Dissertation on

Monitoring and Controlling the Crops in Warehouse using IOT

Submitted in partial fulfilment of the requirements for the award of degree of

Bachelor of Technology
in
Computer Science & Engineering

UE17CS490B – Capstone Project Phase - 2

Submitted by:

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CERTIFICATE

This is to certify that the dissertation entitled

Monitoring and Controlling the Crops in Warehouse using IOT

is a bonafide work carried out by

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In partial fulfilment for the completion of seventh semester Capstone Project Phase - 2 (UE17CS490B) in the Program of Study - Bachelor of Technology in Computer Science and Engineering under rules and regulations of PES University, Bengaluru during the period January. 2021 – May. 2021. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report. The dissertation has been approved as it satisfies the 7th semester academic requirements in respect of project work.

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Name of the Examiners	**Signature with Date**
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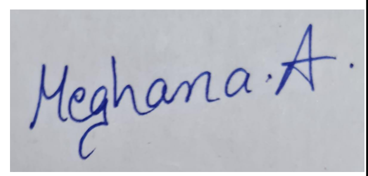
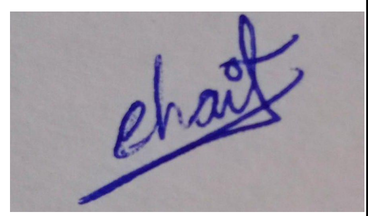
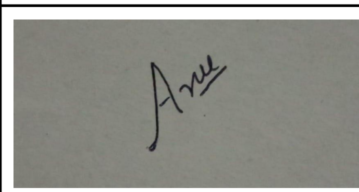
DECLARATION

We hereby declare that the Capstone Project Phase - 2 entitled **Monitoring and Controlling the Crops in Warehouse using IOT** has been carried out by us under the guidance of Prof. Rachana B S and submitted in partial fulfilment of the course requirements for the award of degree of **Bachelor of Technology** in **Computer Science and Engineering** of **PES University, Bengaluru** during the academic semester January – May 2021. The matter embodied in this report has not been submitted to any other university or institution for the award of any degree.

PES1201701279	**Arumilli Meghana**	
PES1201802403	**Chaitra Vishnu Devanga**	
PES1201802436	**Anusha T N**	

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ABSTRACT

Physical science objects related with the web through sensors, equipment, programming, actuators that are embedded in or joined things give us better control over our environmental factors, interface us to systems we use in our step by step life. In various countries' grains are the central wellspring of food. Extended revenue will be certain in light of the fact that food grains make up some place in the scope of 67 and 80% of the world's food deftly. Subsequently, taking care of yields without letting it be demolished is huge. During the yield storing, temperature, dampness, carbon monoxide factors that can impact the quality and measure of the set aside yields.

Hence, we are proposing a keen yield accumulating of chiefs using IOT that will give a productive approach to control and screen the set aside yields in stockrooms. Proposed structure screens stockroom limits, for instance, temperature, carbon monoxide, humidity, smoke by using various sensors and raspberry pi.Thing speak is utilized as a cloud that helps in the perception of information.

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CHAPTER-1

INTRODUCTION

India is where the agrarian areas acknowledge a basic part in the economy. Reliably ranchers face various issues because of the cutoff fundamentals, nonattendance of genuine checking of the food put away.Scattering center in the agribusiness region is considered as the more gigantic locale for the most part for guaranteeing sterilization. In prior days, there were obsolete procedures for putting away the yields which required a tremendous heap of the manual framework by chance which is repetitive and wasteful. Food and grains begin to crush when they are yielding. Moreover, a tiny bit of measure of the food and grains are put away focuses. A huge piece of the harvests is left without real storerooms. Because of the vacillations in the market easily both from one season to promptly and from one year to next, the calamities that the nation faces each year because of dumb cutoff is about Rs.50,000 crores in real money related terms.

A stockroom gives confirmation of food from difficulty and wickedness because of warmth, dampness, residue, and air. The essential point should be to keep up the yield in fantastic condition similarly as may be attainable. Limits of yields is one of the segments of warehousing where security of yields and danger bearing is a crucial factor. Also, it obstructs any catastrophes like thievery or trouble. As seen by the Food and Agriculture Organization that the higher the temperature, the lower ought to be the dampness of the yield to guarantee extraordinary security of the harvests. Due to high temperature, food loses its weight continually and in the end is withered, destroyed.

The essential objective of this work is to build up a checking and controlling of yields in stockrooms utilizing IOT which will give live data of temperature, moistness and various limits and moreover to control these limits remotely preposterous. Means in case an unexpected condition is made, by then the manager can handle the situation utilizing a site page. Another expectation is to mechanize this cycle where all that like accumulating temperature, sogginess is therefore kept up without human correspondence.

CHAPTER-2

PROBLEM STATEMENT

Nowadays ranchers are going up against enormous hardships due to some amassing essentials which are not being fulfilled and in light of nonattendance of induction to sensible refrigeration structures. From now on we have devised an undertaking where all the harvests are being checked ceaselessly with the help of sensors. Fundamentally this undertaking utilizes raspberry pi which goes probably as a microcontroller similarly as a specialist and prefers heat, moistness, smoke and a light sensor. All of these sensors can be easily controlled through a web application. This endeavor makes us screen constantly and grants the customer to control the movements at whatever point required.

CHAPTER-3

LITERATURE SURVEY

In this part, we present the current information on the territory and survey significant discoveries that help shape, advise and change our study.

3.1 Iot Instrumented Food and Grain Warehouse Traceability System for Farmers

Susmita Banerjee, Anil Kumar Saini, Himanshu Nigam, Vijay

Food stockpiling assumes a significant job with regards eatables safety that is influenced by etables misfortune and food wastage. The proposed framework should permit an IoT empowered observing framework to convey in distant regions where the openness is extremely least for ranchers with food storerooms to decrease food misfortunes and increment sanitation.

Components: Temperature and Humidity Sensor, ESP-32,Gas Sensor,PIR Sensor,Vibration Switch.

Methodology :

The main component of this system is ESP-32. They have used various sensors such as PIR sensor,Vibration Switch,Gas sensor DHT11 sensor and Fire sensor. The framework comprises a sensor hub, microcontroller hub, web worker. Microcontroller accumulates sensor values from the sensor hub and sends it to the GSM module, later it communicates to the web worker. GSM is an advanced cell innovation utilized for sending voice and information. It acts as a correspondence interface among microcontrollers and web workers. Sensors are responsible for recognition of different inconsistencies in a stockroom or cold-stockpiling conditions. Certain food items, for example, food grains need appropriate lighting to look after quality, such area LDR are put. Humidity sensor detects high dampness in a distribution centre climate. Furthermore, send the value into the microcontroller. Temperature sensor detects high temperature in a stockroom and sends these qualities into the microcontroller. Smoke alarm distinguishes smoke if in the event that fire occurs in the stockroom and sends these qualities into the microcontroller. Load cells are utilized to check the weight of food items, it occurs if there should be an occurrence of rodent warming and corruption of food items.

Future Work:

- As IoT has entered the horticulture field, this advancement will be successfully open to ranchers.
- Later on we can use dissimilar sensors with peak affectability, peak flexibility, and peak unwavering quality which will be made and which can be valuable to secure the eatables.

Inference: We have learnt about using PIR Sensor to detect heat signals.And I got to know about ESP-32 which can be a great help to choose microcontroller.

3.2 Smart Warehouse Monitoring Using IOT

K.Mohanraj,S.Vijayalakshmi,N.Balaji,R.Chithra kannan,R.Karthikeyan

This project is to catch heat, dampness, quake and fire related data utilizing sensors and send cautions utilizing IOT innovation. The issue looked by the Central Warehouse Corporation is limit loss of food grains account of natural changes Storage loss of limit loss of food grains are being noticed and controlled through quality inspection works on including average and irregular compound treatment, recording of mugginess dampness and other key limits, customary review, proper documentation age examination, sanitization, condition of being of storeroom. By executing the new present day apparatuses for storeroom association structure incorporates different plans of motivations and wants from various financial specialists. Diverse storeroom systems during execution fail to reach their methods. By then the endeavor danger is given after implementation. Due to ill-advised arranging the implementation fizzled. So we need to complete a versatile and progressing course of action to execute a storeroom structure.

Components:Temperature Sensor, Humidity Sensor,Raspberry Pi,Piezo Vibration Sensor Sensor,IR Sensor,LCD Display.

Methodology :

- The different sensors used are heat and dampness sensor and piezo vibration sensor and IR sensor.
- The information collected from the sensors is sent to the Raspberry Pi microcontroller.
- The collected information can be displayed in an LCD display.
- The Raspberry pi has an interior Wi-Fi module through which the IoT is associated. It has a SD space which stores a restricted scope of each sensor.
- Now the yield stored in warehouse information collected by the sensors is updated periodically through the controller.
- The controller checks at standard traverses when the scope out performs it gives an alert. We can screen this by associating with HDMI.

Future Work:

- The feature of this technique is that it has further developed innovation with massive highlights which is fused in the framework itself.
- The outline regarding the smart warehouse system and fire sensor and web camera to pass the information to Raspberry Pi microcontroller via LCD display as SMS/E-Mail.
- Therefore, in future it can be automated for warehouses using IoT. In future the automatic system can be used for irrigation purposes.

Inference: We have learnt about different sensors,Raspberry Pi.

3.3 IOT Based Smart Real Time Agriculture Warehouse Monitoring And Control System Using Raspberry Pi

Dr.R.M. Rewatkar , Mr. Akash V. Gulhane , Ms. Ashwini S. Mungale, Ms. Nikita M. Dhengare , Ms. Pooja P. Thakare , Ms.Prajakta D. Sabane

In Warehouse, ranchers are keeping their horticulture items to build the lifetime of the capacity materials. Ranchers should know if their capacity items have been harmed or not. Consequently our venture plans to make agribusiness shrewd ongoing checking and controlling framework with the assistance of PC, PC and most recent advances.

Components:Temperature Sensor, Humidity Sensor,Raspberry Pi,Smoke Sensor,Relay.

Methodology :

- Web-application module is utilized to keep data about the adjustments in the atmosphere
- Raspberry Pi is essentially a gadget planned which goes about as a microcontroller just as a worker
- Humidity Sensor otherwise called hygrometer faculties and reports both dampness and air temperature.
- Relays are essentially switches which work both precisely and electrically with an electromagnet. It works when there is a low-power sign and this data is helpful to control the circuit.
- Smoke sensors are utilized to recognize smoke dependent on the voltage levels. More smoke demonstrates more noteworthy voltage.
- Essential guideline of a LDR is photo conductivity. It is an optical wonder wherein the materials conductivity is extended when light is devoured by the substance.

Future Work:

- We can use a web camera to capture images or video.It will help to see the actual condition of the product.
- Currently, the system is monitoring only four parameters and controlling two parameters.

Inference: We have learnt about using smoke sensor,relay,raspberry pi.

3.4 Iot Based Food Monitoring System in Warehouses

Shivani Bhandari , Pooja Gangola , Shivani Verma , Surekha K Si

India is the country where the agrarian areas assume a significant part in the economy. Consistently ranchers deal with various issues because of the capacity prerequisites, absence of appropriate checking of the food put away. Distribution centers are utilized for capacity purposes. Just a little piece of the food grains are put away in the state run stockrooms. A huge piece of the harvests is left without legitimate capacity facilities.So the IoT based framework for checking of food grains not just targets carrying out a multi-parametric framework which helps in forestalling the misfortune against different elements like dampness, maturing and rotting yet additionally burns-through less time and cost effectively.This paper presents a food observing framework in stockrooms utilizing raspberry pi and different sensors that ceaselessly screen the different variables which may influence the food quality. The ThingSpeak is utilized as a cloud that helps in the representation of information.

Components:Temperature Sensor, Humidity Sensor,Light Sensor,MQ3 Sensor,Raspberry Pi.

Methodology :

In this paper they have used different sensors like heat sensor, dampness sensor, Light sensor, MQ3 sensor and give different types of notifications to the warehouse manager about the conditions so that the manager can take action. The actions taken by the manager will help them increase the survival of food little longer and proper use of resources will be done, which will make the environment friendly also. Data from different parameters can be seen on computers and SmartPhones. And they have used Raspberry Pi which is Wi-Fi enabled and also thingspeak to store the data in the cloud.

Future Work:

There are 3 methods to notify the directors, with the assistance of LEDs visual caution, with the assistance of Blynk versatile application that can follow live feed too and the diverse alarm sound with assistance of small buzzer .An organization where each segment will have the option to think exclusively, will recover information from cloud to likewise improve their choices each time with the assistance of information mining algorithms.We can associate this entire framework to Soracon Lagoon dashboard to get further inside and out examination with the of GSM module and IoT SIM card on our own computers.Alarm structure can be used to alert the supervisors if there emerge an event of any unusual exercises, this can achieved by using sensors around the field and presenting a live perception in order to perceive remarkable conduct by image processing .

Inference: We have learnt about using raspberry pi,light sensor,thingspeak.

3.5 Intelligent Grain Storage Management System Based on IOT

Ajay Doltade,Ankita Kadam,Sayali Honmore,Sanjeev Wagh

India is the tremendous nation attached to horticulture most generally where in india a large portion of individuals practically 70% individuals lives relies upon agribusiness. Where capacity of food grains is the most significant part and plays an essential role.Indian economy though while putting away grains the temperature, dampness etc.,their focus is more significant and where these components additionally could influence the nature of food grains.

The conventional techniques just cutoff to a portion of the testing climate condition approaches,where different variables must be distinguished or checked independently.The strategy for observing the grain stockpiling progressively is planned by utilizing some IOT devices.The result of this paper has numerous attributes, for example, discovery and simple anticipation helps in improving the nature of the food grain put away and lessens the wastage of grains put away in the stockroom.

Components:Temperature & Humidity Sensor,MQ135 Sensor,MQ2 Sensor,Node MCU ESP8266,PIR Sensor,Buzzer.

Methodology :

The Node MCU ESP8266 is the microcontroller which goes about as the focal control part.DHT11,MQ135,MQ2and PIR are the sensors utilized for detecting and accepting the data.Buzzer is utilized for the alarming the managers.Blynk application is utilized for warning conveyed by blynk cloud.

Future Work:

Need to monitor the temperature and humidity regularly.

Inference: We have learnt about using MQ135,MQ2,Buzzer,Blynk and ESP8266.

Drawbacks:

- Internet connection is very important in case a poor network system fails to control and monitor the system on time.
- Providing security to the warehouse is also more important
- Data security is another drawback
- Requires 24/7 power supply failure in regular supply of power will damage the grains

Conclusion:

- Other than setting up a food support framework, it proposes a minimal effort arrangement dependent on IoT.
- This framework advances the updating of the stockroom, the system framework maintaining a strategic distance from food squander and pointless financial misfortune.
- By execution and usage of the current innovation the stock administration for the cutting edge storage facility, the system is proposed with IOT empowered sensor innovation.

CHAPTER-4

SYSTEM SPECIFICATION AND PROJECT REQUIREMENTS

4.1 Introduction

Internet of Things (IoT) is an idea that licenses real articles with computational and tactile help with one another and access administrations across the Internet. The IoT thought was acquainted with associate gadgets through the Internet and work with admittance to data for customers. The wide scope of possible utilizations of IoT additionally incorporates agribusiness, where broad utilization of IoT is normal later on. The mark of this work is to present the IoT thought as a justification observing and controlling the yield in food stockpiling houses.

4.1.1 Project Scope

- **Aim :**Our Aim is to provide Ranchers yield with good storerooms to reduce food misfortunes and increment food safety. Reducing food misfortune which will consequently build high amounts of food availability.
- **Benefits :** The vital advantage of this cycle is that it permits the Stakeholders to comprehend the present status of the undertaking, the means taken, and financial plan, schedule,remote monitoring,reduced employees and increase in food availability
- **Usage:** Producers, Dealers, Traders, Distributors for good storage facility.

4.2 Product Perspective

With the improvement of business and the nonstop necessities of the food collection, old style storage facilities the board models will not meet that, on account of its substantial limit and low capability. To direct the actual work and to simplify the work, a keen stockroom is executed which is enabled with a couple of sensors and trend setting innovations.

4.2.1 User Classes :

- **FOOD MONITORING:** To establish an ideal climate for food by observing the condition of food consistently and notifies if any issue is conspicuous.
- **CLIMATE CONDITIONS MONITORING**: It is generally essential to screen climate conditions constantly so future exercises can be arranged in like manner. Climatic parameters which are being monitored include temperature, humidity.
- **ANIMALS:** Detection of animals and warm body signatures will help the owners to provide more revenue and more food availability by saving the crops from animal attacks.

4.2.2 Operating Environment

4.2.2.1 Hardware requirements

1. **Raspberry Pi 3 b+**

   Raspberry pi 3b+ is an efficient and cost effective credit card sized computer which sticks up for wireless internet out of the box, with built-in Wi-Fi and Bluetooth and it is also a low-power consumption system.

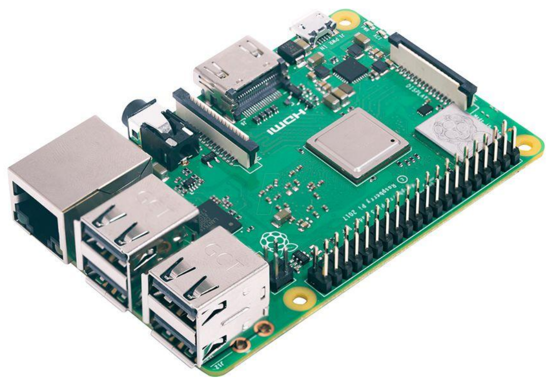


Fig 1: Raspberry Pi 3b+

2. **PIR Sensor**

   PIR motion sensor is used to detect the motion that has been moved around the plant. It has 2 slots and it is made up of a specific substance which is fragile to IR. It mainly detects heat figures like person, insects or creature going.

Fig 2: PIR Sensor

3. DHT22 Sensor

The DHT22 is an essential, cost efficient computerized temperature and dampness sensor.DHT22 has a wide range and better accuracy.It utilizes a capacitive moistness sensor and a thermistor to quantify the encompassing air and gives advanced sign on the information pin.

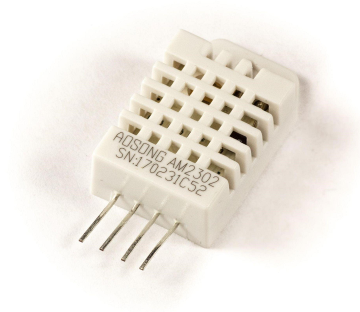


Fig 3: Dht22 Sensor

4. Fire Sensor

A fire identifier is a sensor intended to recognize and react to the presence of a fire or fire, permitting fire discovery. Reactions to an identified fire rely upon the establishment, however can incorporate sounding an alert, deactivating a fuel line, and initiating a fire concealment framework.

Fig 4: Fire Sensor

5. MQ-135 Sensor

Wide recognizing scope.Fast reaction and High sensitivity.Stable and long-life Simple drive circuit. Utilized in air quality control gear for structures/workplaces, is reasonable for distinguishing. of NH3, NOx, firewater, Benzene, smoke, CO2, and so forth.

Fig 5: MQ-135 Sensor

6. MCP-3008

The MCP3008 is a 8-Channel 10-bit ADC IC, so it can gauge 8 distinctive simple voltages with a goal of 10-bit. It estimates the value of simple voltage from 0-1023 and sends the value to a microcontroller or chip through SPI correspondence.

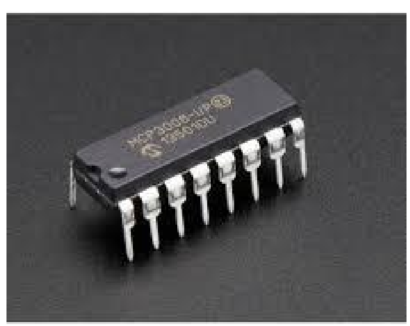


Fig 6: MCP-3008

7. Buzzer

A ringer or beeper is a sound flagging gadget, which might be mechanical, electromechanical, or piezoelectric. Normal employments of ringers and beepers incorporate alert gadgets, clocks, and affirmation of client info, for example, a mouse snap or keystroke.

Fig 7: Buzzer

8. Relay

A relay is an electrically worked switch. It comprises a bunch of info terminals for a solitary or various control signals, and a bunch of working contact terminals. The switch may have quite a few contacts in various contact structures, for example, make contacts, break contacts, or blends.

Fig 8: 5V Relay

4.2.2.2 System Requirements

1. Cloudant

Cloudant is an IBM Software item, which is principally conveyed as a cloud-based assistance. Cloudant is a non-social, conveyed data set with the help of a similar name.Cloudant depends on the Apache-heated .CouchDB project and the open source Big Couch project.

Real-Time Database: Cloudant upholds JSON information and all clients associated with it get live updates after each change.

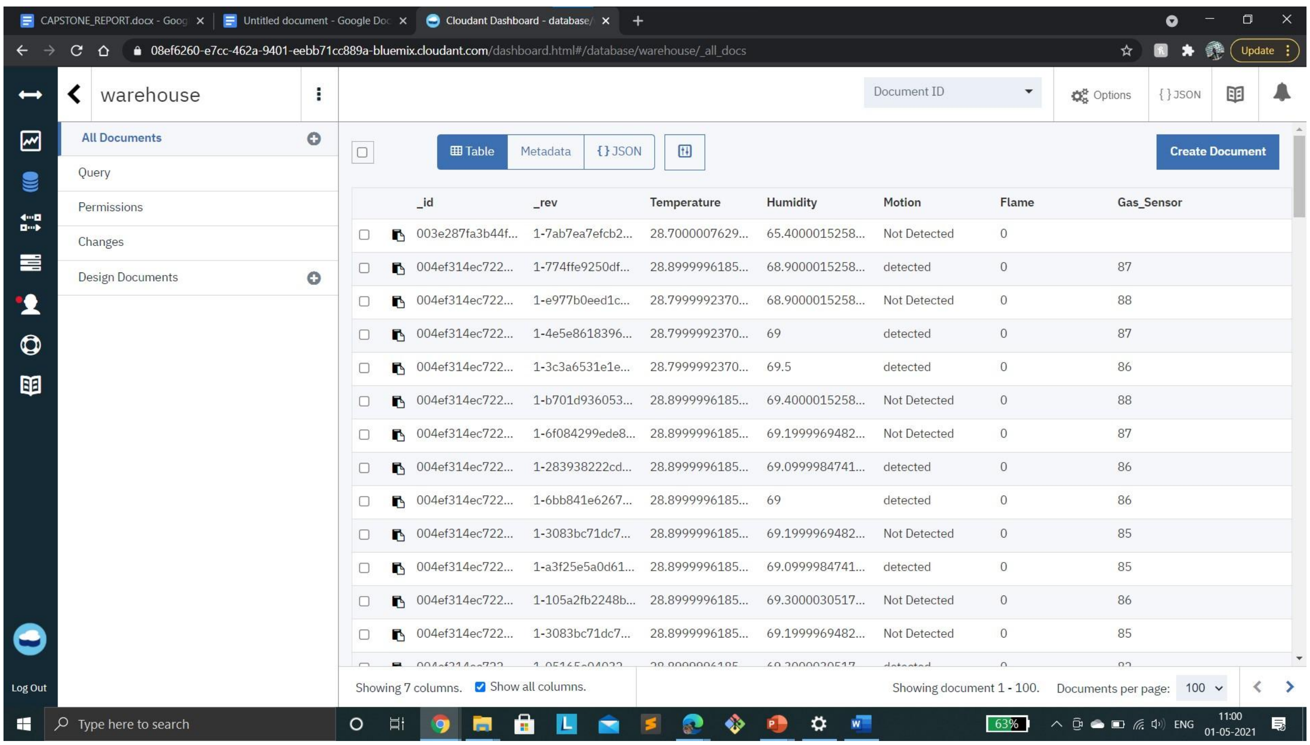


Fig 9:Cloudant

Authentication: We can use passwords or dissimilar social authentications.

Hosting: The application can be sent over secure association with cloudant workers.

Advantages:

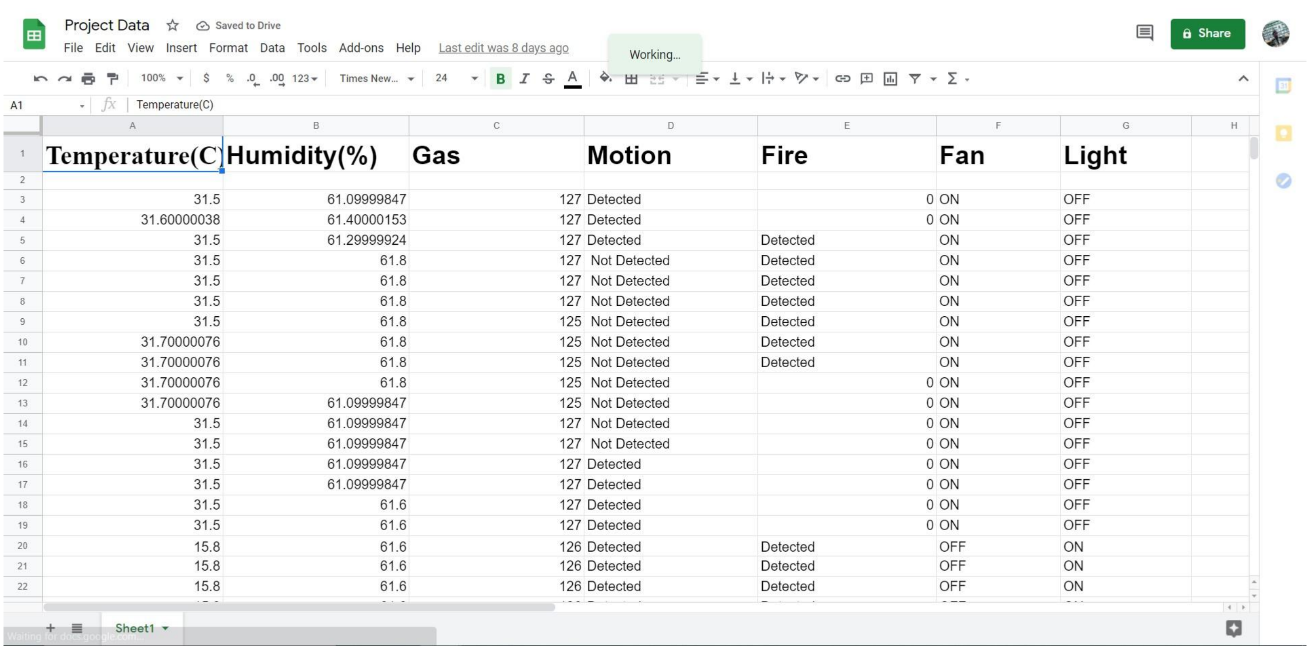
- It is basic and client friendly,no need for muddled design.
- The information is continuous, which implies that each change will naturally refresh associated customers.

2. Google Sheets

Google sheet is a product of Google that provides the capability of a spreadsheet over the cloud. Due to its cloud platform it provides more functionality compared to a standard spreadsheet. It is a Web-based spreadsheet, we can access the data stored on sheets from anywhere via the internet. We can use this as a database also for our small applications or websites. Use Google sheets to store the data and manage it in real- time.

➢ Limitations to using a Google sheet as a database:

- Not fault tolerant - Google sheets are available over the cloud, if any user deletes the spread sheet the complete data will be lost.
- Storage limitations - Google sheet can only store up to 5 million records



Temperature(C)	Humidity(%)	Gas	Motion	Fire	Fan	Light
31.5	61.09999847	127	Detected	0	ON	OFF
31.60000038	61.40000153	127	Detected	0	ON	OFF
31.5	61.29999924	127	Detected	Detected	ON	OFF
31.5	61.8	127	Not Detected	Detected	ON	OFF
31.5	61.8	127	Not Detected	Detected	ON	OFF
31.5	61.8	127	Not Detected	Detected	ON	OFF
31.5	61.8	125	Not Detected	Detected	ON	OFF
31.70000076	61.8	125	Not Detected	Detected	ON	OFF
31.70000076	61.8	125	Not Detected	Detected	ON	OFF
31.70000076	61.8	125	Not Detected	0	ON	OFF
31.70000076	61.09999847	125	Not Detected	0	ON	OFF
31.5	61.09999847	127	Not Detected	0	ON	OFF
31.5	61.09999847	127	Not Detected	0	ON	OFF
31.5	61.09999847	127	Detected	0	ON	OFF
31.5	61.09999847	127	Detected	0	ON	OFF
31.5	61.6	127	Detected	0	ON	OFF
31.5	61.6	127	Detected	0	ON	OFF
15.8	61.6	126	Detected	Detected	OFF	ON
15.8	61.6	126	Detected	Detected	OFF	ON
15.8	61.6	126	Detected	Detected	OFF	ON

Fig 10: Sheets

Web Page: We created this web page using Node-Red in ibm cloud.

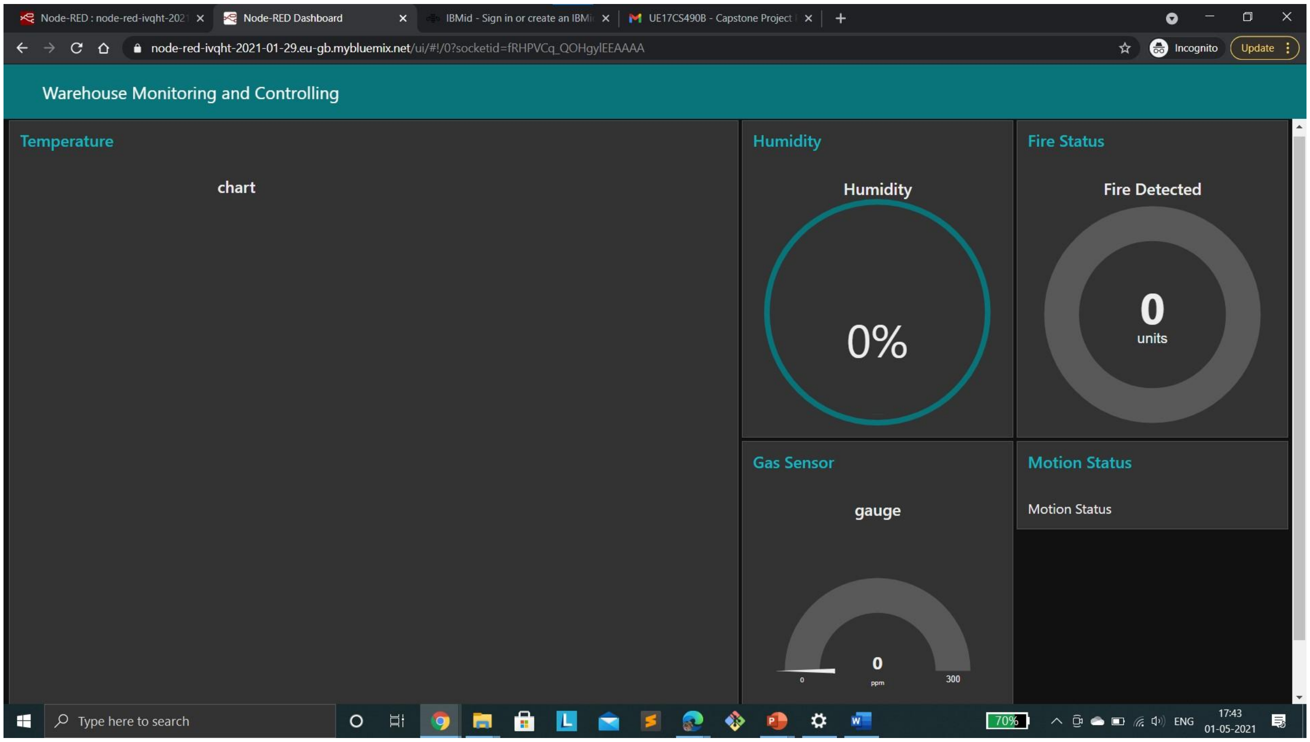


Fig 11: Web Page

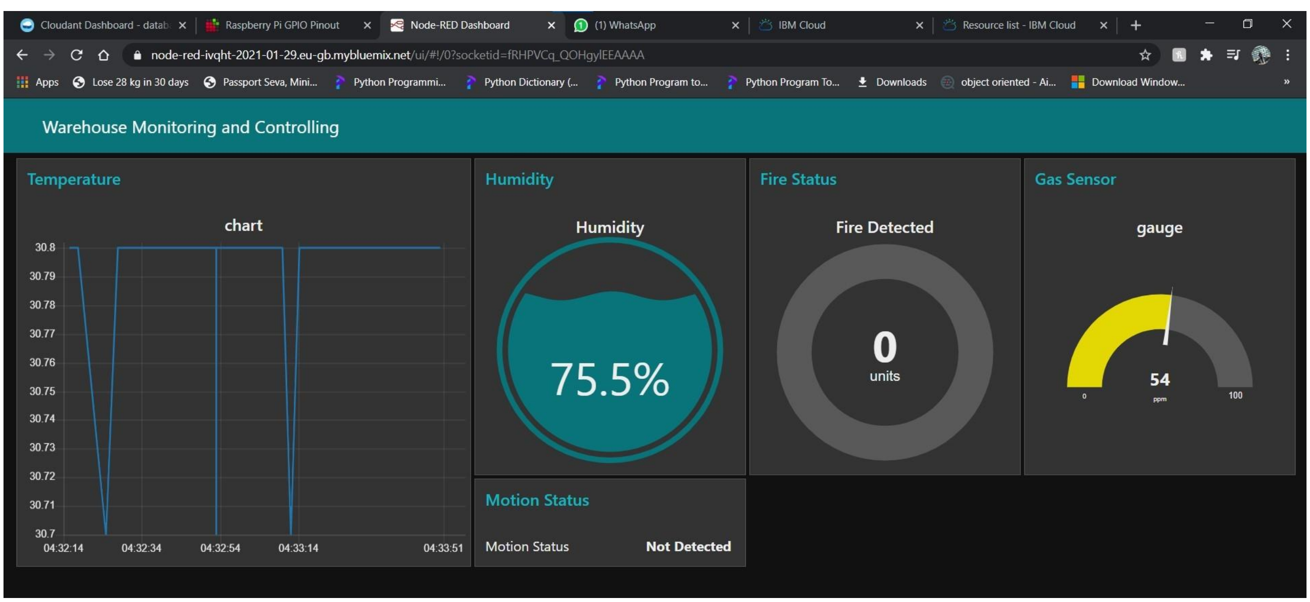


Fig 12: General Readings

4.2.3.General Constraints, Assumptions:

Constraints
Revenue and Affordability
Power Supply
Communication Range
Harsh Device Environment
Quality and Availability of Data
Quality of Wireless Link

Assumptions
Gracefully stock into the business community by having the choice to store items when deftly outperforms demand and a short time later conveying them when solicitation outperforms.
Keeping up solid stock levels makes costs stay stable, simplifying it for associations to gauge creation, advantage and adversity.

4.2.4 Risks

1. THE SECURITY FACTOR
2. TECHNICAL FAILURE AND FALSE ALARMS
3. CHANCES OF RASPBERRY PI GETTING DAMAGED
4. DATA SECURITY AND PRIVACY
5. NOT IN TIME ALERTS
6. CONTEXT-AWARENESS(META DATA)

4.3 Functional Requirements:

The progressive necessities indicate the capacities and units of the proposed framework. They characterize the conduct of the framework identifying with need:

1. Measure Temperature
2. Gauge Humidity
3. Sense Carbon Dioxide
4. Sense Fire
5. Sense Motion
6. Connecting Devices
7. Perit clients to alter the ideal qualities for the sensor
8. React to sensor readings and send alarms to the client.

4.4 External Interface Requirements:

4.4.1 User Interfaces :

The system sends an Alert message when any motion , fire, food spoilage is detected in the warehouse and it will also send alert messages when parameters like temperature , humidity goes below or above the requirements and also send alerts when food is spoiled inside the warehouse.

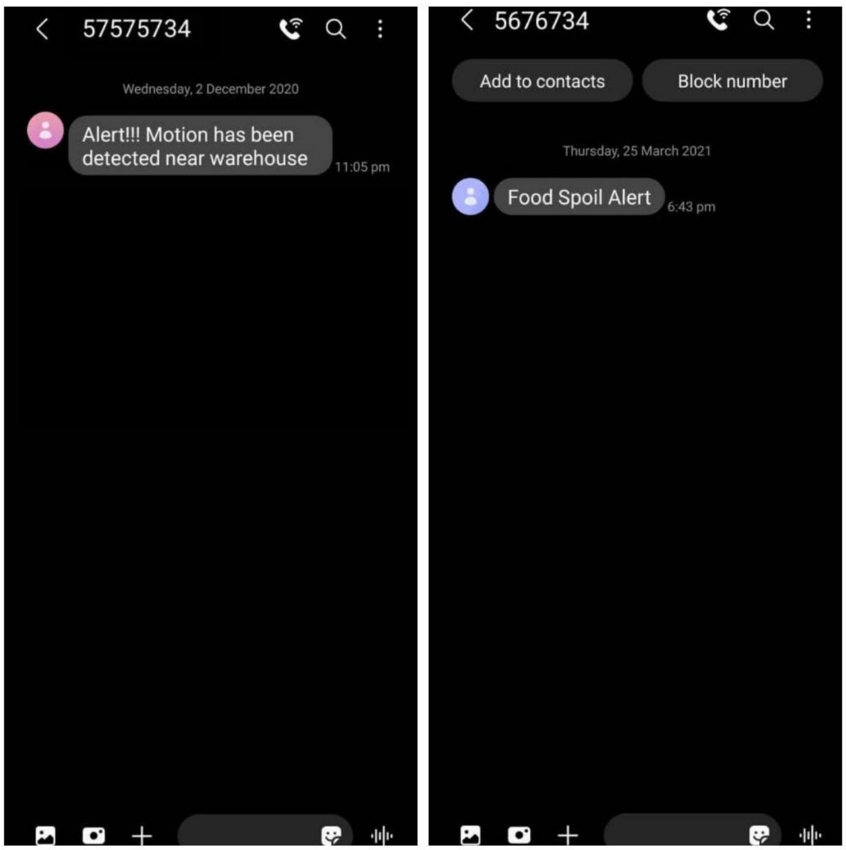


Fig 13: Motion and Food Alert

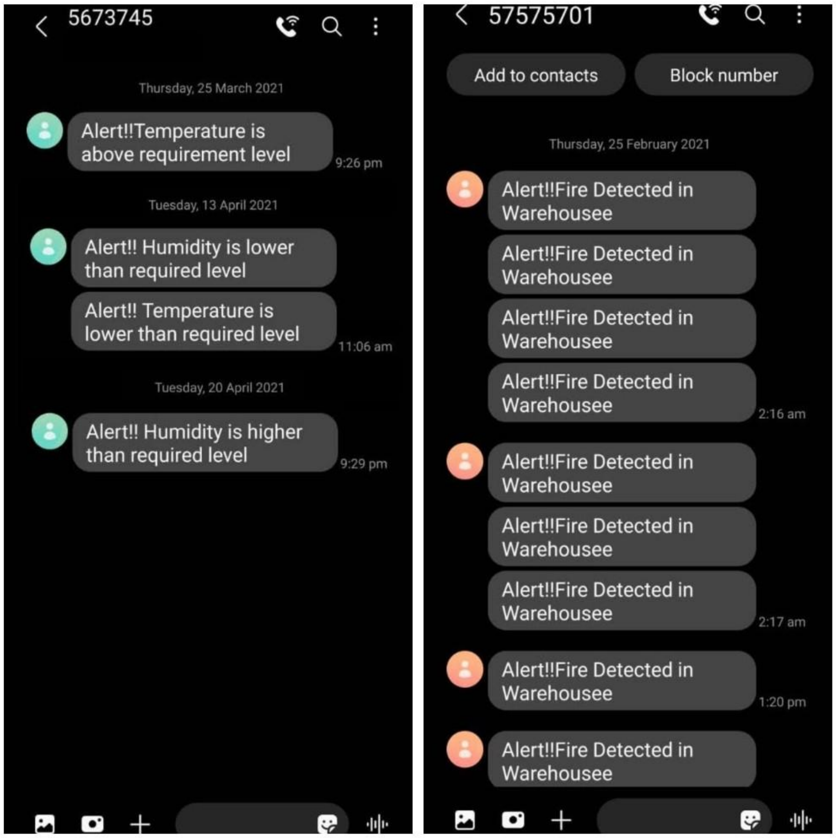


Fig 14: Fire, Temperature and Humidity Alerts

4.5 Non-Functional Requirements :

The Non-Functional Requirements of the proposed work survey the accompanying:

- **Maintainability:** The proposed framework can be updated at ease by simply coordinating extra segments with upgraded highlights.
- **Security:** The proposed system requires this feature to increase users' trust.
- **Availability:** The proposed system is manoeuvred successfully all the time.
- **Reliability:** The system has longer lifespan and the measurements are accurate.

CHAPTER-5

System Design

This segment describes design tasks and contemplations, gives a significant level outline of the system architecture, and describes the information configuration related to the framework, just as the human-machine interface and operational situations.

5.1 High Level System Design:

5.1.1 Design Description:

- **Physical Implementation:**Execution of Sensors, Actuators and Micro Controllers Implementation of Network Equipment
- **System Framework:**
    - o **Subsystems**
    - o **Sensing:** Collection of Data (environment) through Sensors.
    - o **Data Communication:** Communication between the focal and remote sensor hubs. Sensor Data is gathered into Cloud Storage.
    - o **Visualisation:** Visualisation, processing and manipulation of data.

- **Data Analysis:** Data is analysed using different algorithms. Through this the system is capable of decision making and execution based on manipulating sensor data.
- **Circuit Design:**
    - **Wireless Sensor Nodes**: Observing and Recording the states of being of the climate and putting together the gathered information at a central location.
    - **Central Node**: central and wireless nodes communication.

- ➢ Sheets, Various Databases, Cloud Storage collect Data.
- ➢ Decision making and execution is done by manipulated sensor data.
- ➢ Information is gathered through different sensors and sent to servers by wireless sensor networks.
- ➢ Data-information about ecological conditions so this is done to design the framework appropriately.
- ➢ There are many factors other than just observing ecological conditions, yield quality, factors like monitoring temperature,humidity and movements like outsider invasion into the warehouse or motion of undesired objects are some which might also have an effect on food availability and quality and also food spoilage prediction.
- ➢ Using IOT based Smart Warehouse techniques we can limit assets and ensure best utilisation to improve availability of food.

Fig 15: High Level System Design

High level system designs the client will place the food materials(vegetables,fruits) in the warehouse.Food and the warehouse will be monitored using sensors.Even fire and motion in the warehouse will be monitored using the sensors which are associated to raspberry pi by utilizing wired connections the data will be stored in raspberry pi .The information will be sent to the cloud by the wireless connection by making the connection through the cloud and the information will be stored in the database.

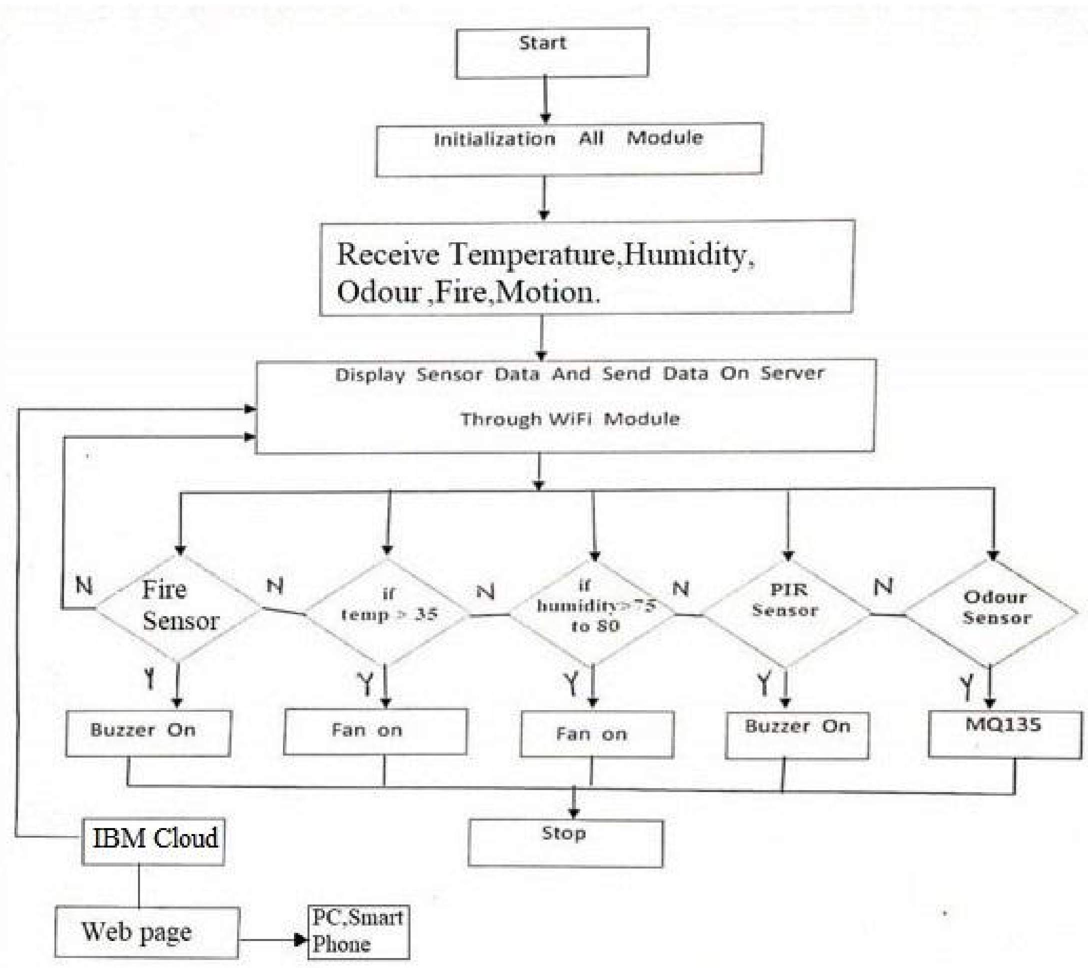


Fig 16:Flow Chart of Prototyping Framework

Remote sensor networks enable us to assemble data from detecting gadgets (sensors) and send it to the center servers.Data aggregated through the sensors gives data about various organic conditions to screen the total system appropriately.Observing the normal conditions or yield benefit isn't the ideal factor for the examination yet there are different components which sway the yield's put away in stockroom, for instance, development of an unfortunate article or food.Likewise, IoT ensures capable arranging of confined assets which ensures the best utilization of IoT to improve productivity.It finds any Temperature, humidity difference in the air and also food which is spoiled through the built application so that he can take care of the food stored in warehouse.Food spoilage detection is done by sensing the gas in the air or using the pre-existing dataset.

MQ-135 is used to monitor the food.If food is spoiled the data is sent to the cloud and the SMS will be sent to the user /client through SMS.So that if any food is spoiled that can be detected and removed from the warehouse manually.If any motion is found in warehouse using PIR sensor then the buzzer will turn ON and also sends SMS to the user/client.Mainly the data is stored on the database through the cloud(IBM CLOUD) and message is sent to the user/client mobile regarding the warehouse conditions and food health.

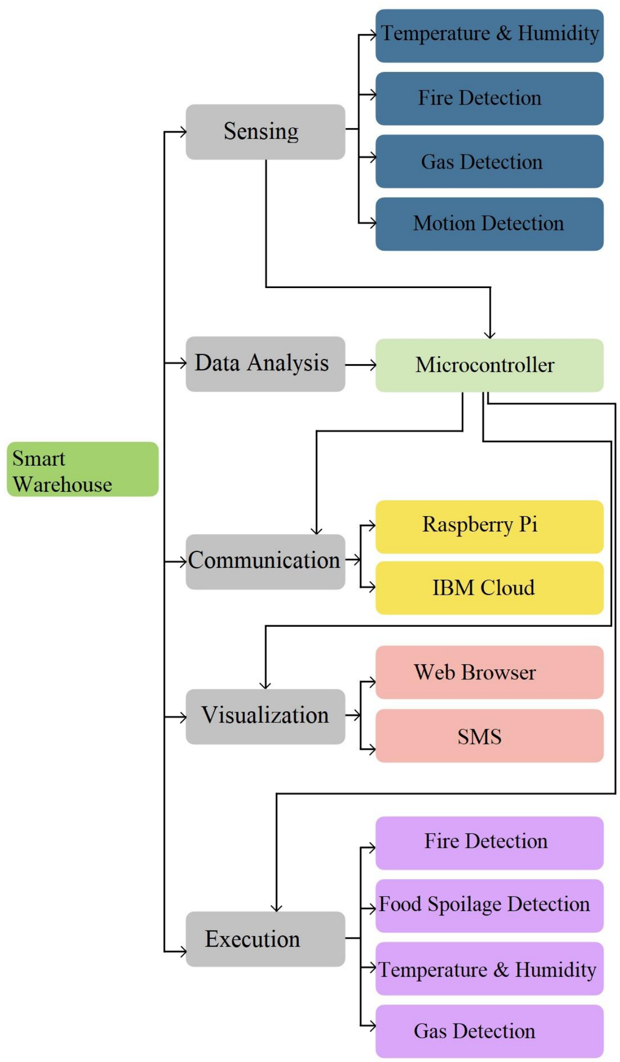


Fig 17: State Diagram

CHAPTER-6

PROPOSED METHODOLOGY

The proposed system consists of monitoring of crops in the warehouse, displaying the data in the Cloud, storing the data in cloud and sheets, website for the updating the status of crops in the mobile by using a website.

- **Monitoring of crops in the warehouse**

  For monitoring the crops in warehouse we have used 4 sensors they are PIR sensor is utilized to detect the motion such as any insects or any human being or animals that are passed around the crops in warehouse then the buzzer will TURN ON,fire sensor is utilized to detect the fire that occurs due to some calamity or if there is any short circuit in the circuit,temperature & humidity sensor is used to check current temperature & humidity which helps the crops in warehouse from early spoilage.If the temperature is less than required level then light will TURN ON and also if the temperature is higher than the required level then fan will TURN ON to either reduce or increase the temperature in the warehouse and finally gas sensor is used to check the carbon dioxide levels in the warehouse to predict the food spoilage.

  All these sensor code is dumped in raspberry pi 3b+ .All these sensors are connected to the raspberry pi 3b+ which is Wi-Fi and bluetooth connected and it is also connected to the power supply where it provides the connection for all the sensors.We have used python in raspberry pi 3b+ for connection of sensors.Fast2SMS is used to send messages to the particular user in our project.We are sending 5 messages to the user.

  1. Fire Detection
  2. Motion Detection
  3. Food Spoilage
  4. Temperature & Humidity levels

  All these are sent to users to monitor the crops and warehouse conditions.

  - **Advantages**
    - Reduced investment risk.
    - Adaptability to plan to particulars.
    - More noteworthy direct control on warehousing exercises.
    - On the off chance that the volume is adequate, this may exercise less expensive.

- **Disadvantages**
  - Cost of manpower.
  - Administrative problems.
  - Stockrooms cause exorbitant costs of merchandise because of lease charges by proprietors of the distribution center.

- **Cloud Platform**

  Here we make use of "CLOUDANT" as our cloud platform where it is used to view the data in the cloud where it can have multiple conditions such here, we set the users as viewer, editor, owner where viewer can only view the data, editor can edit the names of the key but cannot change the values manually and owner can set the viewers and editors. It is basically used for the DATA VISUALIZATION where all the sensors' data is viewed according to the monitoring of the plant.

- **Google Sheet**

  It is a Web-based spreadsheet, we can access the data stored on sheets from anywhere via the internet. We can use this as a database also for our small applications or websites. Use Google sheets to store the data and manage it in real-time. Google sheets are used to store the data that are monitored and viewed in the cloud. Which helps to store the data for every loop as soon as the monitoring is done with day-to-day updates.

- **Website**

  IBM distributed computing is a bunch of distributed computing administrations for business.It provides a web based editor for building web applications and it uses node-red.it has design editor.The design editor is assigning the values to which website can visually layout the logic of the web page using color-coded blocks to describe the program.It helps the user to view the data through Pc,Mobile,Laptop.

CHAPTER – 7

IMPLEMENTATION AND PSEUDO CODE

Step-1: Connecting Hardware Components.

o Hardware Components such as sensors, Actuators, Raspberry Pi 3b+,fan,bulb

Step-2: Collecting Environmental Data from the sensors

Step-3: Analysing the Environmental Data

Step-4: Checking the temperature and humidity levels

Step-5: Sending the alert messages to the user through Fast2SMS

Step-6: Detection of Motion

Step-7: Sending the alert messages to the user through Fast2SMS

Step-8: Detection of Food Spoilage.

Step-9: Sending the alert messages to the user through Fast2SMS

Step-10: Storing the Data in Cloud

Step-11: Saving the data in sheets.

Step-12: Displayed in the Web Browser.

PSEUDO CODE :

- **PIR Motion Detection Sensor**

```
GPIO.setup(23, GPIO.IN)
    sleep(0.5) #Wait 5 seconds and read again
      if GPIO.input(23):#pir
        M='detected'
        GPIO.output(24, True)#buzzer
        print("Motion Detected...")
        time.sleep(1)
      else:
          M='Not Detected'
          GPIO.output(24, False)
      q=requests.get('https://www.fast2sms.com/dev/bulkV2?authorization=CZajTYBFxqW9thEIuMd3QKlceHgikzSyRo0JL7b6UPVn4fpvsDJd6pvkVMt71eGDcnKIRBqQHzgNo5L9&message= Alert!!Motion is Detected&language=english&route=q&numbers=7993397777')
      print(q)
```

- **DHT22 Sensor**

```
import Adafruit_DHT

DHT_SENSOR = Adafruit_DHT.DHT22

DHT_PIN = 4

GPIO.setup(16,GPIO.OUT)#fan

GPIO.setup(27,GPIO.OUT)#Light

T=0

H=0

while True:

    H, T = Adafruit_DHT.read_retry(DHT_SENSOR, DHT_PIN)

    sensorValue = _range(channel_0.value, 0, 60000, 0, 1023)#gas sensor

    if H is not None and T is not None:

        print("Temp={0:0.1f}*C  Humidity={1:0.1f}%".format(T, H))

    else:

        print("Failed to retrieve data from humidity sensor")

    if T>30:

        GPIO.output(16,True)

        GPIO.output(27,False)#light

        print("Fan ON")

    else:

        GPIO.output(27,True)

        GPIO.output(16,False)#fan

        print('Light ON')
```

- **Fire Sensor**

```
channel=25
GPIO.setup(channel,GPIO.IN)#flame
flame=0
def callback(channel):
    print("channel",channel)
    global flame
    flame=1
    print("flame detected")
    r=
requests.get('https://www.fast2sms.com/dev/bulkV2?authorization=CZajTYBFxqW9thEIuM
d3QKlceHgikzSyRo0JL7b6UPVn4fpvsDJd6pvkVMt71eGDcnKIRBqQHzgNo5L9&message
=Alert!!Fire Detected in Warehousee&language=english&route=q&numbers=7993397777')
    print(r)
GPIO.add_event_detect(channel, GPIO.BOTH, bouncetime=300)  # let us know when the pin
goes HIGH or LOW
GPIO.add_event_callback(channel, callback)  # assign function to GPIO PIN, Run function
on change
```

- **MQ-135**

```
import adafruit_mcp3xxx.mcp3008 as MCP
from adafruit_mcp3xxx.analog_in import AnalogIn
 # Create the SPI bus
 spi = busio.SPI(clock=board.SCK, MISO=board.MISO, MOSI=board.MOSI)

 # Create the cs (chip select)
 cs = digitalio.DigitalInOut(board.D5)

 # Create the mcp object
 mcp = MCP.MCP3008(spi, cs)
 while True:
    H, T = Adafruit_DHT.read_retry(DHT_SENSOR, DHT_PIN)
    sensorValue = _range(channel_0.value, 0, 60000, 0, 1023)#gas sensor
 if (T>40 and sensorValue>150):
      print("Spoil Alert!!!")

 q=requests.get('https://www.fast2sms.com/dev/bulkV2?authorization=CZajTYBFxqW9thEIuMd3QKlceHgikzSyRo0JL7b6UPVn4fpvsDJd6pvkVMt71eGDcnKIRBqQHzgNo5L9&message=Food Spoil Alert&language=english&route=q&numbers=7993397777')
      print(q)
```

- **MCP-3008**

```
from spidev import SpiDev

class MCP3008:

    def __init__(self, bus = 0, device = 0):

        self.bus, self.device = bus, device

        self.spi = SpiDev()

        self.open()

        self.spi.max_speed_hz = 1000000 # 1MHz

    def open(self):

        self.spi.open(self.bus, self.device)

        self.spi.max_speed_hz = 1000000 # 1MHz

    def read(self, channel = 0):

        cmd1 = 4 | 2 | (( channel & 4) >> 2)

        cmd2 = (channel & 3) << 6

        adc = self.spi.xfer2([cmd1, cmd2, 0])

        data = ((adc[1] & 15) << 8) + adc[2]

        return data

    def close(self):

        self.spi.close()
```

- **IBM CLOUD**

```
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method":
authMethod, "auth-token": authToken}

deviceCli = ibmiotf.device.Client(deviceOptions)
```

- **Call Back**

```
def myOnPublishCallback():
print ("Published Temperature = %s C" % T, "Humidity = %s %%" % H, "to IBM Watson")


success = deviceCli.publishEvent("iotproject", "json", data, qos=0,
on_publish=myOnPublishCallback)
    if not success:
        print("Not connected to IoTF")
    time.sleep(1)
    flame=0
    deviceCli.commandCallback = myCommandCallback


data = { 'Temperature' : T, 'Humidity': H ,'Motion':M,'Flame':flame ,'Gas_Sensor':sensorValue}
print (data)
```

CHAPTER – 8

RESULT AND DISCUSSION

In this project the analysis of the results are Crop monitoring and Visualizing the data in Cloudant and storing the data in the sheets and alerts regarding the warehouse is sent to the user.

Crop Monitoring:

In this module it monitors the complete crop with the help of sensors and the data is visualized in cloudant and stored in sheets.

Monitoring and Controlling System:

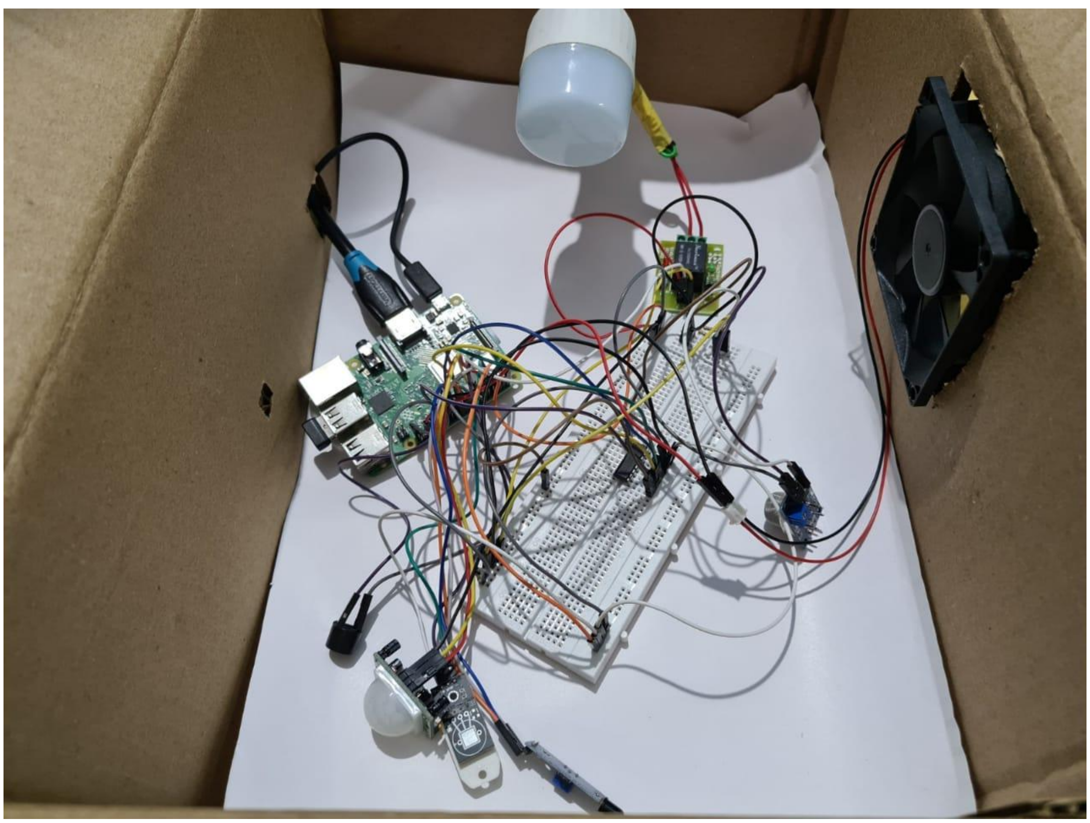


Fig 18: Smart Warehouse System

Day 1:

Fig 19: Comparing Banana in warehouse and outside the warehouse(Day 1)

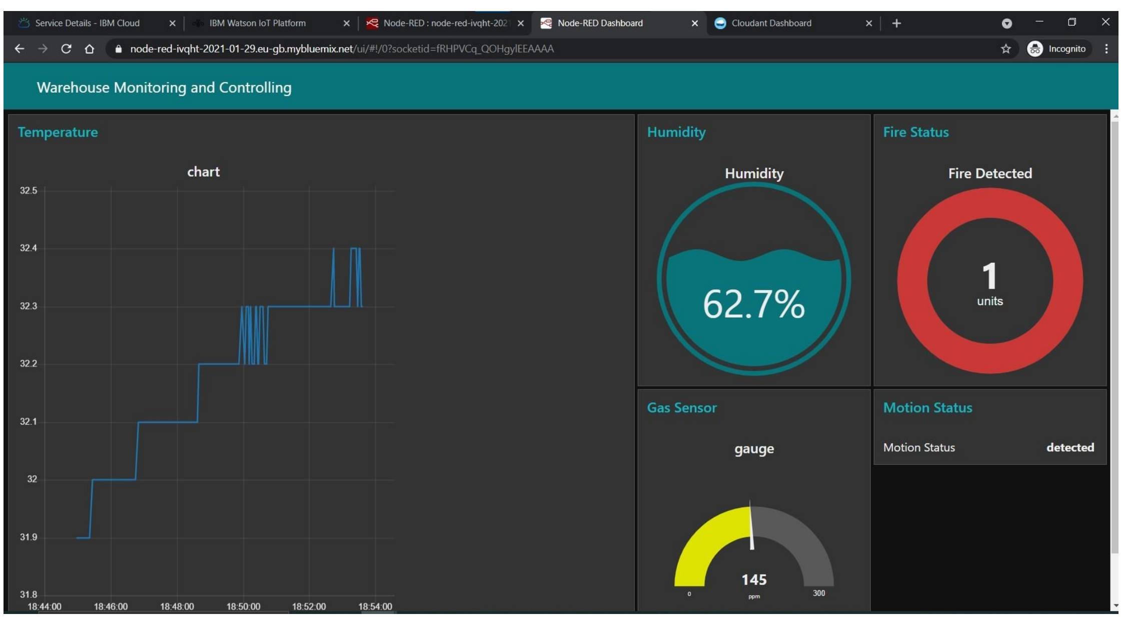


Fig 20: Results With Fire(Day 1)

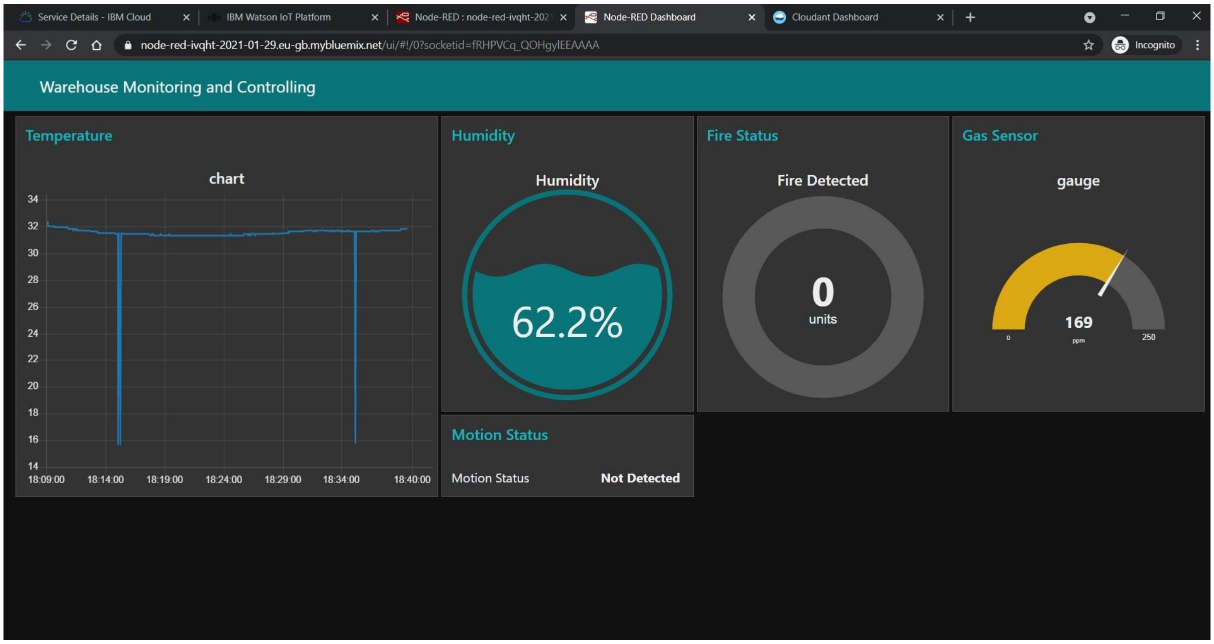


Fig 21:Results without Fire(Day 1)

Day 2:

Fig 22: Comparing Banana in warehouse and outside the warehouse(Day 2)

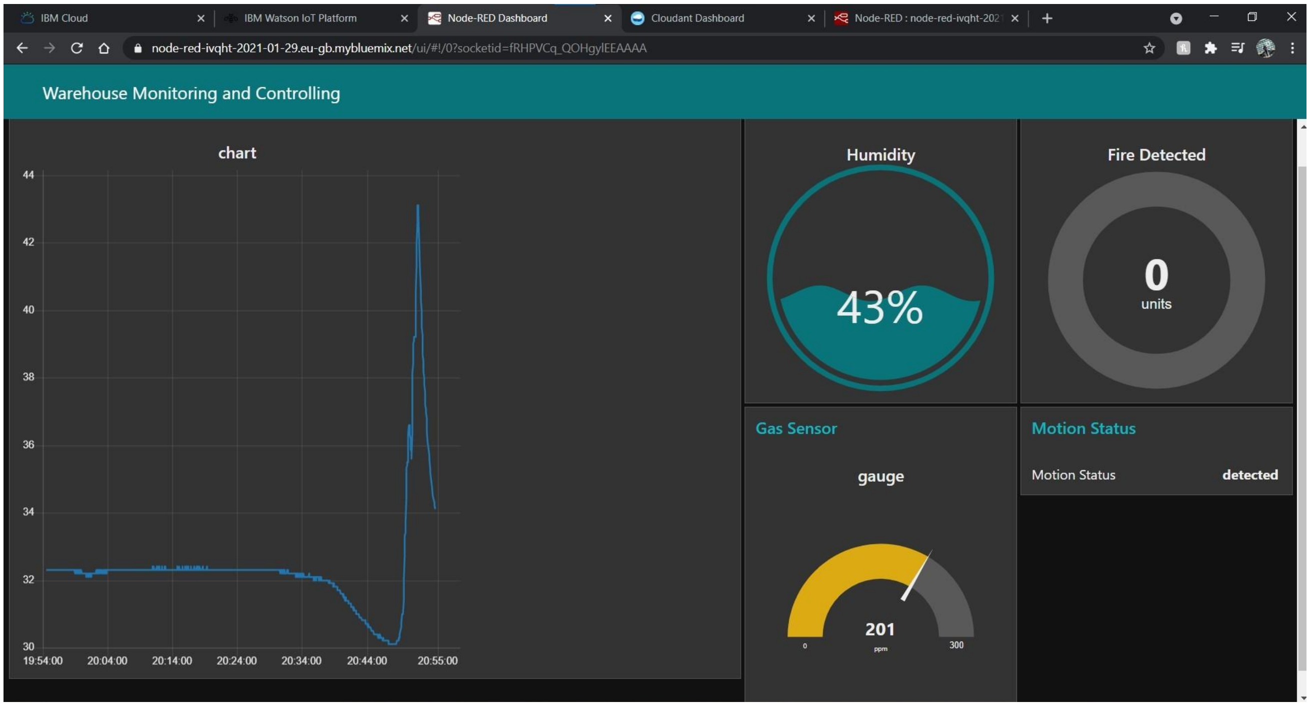


Fig 23: Results Without Fire(Day 2)

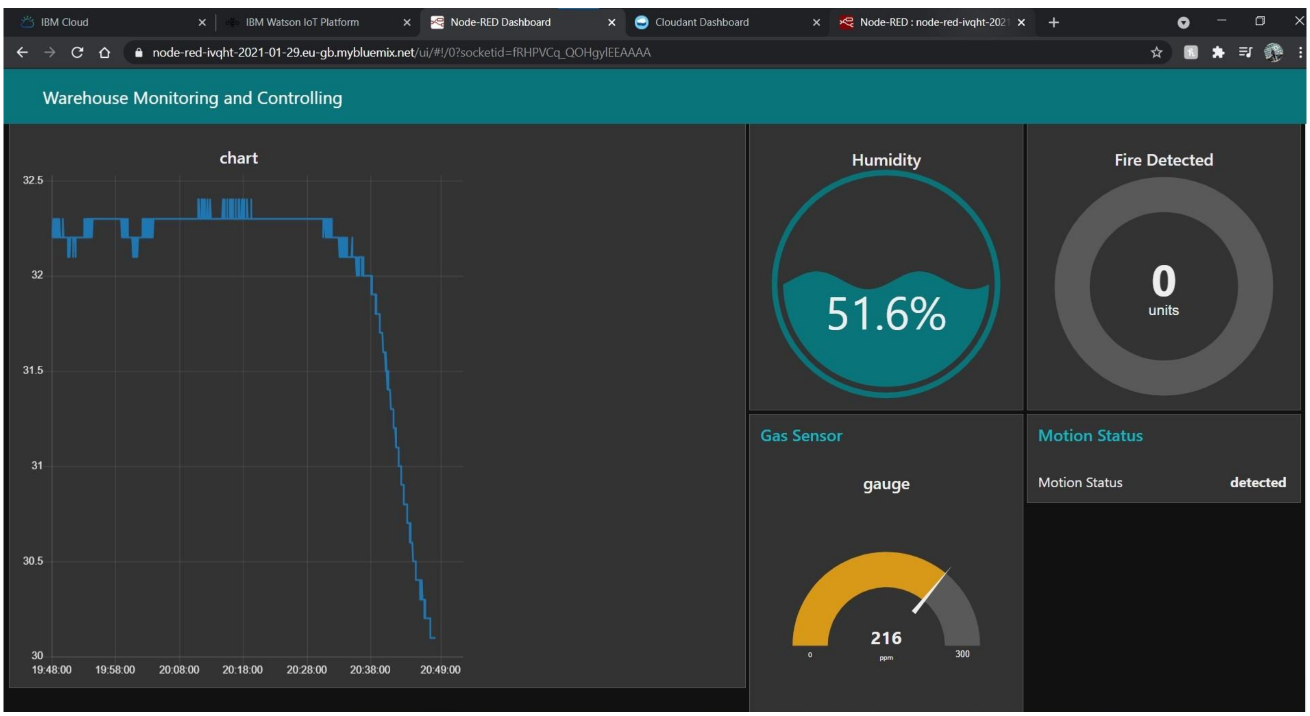


Fig 24: Results With difference in gas (Day 2)

Day 3:

Fig 25: Comparing Banana in warehouse and outside the warehouse(Day 3)

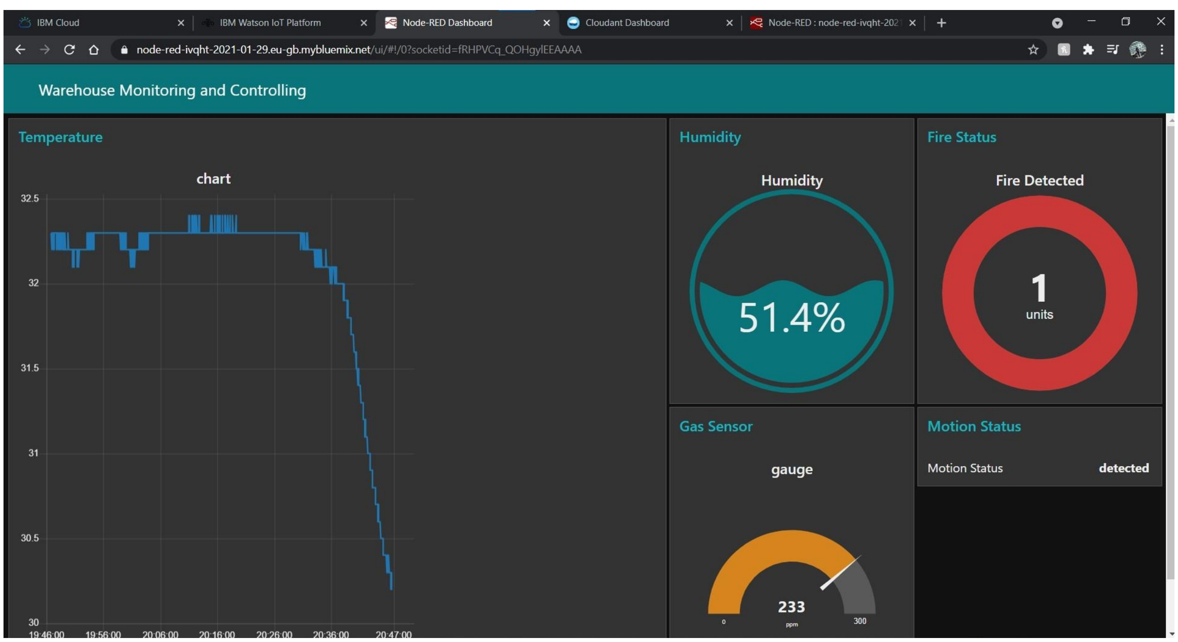


Fig 26: Results With Fire and difference in gas(Day 3)

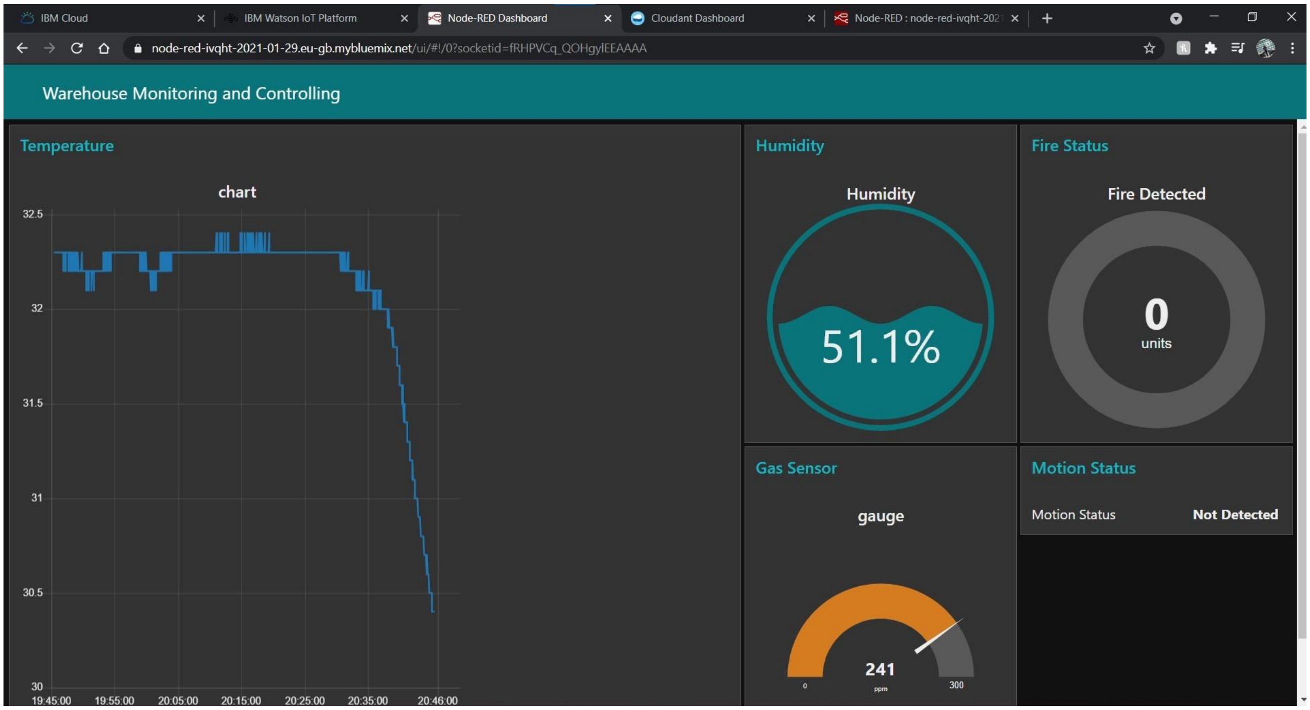


Fig 27: Results Without Fire and difference in gas(Day 3)

Day 4:

Fig 28: Comparing Banana in warehouse and outside the warehouse(Day 4)

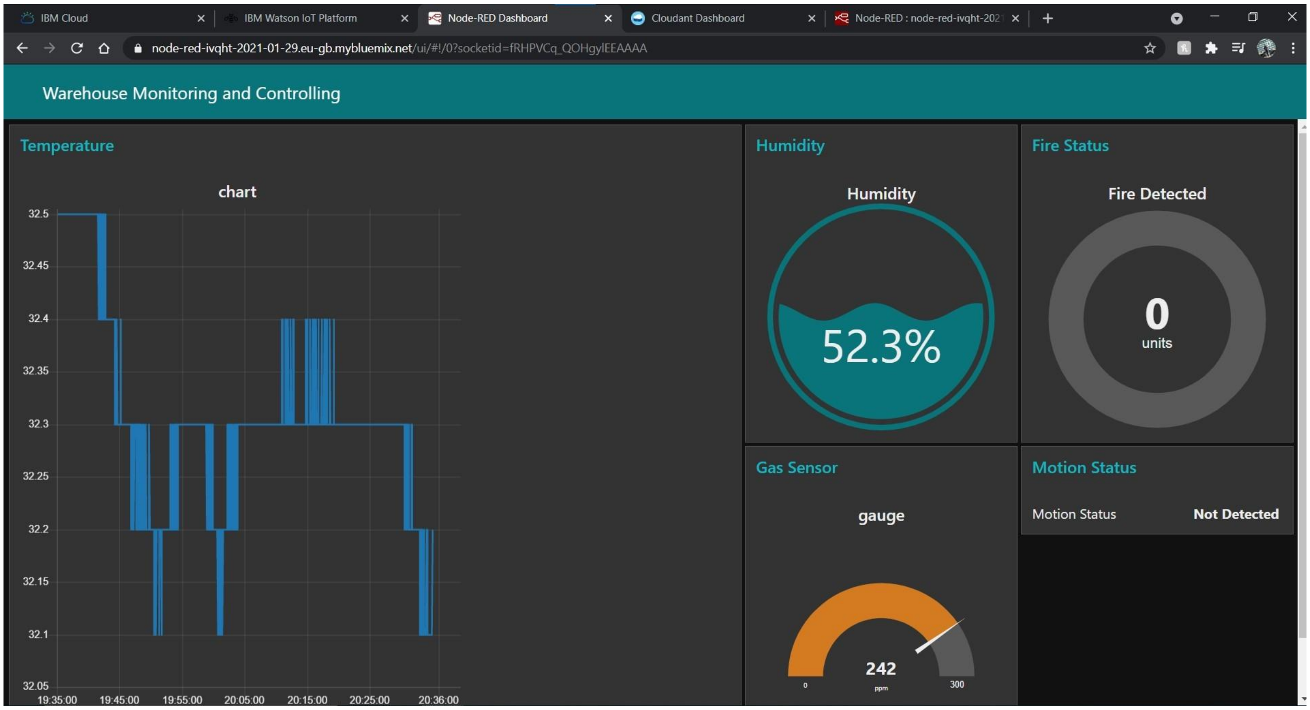


Fig 29: Results Without Fire and motion detected(Day 4)

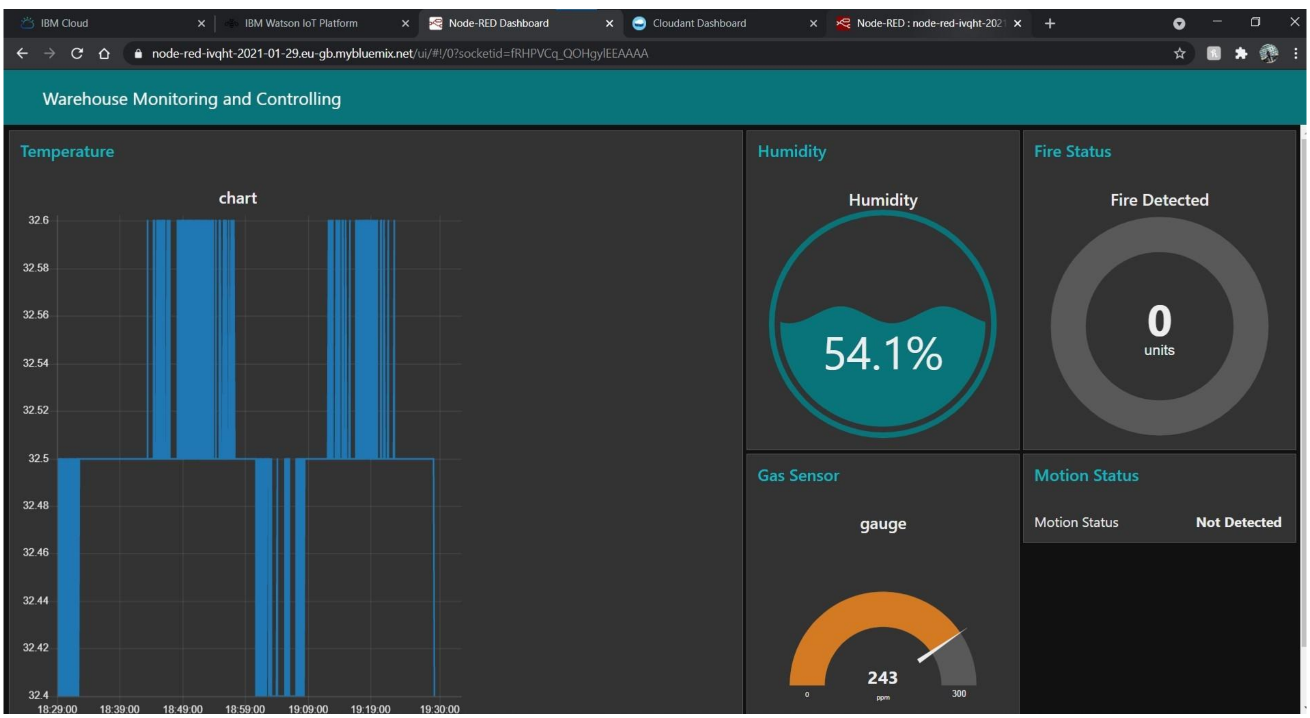


Fig 30: Results Without Fire,motion not detected and difference in gas(Day4)

Day 5:

Fig 31: Comparing Banana in warehouse and outside the warehouse(Day 5)

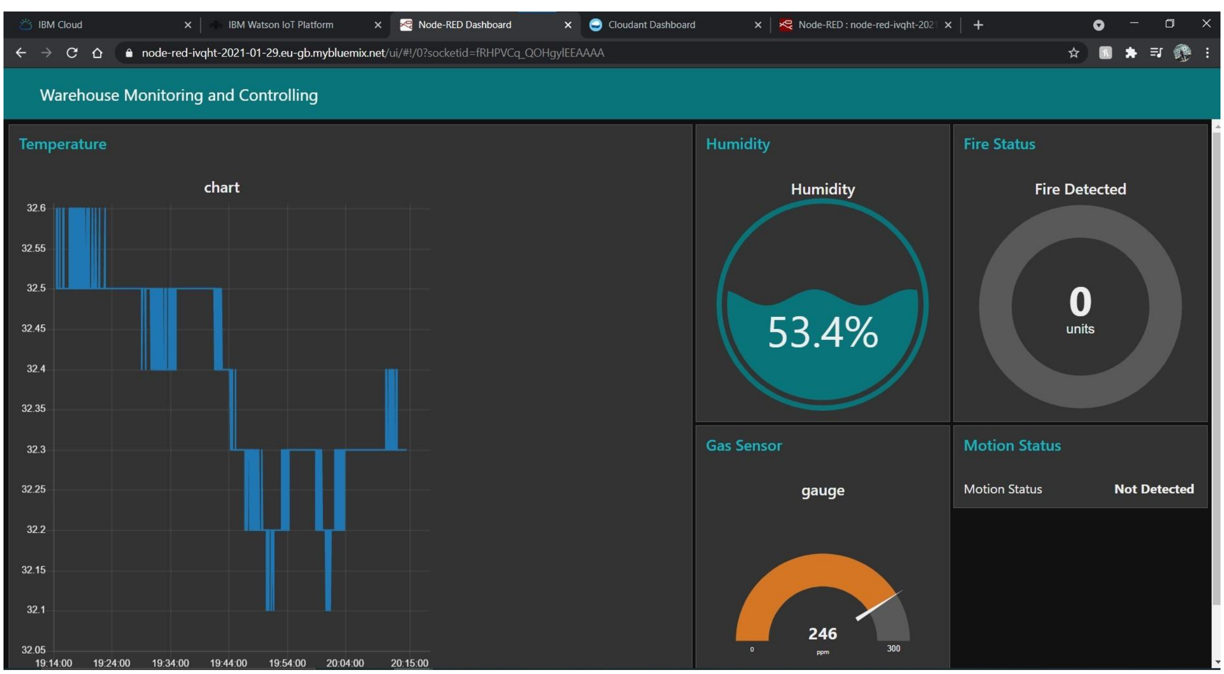


Fig 32: Results Without Fire and difference in gas(Day 5)

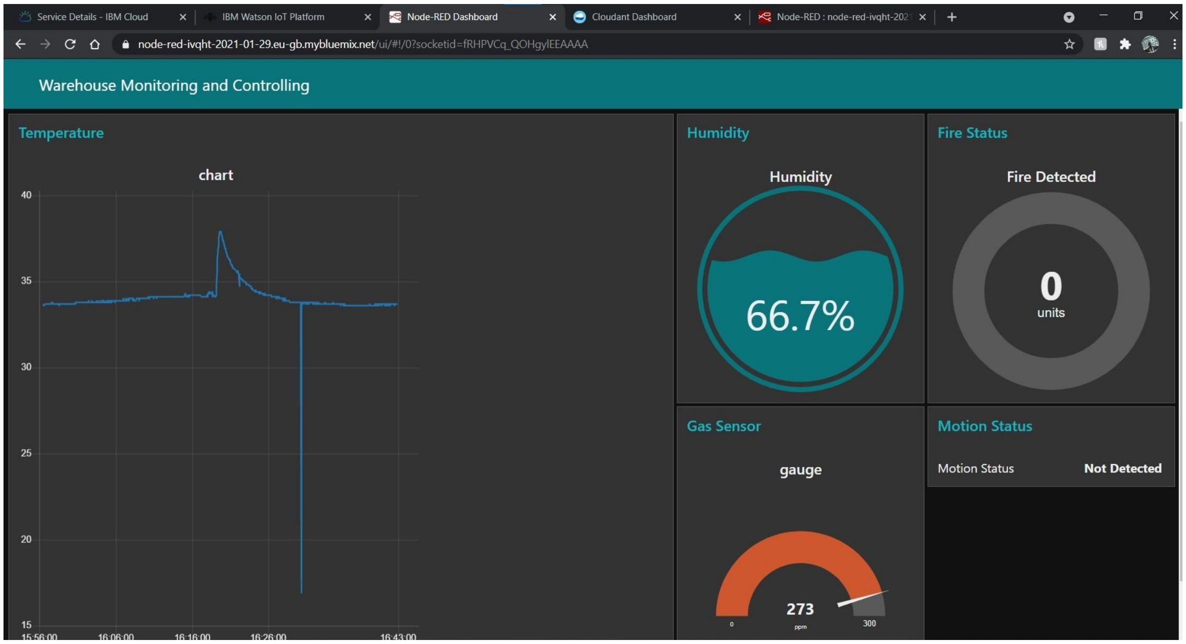


Fig 33: Results Without Fire and difference in temperature(Day 5)

Day 6:

Fig 34: Comparing Banana in warehouse and outside the warehouse(Day 6)

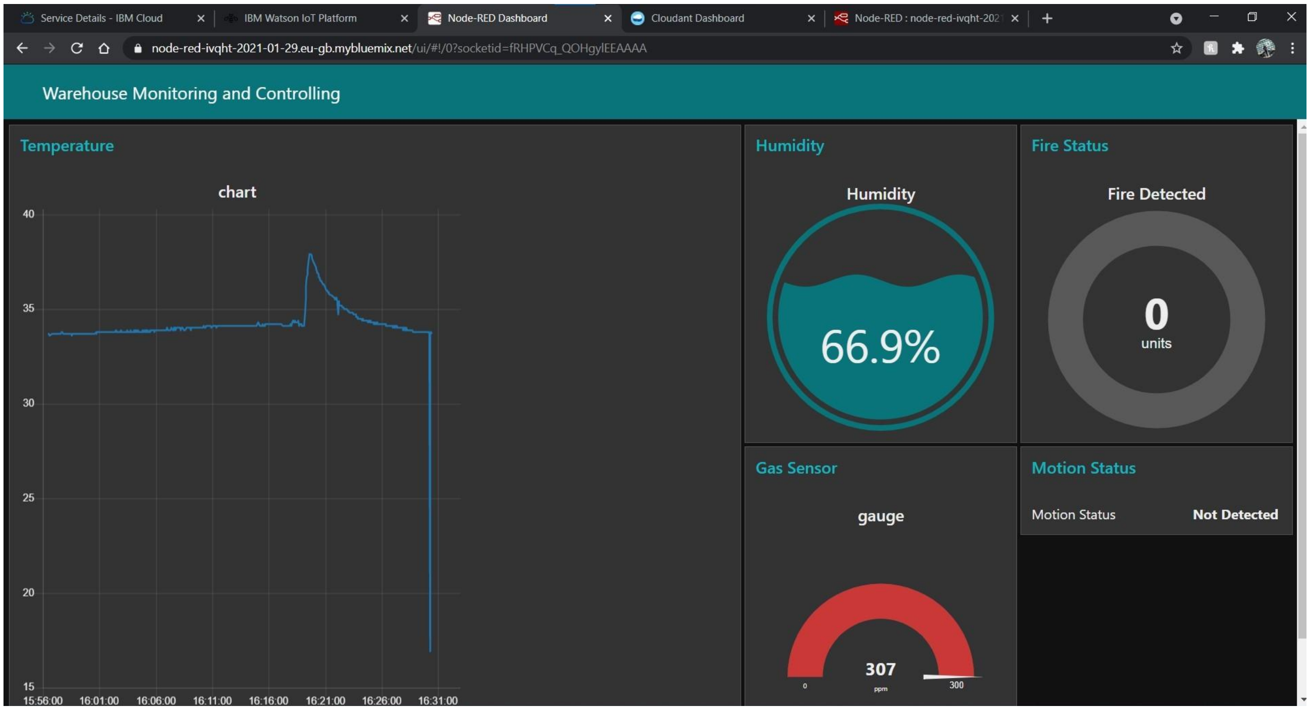


Fig 35: Results Without Fire and difference in gas(Day 6)

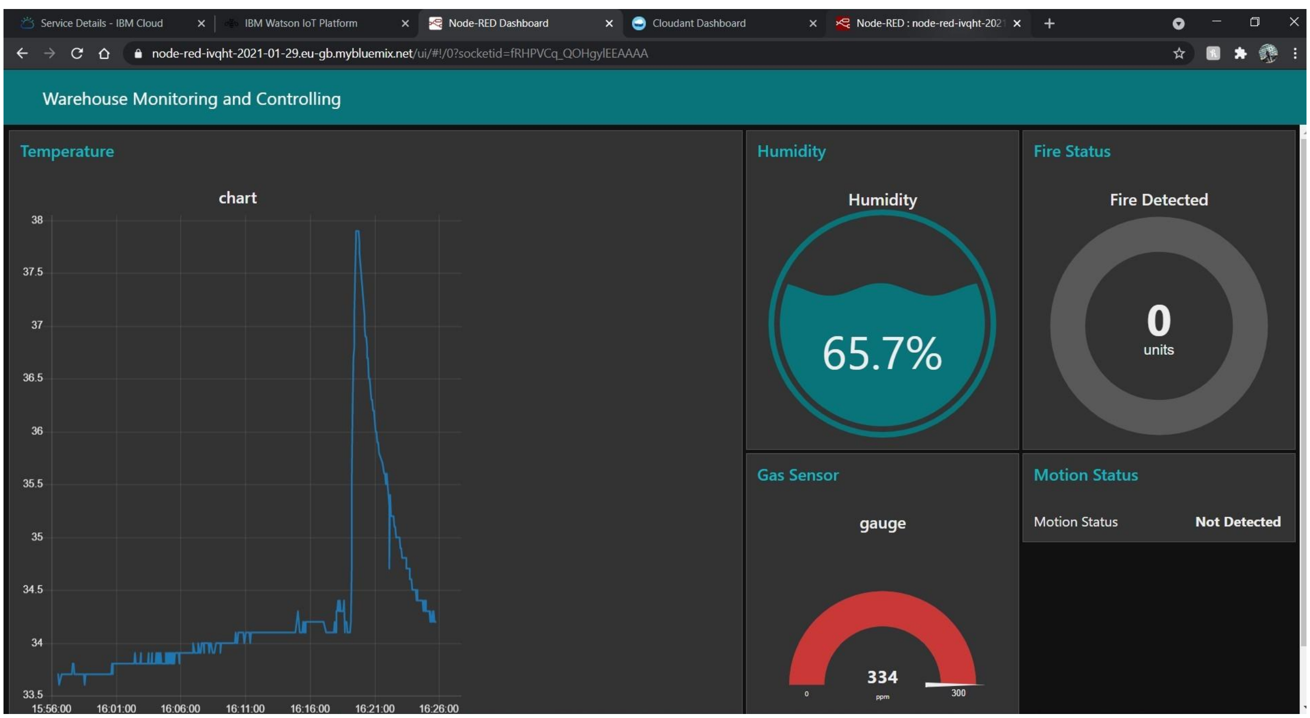


Fig 36: Results Without Fire and difference in temperature(Day 6)

Day 7:

Fig 37: Comparing Banana in warehouse and outside the warehouse(Day 7)

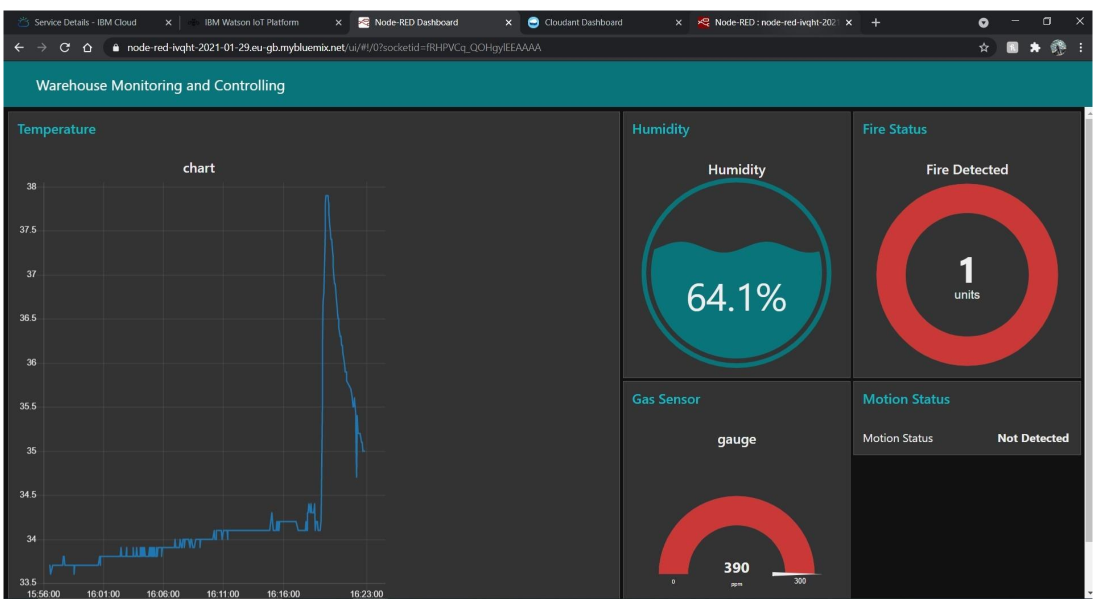


Fig 38: Results With Fire and difference in temperature(Day 7)

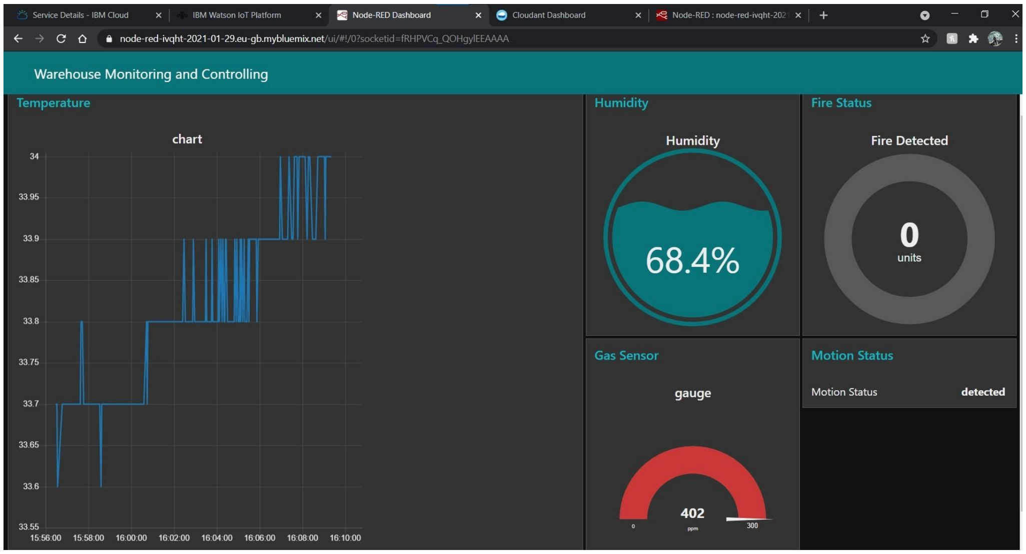


Fig 39: Results Without Fire and difference in gas(Day 7)

Day 8:

Fig 40: Comparing Banana in warehouse and outside the warehouse(Day 8)

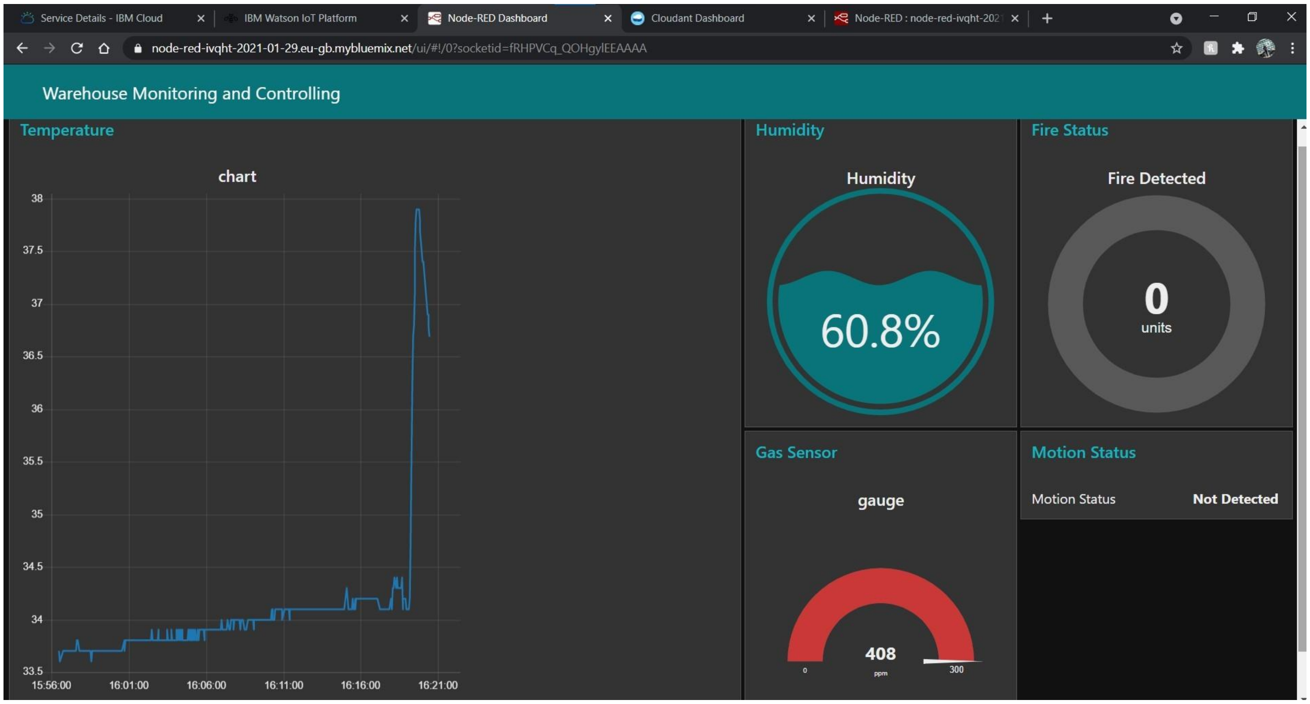


Fig 41: Results Without Fire and difference in temperature(Day 8)

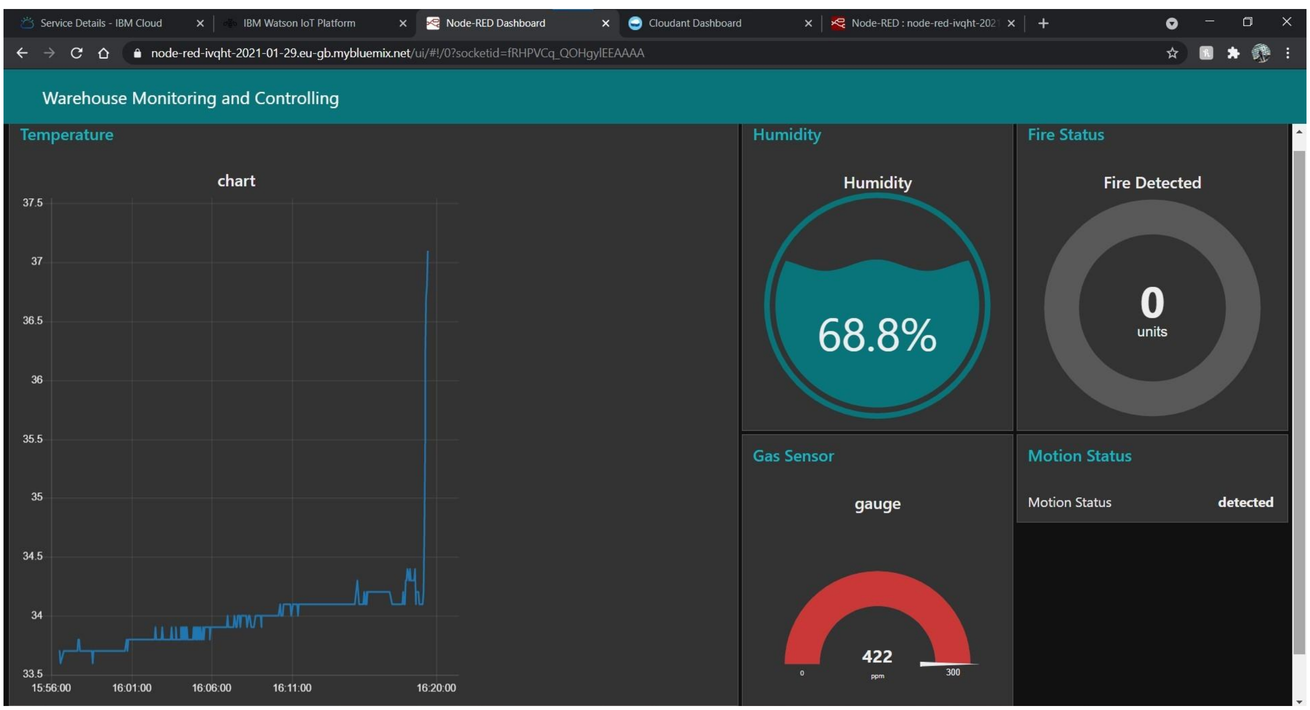


Fig 42: Results Without Fire and difference in gas(Day 8)

Day 9:

Fig 43: Comparing Banana in warehouse and outside the warehouse(Day 9)

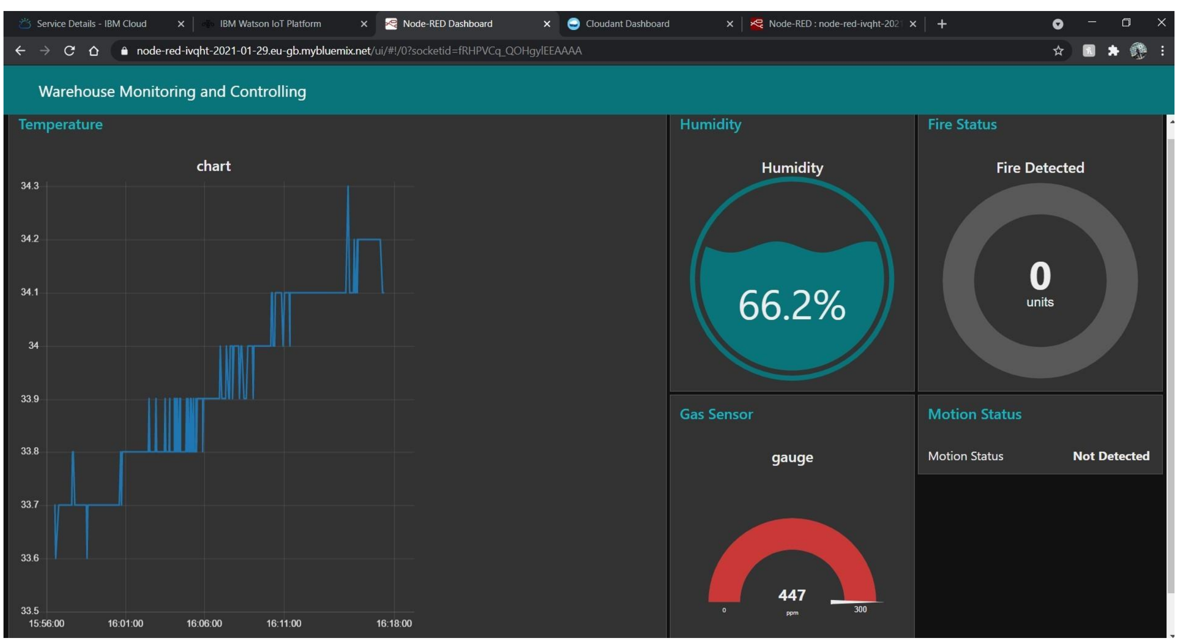


Fig 44: Results Without Fire and difference in gas(Day 9)

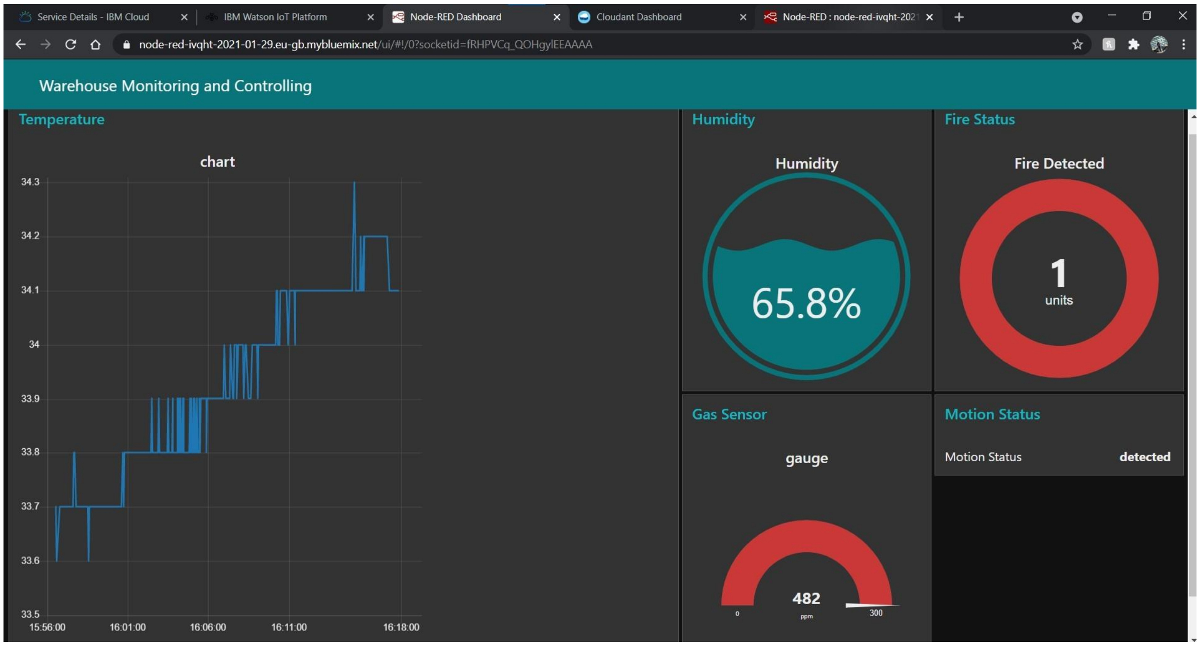


Fig 45: Results With Fire and difference in temperature & gas(Day 9)

Database:

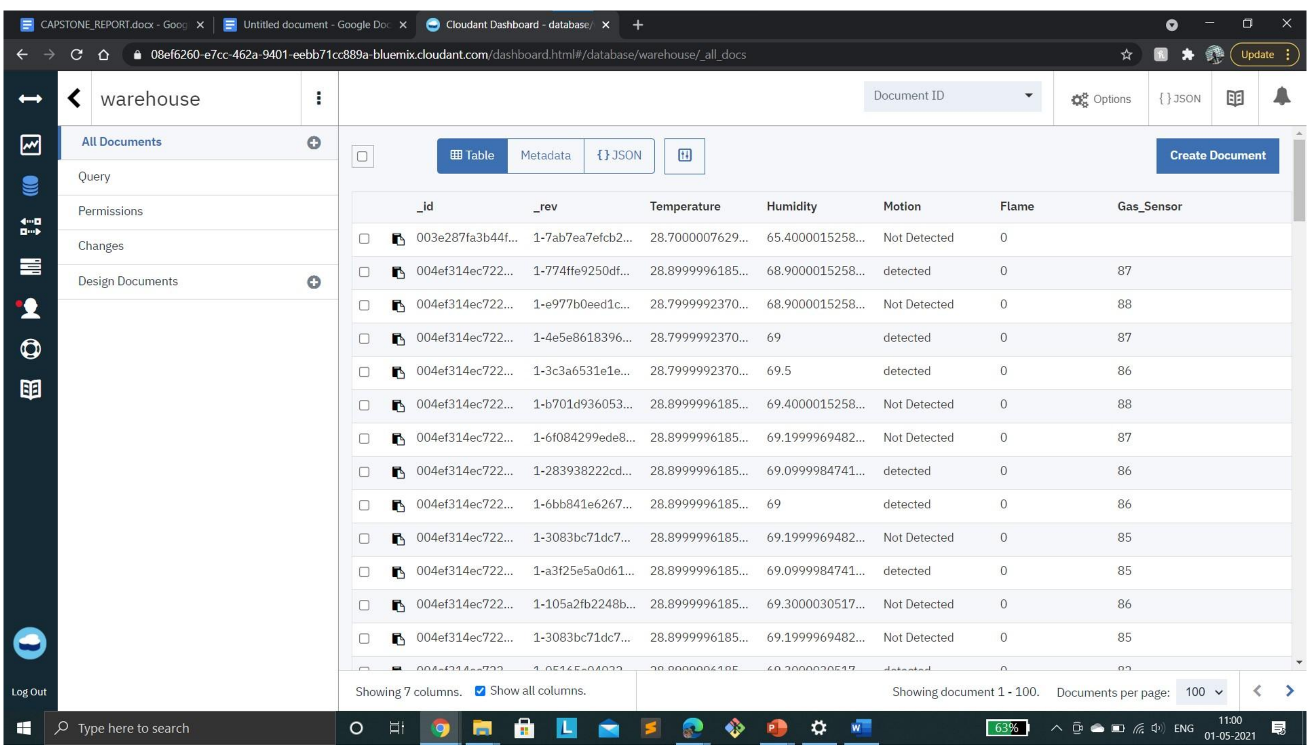
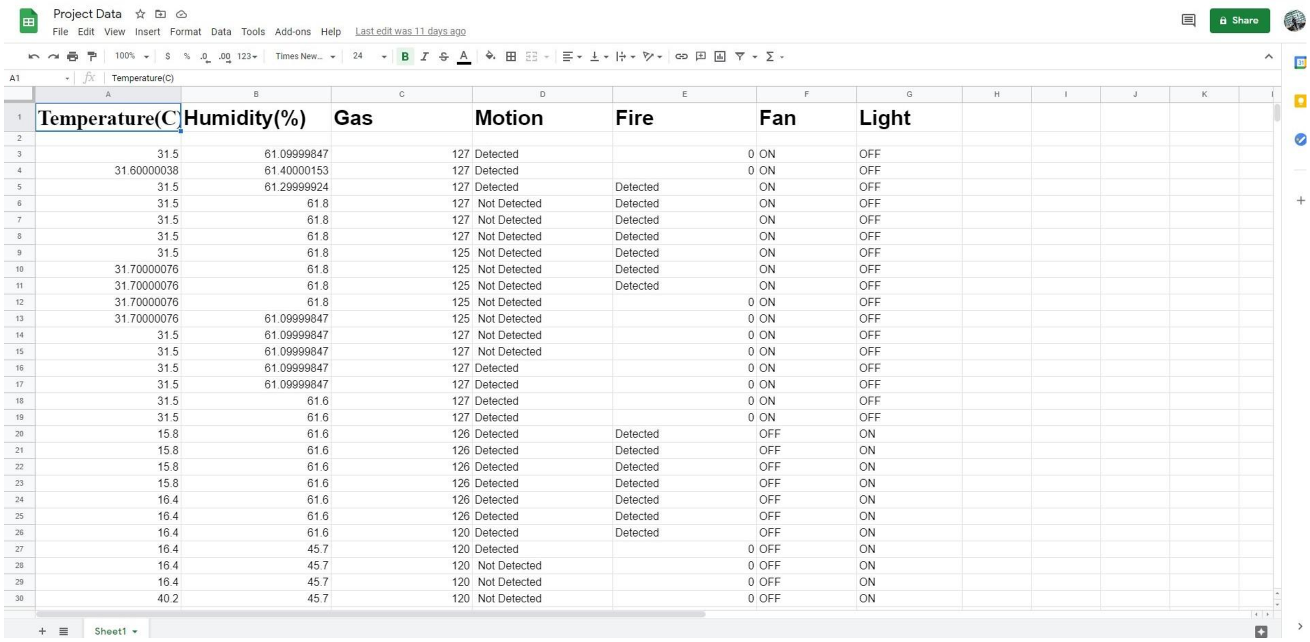


Fig 46:Results stored in cloud

Sheets:



Temperature(C	Humidity(%)	Gas	Motion	Fire	Fan	Light
31.5	61.09999847	127	Detected	0	ON	OFF
31.60000038	61.40000153	127	Detected	0	ON	OFF
31.5	61.29999924	127	Detected	Detected	ON	OFF
31.5	61.8	127	Not Detected	Detected	ON	OFF
31.5	61.8	127	Not Detected	Detected	ON	OFF
31.5	61.8	127	Not Detected	Detected	ON	OFF
31.5	61.8	125	Not Detected	Detected	ON	OFF
31.70000076	61.8	125	Not Detected	Detected	ON	OFF
31.70000076	61.8	125	Not Detected	Detected	ON	OFF
31.70000076	61.8	125	Not Detected	0	ON	OFF
31.70000076	61.09999847	125	Not Detected	0	ON	OFF
31.5	61.09999847	127	Not Detected	0	ON	OFF
31.5	61.09999847	127	Not Detected	0	ON	OFF
31.5	61.09999847	127	Detected	0	ON	OFF
31.5	61.09999847	127	Detected	0	ON	OFF
31.5	61.6	127	Detected	0	ON	OFF
31.5	61.6	127	Detected	0	ON	OFF
15.8	61.6	126	Detected	Detected	OFF	ON
15.8	61.6	126	Detected	Detected	OFF	ON
15.8	61.6	126	Detected	Detected	OFF	ON
15.8	61.6	126	Detected	Detected	OFF	ON
16.4	61.6	126	Detected	Detected	OFF	ON
16.4	61.6	126	Detected	Detected	OFF	ON
16.4	61.6	120	Detected	Detected	OFF	ON
16.4	45.7	120	Detected	0	OFF	ON
16.4	45.7	120	Not Detected	0	OFF	ON
16.4	45.7	120	Not Detected	0	OFF	ON
40.2	45.7	120	Not Detected	0	OFF	ON

Fig 47: Results stored in sheets

CHAPTER – 9

CONCLUSION AND FUTURE WORK

There are no limitations on how many connections and sensors can be set up in an IOT smart warehouse system. The discussed model and IOT system design explored in this project can be implemented in a small setting like a storage house in the backyard and even on a large-scale warehouse.All the components and design can be scaled down to meet the user's needs.However,it should be noted that the smart warehouse(as an application of IOT Technology) has not been given much attention and sufficient research. This basically happened because this kind of warehouse is costly and it's available only in highly developed areas.But given more attention especially from countries with much agricultural exports,smart warehouses have the potential to revolutionize the way warehouses operate and hence to boost the food availability and food market around the world.

For further research and study, we can use ML Algorithm.Furthermore,in this system we can add a GSM module and incorporate USSD functionality to implement an offline action control mechanism for warehouse management.This is relevant to users in remote areas where the internet connection is weak. We can add more sensors likeMQ-2,IR Sensor,LDR Sensor etc..We can add a heater instead of light.We can add LCD Display.Create an app instead of Web Page.

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12. https://ieeexplore.ieee.org/abstract/document/9198549/authors#authors /2020

Appendix A:Definitions, Acronyms and Abbreviations

- ML : Machine Learning Techniques
- IR : Infrared Radiation Sensor
- LDR : Light Dependent Resistor Sensor
- GSM : Global System for Mobile Communication
- PIR : A passive infrared sensor
- IOT : Internet Of Things
- HTML : Hypertext Mark-up Language is the standard mark-up language for documents designed to be displayed in a web browser. It can be assisted by technologies such as Cascading Style Sheets and scripting languages such as JavaScript.
- Food : Any nutritious substance that people or animals eat or drink or that plants absorb in order to maintain life and growth.