

# **Implementation of IoT Based Onion Preservation System**

*A project submitted in partial fulfilment of the requirements for the award of the degree of*

**BACHELOR OF TECHNOLOGY**

**IN**

**ELECTRONICS AND COMMUNICATION ENGINEERING**

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES**

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*(Permanently Affiliated to AU, Approved by AICTE and Accredited by NBA & NAAC with 'A' Grade)*

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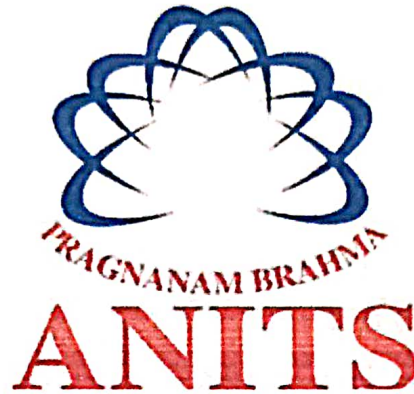
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### CERTIFICATE

This is to certify that the project report entitled “IMPLEMENTATION OF IoT BASED ONION PRESERVATION SYSTEM” submitted by S.Swarna Reddy (3109126512053), K.Lokesh (319126512028), B.Manjusri(320126512L01) and K.Kumar Swamy (319126512024) in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Electronics & Communication Engineering of Andhra University, Visakhapatnam is a record of bonafide work carried out under my guidance and supervision.

  
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## **ABSTRACT**

India is the second largest onion producer in the world. Onions are harvested in three different seasons, but ongoing climate change in India has made storage of onions during rabbi season a challenge. Therefore, it is important to control post-harvest losses, manage temperature and humidity, and anticipate spoilage for long-term storage.

A sensor-based onion preservation system that primarily consists of a temperature and humidity sensor, a gas sensor, and a microcontroller is chosen in order to address the issues associated with storing onions. The Internet of Things (IoT) enables the proposed system to become intelligent and effective.

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**CHAPTER-1**  
**INTRODUCTION**

The Allium family, which also contains garlic, shallots, and chives, includes the vegetable onion (*Allium Cepa*). Onions are a common ingredient in cuisine all around the world and have a unique flavour and scent. They come in numerous types, including sweet onions, scallions, red, white, and yellow onions. The vitamins C and B6 as well as folate and potassium are all present in onions in good amounts. They also contain antioxidants, which have been linked to a number of health advantages, including lowering the risk of certain malignancies and reducing inflammation. Onions can be preserved in a variety of ways, including freezing or refrigeration, or they can be kept for a number of weeks in a cold, dry, and well-ventilated place. Onion has a lengthy and significant past in India, both as an essential component of local cuisine and as a product for export. One of the world's biggest producers and consumers of onions is India. Indian literature and traditions date back to 5000 BCE, and onion growing has been practised there since then. Onion has been used to cure a number of conditions in traditional Indian medicine, including fever, coughing, and colds. Onions are a common ingredient in curries, biryanis, and samosas in Indian cuisine. To enhance the flavour and texture of the dish, they are frequently sautéed or caramelised. The Indian spice mixture garam masala, which is used to flavour many Indian cuisines, also has onions as a prominent component. Onions are raised in various regions of India, with Maharashtra, Karnataka, Madhya Pradesh, Gujarat, and Rajasthan being the principal producing states. Additionally, India exports onions to nations including Bangladesh, Sri Lanka, and the United Arab Emirates. However, due to a number of variables, including climatic conditions, levels of production, and export regulations, onion prices in India have been known to change significantly. Since high prices can significantly affect the cost of living for many households, onions have also been a politically sensitive topic in India.

## **1.1 NEED OF ONION PRESERVATION SYSTEM**

### **1.1.1 RABI SEASON CROP**

Onion rabi crops need preservation methods since they must be preserved for several months until the next harvest because they are harvested in the winter. As a perishable vegetable, onions can rot quickly and cause farmers to suffer large financial losses if they aren't properly preserved. Pests, insects, and wetness can harm onion rabi crops and cause them to produce less of the crops in terms of both quality and quantity. Therefore, to avoid these problems and increase the onions' shelf life, suitable preservation methods are required. For onion rabi crops, standard preservation methods include drying, curing, and storing in a cold, dry, and well-ventilated space. Before being kept, onions are often dried in the sun for a few days. This aids in decrease the onions' moisture content to stop bacterial and fungal growth. Another crucial stage in preserving onions is curing. Curing is storing the onions in a warm, dry environment for many weeks so that the skin may build a protective covering. By doing this, moisture loss and food degradation during storage are reduced.

### **1.1.2 POST HARVEST LOSSES:**

#### **SPROUTING**

Light, warmth, and dampness. When the top of the onion bulb starts to sprout a green stalk, this is known as sprouting. Sprouting can happen when the onion is being stored or even before it is picked. The chance of sprouting increases if the onion is not picked at the proper time or

is kept in warm, moist storage. However, compared to non-sprouted onions, sprouted onions may have a different texture and flavour. The green branch is typically removed before cooking since it can be bitter or difficult.



Fig 1.1: Sprouting of onions

It's crucial to keep onions in a cold, dry environment to avoid sprouting. Onions should be kept out of direct sunlight and wetness in a space with good ventilation. Additionally, they should be kept away from other fruits and vegetables because some of them generate an ethylene gas that might hasten the sprouting of onions. You can still use onions in your cooking if you see that they have already begun to sprout. However, you might need to cut off the green stalk and throw away any onion pieces that have already begun to rot or soften.

### **ROTTING:**

If onions are not stored properly or if they sustain injury during the growing or harvesting process, they may rot. When bacteria and fungi begin to degrade the onion's tissues, resulting in a mushy and soft texture, rotting takes place naturally.



Fig 1.2: Rotting

There are a number of things that might cause onions to rot, including.

In order to prevent the onion from becoming mushy and rotting, it should be stored in a cold, dry environment. For onions that have been harmed or had their outer covering removed, this is especially true.

**Damage:** During the growing or harvesting process, onions that have been sliced or damaged are more prone to rotting. To stop the rot from spreading, damaged onions should be utilised or stored separately from healthy onions.

**Temperature:** To prevent rotting, onions should be stored at a cold temperature, ideally between 0 and 5 °C (32 and 41 °F). The onion may become spoiled as a result of the growth of bacteria and fungi in warm environments.

**Airflow:** To ensure proper airflow, onions should be stored in a space that is well-ventilated. Airtight storage of onions can keep out moisture and encourage rotting.

## **PHYSICAL LOSS WEIGHT:**

The natural process of dryness during storage can cause onions to physically lose weight. When moisture is lost from the tissues of the onion, dehydration takes place, which results in the onion losing weight and shrinking. Temperature, humidity, airflow, and time are among elements that might cause onions to physically lose weight while in storage. In addition to preventing weight loss, proper handling and storage will keep the onion fresh and flavorful for longer. While there may be some physical weight loss during storage, it's crucial to remember that the onion's flavour and nutritional content are unaffected.

## **1.1.2 ONION PRESERVATION SYSTEMS:**

### **KANDHA CHAWL:**

A scientific onion hut with natural ventilation, the KANDHA CHAWL is designed to reduce storage-related losses. The majority of onion storage in India occurs in such uncontrolled buildings for temperature and relative humidity. Depending on the necessary capacity, the farmers build various varieties of kandha chawl.



Fig 1.3: Kandha Chawl

### **THATCHED ROOF BAMBOO STORAGE:**

Low-cost bamboo storage structures with thatched roofs are popular for "on-farm" storage of onions. These structures are typically built of bamboo framework and thatched roofs made of sugarcane leaves. A single row storage structure with a capacity of 5 to 10 tonnes can be constructed. The building's rafters are made of bamboo. For pillars, full solid bamboos are

used.



Fig 1.4: Thatched Roof Bamboo

The floor is constructed of half split bamboo, while the sidewalls are built of split bamboo (1/6). Five feet apart, entire bamboos are used to build the pillars. All of the pillars are supported by the iron angle. At the base of each iron angle pillar, bricks are placed to enable bottom ventilation. Although similar types of grass can also be utilized, sugarcane leaves are typically used to make roofs. To stop rainwater leaks, a gunny fabric interior lining is offered. It is best to build this kind of construction from north to south. Although it is inexpensive and simple to build, this form of storage structure results in up to 40–42% losses of onions over the course of four months. Due to the usage of organic materials like bamboo, the structure has a low degree of durability. Since it relies on natural airflow, the temperature and humidity cannot be adjusted.

### **BOTTOM AND SIDE VENTILATED STORAGE STRUCTURE:**

This has an expanded ceiling, a centrally ventilated corridor, and a provisionally ventilated floor composed of hardwood bantams. Galvanized iron channels were used to build the structure's framework. A gap of 2.5 cm was maintained between each wooden bantam when building the floor and side walls. Asbestos sheets are used in the roof's construction. To prevent



rain splashes, the roof was raised to a height of one metre. This kind of building has bottom and side ventilation openings.



Fig 1.5: Bottom and side ventilated storage structure

The capacity and cost of the current structures may change in order to meet the needs of farmers and traders across all economic brackets. Even though these naturally ventilated storage structures are widely used, significant losses still happen because the temperature, relative humidity, and airflow cannot be controlled—three factors that are crucial for the successful and loss-free storage of onions. The 50 MT double row modified bottom and side ventilated storage building will cost roughly Rs. 7 lakhs to build. The majority of Indian farmers use these types of naturally ventilated storage buildings to keep their onions, although these are unsuitable in areas with extremely high temperatures, high relative humidity, high temperatures and low relative humidity, or low temperatures and high relative humidity. This structure has room for improvement by effective ventilation, temperature management during the sweltering heat, relative humidity reduction using the right materials, and other techniques.

### **CONTROLLED ONION STORAGE STRUCTURE:**

Due to poor economics and a lack of cold chain facilities needed to maintain the quality in the high ambient temperature common in our nation, India rarely adopts cold storage systems for onions, despite the fact that they are employed in certain other nations. When the temperature is kept between 25°C and 30°C with a relative humidity range of 65-70%, onion storage under ventilation conditions is pretty excellent. In controlled onion storage buildings, onions are kept at 0 to 5 °C and 60 to 65% RH, resulting in significantly lower losses than in ventilated storage structures. Construction costs (about 20–25 lakhs per 20 tonnes) and operating costs (i.e., Rs. 0.6–0.65 per kilogramme per month) are quite high due to the high energy requirements to maintain the storage facility in the temperature range of 0–5°C. Condensation is another issue that takes a lot of time and energy to solve. The moment the bulbs are taken out of the cold storage, they begin to sprout.



Fig 1.6: Controlled onion storage structure

### 1.1.3 PERCENTAGE OF LOSSES

	Current status (averages losses)				
	PLW (%)	Rot (%)	Scale removal (%)	Sprouting (%)	Black mould (%)
<b>Low cost Thatched roof structure</b>	17.4	10.8	0.34	1.35	2.11
<b>Modified bottom ventilated double row storage structure</b>	19.4	17.94	0.32	37.69	11.6
<b>Modified Bottom ventilated storage structure chain linked side walls</b>	22.7	14.19	0.38	3.29	5.58

Table 1.1: Different types of losses (average) are reported in Rabi Onion that are stored in different storage structures



	<b>Type of loss</b>	<b>Reported losses</b>
1	Physiological weight loss (PLW)	20-25%
2	Rotting/ decay	10-12%
3	Sprouting	8-10%

Table 1.2 : Current Quantitative losses

## **1.2 Objectives**

- 1.To design a sensor based onion preservation system.
- 2.To increase the storage period of onions.

**CHAPTER-2**  
**INTERNET of THINGS**

## 2.1 Introduction of IOT:

The Internet of Things (IOT) refers to physical objects (or group of such objects). The Internet of Things has been viewed as a misnomer because devices do not need to be connected to the public Internet, they just need to be networked and individually addressable.



Fig 2.1: Internet of Things

The Internet of Things (IOT) is a network of physical objects or people, called "things", embedded with software, electronics, networks, and sensors that enable these objects to collect and share data. increase. The goal of IOT is to extend Internet connectivity from standard devices such as computers, mobile phones and tablets to relatively featureless devices such as toasters. The IOT will make virtually everything “smart,” enhancing aspects of our lives with the power of data collection, AI algorithms, and networks. IOT targets could also be people with diabetes monitor implants, animals with tracking devices, and so on. This beginner IOT tutorial of his will teach you all the basics of IOT. There are many concerns about the risks associated with the growth of IoT technologies and products, especially in the areas of privacy and security, and as a result industry and governments are taking steps to address these concerns, including It includes the development of international and regional standards. policy and regulatory framework;

The concept of the “Internet of Things” and the term itself first appeared in

Peter T. Lewis to Congressional Black Caucus Foundation's 15th Annual Legislative Session Weekend in Washington, D.C., published September 1985. such a device. "

The term "Internet of Things" was originally coined by Kevin Ashton at his Procter & Gamble (later his Auto-ID center at MIT) in 1999, although he coined the term "Internet of Things" I like At that point, he saw radio frequency identification (RFID) as essential to the Internet of Things. This allows the computer to manage all individual things. The main theme of the Internet of Things is the embedding of short-range mobile transceivers in various devices and everyday objects to enable new forms of communication between people and things and between things.

## **2.2 IoT Definitions:**

Who Defined IoT?

Kevin Ashton, executive director of his Auto-ID Labs at MIT, coined the term "Internet of Things" in 1999. He was the first to explain IoT in his Procter & Gamble presentation, but the definition of IoT has evolved over time.

Definition 1:

The term IoT or Internet of Things refers to a collective network of connected devices and technologies that enable communication between devices and the cloud and between themselves.

Definition 2:

IoT (Internet of Things) is an advanced automation and analytics system that uses networks, sensors, big data and artificial intelligence technologies to provide a complete system for products and services. These systems enable greater visibility, control and performance when applied to any industry or system.

Definition 3:

The Internet of Things (IoT) describes a network of physical objects ("things") that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the Internet. increase.

## **2.3 Features of IoT:**

Key capabilities of IoT include artificial intelligence, connectivity, sensors, active engagement, and the use of small devices. Below is a brief overview of these features.

AI – IoT makes virtually everything “smart”. In short, powering every aspect of life with the power of data collection, artificial intelligence algorithms, and networks. This can be as simple as upgrading your refrigerator and cupboards and ordering them from your favorite grocery store when you're low on milk or your favorite cereal.

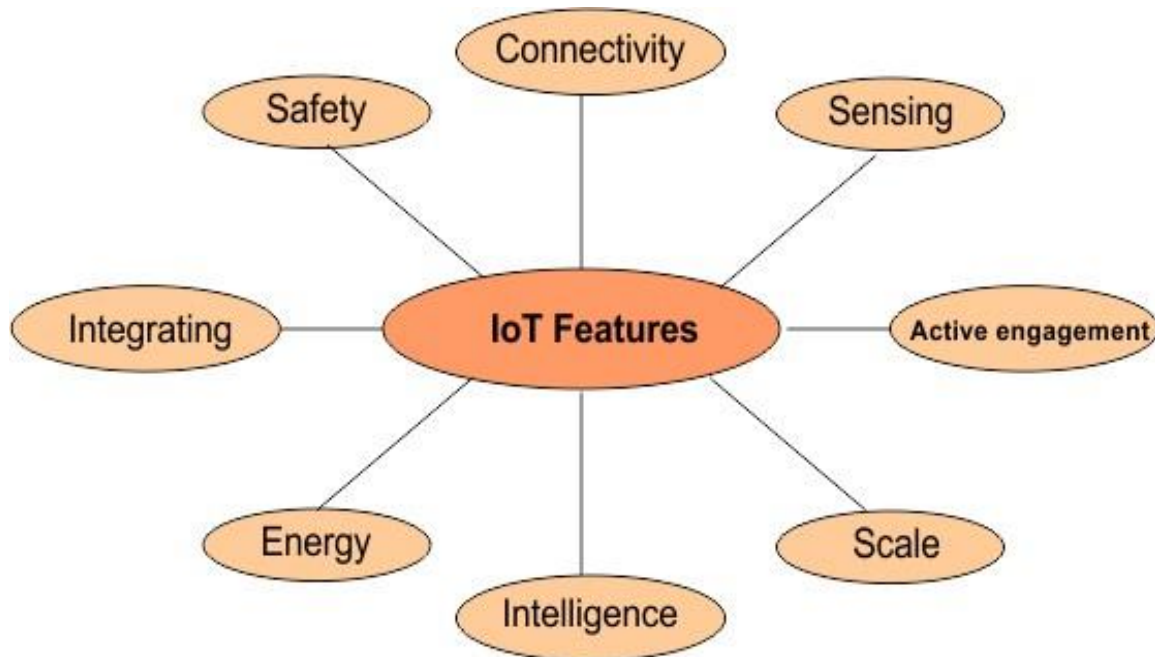


Fig 2.2: Features of IoT

**Connectivity** – New technologies enabling networks, especially IoT networks, mean that networks are no longer tied to just large providers. Networks can exist on a much smaller and cheaper scale and still be practical. IoT creates these tiny networks between system devices.

**Sensors** – IoT is meaningless without sensors. They serve as defining tools to transform the IoT from a typical passive network of devices to an active system that can be integrated into the real world.

**Active Engagement** – Much of our interaction with connected technology today is driven by passive engagement. IoT introduces a new paradigm for active content, products or services.

**Smaller Devices** – As expected, devices are getting smaller, cheaper, and more powerful over time. IoT offers its precision, scalability, and versatility using dedicated small devices.

**Power** – When designing an IoT ecosystem (sensors, devices, servers, etc.) there is a fundamental need to power all components of the IoT ecosystem. So design your ecosystem to use the least amount of energy. In most cases, smaller devices consume less power than larger devices.

**Security** - Undoubtedly, the security of IoT systems is not sufficient compared to traditional networks. The reason is that in the IoT ecosystem many components are connected to communicate with each other. A breach of his one component of the IoT ecosystem could lead to failure of the entire pipeline. Therefore, you should ensure proper security when designing your IoT ecosystem.

**Intelligence** – Artificial Intelligence is playing an increasingly important role in IoT applications. Major IoT device vendors are now adding embedded AI capabilities. In the future, there may be rare cases where AI is not implemented in IoT. AI minimize the human interaction where are mostly designs are made by machine such as machine learning-based analytics.

## Examples of Real World where AI Embedded IoT Devices

- Self- Driving Cars.
- Smart Homes.
- Body Sensors
- Robots for Manufacturing Industries

**Data processing** – When data is sent to the cloud (we explain what we mean by cloud in the data processing section), the software does some processing. This can be very simple like this: B. Make sure the temperature reading is within the acceptable range. Or it can be very complicated like this: B. Use computer vision in video to identify objects (e.g. trespassers on premises). But what if the temperature is too hot or there are thieves on the premises?

**User Interface** – A user may have an interface that allows them to check-in to the system ahead of time. For example, a user can check out video feeds of various properties via the Phone app or her web browser. However, it is not always a one-way street. Depending on the IoT application, users can also take actions and affect the system. For example, users can remotely adjust the temperature of their refrigerator via an app on their smartphone.

## 2.4 Need of IoT:

IoT hopes to connect all potential objects to interact with each other on the Internet, bringing a safe and comfortable life for humans. The Internet of Things (IoT) is making our world as connected as possible. Today, Internet infrastructure is almost ubiquitous and available at all times. Embedded computing devices can be exposed to the influence of the Internet. Common examples of embedded computing devices include MP3 players, MRIs, traffic lights, microwave ovens, washing machines and dishwashers, GPS, and even cardiac monitoring implants and biochips.

IOT seeks to establish advanced connectivity (using the Internet) between these devices, systems, or services in order to automate everything over time. Imagine everything being connected and collected, and all information about standards and other protocol domains and applications being passed back and forth. In short, IOT hopes to connect all potential objects to interact on the Internet and bring humans a safe and comfortable life. A recent study predicts that by 2020 there will be over 20 billion devices using IoT. IOT does this for on-device control and the low cost of radio. However, these huge fields present challenges such as: B. Lack of IP addresses, development of compatible and useful protocols and environments.

## Why IoT?

### **Environmental Monitoring**

A simple example is:

If you're surfing the internet and suddenly open Gmail, you've probably already noticed something interesting popping up near your favorites. Or on Facebook, if you like a page, you'll see similar content pages in the right section. These are pervasive and visible, but if we could monitor all embedded computer systems to improve our lives, it would be a picture.

### **Infrastructure Management**

Infrastructure management helps monitor and track problems with urban or rural infrastructure such as bridges, railways, etc., to reduce and mitigate the risk of hazards, and to test and alert as soon as possible if there are severe disturbances. ,to correct. that.

### **Industrial Applications**

Industrial applications explore and optimize product quality in real time for better marketing. B. Who is most interested in which product, how to find marketing for that product, and what small changes to make.

### **Energy Management**

Energy management is classified as a system that is connected to the Internet and connected to some sensors to reduce power consumption. This includes cloud-based, remote control of ovens, lamps, etc.

### **Medical and Healthcare Systems**

Healthcare systems help improve patient conditions by monitoring and controlling heart rate, blood pressure, and even diet. A smart tablet that shows you which slopes will help your patient recover.

### **Large Scale Deployments**

There are cities that have almost full smart cities with varying IoT usage and wireless coverage.

## **Why IoT is so popular?**

We live in a world in dire need of a good revenue management system, which is becoming one of the hottest topics these days. The Internet of Things aims to develop Internet connectivity for everyday devices that can send and receive data efficiently. These IoT devices can also come in the form of printers, thermometers, alarm clocks, phones, and other everyday devices. Internet of Things devices connect to the Internet with on and off capabilities. This allows us to serve people better. It should also be noted that objects attached to sensors can exchange data at scale, thus enabling efficient decision-making using the Internet, literally called the Internet of Things. For example, if your device is equipped with the Internet of Things, it can notify you about upcoming weather conditions and allow you to use your space accordingly. An IoT-based refrigerator is another example that monitors a user's health and suggests the best meals in it. The Internet of Things can be defined as the evolution of Internet-connected mobile and installed applications. Because IoT-based devices successfully gather information using data analytics, these devices can also share information in the cloud. In addition, Internet of Things devices are also analyzing it in a secure context, and our business is also growing strongly. Therefore, there are many industries that adopt IoT solution technology and improve their current systems considering future demand. Part one. With Internet of Things devices, development

and maintenance costs are low, and the medical results have been astonishing. IoT devices have been in the news dramatically lately, and they are business-critical for multiple reasons. IoT devices also make the shopping experience exceptional and, most importantly, enjoyable for getting the best offers. As always, conveniently managing internal processes is no small task at a time of increasing customer burden.

## **2.5 Advantages of IoT:**

IoT platforms are used to bring awareness of modern devices to a new level in the world. There are a myriad of implementations of the Internet of Things these days, and these are growing significantly by the day. This section focuses on the needs of the Internet of Things.

### **1. Disaster management:**

With smart devices enabled for the Internet of Things, we always have a granular view of wildfires and other disasters. Smart devices can handle this situation efficiently. Containment teams can also be notified in a timely manner before they start warning, so they can respond quickly and efficiently. Smart disaster management also addresses the effects of avalanches, landslides and earthquakes.

### **2. Urban management:**

Increased traffic is one of the greatest concerns among developing countries, and addressing these issues is one that governments cannot manage effectively. Therefore, IoT devices can play an important role in automating traffic management, where traffic flows can be detected and controlled appropriately. An intelligent management system allows the pairing application to guide people to parking spaces efficiently, eliminating the possibility of wasting time and energy. It also reduces waste significantly beyond current system trends.

### **3. Smart healthcare:**

Wearable devices used in the medical field have the ability to detect various health problems simultaneously and notify you before they occur. Upon detecting certain diseases, these devices will immediately notify family members to take control of them. These devices also provide details.

### **4. Interactive performance:**

Effective data analysis allows you to interact effectively with others in real time. It also allows businesses to track location timings and search types to determine actual customer needs. Here we can say that dynamic interactions are created by IoT devices demonstrating multiple sizes simultaneously.

### **5. Superior functionalities:**

After using IoT devices, the advanced features will provide users with a pleasant experience almost equivalent to mobile payments. The superior capabilities of Internet of Things devices help them perform efficient operations at various stages.



## **6. Convenient usage:**

Appropriate control is the most important reason for the recent spread of smart devices equipped with IoT functions. Many of his IoT devices have been implemented in homes, helping to make them smarter. For example, smart refrigerators and Amazon dashboard buttons are examples of IoT implementations that can log items and notify you sooner. In this way, the Internet of Things is helping people dramatically ease their lives and save time.

## **7. Advanced Data Collection:**

Large-scale potential for data collecting and company expansion are presented by the Internet of Things. Business leaders may make decisions at both the macro and granular levels thanks to the advantages of her IoT data collecting implemented across numerous devices. His web-enabled tag for retail merchandise is a straightforward illustration. On daily or weekly purchasing decisions and trends, it can offer real-time statistics. This straightforward procedure might enhance inventory control and offer crucial information into consumer behaviour and buying habits. Do a cross-referencing analysis between these numbers and other data. B. Each customer's unique zip code (membership card number) can produce a sizable amount of statistically relevant data.

## **8. Improved Quality Of Life:**

The Internet of Things has many advantages for business, but focusing solely on this benefit would be myopic. There are numerous ways big data and the Internet of Things might enhance the standard of living for regular people. Intelligent devices, for instance, might save a lot of lives in medicine. A smart medication that communicates with his IoT system through the gastrointestinal tract or a blood pressure monitor that transmits real-time data could save his life. IOT networks can enhance quality of life for everyone, not just people. Smart gadgets, including internet-connected traffic sensors and traffic lights that reduce congestion in densely populated regions, have the potential to benefit entire communities. Smart devices in cars can connect to toll booths, traffic safety monitors, and traffic lights in addition to traffic lights, providing drivers with real-time feedback on the state of the roads as they travel to their respective destinations.

**CHAPTER-3**  
**HARDWARE DESCRIPTION**

### 3.1 Hardware Components:

There are six components are used in our project as shown below:

- 1.DHT11 Sensor
2. MQ-4 Sensor
3. NodeMCU ESP8266
4. Regulator
5. Relay
6. AC Fan

#### 3.1.1 DHT11 Sensor:

The DHT11 sensor is an affordable device that can measure both temperature and humidity digitally. It can be easily connected to microcontrollers like Arduino or Raspberry Pi to obtain real-time readings. The sensor comes in two forms: as a stand-alone sensor or a module, with the latter having an added pull-up resistor and power on LED. This sensor uses a thermistor and capacitive humidity sensor to measure relative humidity in the surrounding air. It has three pins for connectivity.

VCC, data output, GND. The voltage range of the VCC pin is 3.5V to 5.5V and a 5V supply is fine. Data from the Data Out pin is serial digital data.

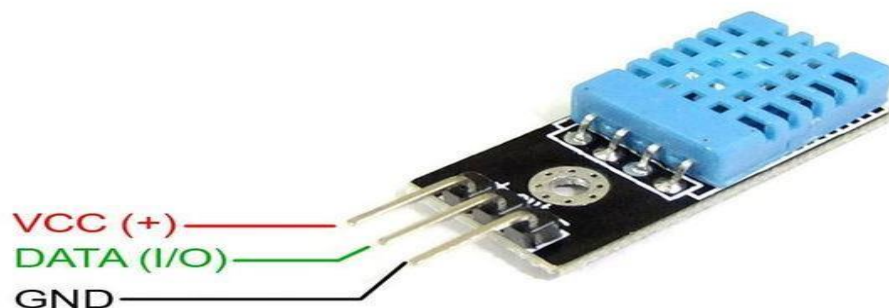


Fig 3.1: DHT11 Sensor

#### Specifications of DHT11 Sensor:

- Power Supply: 3.3~5.5V DC
- Output: 4 pin single row
- Measurement Range: Humidity 20-90%RH, Temperature 0~50°C

- Accuracy: Humidity  $\pm 5\%RH$ , Temperature  $\pm 2^{\circ}C$
- Resolution: Humidity  $1\%RH$ , Temperature  $1^{\circ}C$
- Interchangeability: Fully Interchangeable
- Long-Term Stability:  $<\pm 1\%RH/year$

### **Pin Description Of DHT11 Sensor:**

- Pin 1: Power +Ve (3.3VDC to 5.5VDC Max wrt. GND)
- Pin 2: Serial Data Output
- Pin 3: Power Ground or Power –Ve

### **Working Principle of DHT11 Sensor:**

The DHT11 sensor is comprised of two main components: a capacitive humidity sensing element and a thermistor for measuring temperature. The humidity sensing element consists of moisture-sensitive capacitors with a moisture-retaining substrate as the dielectric material between them. The capacitance value changes as the humidity level changes, and the IC (integrated circuit) of the sensor measures these resistance values, processes them, and converts them into digital form. To measure temperature, the DHT11 sensor employs a thermistor with a negative temperature coefficient, meaning that the resistance decreases as the temperature increases. These thermistors are typically made from semiconducting ceramics or polymers to obtain high resistance values with small temperature changes. The DHT11 has a temperature range of 0 to 50 degrees Celsius with an accuracy of 2 degrees, and a humidity range of 20-80% with an accuracy of 5°. The sampling rate of the DHT11 sensor is 1Hz, which means it takes readings every second.

This sensor is small in size and requires an operating voltage of 3-5 volts, with a maximum current of 2.5 mA used during measurement.

### **Applications Of DHT11 Sensor:**

The DHT11 sensor finds application in a variety of settings due to its versatility. It is commonly used in heating, ventilation, and air conditioning (HVAC) systems to measure temperature and humidity levels. Weather stations also utilize this sensor to predict and forecast weather patterns. Humidity sensors, in general, are used in households to prevent excess humidity, and the DHT11 sensor is no exception.

Moreover, this sensor is employed in different environments such as offices, cars, museums, greenhouses, and industries, to monitor humidity levels as a safety measure. The use of the DHT11 sensor in these environments is particularly important because high humidity levels can lead to adverse effects, such as mold growth, equipment damage, and discomfort to individuals in the vicinity. Therefore, this sensor's applications are wide-ranging and play a crucial role in maintaining a safe and comfortable environment.

### 3.1.2 MQ-4 Sensor:

The MQ4 gas sensor is a metal-oxide-semiconductor (MOS) type gas sensor, mainly used in homes and industries to detect the gas concentration of methane (CNG) in the air. The sensor contains a sensing element that is primarily an alumina-based ceramic coated with tin dioxide and covered with a stainless steel mesh.

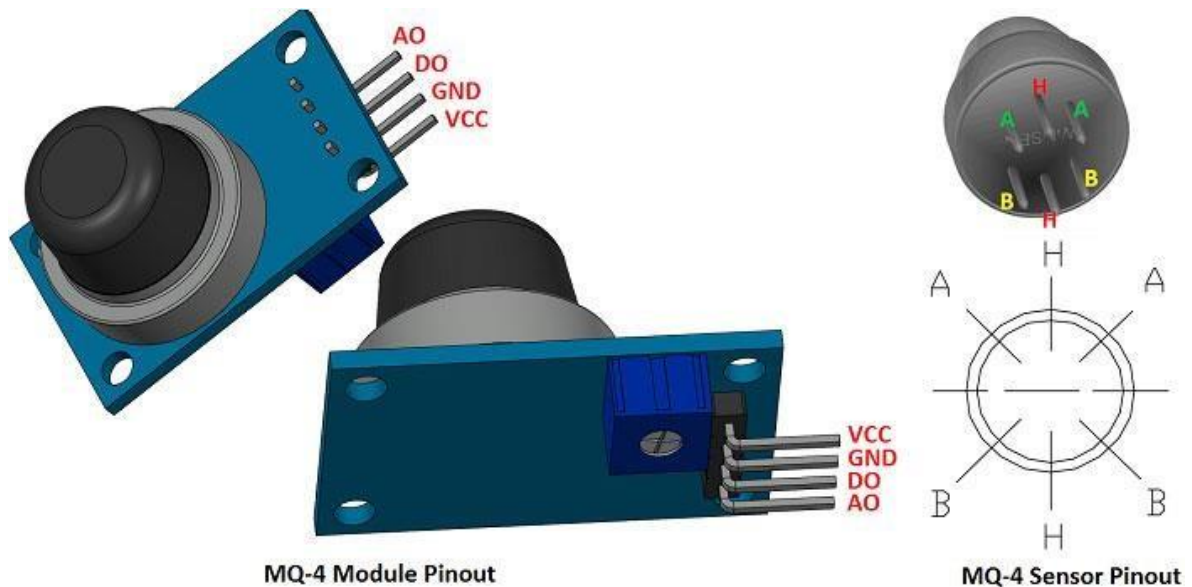


Fig 3.2: MQ-4 Sensor

### Pin Description Of MQ-4 Sensor:

Pin Name	Description
VCC	Typically, the module is powered through a pin that operates at a voltage of +5V.
GND	Utilised to link the module to the system ground.
Digital Out (DO)	It is also possible to obtain digital output from the sensor's pin by setting a threshold value using the potentiometer.
Analog Out (AO)	By adjusting the potentiometer to establish a threshold value, the sensor's pin can also produce digital output.

Table No 3.1: pin Description Of MQ-4 Sensor

## **Specifications Of MQ-4 Sensor:**

- The sensor type is semiconductor-based.
- It requires a power supply of VCC -  $5V \pm 0.1$ .
- The DO output produces TTL digital signals of 0 and 1 (0.1 and 5V).
- The AO output generates a voltage range of 0.1-0.3 V relative to contamination, with a maximum concentration voltage of around 4V.
- The sensor is designed to detect natural gas/methane.
- The detection concentration range is 200-10000ppm for natural gas/methane.
- The sensor has an interface that includes 1 TTL-compatible input (HSW) and 1 TTL-compatible output (ALR).
- The heater consumption of the sensor is less than 750mw.
- The operating temperature range is between 14 to 122 °F (-10 to 50°C).
- The RH is related to humidity and is less than 750mw.

## **How To Use MQ-4 Sensor Module:**

The MQ4 Gas Sensor Module has simple connections that can be established in the following manner:

- VCC to 5V
- GND to GND
- AO to Analog
- DO to Digital

Detecting gases using this sensor is relatively easy. You can use either digital or analog pins to do so. Firstly, connect the module to a 5V power supply, and the power LED on the module will illuminate. If no gas is detected, the output LED will remain off, which means the digital output pin is at 0V. However, it is essential to note that these sensors require warm-up time before they can be used effectively. Once the sensor has been warmed up, insert it into the gas you want to

detect. If the gas is present, the output LED and digital pin will go high, indicating a 5V output. If the gas is not present, the digital pin will remain low, indicating a 0V output. This feature ensures that the digital pin goes high each time the sensor is inserted into that particular concentration of gas and stays low otherwise. Additionally, gases can also be detected using analog pins. The sensor's analog output can be read with a microcontroller, providing an analog value that is directly proportional to the concentration of the gas detected by the sensor.

### Applications Of MQ-4 Sensor:

- The MQ4 Gas Sensor Module is widely used in various gas detection applications in both homes and industries. It is commonly used in gas leak detection equipment and is well-suited for detecting CH<sub>4</sub> and CNG gases.
- In industrial settings, the MQ4 sensor is used in combustible gas detectors to detect gases such as methane and natural gas. These detectors are vital for maintaining the safety of workers and preventing potential accidents.
- The MQ4 Gas Sensor Module is also utilized in portable gas detectors, which are highly portable and convenient for monitoring gas levels on the go. These detectors are essential for ensuring the safety of individuals working in potentially hazardous environments where gas leaks can occur.
- Overall, the MQ4 Gas Sensor Module's versatility and reliability make it an essential component in gas detection systems used in various industries, homes, and portable devices.

### 3.1.3 NodeMCU ESP8266:



Fig 3.3: NodeMCU ESP8266

NodeMCU (Node MicroController Unit) is an open source software and hardware development environment built around a low-cost system-on-chip (SoC) called ESP8266. Designed and manufactured by Espressif Systems, the ESP8266 contains the essential elements of a computer.

The ESP8266 is an ideal choice for Internet of Things (IoT) projects due to its powerful CPU, RAM, network capabilities, and the latest operating system and SDK. However, it can be challenging to use and access as a chip. Even simple tasks like turning on power or sending keystrokes require soldering wires to specific pins with the appropriate analog voltage.

Additionally, programming the chip with low-level machine instructions that the hardware can interpret is required, making it challenging for hobbyists, hackers, or students who want to use it for their IoT projects. While this level of integration is not an issue for mass electronics using the ESP8266 as an embedded controller chip, it can be a significant burden for individual projects.

### NodeMCU Specifications:

The ESP8266 module has the following specifications:

- It is powered by a Tensilica 32-bit RISC CPU called Xtensa LX106.
- It operates at 3.3V, and can accept input voltages between 7-12V.
- It has 16 digital input/output (I/O) pins and one analog input pin for reading analog signals.
- It has one UART (Universal Asynchronous Receiver-Transmitter) for serial communication, one SPI (Serial Peripheral Interface) for communication with other devices, and one I2C (Inter-Integrated Circuit) for communicating with sensors and other microcontrollers.
- It has 4 MB of Flash memory for program storage, and 64 KB of SRAM for data storage.
- It runs at a clock speed of 80 MHz.
- It comes with a USB-TTL (Transistor-Transistor Logic) converter based on CP2102, which enables easy plug-and-play connectivity with a computer.
- It has a PCB antenna for wireless communication, and its small size makes it suitable for use in compact IoT projects.

### Pin Description Of NodeMCU Esp8266:

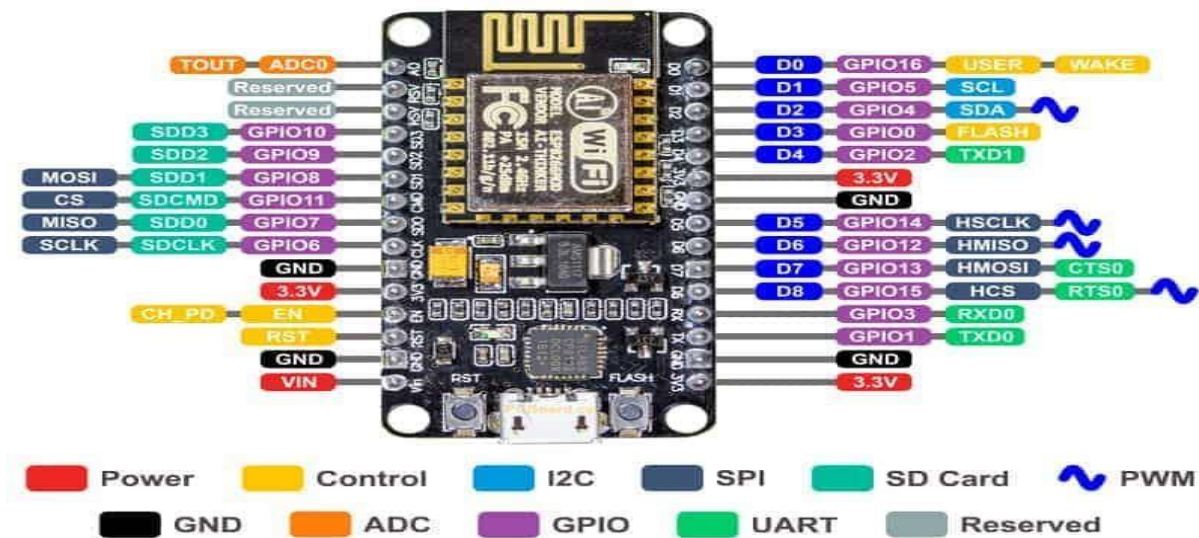


Fig 3.4: Pin Diagram Of NodeMCU Esp8266

Power Pins There are four power pins. A VIN pin and three 3.3V pins.



VIN can be used to directly power the NodeMCU/ESP8266 and its peripherals. The power supplied to VIN is regulated by the NodeMCU module's onboard regulator. It is also possible to supply a regulated 5V to the VIN pin.

The 3.3V pin is the output of the onboard voltage regulator and can be used to power external components. size:

To connect I2C sensors and peripherals, the NodeMCU/ESP8266 has a I2C pin that supports both I2C masters and I2C slaves with a programmable clock frequency of up to 100 kHz. It's essential to ensure that the I2C clock frequency is higher than the slowest clock frequency of the slave device. The NodeMCU/ESP8266 has 17 GPIO pins that can be programmatically configured to perform various functions such as I2C, I2S, UART, PWM, IR remote control, LED lights, and buttons. Each GPIO can be configured for internal pullup or pulldown or set for high impedance. When configured as an input, it can generate a CPU interrupt by setting it to edge- or level-triggered. The NodeMCU has a 10-bit precision SAR ADC that can test the supply voltage on pin VDD3P3 and the input voltage on pin TOUT, but these functions cannot be implemented simultaneously. The NodeMCU/ESP8266 has two UART interfaces (UART0 and UART1) that support asynchronous communication (RS232 and RS485) at speeds up to 4.5 Mbit/s. The UART0 (TXD0, RXD0, RST0, CTS0 pins) can be used for communication, while the UART1 (TXD1 pin) only has a data transmission signal and is usually used for log output. Additionally, the NodeMCU/ESP8266 has two SPIs (SPI and HSPI) that support both master and slave modes. These SPIs also support the following general-purpose SPI features:

- 4 timing modes of the SPI format transfer
- Up to 80 MHz and the divided clocks of 80 MHz
- Up to 64-Byte FIFO

The SDIO pins are used to directly connect to SD cards with support for 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0.

There are 4 PWM pins that can be programmed to drive digital motors and LEDs with adjustable frequency ranging from 100 Hz to 1 kHz.

The board also has control pins including the Chip Enable pin (EN), Reset pin (RST), and WAKE pin for controlling the NodeMCU/ESP8266.

### **Applications Of NodeMCU ESP8266:**

- Prototyping of IoT devices
- Low power battery operated applications

- Network projects
- Projects requiring multiple I/O interfaces with Wi-Fi and Bluetooth functionalities

### 3.1.4 Regulator (LM7085):

A voltage regulator with an output of +5 volts is the LM7805. This is a 3 pin IC, like the majority of other regulators on the market. a ground pin to provide a ground for the regulator, an output pin to supply positive 5 volts, and an input pin to accept an input DC voltage.

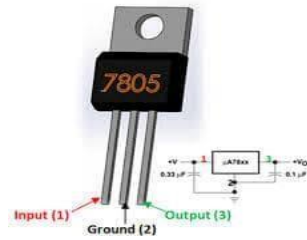


Fig 3.5: voltage Regulator

#### Pin Description of Voltage Regulator:

Pin No.	Pin	Function	Description
1	INPUT	Input voltage (7V-35V)	The IC provides an unregulated positive voltage through this pin during the regulation process.
2	GROUND	Ground (0V)	This pin serves as the ground and provides the neutral connection for both the input and output simultaneously.
3	OUTPUT	Regulated output; 5V (4.8V-5.2V)	This pin is used to obtain the regulated output of 5V from the IC regulator.

## Features Of Voltage Regulator:

- The device has a built-in protection against thermal overload to prevent damage from excessive heat.
- It is capable of dissipating high power, meaning it can handle a significant amount of energy without damage.
- The device also has internal protection against short-circuit currents, preventing damage in the event of a short circuit.
- The output transistor has safe-area compensation to ensure reliable operation even under challenging conditions.
- It is a 3-terminal regulator, meaning it has input, output, and ground terminals.
- The maximum output current it can supply is up to 1.5A.
- It also has internal protection against short-circuit currents to prevent damage.

## Specifications Of Voltage Regulator:

This device has a minimum input voltage of 7V and a maximum input voltage of 35V. The current rating of the device is  $I_c = 1A$ . The maximum output voltage is  $V_{Max}=5.2V$  and the minimum output voltage is  $V_{Min}=4.8V$ .

## Brief Description of 7805 Voltage Regulator IC:

Voltage regulators are commonly used components in electronic circuits to maintain a constant output voltage for varying input voltages. The 7805 IC is a popular regulator IC that is frequently used in many projects. The name "7805" has two meanings: "78" indicates that it is a positive voltage regulator, and "05" denotes that the output voltage is 5V. Thus, the 7805 IC provides a +5V output voltage, with a maximum output current of 1.5A. However, due to significant heat loss, it is advisable to use a heatsink for more power-hungry projects. For instance, if the input voltage is 12V and it consumes 1A, the power dissipated as heat would be  $(12-5) * 1 = 7W$ .

## 7805 as +5V Voltage Regulator:

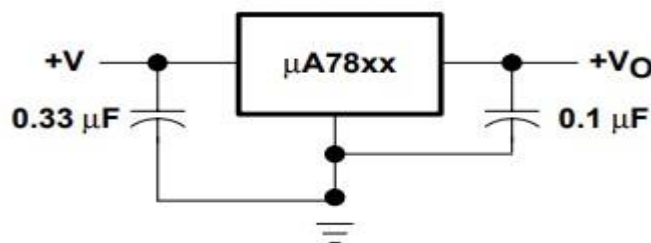


Fig 3.6: +5V Voltage Regulator

This circuit diagram shows a common application of the 7805 IC, which requires only two capacitors, one with a capacitance of 33 $\mu$ F and the other with a capacitance of 0.1 $\mu$ F. The 0.33 $\mu$ F input capacitor is a ceramic capacitor that helps to address the input inductance issue, while the 0.1 $\mu$ F output capacitor is also a ceramic capacitor that contributes to circuit stability. These capacitors must be placed near the terminals for optimal performance. Since ceramic capacitors are faster than electrolytic capacitors, it is recommended to use ceramic capacitors in this application.

### 7805 as adjustable output regulator:

The 7805 IC is not limited to providing a fixed output voltage of 5V. It can also be configured to act as an adjustable output voltage regulator. This means that you can adjust the output voltage to your desired value using the circuit provided below.

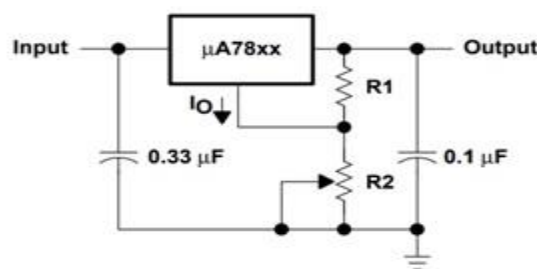


Fig 3.7: Adjustable Regulator

In this circuit, the input voltage range is from 9V to 25V, and the output voltage can be adjusted by selecting appropriate resistor values for R1 and R2. You can use the following formula to calculate the output voltage: Where,  $V_{xx}=5$ ,  $I_Q = 5 \cdot 10^{-3}$

$$V_O = V_{xx} + \left( \frac{V_{xx}}{R1} + I_Q \right) R2$$

### 7805 applications:

- This device provides a steady 5V output, which is commonly used to power microcontrollers and sensors in a variety of projects.
- Adjustable Output Regulator
- Current Limiter for certain applications
- Regulated Dual Supply
- Output Polarity-Reversal-Protection Circuit

**3.1.5 Relay Module:** A 5V relay is a switch that is frequently used in automatic control circuits to regulate high current with a low current signal. The relay is triggered by a signal that has an input voltage range of 0 to 5V.



Fig 3.8: Relay Module

### Features Of Relay Module:

The 5V relay possesses several characteristics, which include:

- A standard voltage of 5V DC
- A standard current of 70mA
- An AC load current of up to 10A at 250VAC or 125VAC
- A DC load current of up to 10A at 30VDC or 28VDC.
- The relay has a plastic design and consists of five pins. The operating time of the relay is 10 milliseconds, while the release time is 5 milliseconds. Additionally, the maximum number of switching operations per minute is 300.

### 5V Relay Module Pin Configuration:

The pin configuration of the 5V relay is shown below. This relay includes 5-pins where each pin and its functionality are shown below.

- **Pin 1**, also known as End 1, is utilized to trigger the relay, with one end connected to 5 volts and the other to ground.
- **Pin 2**, on the other hand, is used to activate the relay.
- **Pin 3**, or Common (COM), is connected to the primary terminal of the load to activate it.
- **Pin 4**, or Normally Closed (NC), is the secondary terminal of the load connected to either the NC or NO pins. If it is attached to the load, it will be ON before the switch.
- **Pin 5**, or Normally Open (NO), is the second terminal of the load. If it is connected to the NO pin, the load will be turned off before the switch.

### Applications Of Relay Module:

- Used in overvoltage/undervoltage protection systems

- Grid switching
- Speed control of motor by starting delta converter
- Automatic electrical equipment
- Electrical isolation between high and low voltage sources;
- Lighting
- AC load switching with less DC voltage
- Supply isolated power
- Home automation projects
- High current switching

### 3.16 AC Fan:

An AC fan is a fan that runs on sinusoidal alternating current. These fans operate with the same amount of negative current as positive current. Common AC voltage frequencies for AC fans are up to 100 volts, 120 volts, 220 volts, 230 volts, and 240 volts. The AC fan motor spins at 50 RPM. This means that the blade rotates 50 times per second of rotation. AC fans are designed for a specific rotational frequency of 50 Hz, but you can adjust the speed and airflow if you have critical requirements.



Fig 3.9: AC Fan

AC fans can be designed to operate at different speeds. This is usually achieved using a control circuit or variable voltage supply. Some AC fans also have features such as thermal protection to prevent the motor from overheating and auto shutoff to turn off the fan once the desired temperature is reached.

### 3.2 Software Tools:

There are two software tools are used in our project as shown below:

1. Arduino IDE

2.ThingSpeak

3.IFTTT

### 3.2.1 Arduino IDE:

Arduino is a versatile hardware and software platform that is commonly used for electronic projects. It is an open source platform that includes different controllers and microprocessors for various purposes. The Arduino board is a single circuit board that features multiple interfaces and components. These include digital and analog pins, which are used to connect various devices and components required for electronic devices to function. The majority of Arduino boards contain 14 digital I/O pins, while the analog pins provide fine-grained control. The board pins are arranged in a specific pattern and other components present on the board include USB connectors, voltage regulators, oscillators, microcontrollers, and power connectors.



Fig 3.10: Arduino IDE

### Features Of Arduino:

- Arduino programming is a simplified version of C++, making it easier to learn. The Arduino IDE is used to control the functionality of the board. It also sends a set of specifications to the microcontroller.
- Arduino does not require additional boards or pieces to load new code.
- Arduino can read analog and digital input signals. The hardware and software platform is easy to use and easy to implement.

## How it is use the Arduino IDE:

The Arduino software and hardware platforms have simplified the development of electronics. These tools enable the creation of digital and interactive devices with the assistance of other components. The Arduino software, also known as IDE, is an open source programming software that was developed by arduino.cc. It provides an integrated development environment to write and upload code to Arduino boards, and comes with libraries and sample projects. The Arduino software is compatible with various operating systems, such as Windows, Linux, and Mac OS X, and supports programming languages like C/C++. It is user-friendly and suitable for both beginners and advanced users, making it a great tool for electronic programming, robotics, and prototyping.

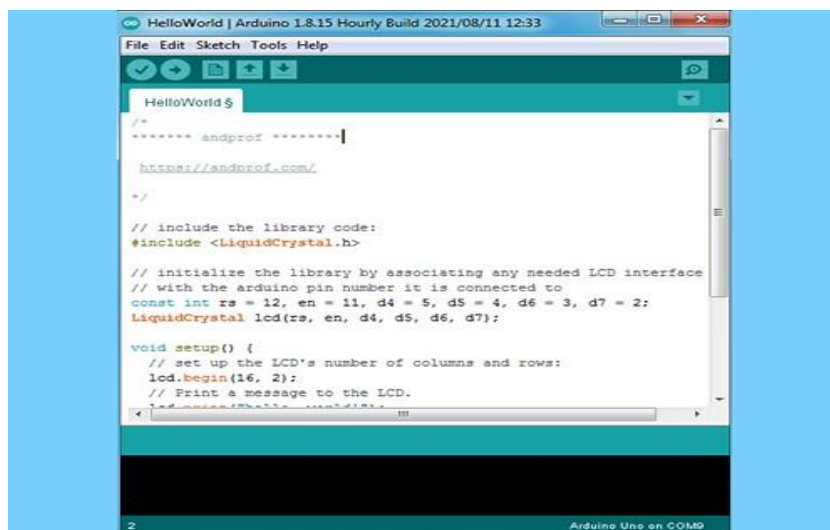


Fig 3.11: Arduino Software Interface

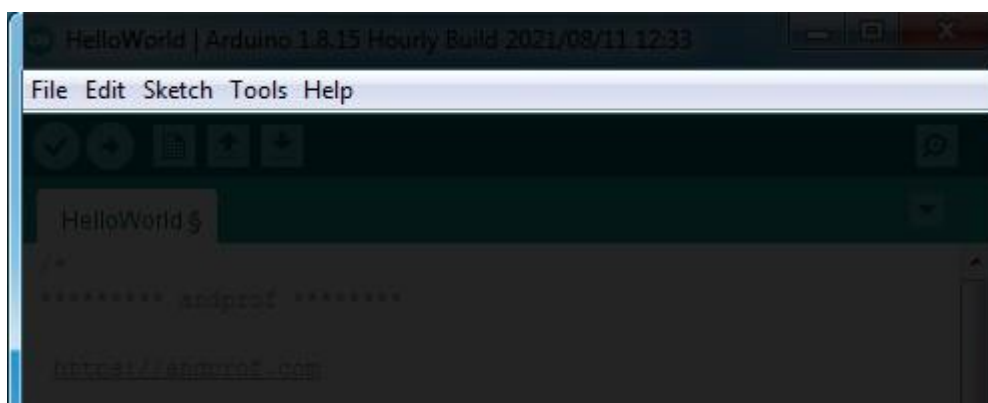


Fig 3.12: Menu Section

Menu is the main menu of the program, five menus (File, Edit, Sketch, Tools, Help) are used to add or modify the code you write.

Toolbar section:



The toolbar is the most important section of the Arduino software as it contains tools that you will use continuously while programming your Arduino board. These tools are:

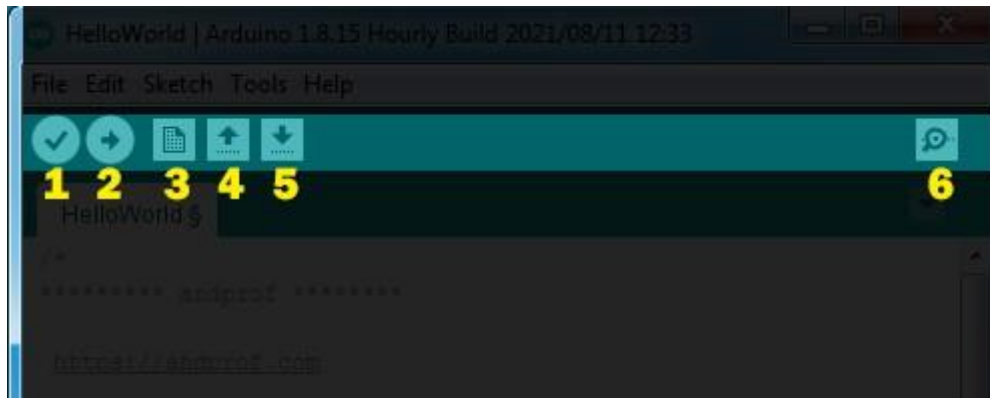


Fig 3.13: Toolbar Section

**1. Check:**

Use this button to review your code or ensure there are no errors.

**2. Upload:**

This button is for uploading the code to the Arduino board.

**3. New:**

Use this button to create a new project or sketch (a sketch is a code file).

**4. Open:**

Used to open a sketch from a sketchbook.

**5. Save:**

Save the current sketch to Sketchbook.

**6. Serial monitor:**

It shows the data sent from the Arduino.

**Code Editor Section:**

Code editor is liberator of codes, is the white space in the program, in which codes are been writting, and modifying on it.

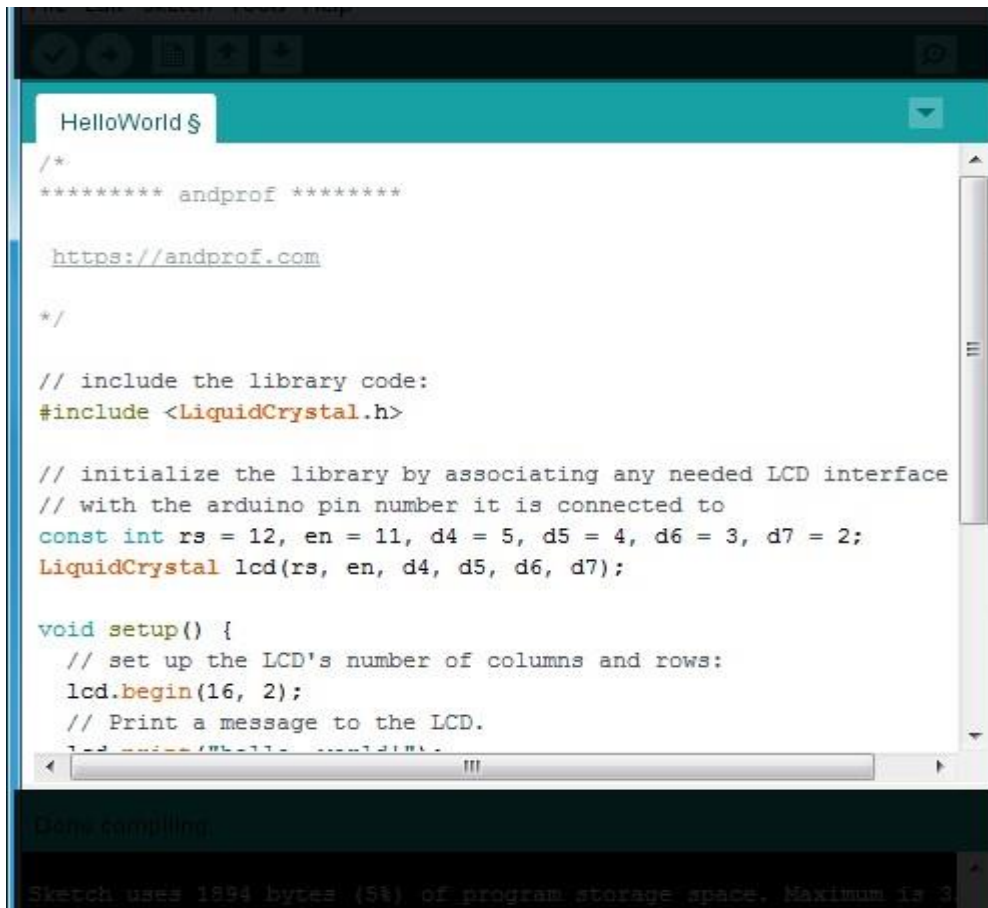


Fig 3.14: Code Editor

### Status bar section:



Fig 3.15: Status bar section

The status bar is the space at the bottom of the code editor that indicates the completion status of an operation (compile, upload, etc.).

## Program Notifications Section:

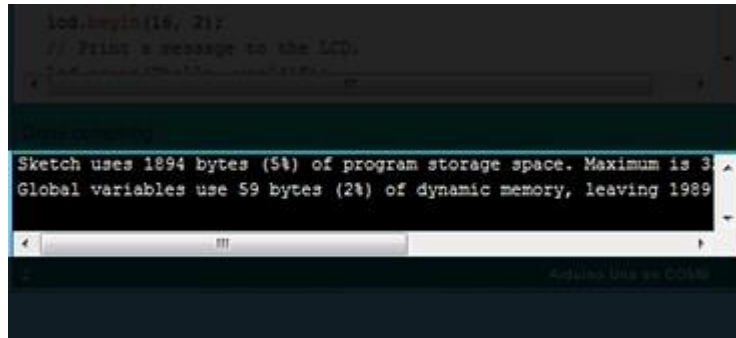


Fig 3.16: Program Notifications

Program notifications this program showing you the mistakes of codes, and some problems that can be face you during the programming process.

**Serial Port & Board Selections:** Serial ports selections is a space in which the program showing you the type of the port which is used to connect the arduino by computer.

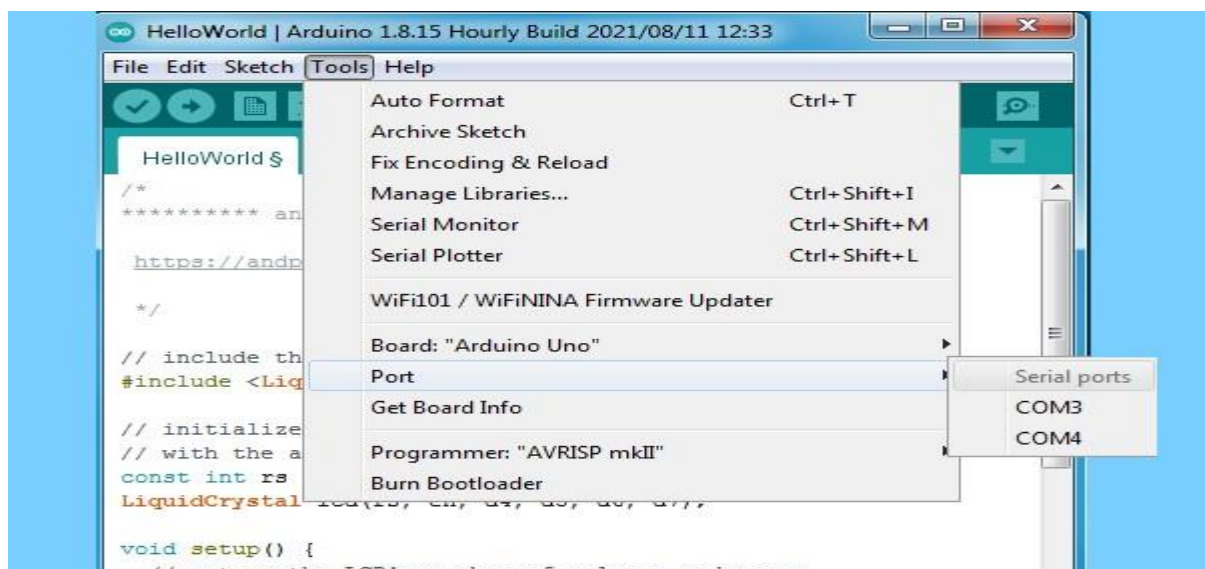


Fig 3.17: Serial Ports

Board selections is a space in which the program showing you the type of the arduino board.

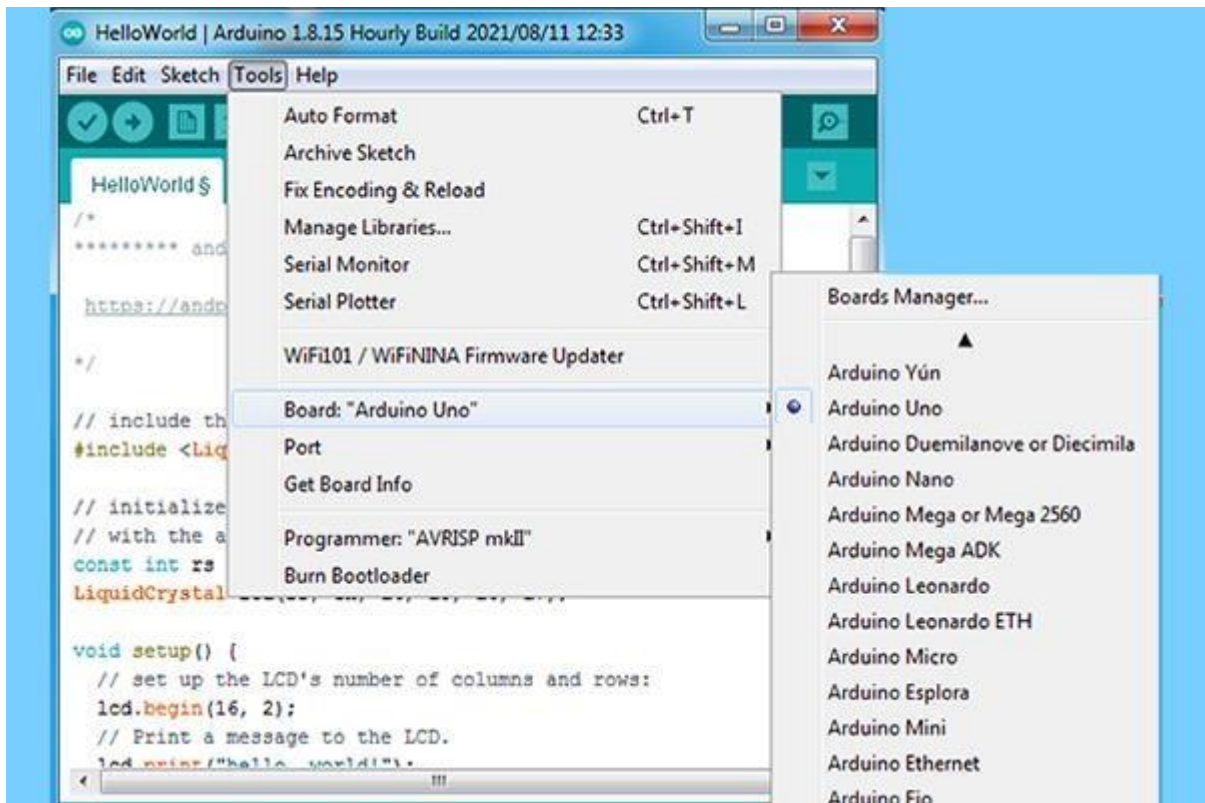


Fig 3.18: Boards Manager

After installing electronic components using the input/output pins of the Arduino board. Connect the Arduino board to your computer with a USB cable and open the Arduino software.

- First things first:

Click "Tools" in the menu, then "Board" and select the Arduino board you are using.

- The second:

In the menu, click "Tools" again, click "Ports" and select the serial port you connected your Arduino board to.

- third party:

Write your programming code in the "Code Editor" and click "Check" to check its correctness.

- the 4th:

Click "Upload" to upload the code to your Arduino board.

So I used the Arduino program to program the Arduino board.

### 3.2.2 ThingSpeak:

ThingSpeak is a Ruby-based open-source software that enables users to interact with Internet-connected devices. It offers APIs for both devices and social media platforms, facilitating access, retrieval, and logging of data. ThingSpeak is a cloud-based platform accessible online, allowing users to monitor real-time data changes from anywhere in the world, as long as there is a stable internet connection between the computer and the device being monitored. The platform is commonly used to keep track of changing data and offers the convenience of monitoring data changes remotely via ThingSpeak from a personal computer.

# ThingSpeak Nodemcu

## Sensor Data to ThingSpeak

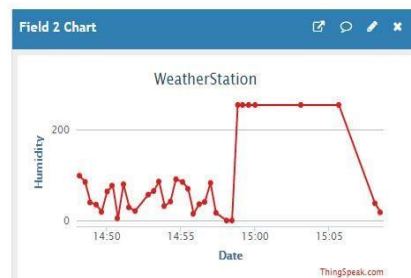
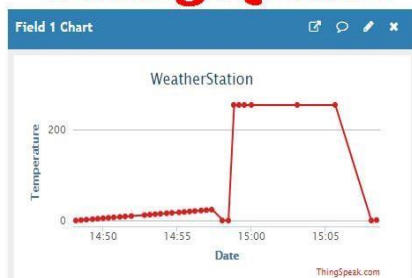
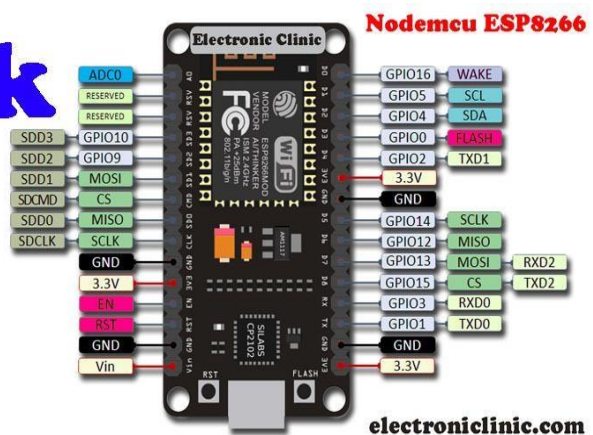


Fig 3.19: Sensor Data to ThingSpeak

### Getting Started:

open <https://thingspeak.com/>:

To start using ThingSpeak, visit [//thingspeak.com/](https://thingspeak.com/) and click on the "Get Started Now" button located at the center of the page. You will be directed to the login page, which can also be accessed by clicking the "Login" button located at the far right side of the page. Fill in the necessary details and click on the "Create Account" button to complete the

process.

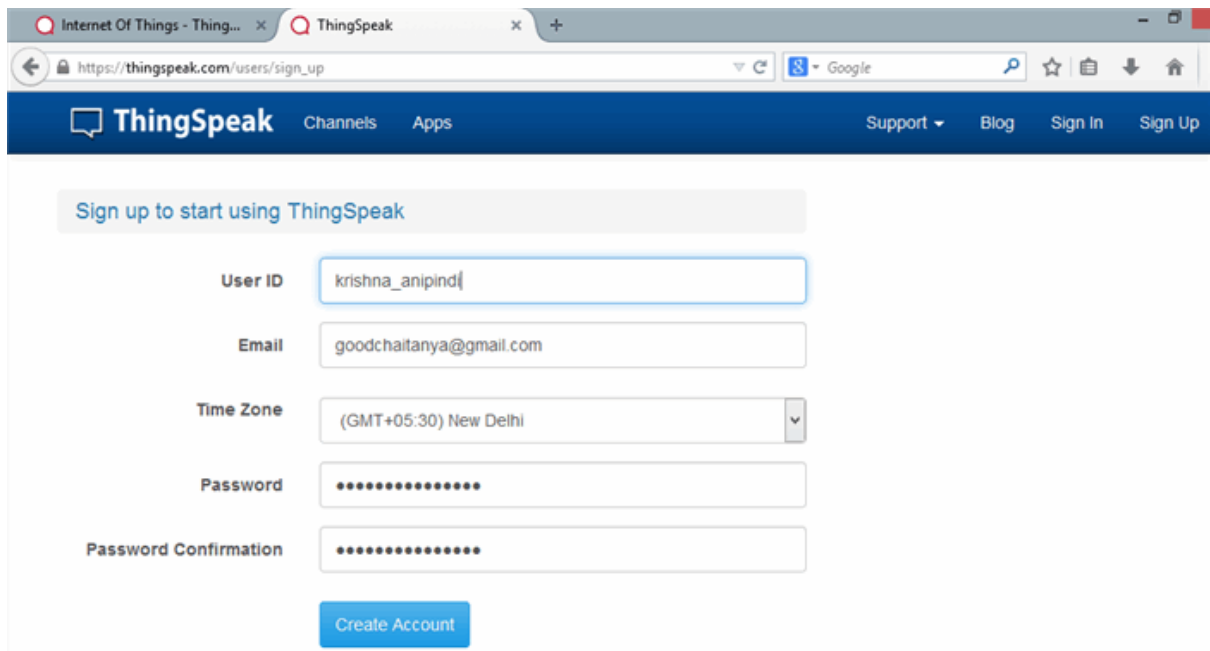


Fig 3.20: Sign up to start using Thingspeak

A screen that states the account was successfully established appears. After a little period of time, the confirmation notice vanishes, and the following screen shows as the last page.

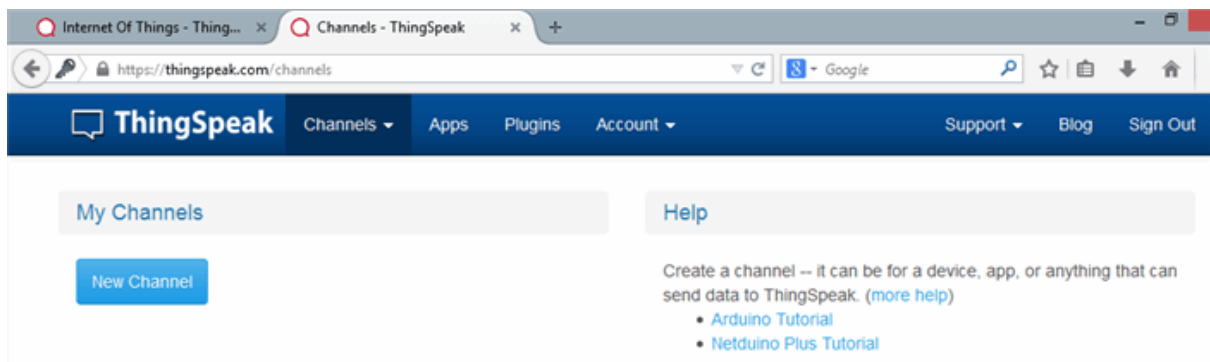


Fig 3.21: Channel Creation

Go ahead and click on 'New Channel'. You should see a page like the below:

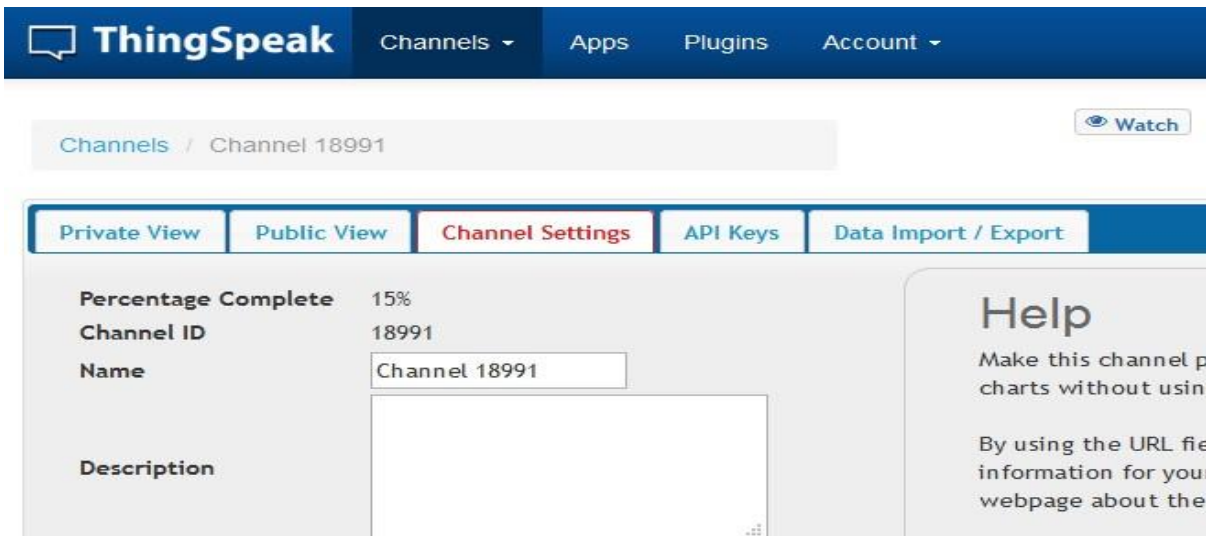


Fig 3.22: Channel Creation

After creating your ThingSpeak account, you can rename your channel and add a description that is appropriate for it. Additionally, you can enter other relevant information in the metadata fields. The page also includes fields for latitude, longitude, and altitude. Furthermore, there is a 'Publish?' checkbox that you can use. You can also explore the different tabs and fields to see what they mean.

- Latitude, Longitude, and Altitude - These fields indicate the location of the device or 'thing', and are particularly important if the device is mobile.
- Publish? - This checkbox determines whether your channel is public or private. If the box is checked, anyone can view the data feed and charts of your channel. If unchecked, the user must provide the corresponding API key for each read or write operation.
- URL - This field allows you to specify the URL of your blog or website. If provided, it will be visible in the public view of your channel.
- Video ID - This is the ID for your YouTube or Vimeo video. If entered, the video will be displayed in the public view of your channel.

Fields 1-8 are used to store the data transmitted by the sensor or device. These fields need to be added before they can be used to store data, with Field 1 being added by default. If a field is not added and data is transmitted to it, the data will be accepted but not visible in charts and corresponding data. Each field can be added by clicking the small box next to the "Add Field" text. Once added, the default label names appear in the text boxes for each field, and the "Add Field" text changes to "Remove Field." To make the field labels more meaningful, you can edit the default text that appears when adding the field. For example, in the screenshot below, Field 2 was changed to "Sensor Input." To remove an added field, simply click the "Remove Field"



box next to it. The "Remove Field" text then changes back to "Add Field," and the corresponding text is removed.



The screenshot shows the 'Channels' page in the ThingSpeak interface. At the top, there is a navigation bar with 'Channels', 'Apps', 'Plugins', and 'Account' menus. The main form includes a 'Make Public?' checkbox which is checked. Below this are input fields for 'URL', 'Video ID', and a selection between 'YouTube' and 'Vimeo'. There are eight 'Field' entries, each with a text input and a checkbox. 'Field 1' has 'Field Label 1' and a 'remove field' checkbox. 'Field 2' has 'SensorInput' and a 'remove field' checkbox. Fields 3 through 8 have empty text inputs and 'add field' checkboxes. A blue 'Save Channel' button is at the bottom.

Fig 3.23: Channel Creation

After making your changes, click the "Save Channel" button. As of right now, the 'Private View' tab should be set by default on a page similar to the one below:

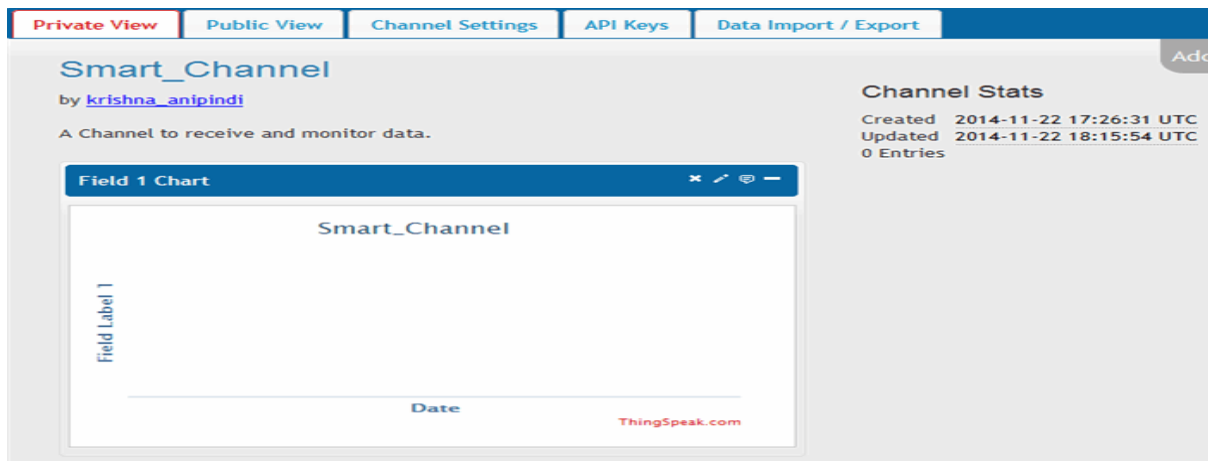


Fig 3.24: Private View Of Channel

After viewing the Private View tab, you can click on the Public View tab, which displays charts for each field that was added to the channel. If the channel is not public, the Public View tab will show "This channel is not public." To access the API Keys tab, click on its corresponding tab. This tab provides the Write API key for sending data to the channel and the Read API key for reading channel data. By default, a Write API key is generated when a channel is created.



To generate a Read API key, click the "Generate New Read API Key" button on this tab. You can also add a note for each Read API key that is generated.

**Exploring the code:** I started creating URIs to update fields. The initial URI is http:

You need to add the key //api.thingspeak.com/update. Note that you should replace the string YOUR\_KEY with the actual write API key you receive after signing up and creating a channel. After that, I declared two constants to push to the ThingSpeak channel. Then add these fields to the URL under the field1 and field2 parameters. You can move other fields to field8 in a similar way. after that,

Edit WebRequest to create an HTTPWebRequest object corresponding to this URI.

Create a method.

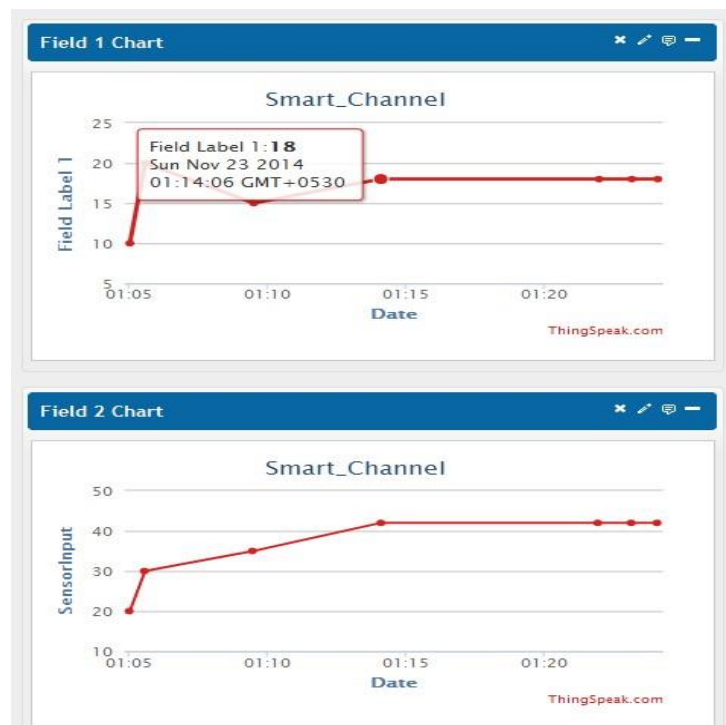


Fig 3.25: Graphical Representation Of Field1&Field2

The graph on the channel page displays data points that correspond to values and the time they were sent to the channel. By hovering the mouse over a point, one can see details such as the exact date the value was posted and the corresponding GMT offset. In the example provided, sample values were sent to the channel, but any data can be sent to it, such as regular temperature readings or speed values of motors. The labels for each axis are the names we gave to the fields while setting up the channel.

### Conclusion:

ThingSpeak is an IoT service platform that provides a range of features to manage and process data collected from connected devices or "things." It offers the ability to create channels to store and analyze data, as well as apps for integrating with other web services, APIs, and social networks. This makes it a powerful tool for building IoT applications and services. With

ThingSpeak, users can visualize, analyze, and act on data in real-time, enabling them to make informed decisions and optimize their IoT systems. Additionally, ThingSpeak supports multiple communication protocols, making it easy to connect to a wide range of devices and sensors.

### 3.2.3 IFTTT( If This Then That):

Founded in 2011, it is a private trading company that operates an online digital automation platform delivered as a service. Their platform provides a cross-platform if-statement visual interface to 2020 he reached 18 million users. IFTTT partners with various everyday service providers and integrates with each other through the platform using public APIs. Event notifications he delivers to IFTTT and executes commands to implement responses.



3.26: IFTT(If This Then That)

### Features of IFTTT:

- IFTTT (If This Then That) is a platform that allows users to connect and automate various web services and smart devices. The basic components of IFTTT are called Services, which represent data from web services or APIs, as well as information like weather or stocks. Each Service has a specific set of triggers and actions that can be used to create custom applets.
- Triggers are the "This" part of an applet and are the elements that initiate actions. They can be based on a wide range of inputs, such as RSS feeds or social media activity.
- Actions are the "That" part of an applet and are the outputs that result from the trigger's inputs. For example, an action could be to send a photo to a user's Dropbox account when they like an Instagram image.
- Applets (previously called recipes) are the combinations of triggers and actions that automate tasks. They allow users to create custom automations and connect different services together.

- "Ingredients" are the underlying data available from the trigger, such as the subject, body, attachments, and sender address of an email trigger.

## How to Set Up an Applet:

There are various combinations of applets. An applet is available that connects Alexa to your to-do list or Google Calendar. Similarly, you can create an applet that saves fitness tracker data to Google Sheets. Not only that, but there are billions of applets that you can create and use to conveniently manage your daily tasks. how? Check it out below.

Here is an example of creating an applet for Instagram and Twitter accounts.

step 1:

First, log into her IFTTT account using your credentials.

Step 2:

Go to your username and click My Services.



Fig 3.27: Applet Creation

Note:

An auto-generated applet may be created depending on the account information you entered.

Step 3:

Then search for channels. B. I want to get the associated applet Instagram

Step 4:

At this point select each applet you want to use

Note:

Suppose you want to tweet an Instagram photo. Therefore, you should choose a specific applet to automatically tweet your Instagram photos.



Fig 3.28: Applet Creation

**Step 5:**

After selecting the applet of your choice, click the Activate button.

**Step 6:**

Next, you will be asked for permission to access Instagram and Twitter. Click OK here

**Step 7:**

Finally, after authorizing access to each service, you will be redirected to the activated applet page.

**Note:**

To view your applet list, click the My Applets option at the top of your IFTTT dashboard.

**Usage examples:**

- IFTTT can automate web application tasks. B. Post the same content on multiple social networks.
- Marketer can use her IFTTT to track company mentions in RSS feeds.
- IFTTT is also used in home automation. For example, turn on lights (with relevant compliant devices) when motion is detected in the room.

**CHAPTER-4**  
**PROJECT DESCRIPTION**

## 4.1 Block Diagram:

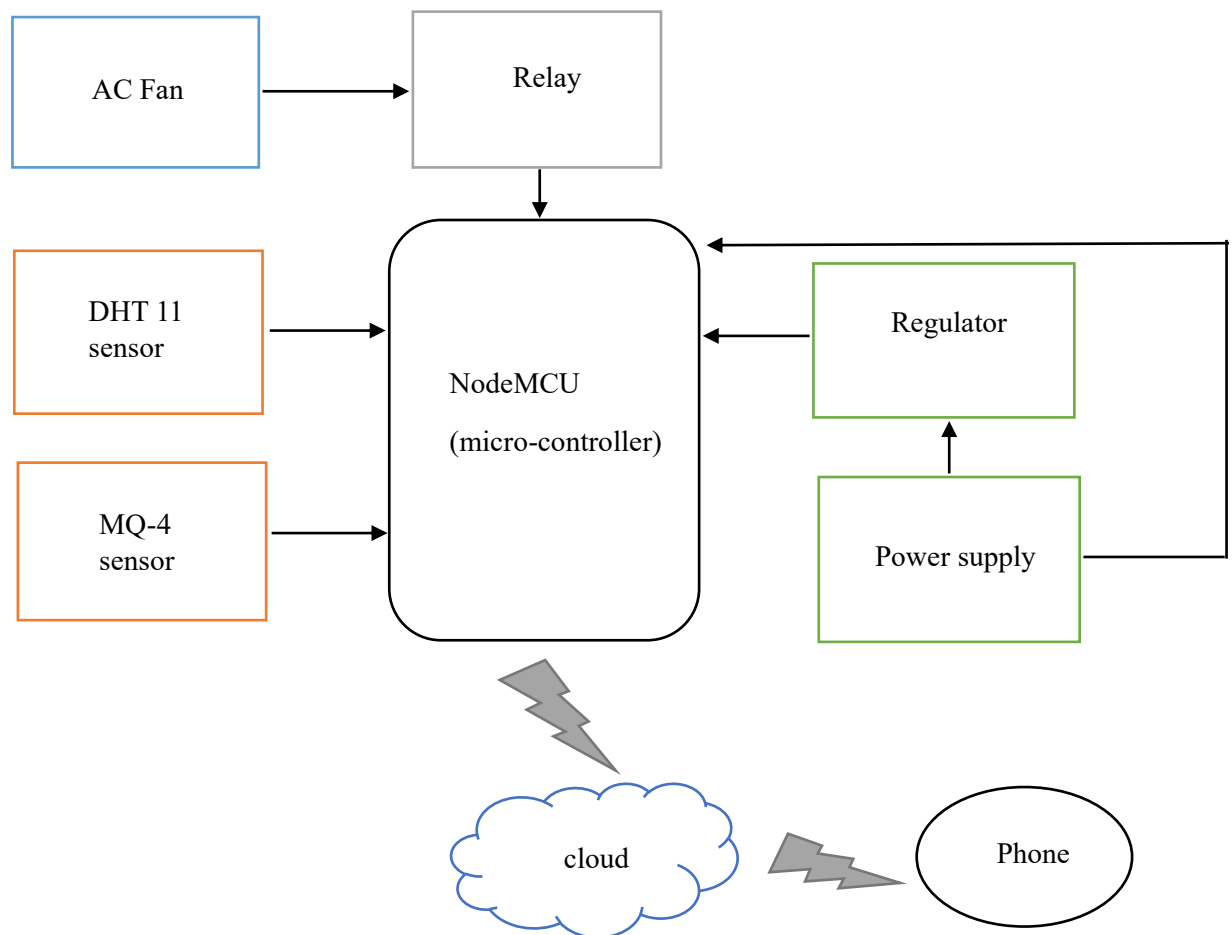


Fig 4.1: Block diagram of sensor system

## 4.2 Operation of Sensor System:

Onions when stored between 25oC-30oC and 65%RH-70%RH, their durability increases. To achieve this a DHT-11 sensor is used, which detects the temperature and humidity. In order to maintain the specified range, forced ventilation i.e, fans are used. Whenever the temperature and humidity exceed 30oC and 70%RH respectively, DHT 11 sensor sends message to micro-controller which then forwards the message to the relay to turn on the fans, vice versa action happens when temperature and humidity are below 25oC and 65%RH respectively. This is how temperature and humidity are maintained. MQ-4 gas sensor is used to detect the spoilage of onions in advance. Threshold value of 450ppm is preferred, so whenever the methane level in the air exceeds 450ppm, the sensor sends an alert to the phone through the microcontroller. This entire sensor system is kept near the onions which are being stored and monitors them continuously.

An alert is created using software tools IFTTT and ThingSpeak. The threshold value is fixed in ThingSpeak and alert is created in IFTTT.

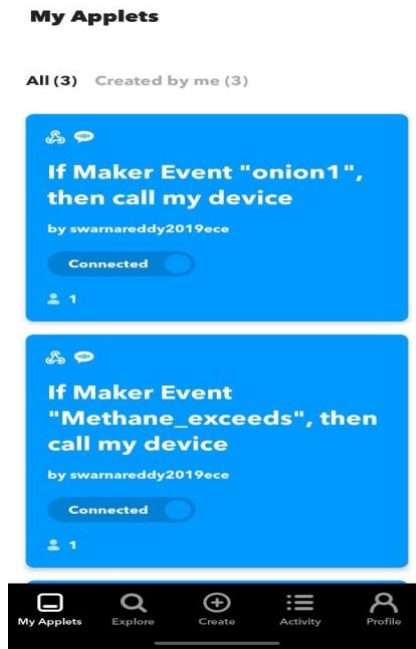
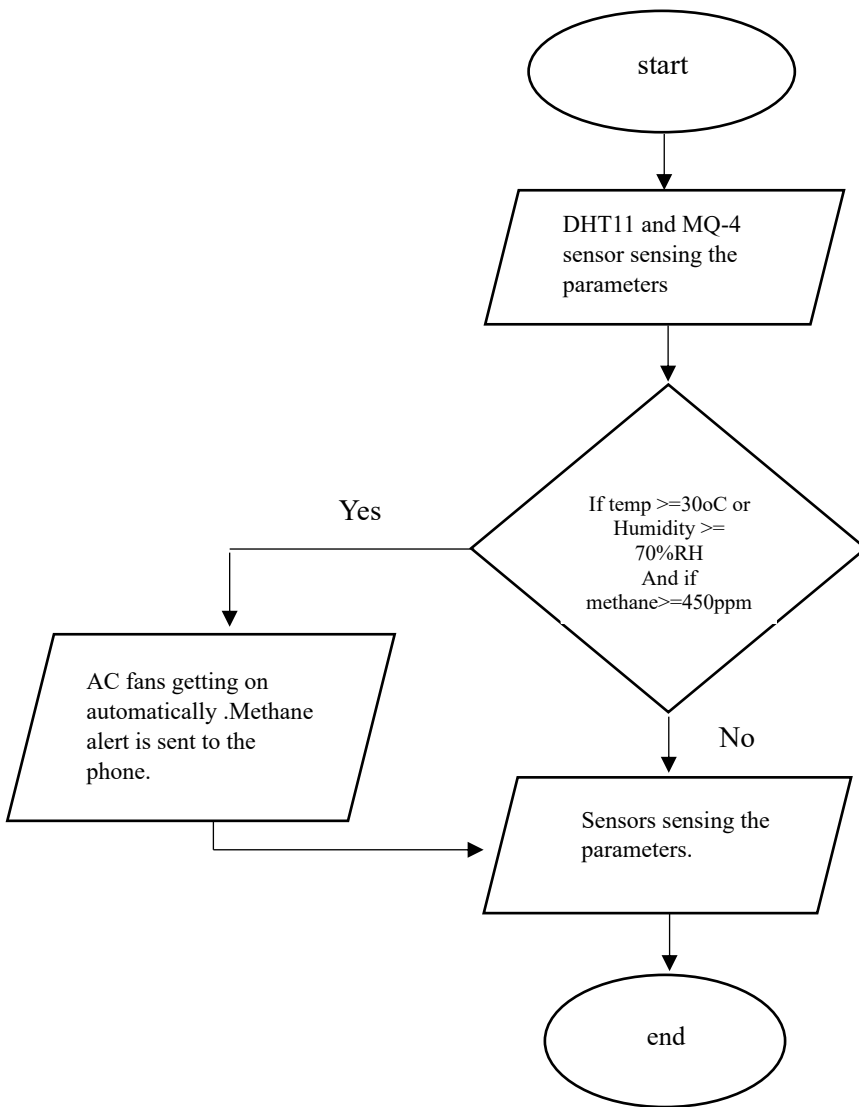


Fig 4.2: Applets created in IFTTT for alerts

### 4.3 Flowchart:



# **CHAPTER 5**

## **RESULTS**



## 5.1 CIRCUIT AND RESULTS

The designed sensor system has to keep near the onions that are being stored in order to monitor them continuously. The sensor system detects the temperature and humidity, and sends the message to the microcontroller whenever the data is out of range. The same message will be forwarded to the relay which acts as a switch, so that it takes the appropriate action. Spoilage in onions is detected by the gas sensor MQ-4, which alerts us when the methane level exceeds its threshold value(450ppm). This is how onions can be stored for long period of time.

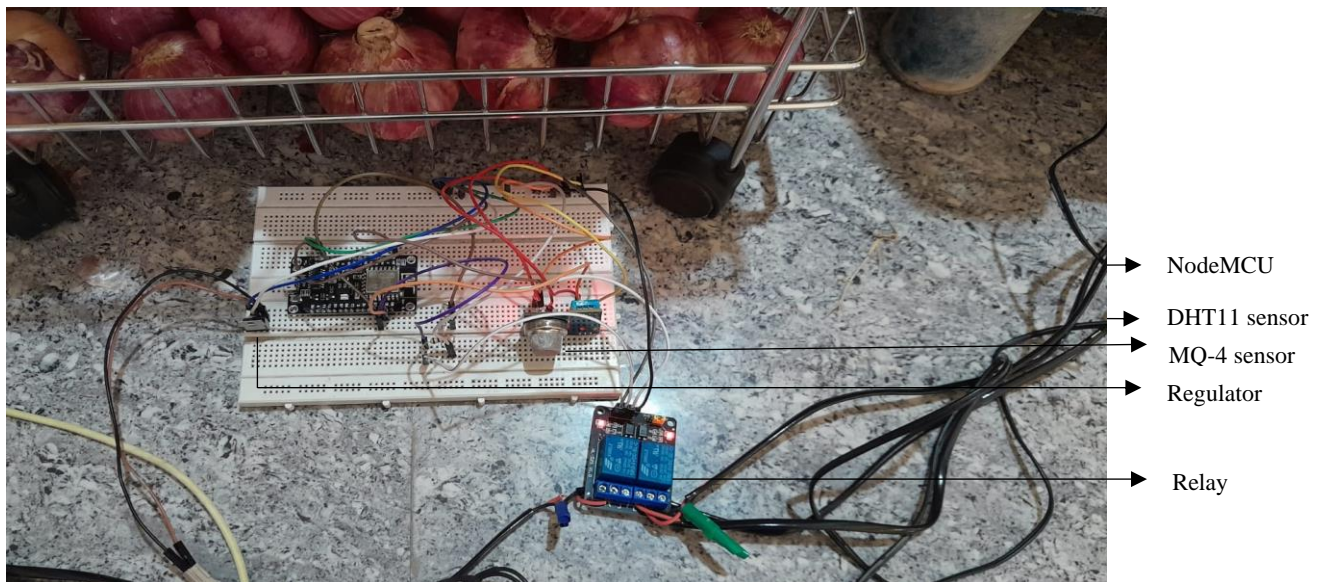


Fig 5.1: The designed sensor system



Fig 5.2: Sensor based onion preservation system

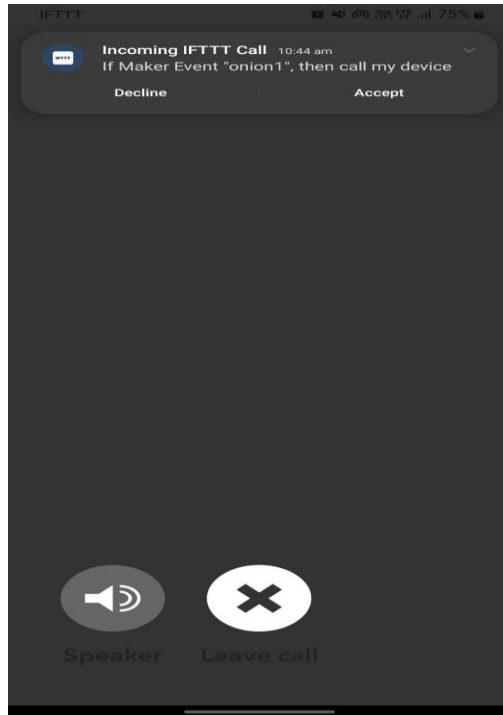


Fig 5.3: IFTTT alerting the spoilage

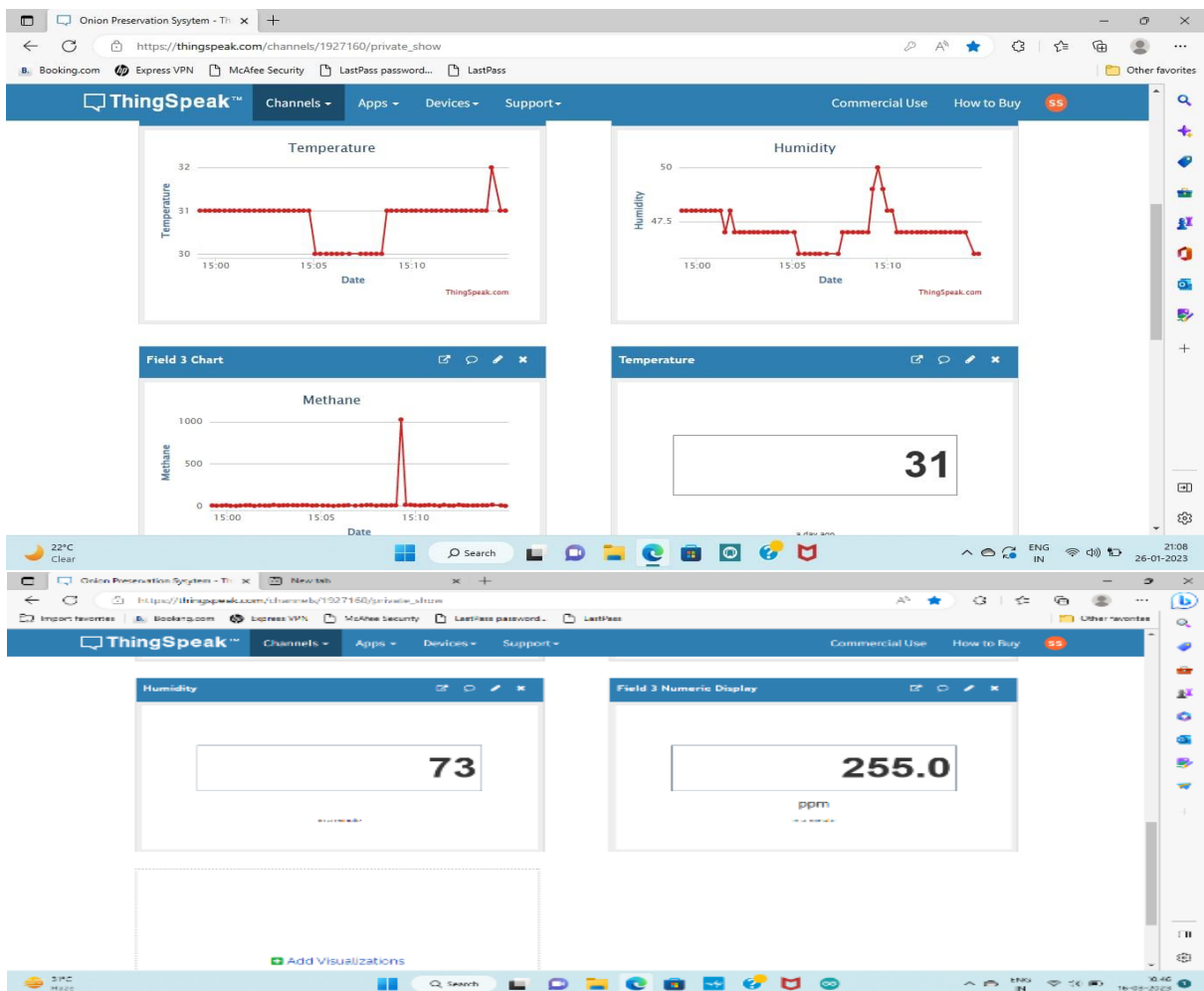


Fig 5.4: Data of temperature, humidity and methane gas in ThingSpeak

The image displayed depicts a set of data regarding the temperature, humidity, and methane gas levels in a room where onions have been kept for thirty days.

**CHAPTER-6**  
**PROJECT CODE**

## 6.1 Code:

```
#include "DHT.h" // Adding the library for dht (a type of temperature and humidity sensor) to  
a code or project.
```

```
#include<BlynkSimpleEsp8266.h>
```

```
String apiKey = "BOGC1GDWU6OV0851"; // input your ThingSpeak Write API key.
```

```
const char *ssid = "ssid"; // Substitute the wifi network name (SSID) and the WPA2 key  
with your own values.
```

```
const char *pass = "password";
```

```
const char *server = "api.thingspeak.com";
```

```
int relay=4;
```

```
//int relay1=0;
```

```
#define DHTPIN 5
```

```
#define MQPIN 16
```

```
DHT dht;
```

```
WiFiClient client;
```

```
void setup()
```

```
{
```

```
  Serial.begin(115200);
```

```
  delay(10);
```

```
  dht.setup(5);
```

```
  pinMode(relay,OUTPUT);
```

```
  //pinMode(relay1,OUTPUT);
```

```
  //digitalWrite(4,LOW);
```

```
  Serial.println("Connecting to ");
```

```
  Serial.println(ssid);
```

```

WiFi.begin(ssid, pass);

while (WiFi.status() != WL_CONNECTED)
{
    delay(500);
    Serial.print(".");
}
Serial.println("");
Serial.println("WiFi connected");

}

void loop()
{

    float h = dht.getHumidity();
    float t = dht.getTemperature();
    float MQ = analogRead(0);

    if (client.connect(server,80) // "184.106.153.149" or api.thingspeak.com
    {

        String postStr = apiKey;
        postStr += "&field1=";
        postStr += String(t);
        postStr += "&field2=";

```

```

    postStr += String(h);
    postStr += "\r\n\r\n";
    postStr += "&field3=";
    postStr += String(MQ);

    client.print("POST /update HTTP/1.1\n");
    client.print("Host: api.thingspeak.com\n");
    client.print("Connection: close\n");
    client.print("X-THINGSPEAKAPIKEY: "+apiKey+"\n");
    client.print("Content-Type: application/x-www-form-urlencoded\n");
    client.print("Content-Length: ");
    client.print(postStr.length());
    client.print("\n\n");
    client.print(postStr);

    Serial.println("Sending data to Thingspeak.com ");
}
client.stop();

Serial.println("Waiting...");
Serial.println(MQ);

if ( 30 <=t || 70 <=h )
{
    digitalWrite(relay,LOW);
    //digitalWrite(relay1,LOW);
}

```

```
else
{
    digitalWrite(relay,HIGH);
    // digitalWrite(relay1,HIGH);
}
}
```



## **Conclusion and Future Scope**

### **Conclusion:**

A low-cost and easy-to-use method of preserving onions has been developed utilizing sensors. The system is programmed to continuously observe the onions and send a notification to the user when they reach the desired state. Depending on the amount of onions, the sensor system can be customized and set up. With the help of this sensor system, onions can be stored for as long as eight months.

### **Future Scope:**

The developed sensor system has real-world applications. The sensor system can be used at low cost by farmers who store onions. This system uses less power and is cost-effective. Small farmers that want to store onions for a long time might therefore utilise this.

## REFERENCES

- [1] **Patel M.B1.**, Assistant Professor (Post Harvest Technology), **Nath, A.2**, Assistant Professor (Post Harvest Technology), College of Horticulture,-Onion harvesting, curing, grading and storage: A Review Study -Research Gate,2020.
- [2] **V.G Wagh1, S.A Pawar**,-Advance Rotten Onion (Allium Cepa) SnifferRottening Detection and Primary Prevention Using Sensors, Actuators & Transducers ,-International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering(An ISO 3297: 2007 Certified Organization)-vol.5,Issue 10,October 2016.
- [3] **NABARD Head Office Mumbai**-Model Scheme on Onion Storage Structures.
- [4] **P. C. Tripathi** and **K. E. Lawande**-Designing and evaluation of onion storage structures for Indian conditions –International Scholars Journals-International Journal of Agricultural Sciences ISSN 2167-0447 Vol. 6 (2), pp. 918-924, February, 2016.
- [5] **Indiascience**-technology-for-long-term-onion-storage
- [6] **Plantvillage.psu.edu**-onion description.
- [7] **Utkarsha Sulakhe, Sangram Pharate, Avinash karale, Sugat Pawar** -Onion preservation system.
- [8] **Mokshi Vyas, Rutuja Gore, Manali Misal, Sneha Jagtap**, and Prof. S.V. Todkari. Post harvesting onion storage methodology using IOT. International Journal of Advanced Research in Computer and Communication Engineering. Vol. 8, Issue 5, May 2019.
- [9] **Walter E. Matson**. Oregon State University. Published in “A Pacific Northwest Extension”- Onion Storage Guidelines for Commercial Growers.
- [10] **Mr. S. A. Pawar-published**- published in IJAREEIE- Cost Effective Long-Time Preservation and reporting of Onion Rotting and Onion Decay with Online Feedback.