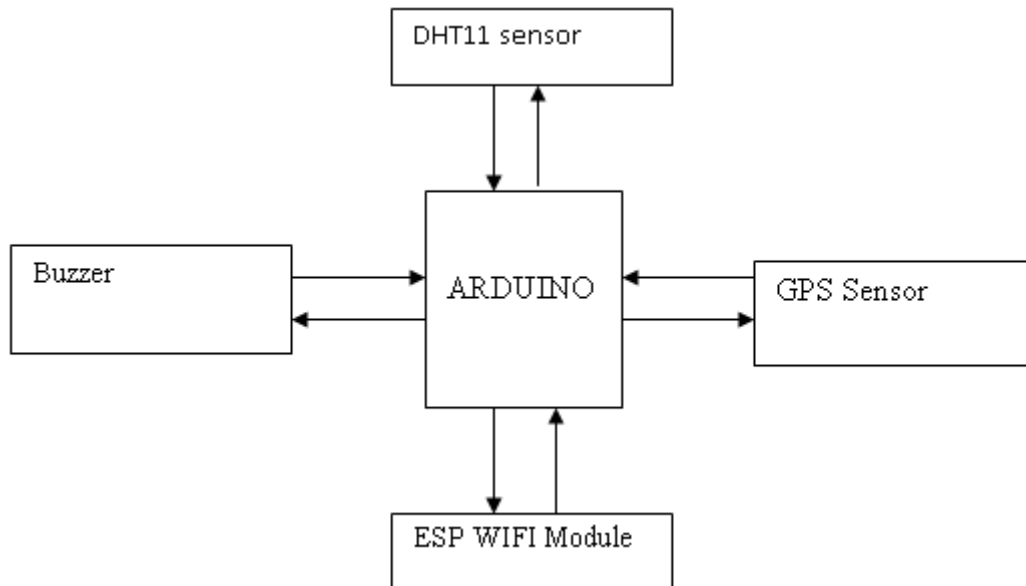
**SYSTEM DESIGN**

Fig. 7.1 : Communication Process and Architecture

- Arduino is the base component of this project with which different sensors like DHT11, GPS sensor, Buzzer, ESP wifi module as shown in above figure, are connected whose output are taken as the input of the Arduino.
- The DHT11 sensor is used to sense the temperature and humidity of particular area then send it to the Arduino in celcius as well as fahreheit format.
- Power supply of 5v and 3v are driven from the Arduino and given to various sensors.
- For locating the position, GPS sensor is connected to the Arduino which will give the latitude and longitude of the area.
- The communication between the devices is done with the help of the ESP wifi module.
- Buzzer is used to alert for any emergency if occurs.
- All the data of DHT11 sensor and the GPS sensor will be send to the cloud (ThingSpeak). If the data is required to be monitored then the cloud can be accessed for it.

## **7.1 Flowchart**

### 7.1.1 ESP-01 wifi

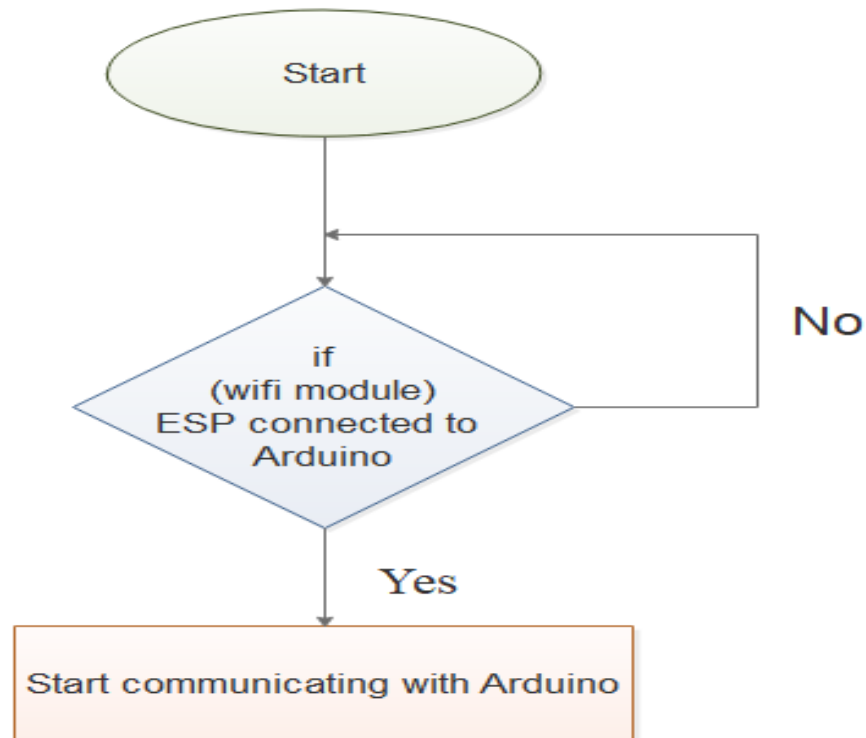


Fig 7.2: ESP-01 wifi module flowchart

A flowchart is a diagrammatic representation that illustrates the sequence of operations to be performed to get the solution to a problem. It can be seen from the definition that a flow always accompanies with business or transaction.

### 7.1.2 DHT11 Sensor

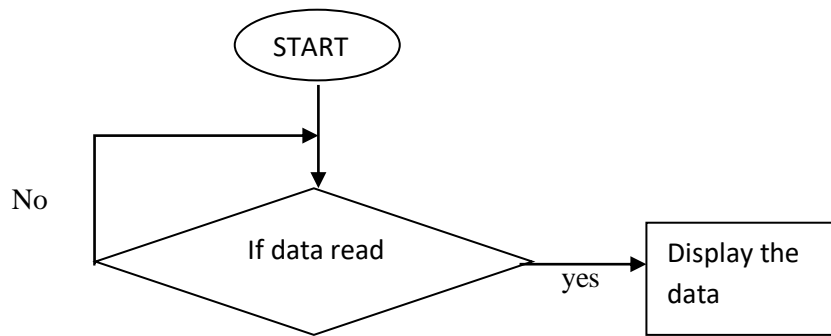


Fig 7.3:DHT11 sensor flowchart

This flowchart usually shows the working of DHT11 sensor. A DHT11 sensor is used to detect the temperature and humidity presents in the environment.

### 7.1.3 GPS Sensor

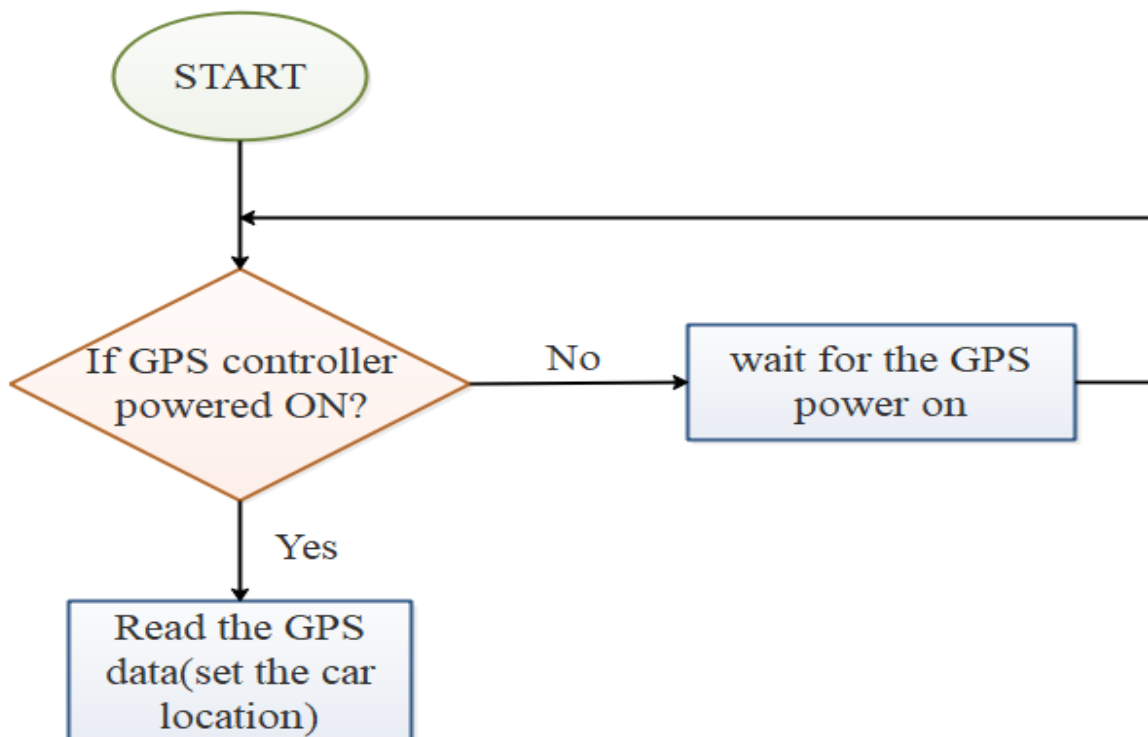


Fig 7.4: GPS sensor working

It is a GPS navigation GPS receiver module piece of hardware that you add to other piece of hardware (e.g. car head unit, Raspberry PI, Arduino even your computer) to give it the possibility to receive information from GPS satellites.

#### 7.1.4 Buzzer

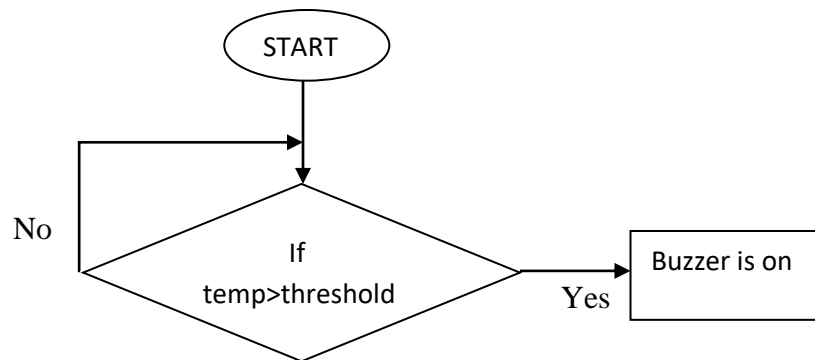


Fig 7.5: Buzzer Flowchart

A buzzer is a device which makes a buzzing or beeping noise. There are several kinds; the most basic is a piezoelectric buzzer, which is just a flat piece of piezoelectric material with two electrodes.

## CHAPTER 8

# IMPLEMENTATION

### CODE

```
#include<SoftwareSerial.h>

#include<TinyGPS.h>

#include<DHT.h>


#define DHTPIN 7

#define DHTTYPE DHT11

DHT dht(DHTPIN,DHTTYPE);


const int buzzer=10;

const byte tx=3,rx=2;

float h;

float t;

float f;


float lat,lon;

TinyGPS gps;


SoftwareSerial esp8266(rx,tx);

String ssid="Moto";

String password="11223344";
```

```
boolean found=false;  
int data,data1,data2,data3;  
String api="N3JBD9WFTHSEQNUQ";  
String host="api.thingspeak.com";  
String port="80";  
const float temp,humidity;
```

```
void setup(){  
  pinMode(buzzer,OUTPUT);  
  Serial.begin(9600);  
  Serial.println("DHTXX TEST");  
  dht.begin();  
  esp8266.begin(115200);  
  Serial.println("IOT Project");  
  connectwifi();  
  
  }
```

```
void loop()  
{  
  //temp_humidity(temp,humidity);  
  
  // data=h+t+f;
```



```
//senddata();
```

```
h=dht.readHumidity();
```

```
t=dht.readTemperature();
```

```
f=dht.readTemperature(true);
```

```
Serial.print("Humidity:");
```

```
Serial.print(h);
```

```
Serial.print("%\t");
```

```
Serial.print("Temperature");
```

```
Serial.print(t);
```

```
Serial.print("*C\t");
```

```
Serial.print(f);
```

```
Serial.println("*F\t");
```

```
gps_print();
```

```
Serial.print("Latitude:");
```

```
Serial.print(lat);
```

2019

**Serial.print(command);**

**Serial.print(" ");**

**while(maxtime--){**

**esp8266.println(command);**

**if(esp8266.find(readreply)){**

**found=true;**

**break;**

**}**

**}**

**if(found){**

**Serial.println("OK Done");**

**}**

**else{**

**Serial.println("Fail");**

**}**

**found= false;**

**}**

**void connectwifi(){**

```
sendcommand("AT",5,"OK");

sendcommand("AT+CWMODE=1",5,"OK");


sendcommand("AT+CWJAP=\""+ssid+"\", \""+password+"\",20,\"OK\")
;

}

void senddata(){

    String getData1="GET /update?api_key="+api;

    String
getData2="&field1="+String(t)+"&field2="+String(h)+"&field3="+String
(f)+"&field4="+String(lat)+"&field5="+String(lon);

    //String getData3="&field2="+String(t);

    //String getData4="&field3="+String(f);


sendcommand("AT+CIPSTART=\"TCP\", \""+host+"\", "+port,5,"OK");


sendcommand("AT+CIPSEND="+String(getData1.length()+getData2.leng
th()+2),7,">");

    delay(10);


    esp8266.println(getData1+getData2);

    Serial.println(getData1+getData2);

    delay(1000);

    // sendcommand("AT+CIPCLOSE=0",5,"OK");

    Serial.println("-----");
```

```
}
```

```
void gps_print()
```

```
{
```

```
  while(Serial.available())
```

```
  {
```

```
    if(gps.encode(Serial.read()))
```

```
    {
```

```
      gps.f_get_position(&lat,&lon);
```

```
      Serial.print("latitude:");
```

```
      Serial.println(lat,4);
```

```
      Serial.print("longitude:");
```

```
      Serial.println(lon,4);
```

```
      delay(1000);
```

```
    }
```

```
  }
```

```
}
```

## CHAPTER 9

# SYSTEM TESTING

### 9.1 Introduction

Software testing is the main activity of evaluating and executing software with a view to find out errors. It is the process where the system requirements and system components are exercised and evaluated manually or by using automation tools to find out whether the system is satisfying the specified requirements and the differences between expected and actual results are determined. This paper at a high - level is divided into two sections. The first section covers optimized testing process, which elaborates all phases of the testing life cycle and the second section covers testing types. The first section emphasizes the main activities, which are Analysis [A], Planning and Preparation [P], Execution [E] and Closure[C]. Where closure includes release and root cause analysis activities and execution phase goes hand in hand with bug logging and tracking. The software bug life cycle explained in the paper in the coming section highlights the mandatory steps for bug logging and tracking. The test preparation phase includes test case preparation, test case selection, test case optimization and test data preparation which is going to be elaborated later in this paper. There are lots of available testing types like black box testing, white box testing, state based testing, security testing, look and feel testing, acceptance testing, system testing, alpha and beta testing, and configuration based testing, verification and validation testing. Based on the research and study done this paper categorized all of them under three high - level testing types, which is Functional, Performance and Security (FPS). The last section deals with the conclusion, which shows relevance of our optimized software testing process and FPS as a basis for testing methods

### 9.2 Software Testing Types

There are various software testing techniques as per the research and study like black box, white box, grey box[19][21], regression [22][24], reliability, usability, performance, unit, system, integration, security, smoke, sanity4.2 and object oriented testing etc. it is impossible

to perform all types of testing on a software as there is always fixed amount of time allocated for testing. Functional testing is very common and lots of research is done on them in past that's why only in rare cases a site crashes due to lack of functional testing. The most recent failures happened in past are due to lack of Performance and Security testing. In 2014 Indian Railway site got crashed as it was not able to handle load of customers. Another failure in 2014 is of Delhi University (DU) online application form web site crash on last day of submission due to excessive load on site. Then there were instances in 2013 when Indian government sites were hacked by some external agencies. After analyzing and survey of all these techniques it is found that a right mix of testing types should be performed on a given software to ensure quality and overall reliable software. This paper will focus on the main testing techniques like Functional [F], Performance [P] and Security testing[S]. The right mix of testing should be included from all headers of F, P and S. Functionality is first and foremost aspect of software testing which ensure quality of software.

Verification and Validation is done using Static and Dynamic testing respectively. Static testing involves all types of reviews, inspections, and walkthroughs. Dynamic testing or actual validation involves all functional and non-functional testing types.

### **9.2.1 Functional Testing**

The main quality factor in software is to meet its required functionality and behavior. The functional part of software includes the external behavior that mainly specifies all user requirements. The high level design of the software is produced so that the customer would be satisfied at an early stage of design and development. The functional testing revolves around the basic work flows and alternative flows of software. These flows can be represented by various use case diagrams like sequential diagrams, class diagrams, component diagrams etc [9][10]. Automated Test cases are also generated by UML models [8]. There are different types of functional testing methods and techniques [18] which could be performed at various levels of testing i.e. unit testing, integration testing (top down and bottom up testing) and system testing. There are lots of testing performed at various levels of testing like black box testing[19], white box testing, grey box testing [21] regression testing [22][24], fuzz testing, use case testing, exploratory testing, smoke testing[25], sanity testing[26], acceptance testing [27], alpha, beta testing etc. Test cases are built around

specifications and requirements i.e., what the application is supposed to do. The functional testing method basically focuses on “What” is supposed to do but not on “How”. Unit testing is usually done by developers. Integration testing and System testing is performed by testing team and user acceptance testing is mainly performed by end users or business team.

- **Unit Testing:-** The lowest level of testing mainly performed by developer to test the unit of code
- **Integration Testing: -** This is to test the communication between various modules to make sure data is flowing across various components correctly. This is done following either top-down approach OR bottom-up approach.
- **System Testing: -** The overall system is tested to ensure that it is behaving or functioning as intended and as specified in requirement document. Regression testing is performed to ensure that nothing is broken in system after fixing bugs and testing bugs. Overall Smoke and Sanity testing is performed to ensure all links and features are working and environment is stable.
- **Acceptance:-** Pre acceptance testing is performed mainly known as alpha and beta testing to ensure the customers are able to perform intended functionality and feedback is taken to further enhance quality of software.
- **White box and Black Box Testing:-** Black box testing is performed to ensure output of application is as correct for all various types of positive and negative inputs. There are various types of Black box testing types like Equivalence Class partitioning, Boundary value analysis, error guessing etc. White box deals with internal working of code to ensure there is no redundant code written in s

### 9.2.2 Manual Testing

Manual testing includes testing a software manually, i.e., without using any automated tool or any script. In this type, the tester takes over the role of an end-user and tests the software to identify any unexpected behavior or bug. There are different stages for manual testing such as unit testing, integration testing, system testing, and user acceptance testing. Testers use test plans, test cases, or test scenarios to test a software to ensure the completeness of testing. Manual testing also includes exploratory testing, as testers explore the software to identify errors in it.



### 9.2.3 Automation Testing

Automation testing, which is also known as *Test Automation*, is when the tester writes scripts and uses another software to test the product. This process involves automation of a manual process. Automation Testing is used to re-run the test scenarios that were performed manually, quickly, and repeatedly. Apart from regression testing, automation testing is also used to test the application from load, performance, and stress point of view. It increases the test coverage, improves accuracy, and saves time and money in comparison to manual testing. It is not possible to automate everything in a software. Furthermore, all GUI items, connections with databases, field validations, etc. can be efficiently tested by automating the manual process.

#### When to Automate?

Test Automation should be used by considering the following aspects of a software:

- Large and critical projects
- Projects that require testing the same areas frequently
- Requirements not changing frequently
- Accessing the application for load and performance with many virtual users
- Stable software with respect to manual testing
- Availability of time

## CHAPTER 10

## SNAPSHOTS

## 10.1 Snapshot 1

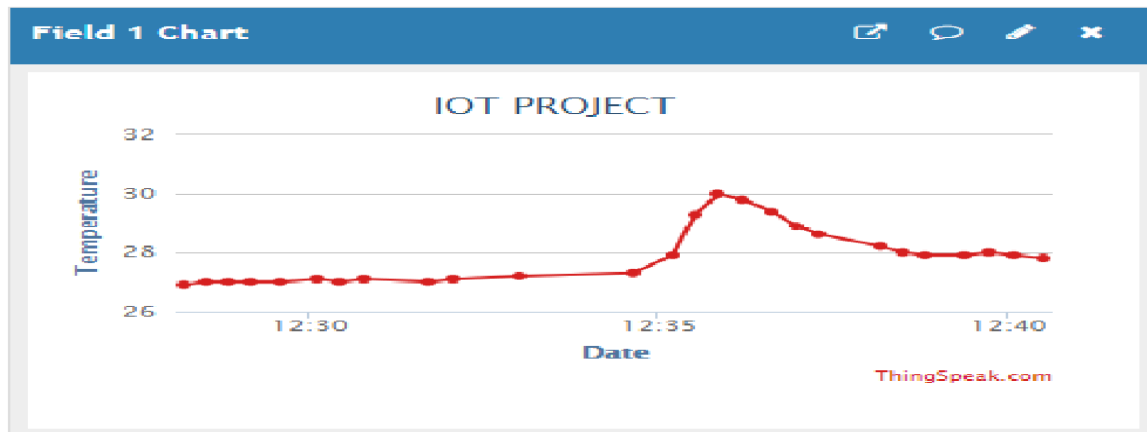


Fig 10.1:Temperature Data

- It is the data of temperature obtained through the DHT11 sensor and stored in the cloud.

## 10.2 Snapshot 2

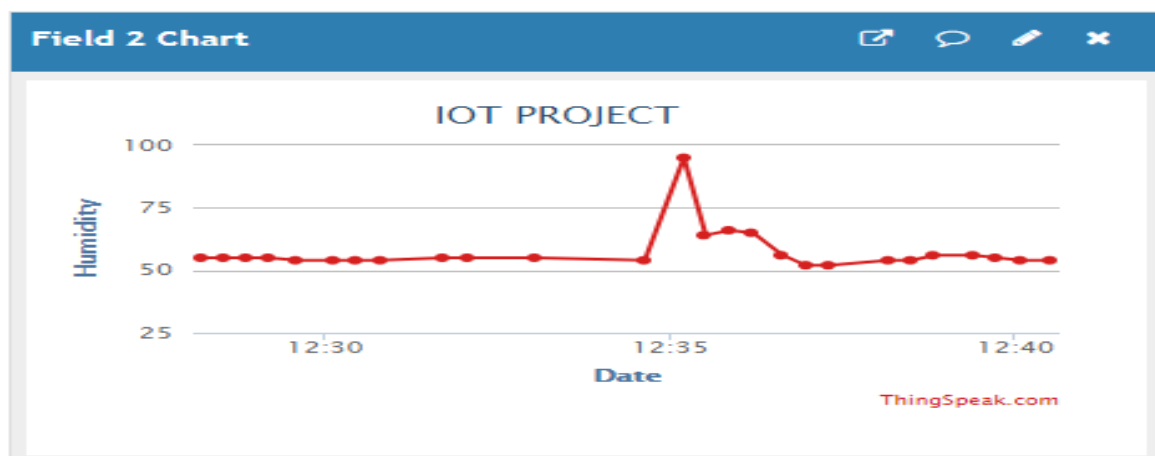


Fig 10.2: Humidity Data

- It is the data of humidity obtained through the DHT11 sensor and stored in the cloud.

## 10.3 Snapshot 3

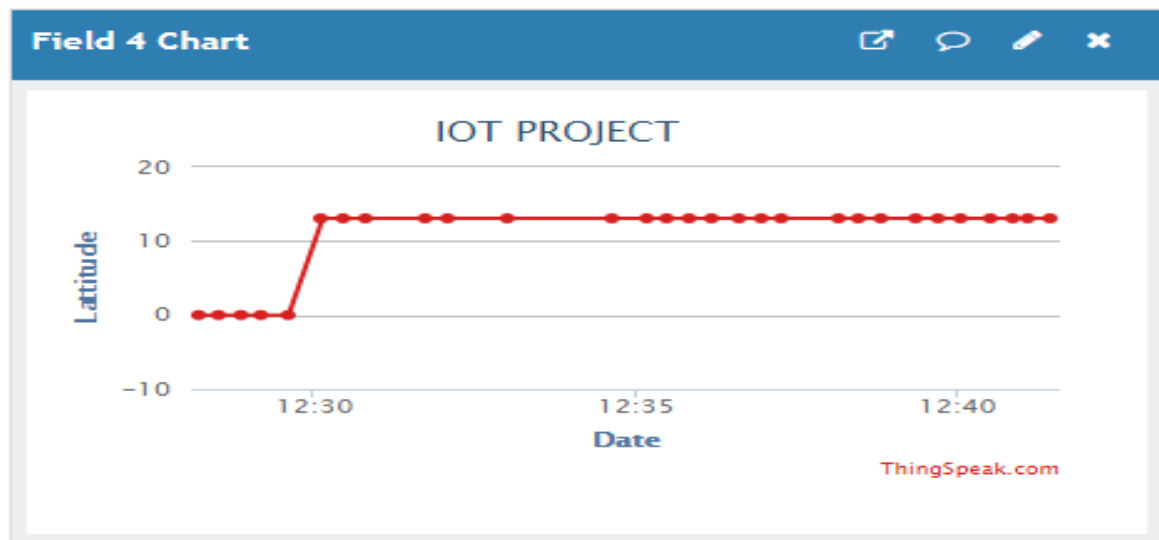


Fig 10.2: latitude Data

- It is the data of latitude obtained through the GPS sensor and stored in the cloud.

## 10.4 Snapshot 4

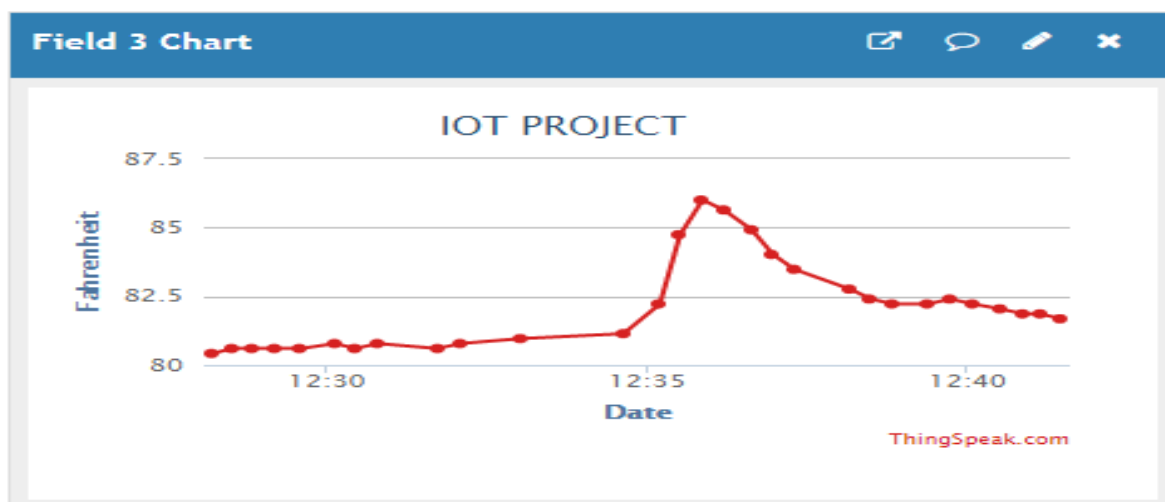


Fig 10.2: 51latitude51t Data

- It is the data of 51latitude51t obtained through the DHT11 sensor and stored in the cloud.

## 10.5 Snapshot 5

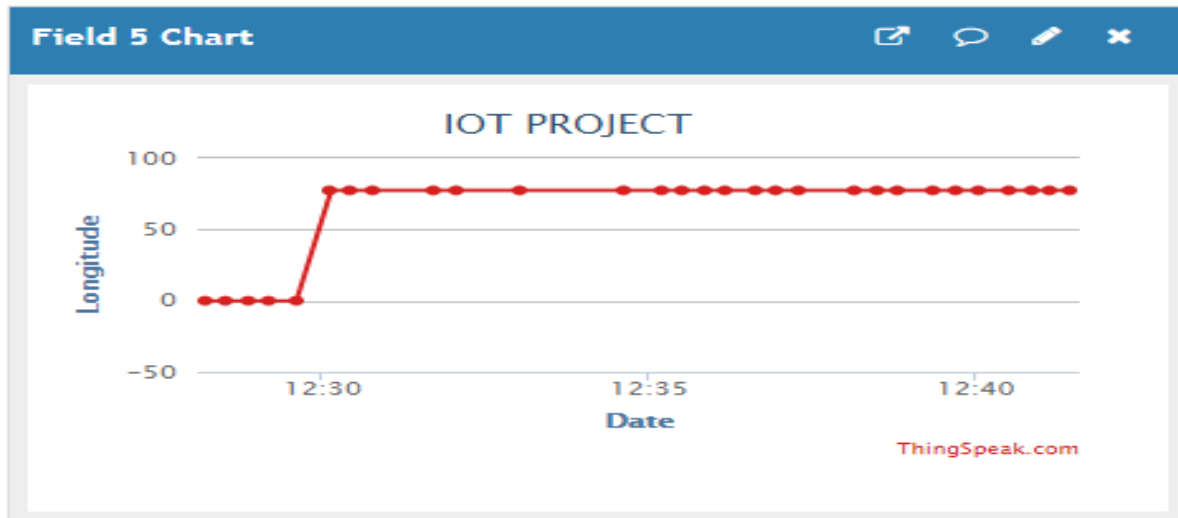


Fig 10.5: longitude Data

- It is the data of 52atititude obtained through the GPS sensor and stored in the cloud.

## 10.6 Snapshot 6

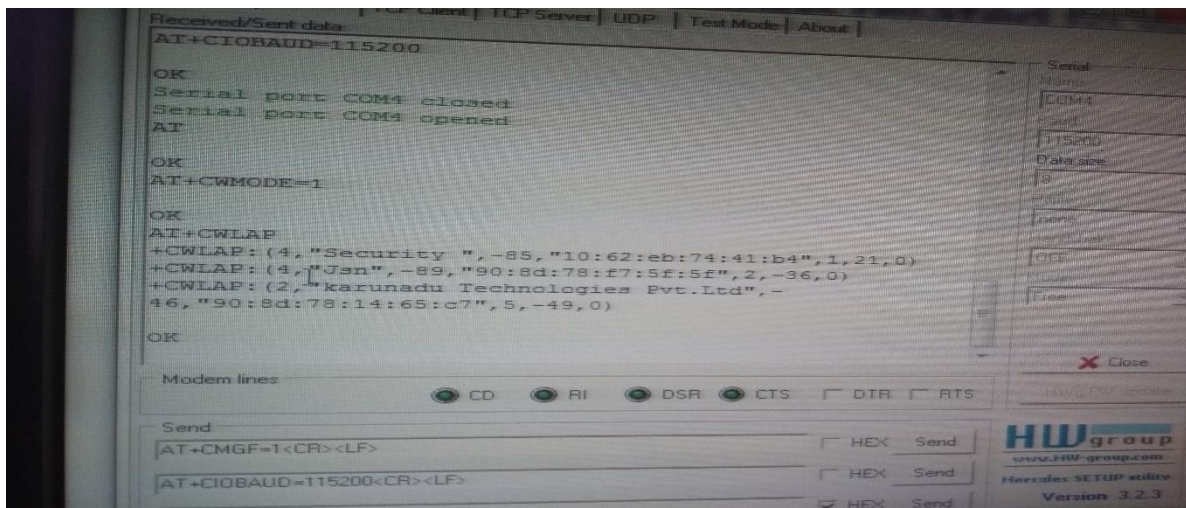


Fig 10.5: checking of ESP module

- It is the process of checking ESP module using the Hercules application whether the device is working correctly or not.

### 10.7 Snapshot 7

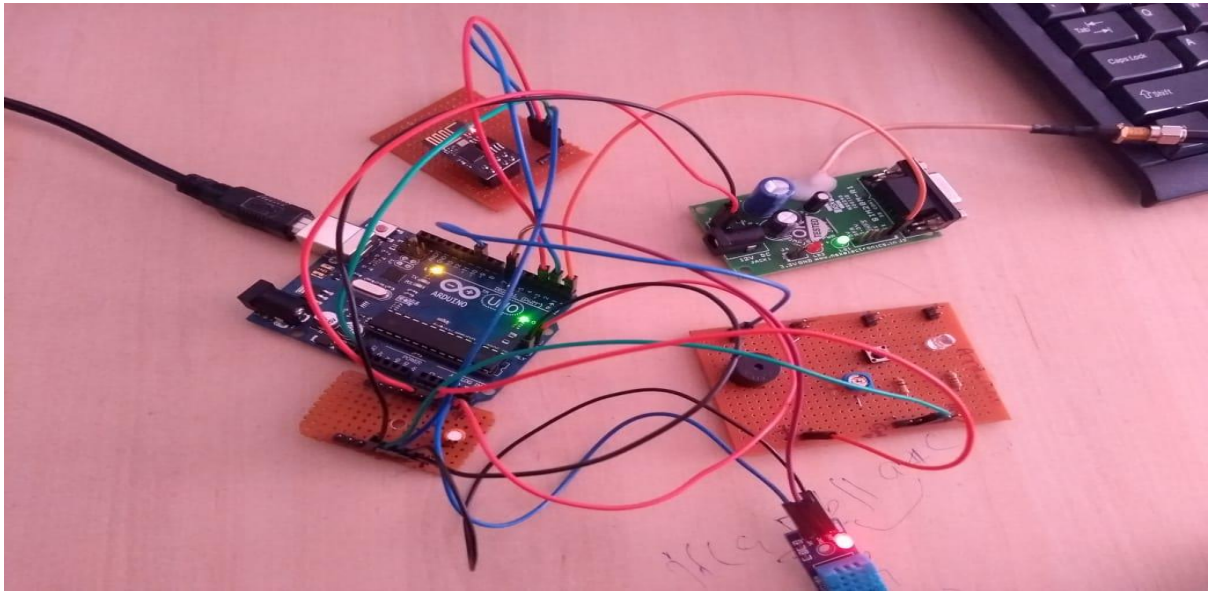


Fig 10.7: Hardware Connection

- It shows the connection off all the devices that took part in the whole project.

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- [WWW.GEEKSFORGEEKS.COM](http://WWW.GEEKSFORGEEKS.COM)
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