VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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A PROJECT REPORT ON

"SMART SECURITY BOX FOR INTELLIGENT PACKING SYSTEM"

Submitted in partial fulfillment of the requirements

for the award of the degree

BACHELOR OF ENGINEERING IN ELECTRONICS AND COMMUNICATION ENGINEERING

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CERTIFICATE

This is to certify that the project work entitled "**Smart Security Box For Intelligent Packing System**" is a bonafide work carried out by our students **Mr. Karthik A, USN: 1DB18EC051, Mr. Kiran B M, USN: 1DB18EC057, Mr. Manjunatha M, USN: 1DB18EC067, Mr. Manoj B R , USN: 1DB18EC068,** of eighth semester, in partial fulfillment for the award of degree of Bachelor of Engineering in Electronics and Communication Engineering of Visvesvaraya Technological University, Belagavi in the academic year 2021-2022. It is certified that all corrections/suggestions indicated during internal assessment have been incorporated in the report deposited in the department library. The project has been approved as it satisfies the academic requirement in respect of the project work described for the said degree.

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ABSTRACT

The Internet of Things (IoT) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT has evolved from the convergence of wireless technologies, micro-electromechanical systems (MEMS) and the Internet. With IoT, devices typically gather data and stream it over the Internet to a central source, where it is analyzed and processed. With IoT, devices typically gather data and stream it over the Internet to a central source, where it is analyzed and processed. As the capabilities of things connected to the Internet continue to advance, they will become more intelligent by combining data into more useful information. To handle such situations we propose a solution by automating the parcel collection unit. This paper discusses about the part of IoT in home sophistication, the proposed approach. Today, Internet is migrating from connecting people to connecting things, leading to the new concept of Internet of thing (IoT). This new trend brings things or objects into the Internet and generates new applications and business. The increasing packaging types and options nowadays also necessitates more systematic and precise way to select the best packaging option for a certain type of product. The application mainly face to two types of users, couriers and customers. When they log-in to the system through the password and username, they can use different functions. The Intelligent Packaging solution aims to use an electronic packaging solution to combat the problem of opening packages during transportation and as well as to measure the characteristics of the product, the inner and outer atmosphere of the package. This is done by using several sensors in a fail-safe system. IPS uses many sensors that continuously track the physical parameters inside the package to ascertain if the package has been opened or there has been some rise in temperature. Once this alert has been sent to those concerned, they can take necessary action. If there is no alert and a normal delivery takes place, the customer uses his/her mobile phone to scan a QR code displayed on the IPS kit. This will result in an OTP that is received at the customer's mobile number. Entering the OTP will reset the device.

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CHAPTER 1

INTRODUCTION

The Intelligent Packaging solution aims to use an electronic packaging solution to combat the problem of opening packages during transportation and as well as to measure the characteristics of the product, the inner and outer atmosphere of the package. This is done by using several sensors in a fail-safe system. IPS uses many sensors that continuously track the physical parameters inside the package to ascertain if the package has been opened or there has been some rise in temperature. Once this alert has been sent to those concerned, they can take necessary action. If there is no alert and a normal delivery takes place, the customer uses his/her mobile phone to scan a QR code displayed on the IPS kit. This will result in an OTP that is received at the customer's mobile number. Entering the OTP will reset the device. Internet of thing (IoT) is not only a promising research topic but also a blooming industrial trend. Some problems that often arise in the packaging of products are difficulty and inaccuracy in determining appropriate packaging options according to type and condition the product to be packaged. Incorrect decision of packaging option can cause quality loss, physical damage, spoilage of the packed products, especially perishable and time sensitive products. Security of data is of primary concern and the system is fully compliant with all data protection standards. With the rise of e-commerce, there is an increasing need to manage online purchase deliveries effectively.

Today, Internet is migrating from connecting people to connecting things, leading to the new concept of Internet of thing (IoT). This new trend brings things or objects into the Internet and generates new applications and business. The increasing packaging types and options nowadays also necessitates more systematic and precise way to select the best packaging option for a certain type of product. The application mainly face to two types of users, couriers and customers. When they log-in to the system through the password and username, they can use different functions.The mobile terminal mainly use the electronic map with GPS location information through IOS API, to obtain the real-time location of courier and package, and then make the automatic route planning for the courier. At the same time, the courier can update the logistical status immediately to the server through communication network, which can share the logistical information timely for each customer.

1.1 MOTIVATION

In our daily life, ordering things online has greatly reduced the time and effort rather purchasing it personally. But in such cases, the availability of the customer at the time of product delivery is always essential. The requirement of this constraint minimizes the easiness of ordering the product online. Hence automation of parcel/product receiving will certainly lead to an easy and safe fulfilment for an online ordering. This is the motive behind the proposal of an approach for automation of parcel receiving .In the modern world, human mistakes sometimes lead to catastrophic events leading to loss of there valuables. One such instance, sometimes intentional is the over loading of all the packages in vehicle. It leads to damage and mishandling of the package. To overcome these problems we propose this system.

1.2 BACKGROUND

In the advanced period of computerized innovation, the security problem is one of the interesting issues. At first what do we comprehend by the word ‘security’. Security is considered as one of the key issues in shipping valuable assets. Security implies the level of protection against fraud, harms , risk , loss and wrongdoing. In recent years, the number of packages sent by Courier, Express and Parcel (CEP) services has increased significantly. Many people order products online expecting fast delivery and, additionally, more than every tenth product is sent back to the merchant. It is required to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and handles a variety of protocols, knowledge bases, and applications. The interconnection of these embedded devices (including smart objects), is expected to usher in automation in virtually all countries, while also enabling advanced applications like a Smart Grid. Affairs, in the IoT, can refer to a broad assortment of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field operation devices that help firefighters in search and delivery. These devices collect useful data with the aid of several existing technologies and then autonomously flow the data between other devices.Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system.

1.3 LITERATURE SURVEY

Himalayee Saini1, Anita Sharma [1] developed a RFID and GSM based Intelligent Courier Mailbox System where this paper describes a device which is capable of identifying the arrival of the courier and forward the same to the receiver. The idea behind this project is to employ an RFID tag to the courier and send the identity number to the user. The user feeds the identity number in the microcontroller using GSM. On the receiver side there is a letterbox which has a RFID reader, GSM module and LCD screen. The courier person scans the RFID tag on the courier using the RFID Reader present at the letterbox. If the identity number matches with the identity number fed by the user, the RFID reader sends a command to the microcontroller to open the gate of the letterbox. The Microcontroller is connected to the DC motor which rotates resulting in the opening of gate. The Microcontroller is programmed in such a manner that after the opening of the gate it automatically closes after 15 seconds. In the event of mismatch of identity number an error message is displayed on the LCD screen.

Tanja Niels,Moritz Travis Hof, Klaus Bogenberger [2] prepared a Design and Operation of an Urban Electric Courier Cargo Bike System this paper presents the number of packages sent by Courier, Express and Parcel (CEP) services has increased significantly. Many people order products online expecting fast delivery and, additionally, more than every tenth product is sent back to the merchant. Delivery tours, which are mainly conducted by the diesel trucks, account for increased traffic congestion and air pollution, especially in cities. Therefore, CEPs are required to create innovative solutions. In this paper, we present a project in Munich, Germany, where the last milepackage delivery is carried out by a CEP company by cargobikes and eBikes. To this end, two containers and one truck trailer are placed in the city center which function as depotstations for the parcels to be delivered nearby. We analyze the delivery data, present an optimization scheme for findingsuitable container locations, and simulate the routes conducted by cargo bikes for an average day. It can be concluded thatthe presented approach is a feasible solution for the package delivery in densely populated cities. The vehicle mileage coveredby diesel trucks per day is significantly reduced from 180 km to 45 km, approximately.

By Ge Wang [3] developed a Verifiable Smart Packaging with Passive RFID where this paper investigates the possibility of using RF signals to test the internal status of packages and detect abnormal internal changes. Towards this goal, we design and implement a non destructive package testing and verification system using commodity passive RFID systems, called Echoscope.

Echoscope extracts unique features from the backscatter signals penetrating the internal space of a package and compares them with the previously collected features during the check-in phase. The use of backscatter signals guarantees that there is no difference in RF sources and the features reflecting the internal status will not be affected. Compared to other nondestructive testing methods such as X-ray and ultrasound, Echoscope is much cheaper and provides ubiquitous usage. Our experiments in practical environments show that Echoscope can achieve very high accuracy and is very sensitive to various types abnormal changes.

Shahriar Rahman Fahim, Subrata K. Sarker [4] presented a Development of a Remote Tracking Security Box with Multi-Factor Authentication System Incorporates with a Biometric Sensing Device in this paper, a security box is designed for safe transportation of important and confidential documents. Most often it is necessary to convey confidential documents from one locus to another and these are being unveiled by the unbidden characters. Again the documents are sometimes not reached in the appointed destination. In this proposed system, the state and the location of the security box is continuously monitored from a base station. Again the implementation of multi-factor authentication (MFA) method for confirming one's identity ensures the security of documents. The box is equipped with a biometric fingerprint sensor and a keypad for entering the passcode. An onboard display shows the current status of the box. In case of the accidental and unwanted opening of the box, a feedback system is provided for notifying the base station. Analyzing and mitigating the risks associated with the system security makes it reliable. The system performance exhibited in this paper validates the reliability of the security box.

Nivedhitha.G, T. Sujithra [5] presented the Automation Of Parcel Delivery Collection Using Iot – Smart Freight Box**,** where this paper deals The Internet of Things (IoT) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT has evolved from the convergence of wireless technologies, micro-electromechanical systems (MEMS) and the Internet. With IoT, devices typically gather data and stream it over the Internet to a central source. As the capabilities of things connected to the Internet continue to advance, they will become more intelligent by combining data into more useful information. In our modern busy lifestyles we are often not having enough time to respond to our routine activities like answering a person at the door or for collecting a door delivery. To handle such situations we propose a solution by automating the parcel collection unit. This paper discusses about the part of IoT in home sophistication, the proposed approach for automating the parcel delivery collection, the working and design of the SFB.

Md R Haque, M Mohammad [6] developed a Autonomous Quadcopter for Product Home Delivery where This paper represents Quadcopter (QC) as a low weight and low-cost autonomous flight capable Unmanned Aerial Vehicle (UAV) for delivering parcel ordered by online by using an android device as its core on-board processing unit. This QC by following Google map can locate and navigate destination. This paper demonstrates the QCs capability of delivering parcel ordered by online and coming back to the starting place. The promising result of this method enables future research on using QC for delivering parcel.

Jiu Wen,Yanchun Sun [7] prepared a Map-Matching Service Designed for Courier Trajectories **t**his paper deals with Courier trajectories have some characteristics different from traditional trajectories. Firstly, couriers have to deliver shipments at different sites, so the trajectories seem more irregular, which is called as "fragmentation" problem. Secondly, unlike cars, couriers' positioning information is mainly generated by Wi-Fi location system, which is not precise as Global Position System (GPS), so the location deviation problem should be taken into account. What's more, couriers usually use electric bikes for delivery, which travel slower than cars, and are less likely to be influenced by traffic. Therefore, the speed or temporal analysis for cars is not suitable here. Based on the analysis of current algorithms and the problems stated above, this paper designs a map-matching service for courier trajectory data. The experiments verify that our service performs better when dealing with courier trajectory data. Besides, our service is efficient with low time complexity and space complexity, making our service responses with low latency.

Beata Skowron-Grabowska, Tomasz Szczepanik [8] developed a Application of RFID technologies in logistics centers to improving operations of courier firms states that the dynamic processes occurring on the market of logistics services determine the implementation of change and the search for optimal solutions. Modern logistics centres that are adjusted to the needs, while also supported by modern technology are the answer to the declared demand from courier firms that place an emphasis on the speed of delivery and quality of service. The application of RFID technologies in logistics centres is the fulfilment of the expectations of courier firms, which in turn enables them to effectively compete on the market of logistics services. RFID technologies have attracted a great deal of interest primarily due to the fact that this technology is between 10 and 20 times faster than the barcode technology. RFID is an automatic system of identification that may identify facilities within range by means of radio waves without interference.

Safial Islam Ayon, Abu Saleh Bin Shahadat [9] presented the Smart security box using Arduino and GSM module **t**his paper presents that security is considered as one of the key issues of the home automation systems because it warrants the convenience and wellbeing to the residents. This paper presents a smart security box that sends messages to the authorized user if an unauthorized user attempts to breach the security of the smart box. The smart security box is fully automated and works without human interaction. This smart device would be used as an advanced technology for the safeguard of people's valuable assets. Along with the advanced security features, affordability and usability are two other main characteristics of this smart security box. This smart security box is primarily developed using an open-source electronics platform named Arduino and Global System for Mobile (GSM) Communications module with Short Message Service (SMS). Based on the empirical evidence it is found that this low cost, low power consumed smart security box is robust and accurate in terms of sensing and sending security breaches notifications to the legal users. This potential smart security box can be used for the personal as well as commercial purpose and is able to penetrate the local and international market of smart security technology quite comprehensively.

1.4 PROBLEM STATEMENT

In this project the security box is trying to implement in shipping valuable assests. Increased customer's experience, expectations and product complexity are driving traditional packaging techniques obsolete. In addition to this, traditional packaging methods do not provide the customer as well as the manufacturer with important information about the product during shipping..To develop an intelligent packaging system that uses the Internet of Things and Machine Learning for authenticating, securing, and tracking high-value packages.

CHAPTER 2

METHODOLOGY

With the rapid development of IoT technology, wireless sensor networks (WSNs) have been widely adopted in the logistics industry. In the studies reported in , sensor information was transmitted to a network platform through gateways. These gateways were installed in the environments of warehouses, trucks, and so on, and greatly improved the efficiency of managing cargo delivery. Papatheocharous and Gouvas [proposed a cargo information management system called eTracer, which combines a variety of sensors through wireless networking to provide systematic cargo information management for logistics operators.

On the other hand, radio frequency identification (RFID) and Global Positioning System (GPS) technology have also been widely used in logistics chains to ensure the safety of cargo transportation. Lien et al. presented an RFID-based integrated hardware/software system for warehousing management in the logistics industry. In this system, RFID tags are adopted to manage the entry and exit of goods at a warehouse. Moreover, this system can check whether goods have entered the RFID can also be combined with different types of sensors for cargo monitoring. For example, Gomes et al. implemented a low-power temperature sensor module with RFID in order to monitor the temperature of frozen goods (such as food, vaccine, drugs, or blood) in real time during cargo transport procedures.

Lin et al. designed a refrigerated cargo tracking system in which Google APIs were adopted to locate trucks and track the status of refrigerated cargo. In this system, a built-in temperature sensor chip was used to monitor the ambient environment. The sensor temperature data were sent to mobile devices via Bluetooth (BT) and simultaneously uploaded to an online database for monitoring the shipment status of frozen goods. Two related works have also been reported in which RFID was used to monitor the shipment status of food products to prevent degradation. In these two studies, RFID technology was used in combination with gas sensors and network communication technology to address the problem of degradation that may occur during food transport .Sun proposed an IoT-based logistics management system that combines RFID, GPS, and GPRS technology to effectively manage the shipment of goods and realize the localization of trucks to improve the quality of goods delivery, thereby reducing operating costs. The proposed IoT-based system is divided into two parts: the first part is an automatic terminal, and the second part is a remote control center.

The below Fig 2.1 determines the block diagram of the model.

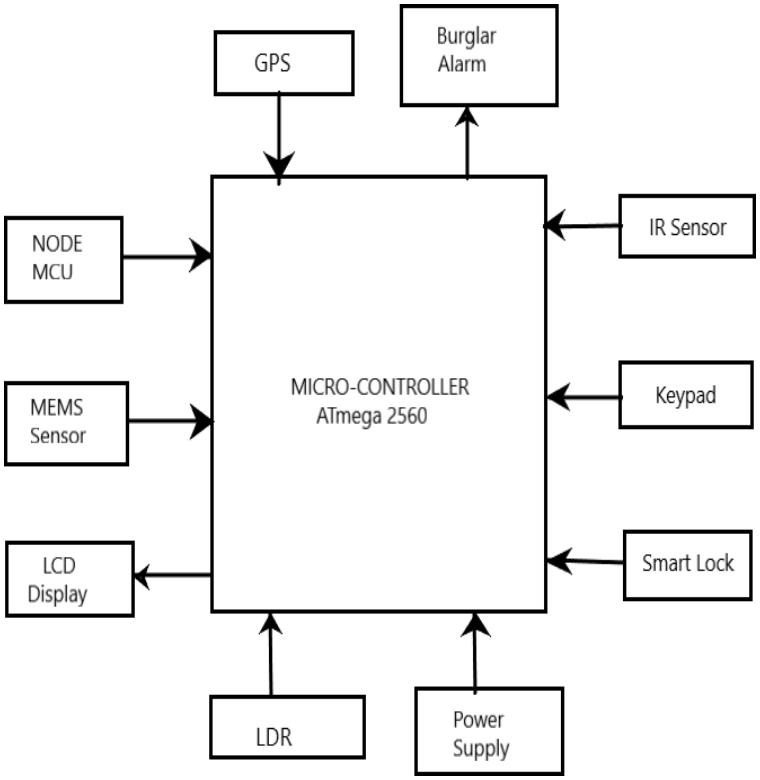

Fig.2.1: Block Diagram

- LCD Display is used to display each operation.
- LDR sensor is used to determine whether the IPS properly closed or not.
- MEMS sensor is used to determine whether the IPS box have been mishandled or thief attempted or not.
- IR Sensor is used to determine the package presence in the IPS kit.
- GPS tracks the current location
- GSM (Node MCU) will send the message to user about mishandled or any theft attempted.
- DHT sensor monitors the temperature and humidity inside the IPS.

➢ DEMONSTRATION

The IPS development kit will be made into a compact space and placed inside the package that is to be secured. The sensors that are used in the IPS development kit will be turned on and will start working. The kit will travel within the box till the destination and will be removed after verification of the data.

- The IPS development kit is first placed in the package, So that it is to be tracked. This is placed inside the package along with the contents of the package.
- For the kit to work properly and without any interruptions it must be placed as close to the package contents as possible.
- The IPS development kit starts running the program that is coded into it and hence starts transmitting data to the cloud. The data on the cloud is visible on the web interface that has been built for this specific purpose.
- The data is monitored in real-time on the cloud as well as in the IPS development kit.
- On receiving the OTP, the IPS development kit is reset and it is ready to be taken back by the shipping company and installed on another parcel and the cycle of the IPS development kit continues.

2.1 LIMITATIONS OF EXISTING SYSTEM

- Existing system doesn't have the security and safety for the valuable things during transportation.
- Existing system doesn't provide the information of the any failure or interrupt. Increased customer experience expectations and product complexity are driving traditional packaging techniques obsolete.
- In addition to this, traditional packaging methods do not provide the customer as well as the manufacturer with important information about the product during shipping.

2.2 PROPOSED METHODOLOGY

The Internet of Things concept is much broader in the sense that everyday objects that did not previously seem electronic are connected to the internet via sensors. The proposed approach uses the integration of IoT, cloud and mobile application for the automation process. The idea is to introduce a Intelligent packing Box which will be able to verify and accept the ordered parcel as well as acknowledging the customer and the e-retailers. The Intelligent Packaging solution aims to use an electronic packaging solution to combat the problem of opening packages during transportation and as well as to measure the characteristics of the product, the inner and outer atmosphere of the package. This is done by using several sensors in a fail-safe system.

IPS uses many sensors that continuously track the physical parameters inside the package to ascertain if the package has been opened or there has been some rise in temperature. Once this alert has been sent to those concerned, they can take necessary action. If there is no alert and a normal delivery takes place, the customer uses his/her mobile phone to scan a QR code displayed on the IPS kit. This will result in an OTP that is received at the customer's mobile number. Entering the OTP will reset the device.

➢ WORKING MODEL

The below figures show the front, top and internal view of the model and interfacing of the sensors and components.

Fig.2.2: Front View

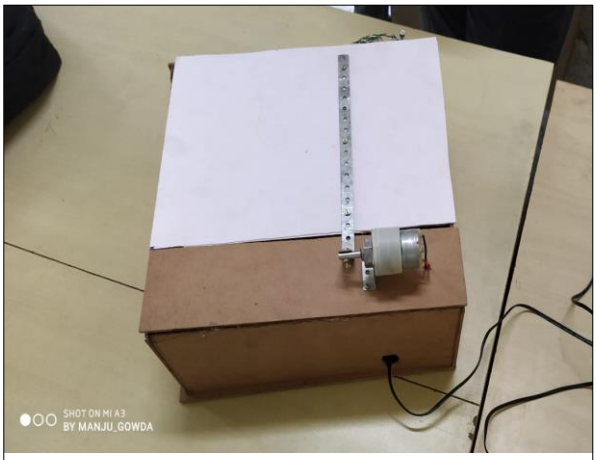

Fig.2.3: Top View

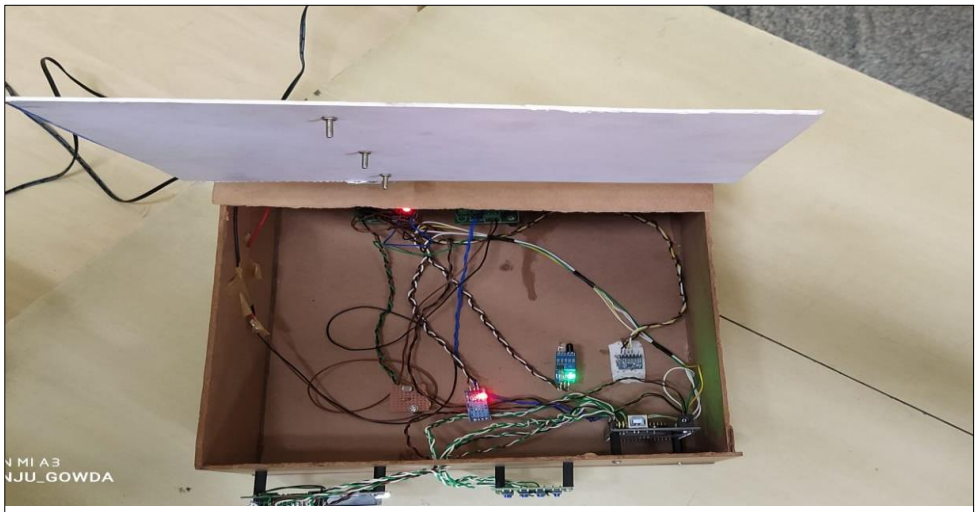

Fig.2.4: Internal View

➢ WORKING FLOW

The flow of the complete working model from the beginning, placing object in the box, transportation of the package, sensors measurements and at last reaching the destination.

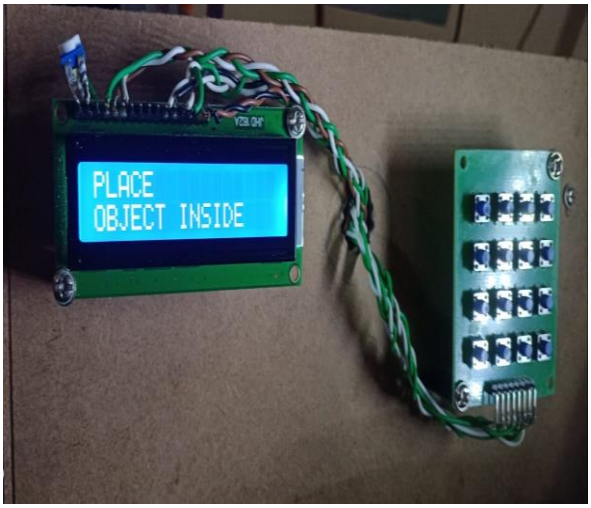

Fig.2.5: Place object inside

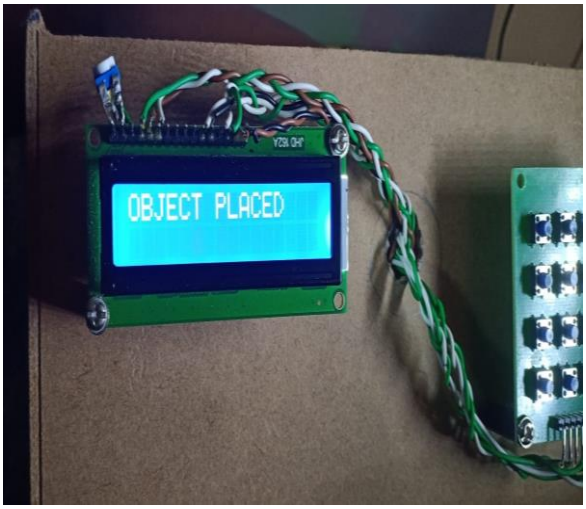

Fig.2.6: Object Placed

- At first object should be placed inside the smart security box, IR sensor will detect th object and "OBJECT PLACED" message will be displayed on LCD as in Fig.2.5 and Fig.2.6.

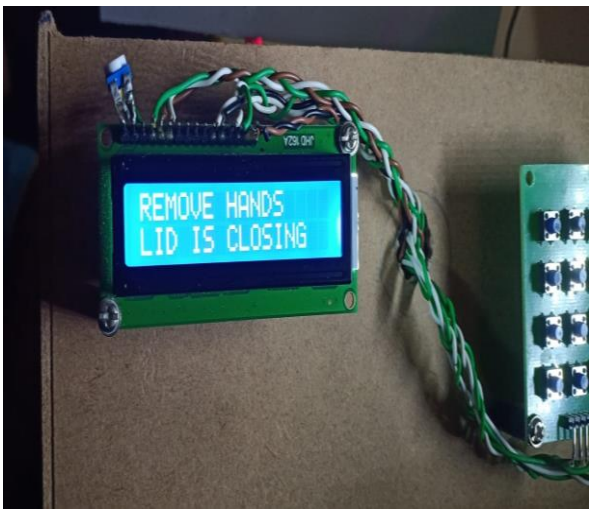

Fig.2.7: Lid is closing

Fig.2.8: Sealed box

- LID will close automatically with the help of gear motor and "SEALED BOX" message will be displayed on LCD as in above Fig.2.7 and Fig.2.8.

Fig.2.9: Sensor measurement

- Detection of humidity and temperature will be done with the help of DHT-11 sensor and the measured temperature and humidity value “Hum:76.00 temp:24.10” is displayed on LCD as shown in Fig.2.9.

Fig.2.10: Enter OTP

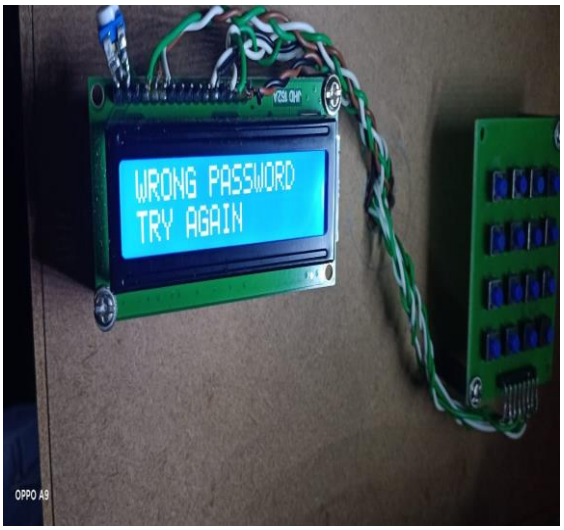

Fig.2.11: Try again

- “ENTER OTP” message will be displayed on the LCD. Here customer has already received a server generated OTP to his mobile, which he has to enter in the pins of 484 keypad provided outside the sealed box , if the customer enters the wrong OTP the “WRONG PASSWORD TRY AGAIN” message will be displayed as in Fig.2.10 and Fig.2.11.

Fig.2.12: OTP Entered

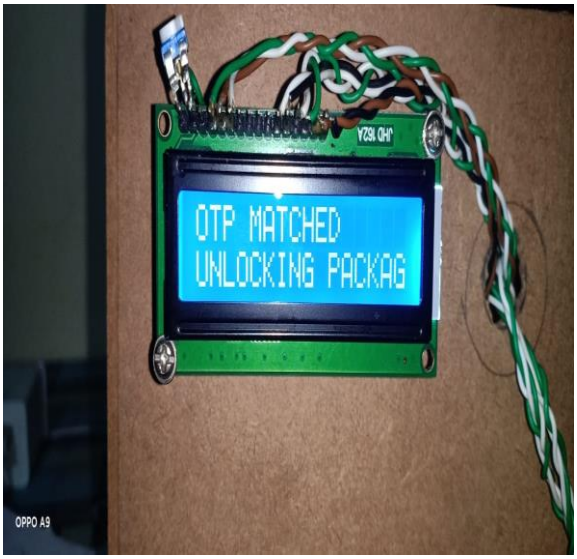

Fig.2.13: Unlocking Package

- When the customer enters the correct OTP then the smart security box will be unlocked and the "OTP MATCHED UNLOCKING PACKAGE" message will be displayed as in Fig.2.12 and Fig.2.13.

Fig.2.14: Pick package

- "PICK PACKAGE" message will be displayed on LED as in Fig.2.14.

2.3 ADVANTAGES OF PROPOSED METHODOLOGY

- Traceability/Supply chain management of the product will be easier and handy.
- Products can be saved from getting damaged or being cloned.
- Company's market reputation won't be harmed.

- Spoilage monitoring.
- Reusable.
- Tamper proof delivery.

2.4 APPLICATIONS

- Same application with modifications can be used in industries for valuable things and other belongings safety.
- Logistics companies.
- In hospitals for keeping belongings of doctors and patients safely.
- The valuable assets are shipped safe and secure.

2.5 TOOLS OR LANGUAGES USED

➢ HARDWARE REQUIREMENTS

- Arduino MEGA
- LCD
- IR Sensors
- LDR Sensor
- Relay
- NODEMCU
- MEME Sensor
- Power Supply
- Smart lock

➢ SOFTWARE REQUIREMENTS

- Ardunio IDE
- IoT Platform
- Cloud storage
- Embedded C

➢ FUNCTIONAL REQUIREMENTS

- System should be continuously monitoring the IPS.
- System should detect the presence of the package.
- System should be able to generate the OTP to the customer.
- System should pass every information about the parcel to the cloud.

➢ NON-FUNCTIONAL REQUIREMENTS

- **Usability**: Easy Interface for packaging management
- **Reliability**: Easy Access
- **Performance**: Should not take excessive time in forwarding the message about theft or mishandling.
- **Support ability**: Contains code that is easy to understand with provisions for future enhancement.

CHAPTER 3

COMPONENTS DESCRIPTION

❖ Arduino Mega

The Arduino Mega2560 can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd pin and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The Mega 2560 differs from all preceding boards in such a way that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 that is programmed as a USB-to-serial converter. The Arduino MEGA 2560 is designed for projects that require more I/O lines, more sketch memory and more RAM. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities maintaining the simplicity and effectiveness of the Arduino platform. This document explains how to connect your Mega2560 board to the computer and upload your first sketch.

The Arduino Mega 2560 is programmed using the Arduino Software (IDE), our Integrated Development Environment common to all our boards and running both online and offline. For more information on how to get started with the Arduino Software visit the Getting Started page.

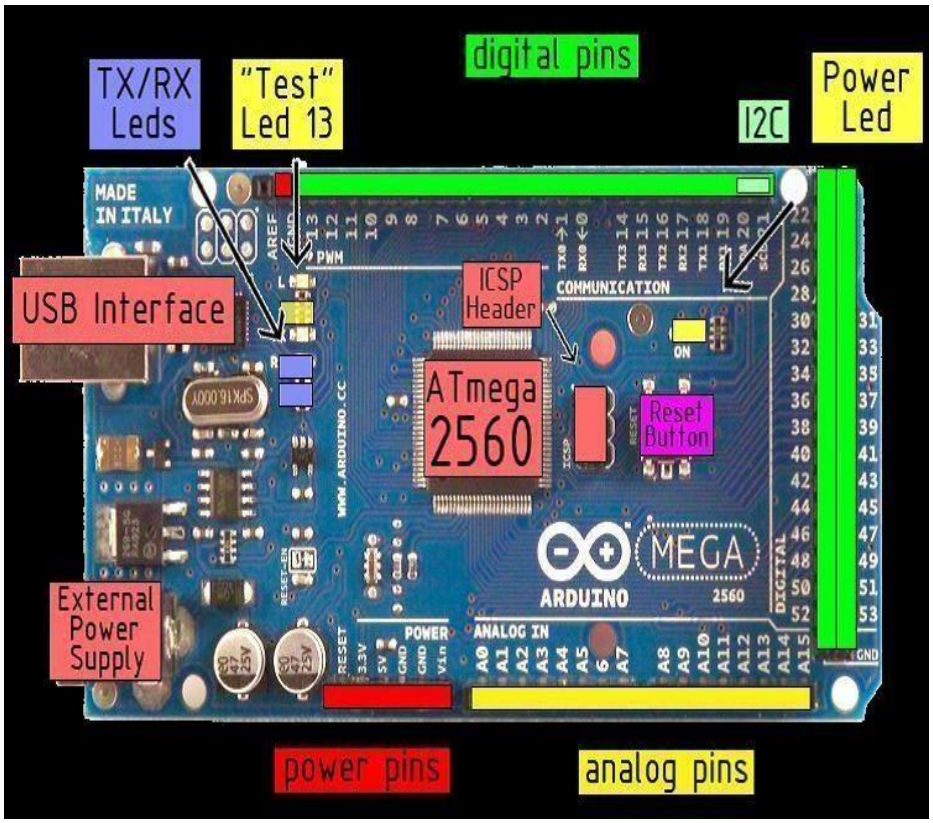

Fig 3.1: Arduino mega

➢ TECHNICAL SPECIFICATIONS

- Micro-controller : ATmega2560
- Operating Voltage : 5V
- Input Voltage (recommended) : 7-12V
- Input Voltage (limits) : 6-20V
- Digital I/O Pins : 54 (of which 14 provide PWM output)
- Analog Input Pins : 16
- DC Current per I/O Pin : 40 mA
- DC Current for 3.3V Pin : 50 mA
- Flash Memory : 256 KB of which 8 KB used by bootloader
- SRAM : 8 KB
- EEPROM : 4 KB
- Clock Speed : 16 MH

➢ PIN DIAGRAMS

The below Fig 3.2 determines the pin diagram of Arduino mega.

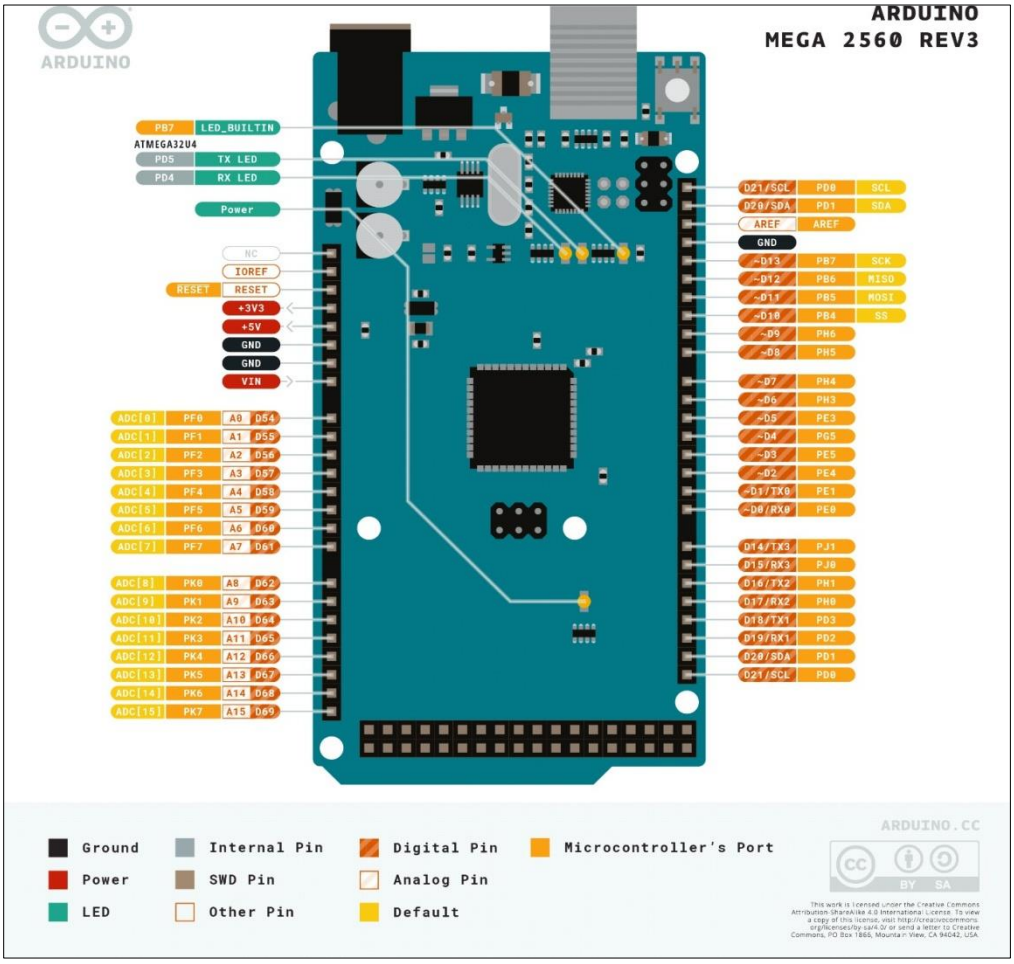

Fig 3.2: Pin Diagram

➢ The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin
- **5V**. The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- **3V.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.
- **Serial:** 0 (RX) and 1 (TX); Serial 1: 19 (RX) and 18 (TX); Serial 2: 17 (RX) and 16 (TX); Serial 3: 15 (RX) and 14 (TX). Used to receive (RX) and transmit (TX) TTL

serial data. Pins 0 and 1 are also connected to the corresponding pins of the ATmega8U2 USB- to-TTL Serial chip.

- **External Interrupts:** 2 (interrupt 0), 3 (interrupt 1), 18 (interrupt 5), 19 (interrupt 4), 20 (interrupt 3), and 21 interrupt 2). These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- **PWM:** 0 to 13. Provide 8-bit PWM output with the analogWrite() function.
- **LED:** 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- **I2C:** 20 (SDA) and 21 (SCL). Support I2C (TWI) communication using the Wire library (documentation on the Wiring website). Note that these pins are not in the same location as the I2C pins on the Duemilanove.

❖ IR SENSOR

An Infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor.The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

Fig 3.3: IR Sensor

- **Working Principle** - "An infrared sensor circuit is one of the basic and popular sensor module in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real- time."

This circuit comprises of the following components:

- LM358 IC 2 IR transmitter and receiver pair
- Resistors of the range of kilo-ohms.
- Variable resistors.
- LED (Light Emitting Diode).

The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength used as infrared sources. The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response.

➢ Principle of Working

The principle of an IR sensor working as an Object Detection Sensor can be explained using the following figure. An IR sensor consists of an IR LED and an IR Photodiode; together they are called as Photo – Coupler or Opto – Coupler.

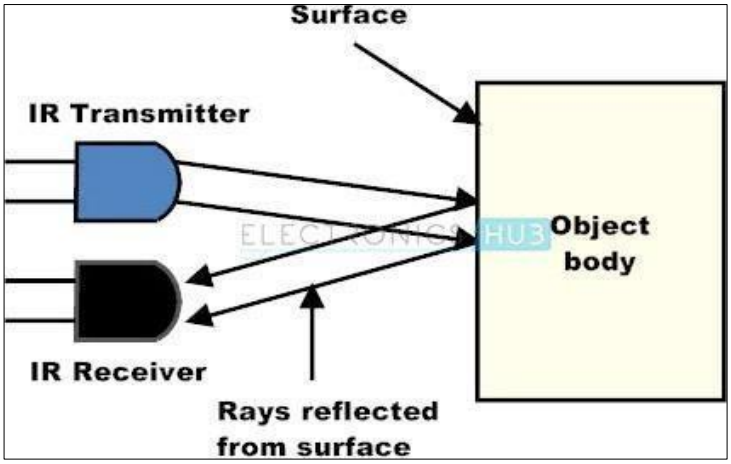

Fig 3.4: Working of IR Sensor

When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor is defined. 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 technology is found not just in industry, but also in every-day life. Televisions, for example, use an infrared detector to interpret the signals sent from a remote control. Passive Infrared sensors are used for motion detection systems, and LDR sensors are used for outdoor lighting systems. The key benefits of infrared sensors include their low power requirements, their simple circuitry and their portable features.

❖ IR SENSOR CIRCUIT

It consists of an IR LED, a photodiode, a potentiometer, an IC Operational amplifier and an LED.IR LED emits infrared light. The Photodiode detects the infrared light. An IC Op – Amp is used as a voltage comparator. The potentiometer is used to calibrate the output of the sensor according to the requirement.

When the light emitted by the IR LED is incident on the photodiode after hitting an object, the resistance of the photodiode falls down from a huge value. One of the input of the op – amp is at threshold value set by the potentiometer. The other input to the op-amp is from the photodiode's series resistor. When the incident radiation is more on the photodiode, the voltage drop across the series resistor will be high. In the IC, both the threshold voltage and the voltage across the series resistor are compared.If the voltage across the resistor series to photodiode is greater than that of the threshold voltage, the output of the IC Op – Amp is high. As the output of the IC is connected to an LED, it lightens up. The threshold voltage can be adjusted by adjusting the potentiometer depending on the environmental conditions.

The positioning of the IR LED and the IR Receiver is an important factor. When the IR LED is held directly in front of the IR receiver, this setup is called Direct Incidence. In this case, almost the entire radiation from the IR LED will fall on the IR receiver. Hence there is a line of sight communication between the infrared transmitter and the receiver. If an object falls in this line, it obstructs the radiation from reaching the receiver either by reflecting the radiation or absorbing the radiation.

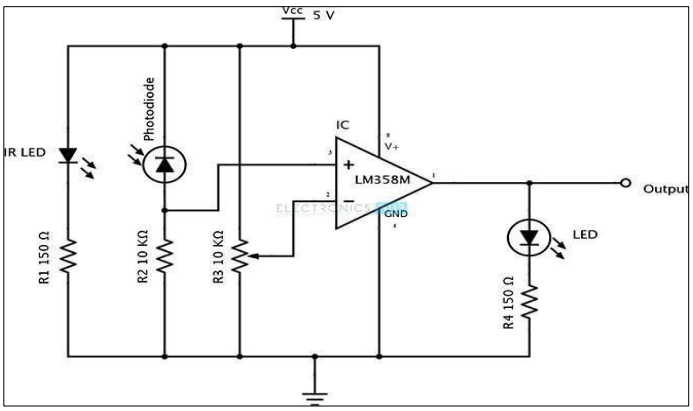

Fig 3.5: Typical IR sensing circuit

❖ BUZZER

A buzzer is a small yet efficient component to add sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications .There are two types are buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beep. sound, the other type is called a readymade buzzer which will look bulkier than this and will produce a Beep. Beep. Beep. Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customised with help of other circuits to fit easily in our application .This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval.

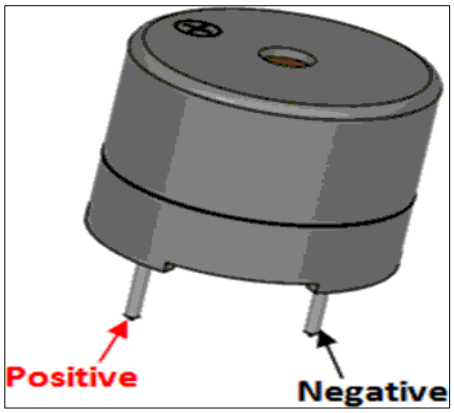

Fig 3.6: Buzzer

❖ LIQUID CRYSTAL DISPLAY

This is the first interfacing example for the Parallel Port. We will start with something simple. This example doesn't use the Bi-directional feature found on newer ports, thus it should work with most, if not all Parallel Ports. It however doesn't show the use of the Status Port as an input for a 16 Character x 2 Line LCD Module to the Parallel Port. These LCD Modules are very common these days, and are quite simple to work with, as all the logic required running them is on board.

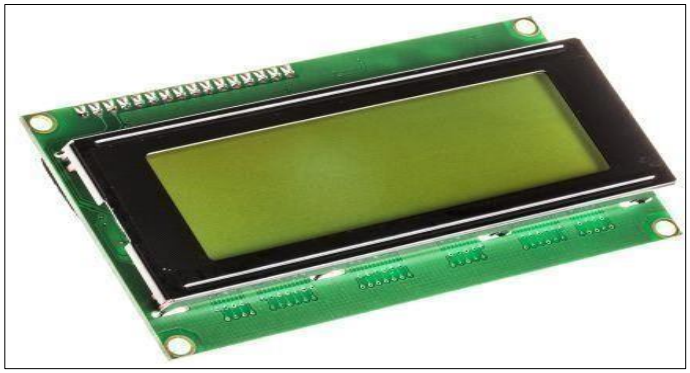

Fig 3.7: LCD

➢ Features of 16×2 LCD module

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is built by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters

❖ LDR

The light sensor is a passive devices that convert this “light energy” whether visible or in the infra-red parts of the spectrum into an electrical signal output. Light sensors are more commonly known as “Photoelectric Devices” or “Photo Sensors”.

- **Photo-emissive Cells** – These are photo devices which release free electrons from a light sensitive material such as caesium when struck by a photon of sufficient energy. The amount of energy the photons have depends on the frequency of the light and the higher the frequency, the more energy the photons have converting light energy into electrical energy.

- **Photo-conductive Cells** – These photodevices vary their electrical resistance when subjected to light. Photoconductivity results from light hitting a semiconductor material which controls the current flow through it. Thus, more light increase the current for a given applied voltage. The most common photoconductive material is Cadmium Sulphide used in LDR photocells.

- **Photo-voltaic Cells** – These photodevices generate an emf in proportion to the radiant light energy received and is similar in effect to photoconductivity. Light energy falls on to two semiconductor materials sandwiched together creating a voltage of approximately 0.5V.The most common photovoltaic material is Selenium used in solar cells.

- **Photo-junction Devices** – These photodevices are mainly true semiconductor devices such as the photodiode or phototransistor which use light to control the flow of electrons and holes across their PN-junction. Photojunction devices are specifically designed for detector application and light penetration with their spectral response tuned to the wavelength of incident light.

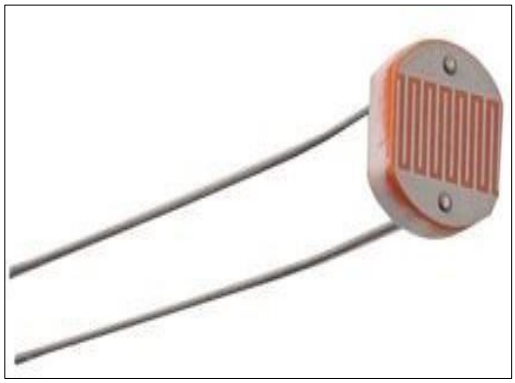

Fig 3.8: LDR

❖ ADXL335 Accelerometer Module (MEMS SENSOR)

An accelerometer is an electromechanical device that will measure acceleration force. It shows acceleration, only due to cause of gravity i.e. gravitational force.

Accelerometer can be used for tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.

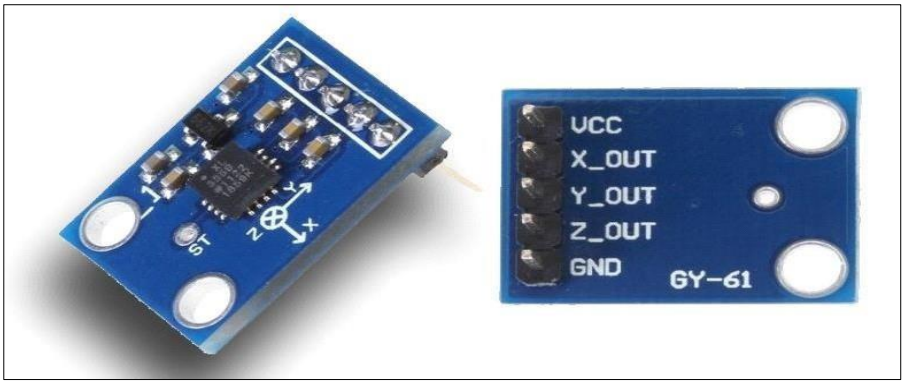

Fig 3.9: ADLX335 Accelerometer

➢ ADXL335 module

An accelerometer is an electromechanical device that will measure acceleration force. It shows acceleration, only due to cause of gravity i.e. g force. It measures acceleration in g unit. On the earth, 1g means acceleration of 9.8 m/s2 is present. On moon, it is 1/6th of earth and on mars it is 1/3rd of earth. Accelerometer can be used for tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.

- The ADXL335 gives complete 3-axis acceleration measurement.
- This module measures acceleration within range ±3 g in the x, y and z axis
- The output signals of this module are analog voltages that are proportional to the acceleration.
- It contains a polysilicon surface-micro machined sensor and signal conditioning circuitry.
- Acceleration deflects the moving mass and unbalances the differential capacitor which results in a sensor output voltage amplitude which is proportional to the acceleration.
- Phase-sensitive demodulation techniques are then used to determine the magnitude and direction of the acceleration.

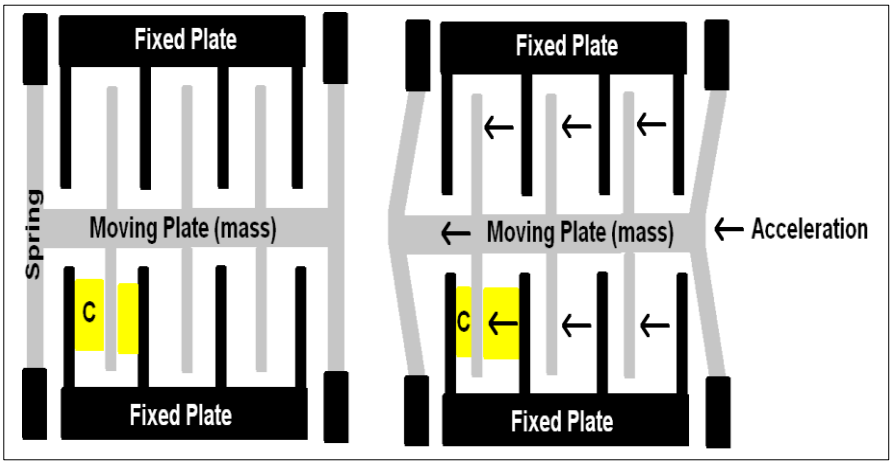

Fig 3.10: Accelerometer Sensor MEM working mechanism

❖ POWER SUPPLY

The transformer 230Volts will be stepped down to 12-0-12 one side of the 12V is given to the 7805 and Lm317.In this project the microcontroller requires +5V power supply. The design description of power supply is given below.

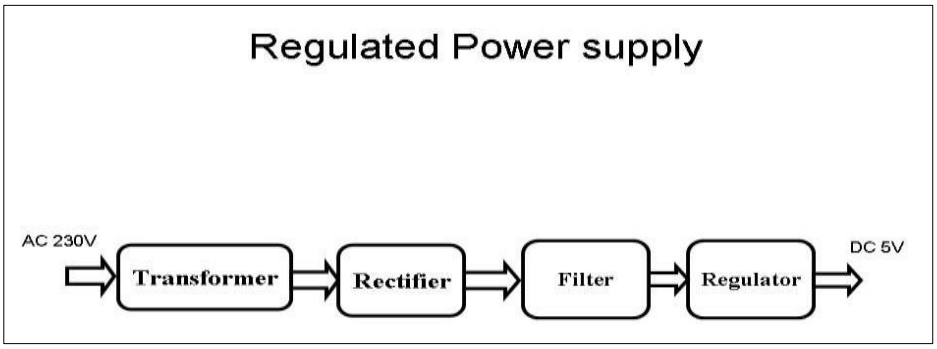

Fig 3.11: Power Supply

Transformer: A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors without changing its frequency. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction. If a load is connected to the secondary, an electric current will flow in the secondary winding and electrical energy will be transferred from the primary circuit through the transformer to the load. This field is made up from lines of force and has the same shape as a bar magnet. If the current is increased, the lines of force move outwards from the coil. If the current is reduced, the lines of force move inwards. If another coil is placed adjacent to the first coil then, as the field moves out or in, the moving lines of force will "cut" the turns of the second coil. As it does this, a voltage is induced in the second coil. With the 50 Hz AC mains supply, this will happen 50 times a second. This is called MUTUAL INDUCTION and forms the basis of the transformer.

Rectifier: A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid-state diodes, vacuum tube diodes, mercury arc valves, and other components. A device that it can perform the opposite function (converting DC to AC) is known as an inverter. When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform),

the difference between the term diode and the term rectifier is merely one of usage, i.e., the term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper (I) oxide or selenium rectifier stacks were used.

Filter: The process of converting a pulsating direct current to a pure direct current using filters is called as filtration. Electronic filters are electronic circuits, which perform signal-processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones.

Regulator: A voltage regulator (also called a _regulator‘) with only three terminals appears to be a simple device, but it is in fact a very complex integrated circuit. It converts a varying input voltage into a constant _regulated ‘output voltage. Voltage Regulators are available in a variety of outputs like 5V, 6V, 9V, 12V and 15V. The LM78XX series of voltage regulators are designed for positive input. For applications requiring negative input, the LM79XX series is used. Using a pair of _voltage-divider resistors can increase the output voltage of a regulator circuit. It is not possible to obtain a voltage lower than the stated rating. You cannot use a 12V regulator to make a 5V power supply. Voltage regulators are very robust. These can withstand over-current draw due to short circuits and also over-heating. In both cases, the regulator will cut off before any damage occurs.

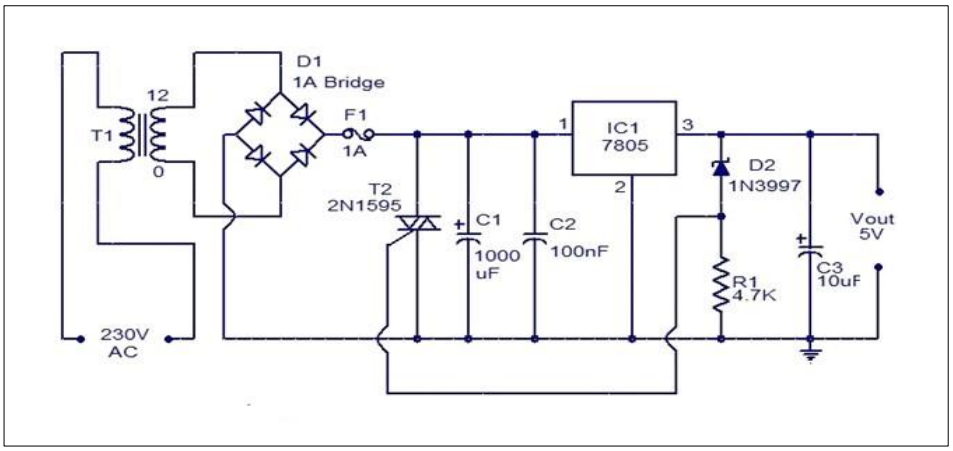

Figure 3.12: 5v power supply with over voltage protection.

❖ NodeMCU

Node MCU is an open source LUA based firmware developed for ESP8266 wifi chip. By exploring functionality with ESP8266 chip, NodeMCU firmware comes with ESP8266 Development board/kit i.e Nod MCU Development board. NodeMCU Dev Kit/board consist of ESP8266 wifi enabled chip. The ESP8266 is a low- cost Wi-Fi chip developed by Express if Systems with TCP/IP protocol NodeMCU Dev Kit has Arduino like Analog (i.e. A0) and Digital (D0-D8) pins on its board.It supports serial communication protocols i.e. UART, SPI, I2C etc.Using such serial protocols we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards etc.

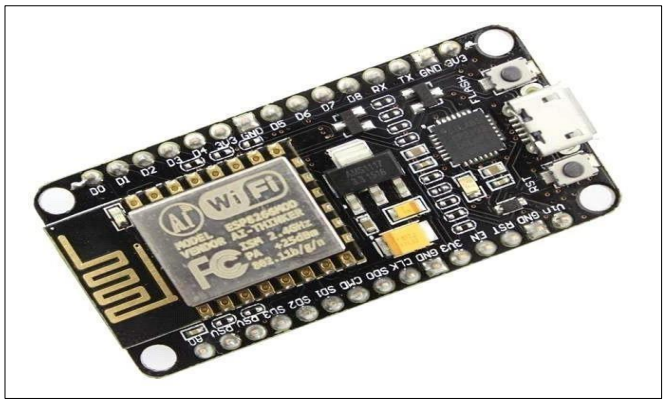

Fig 3.13: Node MCU

➢ PIN DEFINITION

The below Fig 3.14 determines the pin definition of NodeMCU.

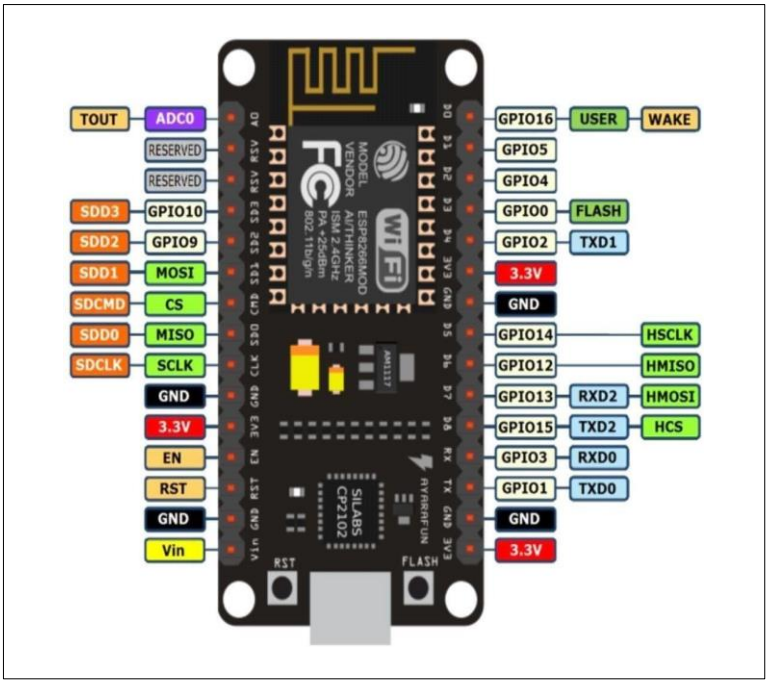

Fig 3.14: NodeMCU Pin Definition

➢ NodeMCU-PIN CONFIGURATION

The below table determines the pin configuration of NodeMCU.

Table -1

Label	GPIO	Input	Output	Notes
D0	GPIO16	no interrupt	no PWM or I2C support	HIGH at boot used to wake up from deep sleep
D1	GPIO5	OK	OK	often used as SCL (I2C)
D2	GPIO4	OK	OK	often used as SDA (I2C)
D3	GPIO0	pulled up	OK	connected to FLASH button, boot fails if pulled LOW
D4	GPIO2	pulled up	OK	HIGH at boot connected to on-board LED, boot fails if pulled LOW
D5	GPIO14	OK	OK	SPI (SCLK)
D6	GPIO12	OK	OK	SPI (MISO)
D7	GPIO13	OK	OK	SPI (MOSI)
D8	GPIO15	pulled to GND		SPI (CS) Boot fails if pulled HIGH
RX	GPIO3	OK	RX pin	HIGH at boot
TX	GPIO1	TX pin	OK	HIGH at boot debug output at boot, boot fails if pulled LOW
A0	ADC0	Analog Input	X	

➢ How to start with NodeMCU?

- NodeMCU Development board is featured with wifi capability, analog pin, digital pins and serial communication protocols.
- To get start with using NodeMCU for IoT applications first we need to know about how to write/download NodeMCU firmware in NodeMCU Development Boards. And before that where this NodeMCU firmware will get as per our requirement.
- There is online NodeMCU custom builds available using which we can easily get our custom NodeMCU firmware as per our requirement.

CHAPTER 4

SOFTWARES AND PROGRAMMING LAUGUAGES

❖ EMBEBBED C LANGUAGE

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems.Embedded C is one of the most popular and most commonly used Programming Languages in the development of Embedded Systems.Embedded C programming typically requires nonstandard extensions to the C language in order to support enhanced microprocessor features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations

Embedded C is perhaps the most popular languages among Embedded Programmers for programming Embedded Systems. There are many popular programming languages like Assembly, ASIC, C++ etc. Embedded C uses most of the syntax and semantics of standard C, e.g., main() function, variable definition, datatype declaration, conditional statements (if, switch case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc.

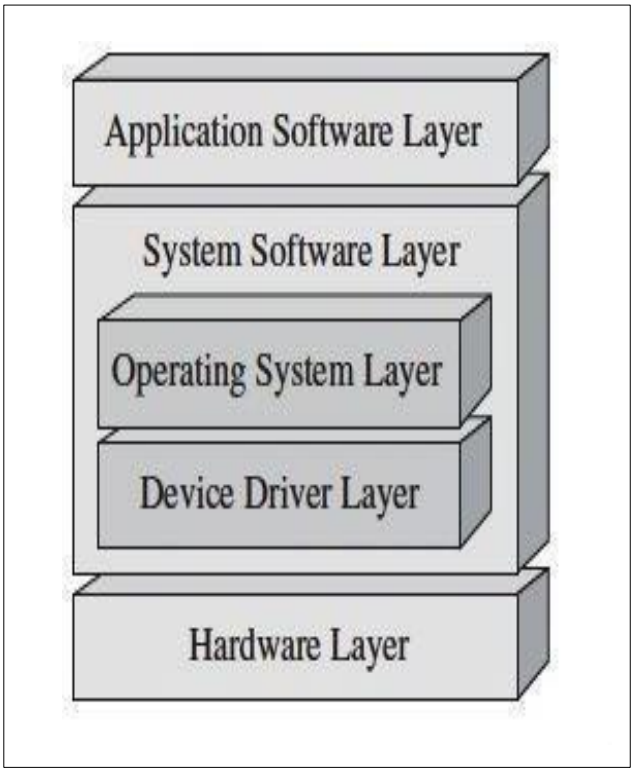

Fig 4.1: Embedded system architecture

➢ Introduction to Embedded C Programming Language

Embedded C Programming Language, which is widely used in the development of Embedded Systems, is an extension of C Program Language. The Embedded C Programming Language uses the same syntax and semantics of the C Programming Language like main function, declaration of datatypes, defining variables, loops, functions, statements, etc. An Embedded System can be best described as a system which has both the hardware and software and is designed to do a specific task.As mentioned earlier, Embedded Systems consists of both Hardware and Software. If w e consider a simple Embedded System, the main Hardware Module is the Processor. The Processor is the heart of the Embedded System and it can be anything like a Microprocessor, Micro-controller, DSP, CPLD (Complex Programmable Logic Device) and FPGA (Field Programmable Gated Array).

➢ Factors for Selecting the Programming Language

The following are few factors that are to be considered while selecting the Programming Language for the development of Embedded Systems:

- Size: The memory that the program occupies is very important as Embedded Processors like Micro-controllers have a very limited amount of ROM.
- Speed: The programs must be very fast i.e. they must run as fast as possible. The hardware should not be slowed down due to a slow running software.
- Portability: The same program can be compiled for different processors.
- Ease of Implementation
- Ease of Maintenance
- Readability

Earlier Embedded Systems were developed mainly using Assembly Language. Even though Assembly Language is closest to the actual machine code instructions, the lack of portability and high amount of resources spent on developing the code, made the Assembly Language difficult to work with.

➢ Programming Embedded Systems

Embedded Systems consists of both Hardware and Software. If we consider a simple Embedded System, the main Hardware Module is the Processor.

The Processor is the heart of the Embedded System and it can be anything like a Microprocessor, Microcontroller, DSP, CPLD (Complex Programmable Logic Device) and FPGA (Field Programmable Gated Array).

All these devices have one thing in common: they are programmable i.e. we can write a program (which is the software part of the Embedded System) to define how the device actually works. Embedded Software or Program allow Hardware to monitor external events (Inputs) and control external devices (Outputs) accordingly. During this process, the program for an Embedded System may have to directly manipulate the internal architecture of the Embedded Hardware (usually the processor) such as Timers, Serial Communications Interface, Interrupt Handling, and I/O Ports etc. From the above statement, it is clear that the Software part of an Embedded System is equally important to the Hardware part. There is no point in having advanced Hardware Components with poorly written programs (Software).

There are many programming languages that are used for Embedded Systems like Assembly (low-level Programming Language), C, C++, JAVA (high-level programming languages), Visual Basic, JAVA Script (Application level Programming Languages), etc.

In the process of making a better embedded system, the programming of the system plays a vital role and hence, the selection of the Programming Language is very important.

➢ Keywords in Embedded C

A Keyword is a special word with a special meaning to the compiler (a C Compiler for example, is a software that is used to convert program written in C to Machine Code). For example, if we take the Keil's Cx51 Compiler (a popular C Compiler for 8051 based Micro- controllers) the following are some of the keywords:

- bit
- sbit
- sfr
- small
- large

These are few of the many keywords associated with the Cx51 C Compiler along with the standard C Keywords.

➢ Data Types in Embedded C

Data Types in C Programming Language (or any programming language for that matter) help us declaring variables in the program. There are many data types in C Programming Language like signed int, unsigned int, signed char, unsigned char, float, double, etc. In addition to these there few more data types in Embedded C.

The following are the extra data types in Embedded C associated with the Keil's Cx51 Compiler

- bit
- sbit
- sfr
- sfr16

➢ Guide to IoT Protocols and Standards

IoT communication protocols are modes of communication that protect and ensure optimum security to the data being exchanged between connected devices.

The IoT devices are typically connected to the Internet via an IP (Internet Protocol) network. However, devices such as Bluetooth and RFID allow IoT devices to connect locally. In these cases, there's a difference in power, range, and memory used. On the other hand, non-IP networks demand comparatively less power and memory but have a range limitation. As far as the IoT communication protocols or technologies are concerned, a mix of both IP and non-IP networks can be considered depending on usage. IoT protocols and standards can be broadly classified into two separate categories.

➢ IoT Network Protocols

IoT network protocols are used to connect devices over the network. These are the set of communication protocols typically used over the Internet. Using IoT network protocols, end-to-end data communication within the scope of the network is allowed. Following are the various IoT Network protocols:

- HTTP (HyperText Transfer Protocol):

  HyperText Transfer Protocol is the best example of IoT network protocol. This protocol has formed the foundation of data communication over the web.

It is the most common protocol that is used for IoT devices when there is a lot of data to be published. However, the HTTP protocol is not preferred because of its cost, battery-life, energy saving, and more constraint.

- LoRaWan (Long Range Wide Area Network):

  Smart street lighting is the practical use case of LoRaWan IoT protocol. The street lights can be connected to a LoRa gateway using this protocol. The gateway, in turn, connects to the cloud application that controls the intensity of light bulbs automatically based on the ambient lighting, which helps in reducing the power consumption during day-times.

- Bluetooth:

  Bluetooth is one of the most widely used protocols for short-range communication. This protocol is mostly used in smart wearables, smartphones, and other mobile devices, where small fragments of data can be exchanged without high power and memory. Offering ease of usage, Bluetooth tops the list of IoT device connectivity protocols.

➢ IoT Data Protocols

IoT data protocols are used to connect low power IoT devices. These protocols provide point-to-point communication with the hardware at the user side without any Internet connection. Connectivity in IoT data protocols is through a wired or a cellular network. Some of the IoT data protocols are:

- Message Queue Telemetry Transport (MQTT):

  One of the most preferred protocols for IoT devices, MQTT collects data from various electronic devices and supports remote device monitoring. MQTT is mainly used in devices which are economical and requires less power and memory. For instance, fire detectors, car sensors, smart watches, and apps for text-based messaging.

- Constrained Application Protocol (CoAP):

  CoAP is an internet-utility protocol for restricted gadgets. Using this protocol, the client can send a request to the server and the server can send back the response to the client in HTTP. CoAP protocol is used mainly in automation, mobiles, and microcontrollers. The protocol sends a request to the application endpoints such as appliances at homes.

- Advanced Message Queuing Protocol (AMQP):

  AMQP is a software layer protocol for message-oriented middleware environment that

provides routing and queuing. It is used for reliable point-to-point connection and supports the seamless and secure exchange of data between the connected devices and the cloud. AMQP consists of three separate components namely Exchange, Message Queue, and Binding. All these three components ensure a secure and successful exchange and storage of messages.

- Machine-to-Machine (M2M) Communication Protocol:

  It is an open industry protocol built to provide remote application management of IoT devices. M2M communication protocols are cost-effective and use public networks. It creates an environment where two machines communicate and exchange data. This protocol supports the self-monitoring of machines and allows the systems to adapt according to the changing environment.

- Extensible Messaging and Presence Protocol (XMPP):

  The XMPP is uniquely designed. It uses a push mechanism to exchange messages in real-time. XMPP is flexible and can integrate with the changes seamlessly. Developed using open XML (Extensible Markup Language), XMPP works as a presence indicator showing the availability status of the servers or devices transmitting or receiving messages.Other than the instant messaging apps such as Google Talk and WhatsApp, XMPP is also used in online gaming, news websites, and Voice over Internet Protocol (VoIP).

➢ IoT Protocols Offers a Secured Environment for Exchange of Data

As per an article published by Forbes, approximately "32,000smart homes and businesses are at risk of leaking data." Therefore, it becomes important to explore the potentials of IoT protocols and standards, which creates a secure environment. Using these protocols, local gateways and other connected devices can communicate and exchange data with the cloud.

❖ ARDUINO SOFTWARE

➢ Introduction To The Arduino IDE

- The Arduino is a single-board microcontroller solution for many DIY projects, we will look at the Integrated Development Environment, or IDE, that is used to program it. Once the installer has downloaded, go ahead and install the IDE. Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.

- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.

➢ Download the IDE

First, you must download the IDE and install it. Start by visiting Arduino‘s software page. The IDE is available for most common operating systems, including Windows, Mac OS X, and Linux, so be sure to download the correct version for your OS. If you are using Windows 7 or older, do not download the Windows app version, as this requires Windows 8.1 or Windows 10.

➢ The Arduino IDE

The Arduino IDE is incredibly minimalistic, yet it provides a near-complete environment for most Arduino-based projects. The middle section of the IDE is a simple text editor that where you can enter the program code. The bottom section of the IDE is dedicated to an output window that is used to see the status of the compilation, how much memory has been u

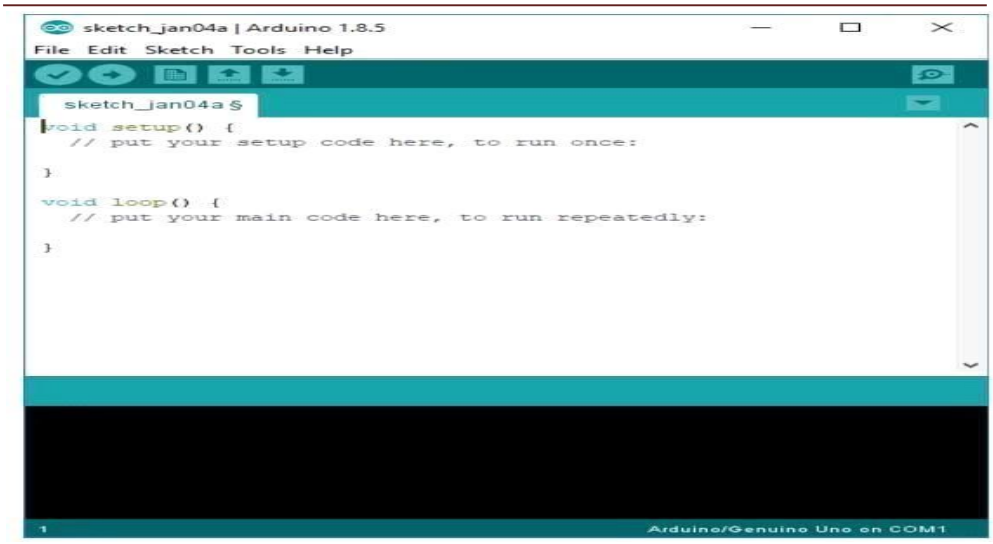

Fig 4.2: Arduino program dumping window

Projects made using the Arduino are called sketches, and such sketches are usually written in a cut-down version of C++ (a number of C++ features are not included). Because programming a microcontroller is somewhat different from programming a computer, there are a number of device-specific libraries (e.g., changing pin modes, output data on pins, reading analog values, and timers). This sometimes confuses users who think Arduino is programmed in an ―Arduino language.‖ However, the Arduino is, in fact, programmed in C++. It just uses unique libraries for the device.

➢ The 6 Buttons

While more advanced projects will take advantage of the built-in tools in the IDE, most projects will rely on the six buttons found below the menu bar.

Fig 4.3: The button bar

1. The check mark is used to verify your code. Click this once you have written your code.
2. The arrow uploads your code to the Arduino to run.
3. The dotted paper will create a new file.
4. The upward arrow is used to open an existing Arduino project.
5. The downward arrow is used to save the current file.
6. The far right button is a serial monitor, which is useful for sending data from the Arduino to the PC for debugging purposes.

➢ Arduino Hardware

Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available. The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed shields. Multiple and possibly stacked shields may be individually addressable via an I^2C serial bus. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator. Some designs, such as the Lily Pad, run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions. Most Arduino boards consist of an Atmel 8-bit AVR microcontroller (ATmega8, ATmega168, ATmega328, ATmega1280, ATmega2560) with varying amounts of flash memory, pins, and features. Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default bootloader of the Arduino UNO is the optiboot bootloader. Boards are loaded with program code via serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips

such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachable USB-to- serial adapter board or cable, Bluetooth or other methods. When used with traditional microcontroller tools, instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used.

The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits. Uno provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.1-inch (2.54 mm) headers. Several plug-in application shields are also commercially available. The Arduino Nano, and Arduino-compatible Bare Bones Board and Boarduino boards may provide male header pins on the underside of the board that can plug into solderless breadboards. There are several I/O digital and analog pins placed on the board which operates at 5V. These pins come with standard operating ratings ranging between 20mA to 40 mA. Internal pull up resistors are used in the board that limits the current exceeding from the given operating conditions. However, too much increase in current makes these resisters useless and damages the device.

❖ Botfather

Botfather is a universal automation framework developed by some European students. Botfather was initialy created to compete with other CS students in creating bots for casual games. Since then it has been extended to allow the automation of Android, Browser and Desktop apps.There are no limits what purpose Botfather could serve for you though. One could for example write automated tests for websites, apps and desktop applications using Botfather. Botfather can also be a great tool for students to learn coding and explore complex subjects such as machine learning.

Fig 4.4: Telegram Botfather

Botfather can be used to run so called scripts. Those contain instructions to control Android Devices and Emulators, Browsers or Desktop Applications. Scripts are written in JavaScript using functions defined by botfather.

You can share Scripts on our website. Read our Documentation to learn how to create your own Scripts. It's simple and a great way to learn to code. You don't need to write your own Scripts by the way, look for existing Scripts on our website instead.

Botfather can be used for instance to:

- Automate boring tasks in online Games, Android Apps and Desktop Games
- Learn to code and how to write efficient algorithms while having fun
- Test your websites, Android apps or desktop applications
- See who of your friends can write the best game playing bot
- Learn about AI by writting your first genetic algorithm

Scripts and botfather itself are crossplatform (Windows and Linux). As a Script developer you just have to write one Script that automatically runs on all botfather supported platforms. Scripts are naturaly open source, later we will introduce a feature that allows you to protect your scripts and deploy them as standalone applications.

How to Create a New Bot for Telegram

Open Telegram messenger, sign in to your account or create a new one.

Step 1. Enter @Botfather in the search tab and choose this bot.

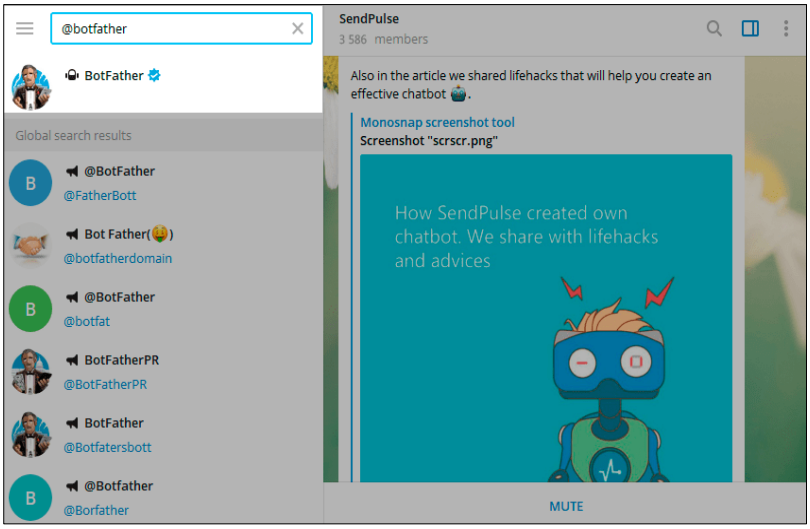

Fig.4.5(a): Telegram Botfather initialization steps

Note: Official Telegram bots have a blue checkmark beside their name, Click “Start” to activate BotFather bot.

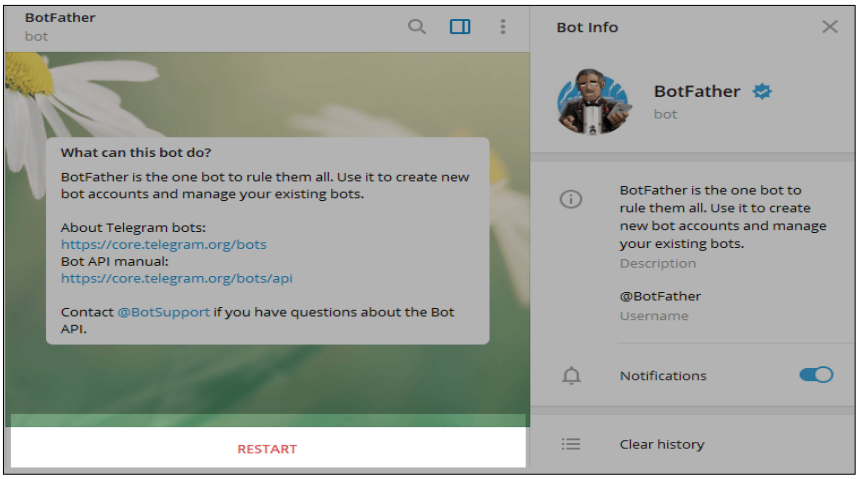

Fig.4.5(b): Telegram Botfather initialization steps

In response, you receive a list of commands to manage bots.

Step 2. Choose or type the /newbot command and send it.

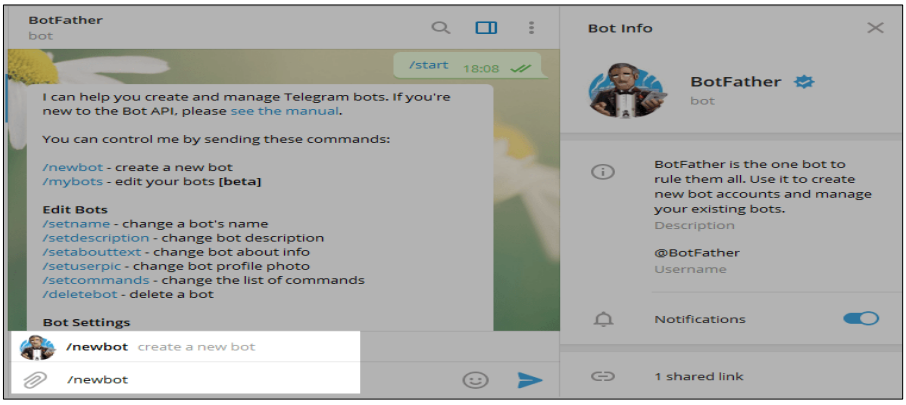

Fig.4.5(c): Telegram Botfather initialization steps

Step 3. Choose a name for your bot — your subscribers will see it in the conversation. And choose a username for your bot — the bot can be found by its username in searches. The username must be unique and end with the word “bot.”

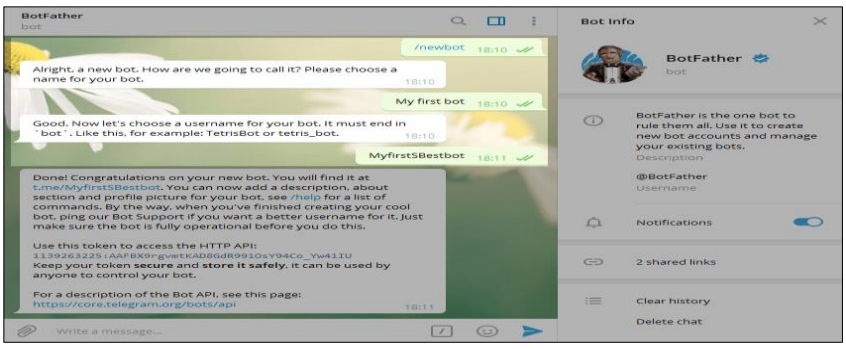

Fig.4.5(d): Telegram Botfather initialization steps

After you choose a suitable name for your bot — the bot is created. You will receive a message with a link to your bot t.me/<bot_username>, recommendations to set up a profile picture, description, and a list of commands to manage your new bot.

How to Find a Token for an Existing Bot

Step 1. Go to the @BotFather bot and send the command /token.

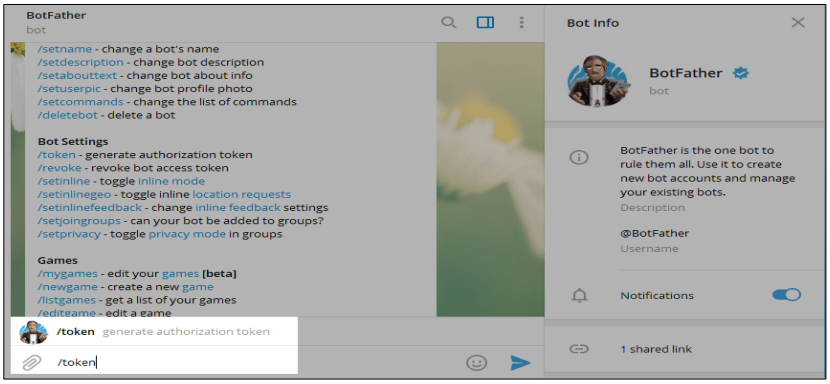

Fig.4.5(e): Telegram Botfather initialization steps

You will see buttons with any bots that you have created.

Step 2. Choose the one you need a token for so you can connect it.

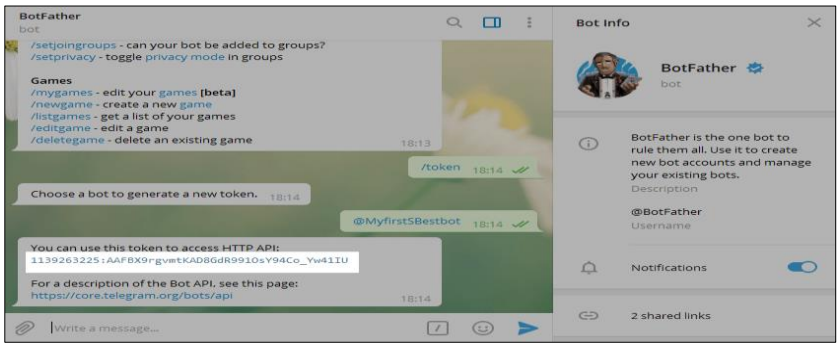

Fig.4.5(f): Telegram Botfather initialization steps

Copy the token value and pasted it in BotToken of nodemcu code.

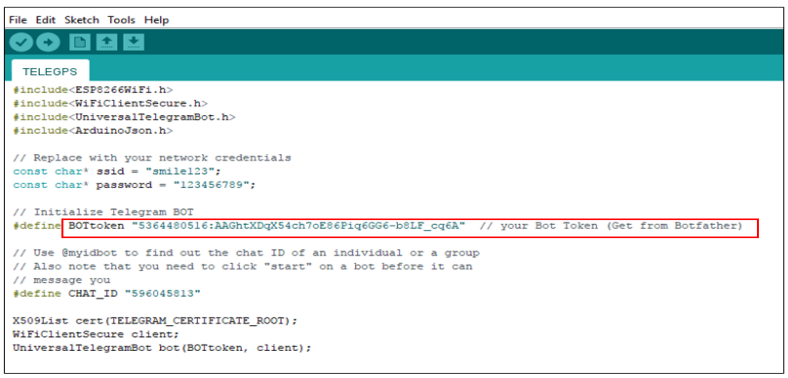

Fig.4.5(f): Telegram Botfather initialization steps

CONCLUSION AND FUTURE SCOPE

In this project, a new idea for automating parcel delivery collection has been proposed. This makes delivery of the parcel easier and safe. The intelligent packing box presented in this project is an advanced technological solution for the safeguard of the valuable assets. This device ensures the security and safety that is considered as one of the key criteria. Using above methodology to develop this device that provides the flexibility of monitoring from anywhere at any time. It can be used for multiple times to transport. The deficiency in security of courier delivery can be improved in our proposed system. This implementation can prove to be very effective in providing security for the goods and also ensures the safe delivery of goods to respective enterprises/costumers. With the help of GPS we can track the location of the package that has to be delivered from source to customer's destination. In vehicle, a server and smart phone are used for courier tracking. A vehicle geographic co-ordinate and vehicle unique ID obtained from black box will be recorded who's location can be tracked from anywhere at any time. This system brings innovation to the existing technology and improvising the safety of the packages.

Future scope can be focussed on customizing the packing Box which improves Security and Scalability. To develop an intelligent packaging system that uses the Internet of Things and Machine Learning for authenticating, securing, and tracking high-value packages. Design a kit that is able to detect any kind of intrusion in its space. The kit should be able to give information about all the necessary parameters of the environment in which the product is kept inside the package. It must alert everyone who is in charge of the delivery cycle of the product. The kit should be able to reset at the end of the delivery cycle and be reusable on the next instance.

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