HIGH LEVEL DESIGN DOCUMENT

Monitoring and Controlling the Crops in Warehouse using IOT

UE17CS490A – Capstone Project Phase – 1

Submitted by:

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1. Introduction

India is the country where the agricultural sectors play a major role in the economy. Every year farmers face numerous problems due to the storage requirements, lack of proper monitoring of the food stored. Warehouse in the agriculture sector is considered as the more crucial sector generally for ensuring food security. In earlier days, there were outmoded methods for storing the foods and grains which required a lot of the manual approach occasionally which is time-consuming and inefficient. Food and grains start to spoil once they are harvested. And only a small part of the food and grains are stored in warehouses. A large part of the crops is left without proper storage facilities. due to the fluctuations in the market supply both from one season to next and from one year to next, the losses that the country faces every year due to improper storage is about Rs.50,000 cores in monetary terms.

A warehouse provides protection of foods from loss and damage due to excessive heat, moisture, dust, and wind. The main aim must be to maintain the crop in good condition for as long as possible. Storage of crops is one of the functions of warehousing where protection of crops and risk bearing is an essential factor. In addition, it prevents any mishaps like theft or loss. As observed by the study of the Food and Agriculture Organization that the higher the temperature, the lower should be the moisture of the grain in order to make sure good conservation of the crops. Due to high temperature, food loses its weight slowly and in the end is rotten.

The main objective of this work is to develop a monitoring and controlling of yields in warehouses using IOT which will give live data of temperature, moisture and other parameters and also to control these parameters remotely over the internet. Means if an unexpected situation is created then admin can control the situation via the internet using a web page. Another purpose is to automate this process where everything like storage temperature, humidity is automatically maintained without human interaction.

2. Design Considerations

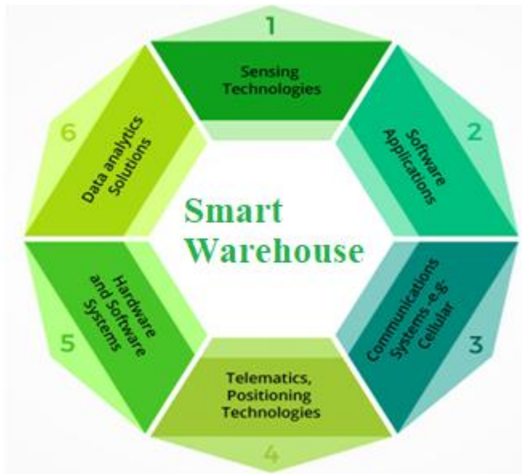
2.1. Design Goals

- **Physical Implementation**:

  Execution of Sensors, Actuators and Micro-Controllers Implementation of Network Equipment

- **Subsystems:**
  - **Sensing**: Collection of Data (environment in warehouse) through Sensors.
  - **Data Communication**:
    - Communication between the central and wireless sensor nodes. Sensor Data is collected into sheets, various Databases, Cloud Storage.
  - **Visualization:** visualization, processing and manipulation of data.
  - **Data Analysis**:
    - Data is analyzed 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**: consists of Raspberry Pi, GSM Module, Exhaust fan.



2.2. Architecture Choices

Our Choice of Architecture is Layered Architecture. layered Architecture consists of :

❖ **Application Layer** - Because of the concern of energy consumption and stern computation involved by the IoT devices there are several lightweight protocols that are adopted on the application layer such as MQTT, CoAP, AMQP, and HTTP. The mentioned protocols can be decreased or increased according to the requirement. The Raspberry-Pi Wi-Fi module uses the protocol HTTP in the application layer. HTTP is a well-known web messaging protocol based on the request/response architecture.

Pros:

- Reduced investment risk.
- Flexibility to design to specifications.
- Greater direct control on warehousing activities.
- If the volume is sufficient, this may workout cheaper.

- Our proposed solution uses a limited number of sensors required for operation and connected using wire networks which are less vulnerable to security.

Cons:

- Cost of manpower.
- Administrative problems.
- Warehouses cause high prices of goods due to rent charges by owners of the warehouse.

2.3. Constraints, Assumptions

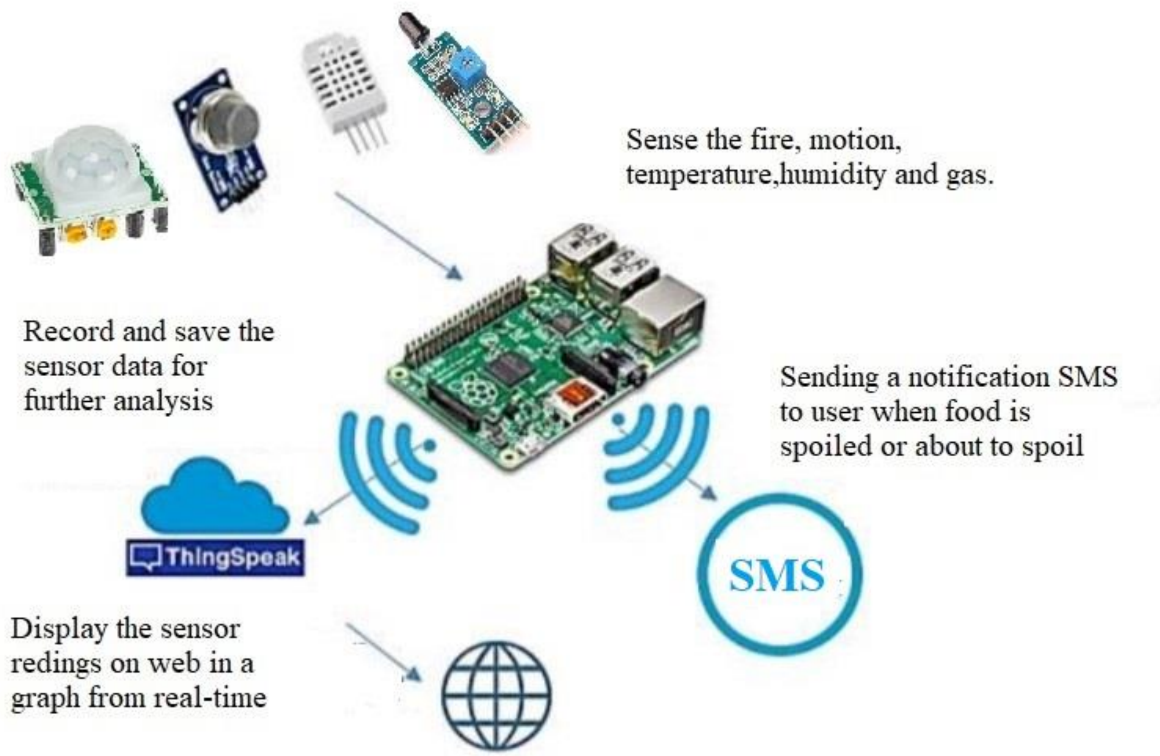
The constraints of the system are:

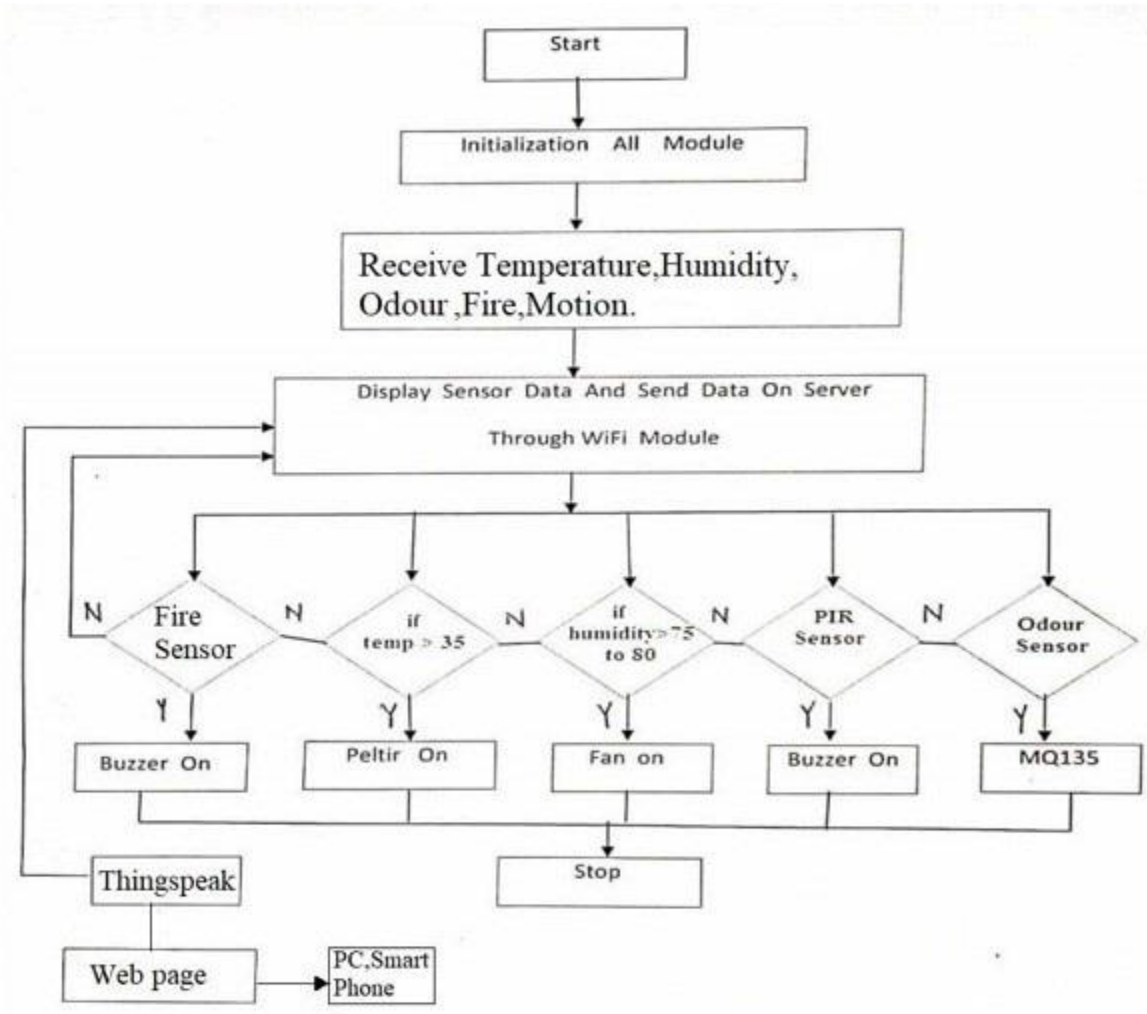
- Revenue and Affordability
- Consumption of Power-Needs 24/7 Power Supply
- Communication Range
- Data Availability and Quality
- Quality of Wireless link

The general assumptions of our product are:

- Regular supply of goods into the market place by being able to store goods when supply exceeds demand and then releasing them when demand exceeds.
- Maintaining consistent stock levels helps prices to stay stable, making it easier for businesses to forecast production, profit and loss.

3. High Level System Design





Wireless sensor networks empower us to gather information from detecting gadgets (sensors) and send it to the core servers. Information gathered through the sensors gives data about various ecological conditions to screen the entire framework appropriately. Observing the ecological conditions or yield productivity isn't just the factor for the assessment yet there are numerous different variables which impact the yield's stored in warehouse, for example, movement of an undesirable object or food. Besides, IoT ensures efficient scheduling of limited 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, Mainly the data is stored on the database through the cloud(Thing Speak) & through the GSM module the signal(message) is sent to client mobile regarding the indication of the temperature, humidity and food spoilage .

Food spoilage detection is done by sensing the gas in the air or using the pre-existing dataset

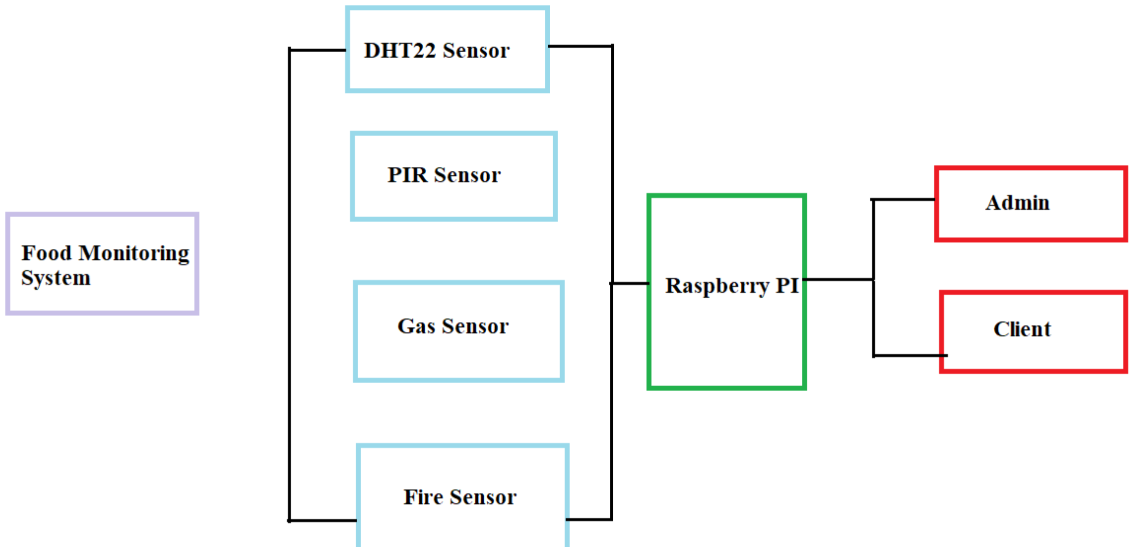


Fig: UML Component Diagram

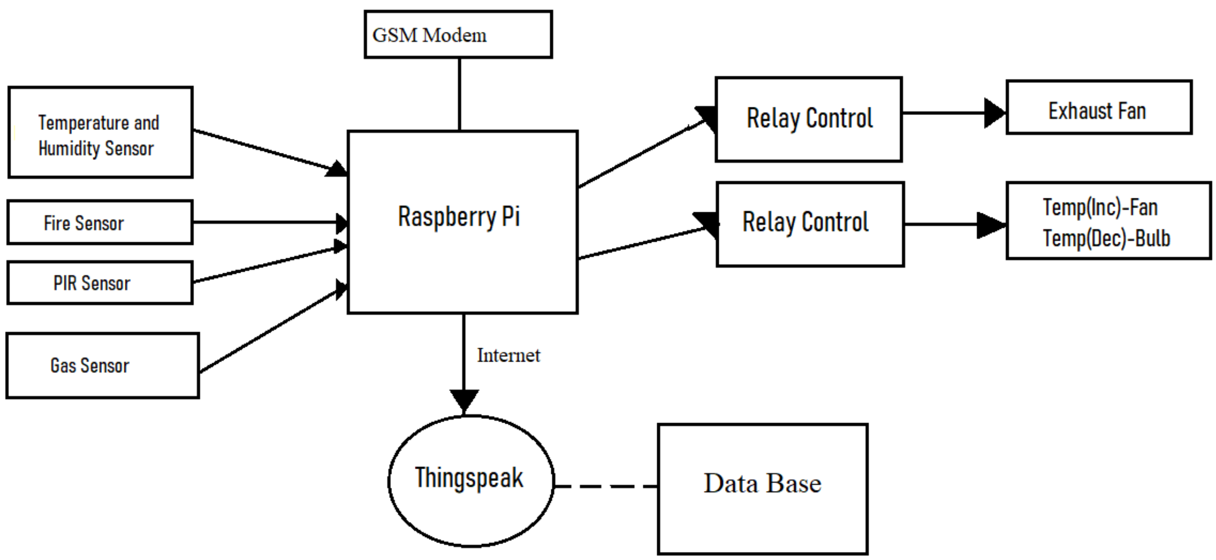
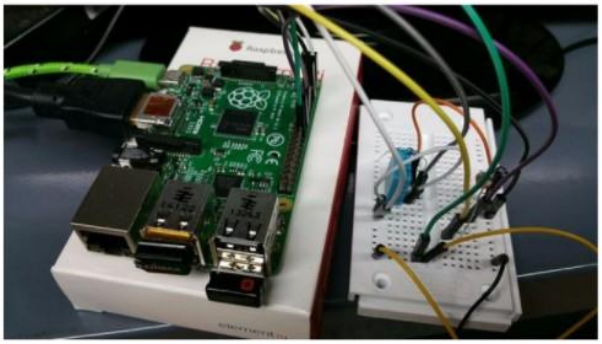
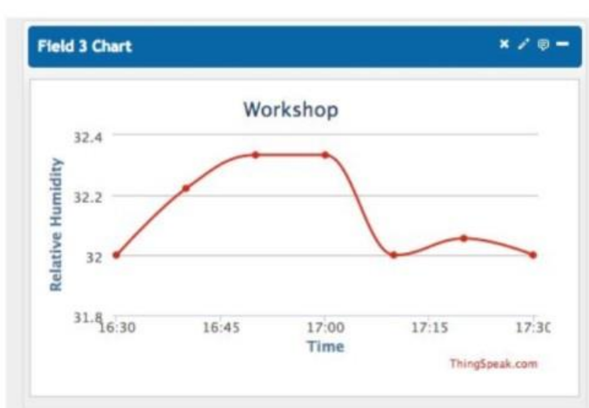
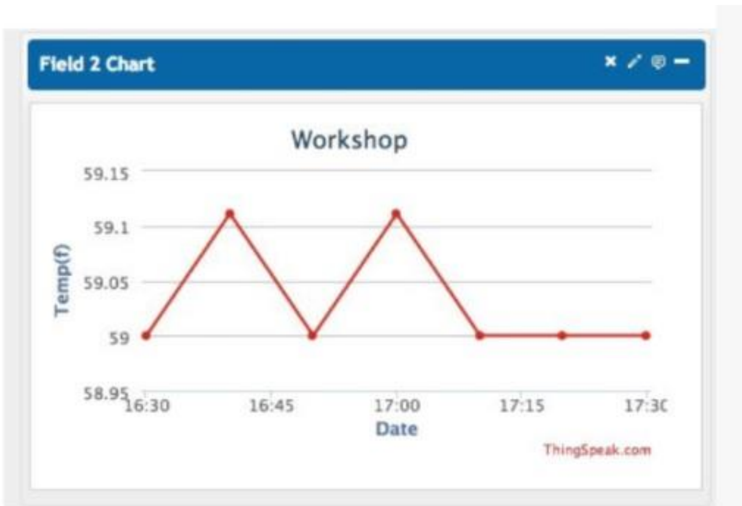


Fig: UML-Deployment Diagram







Code Architecture (Software Architecture) To obtain the desired output from the system it is required to program the system effectively. The mentioned central node and wireless sensor nodes are needed to be programmed separately so as to make them do their assigned work.

1. Including the required headers

2. Defining the pins of each sensor and modules

3. Defining the purpose of each pin (Input/output)

4. Defining variables for containing data of each sensor

5. Each sensor is collecting data and storing to assigned variable

6. Each sensor data is transmitting to the central node

7. Comparing each sensor data with the threshold

8. If sensor data satisfy the threshold loop

9. Send SMS to the user's mobile phone via GSM module

10. Setup and design of webpage

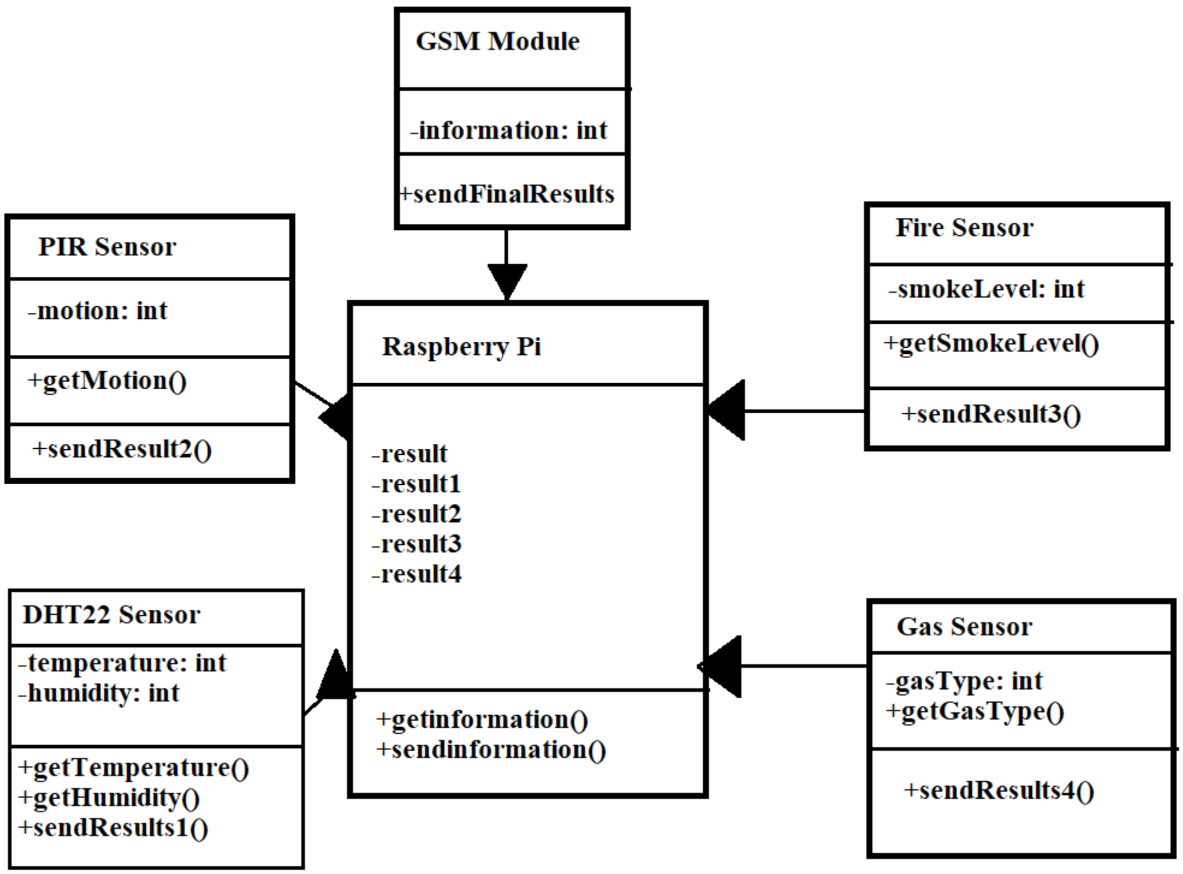
11. Cloud storage configuration (if want to store and visualize data using cloud storage) types of equipment so that the programming of each of them will be the same

- **DATA SECURITY AND PRIVACY** Farmers who deploy smart food storage fear that their data might be stolen by competitors or be publicly released. Hence, data security is crucial and agreements with technology providers should include specific clauses. Although most smart farming techniques process non-personal data, linking of such information to particular personally identifiable information.

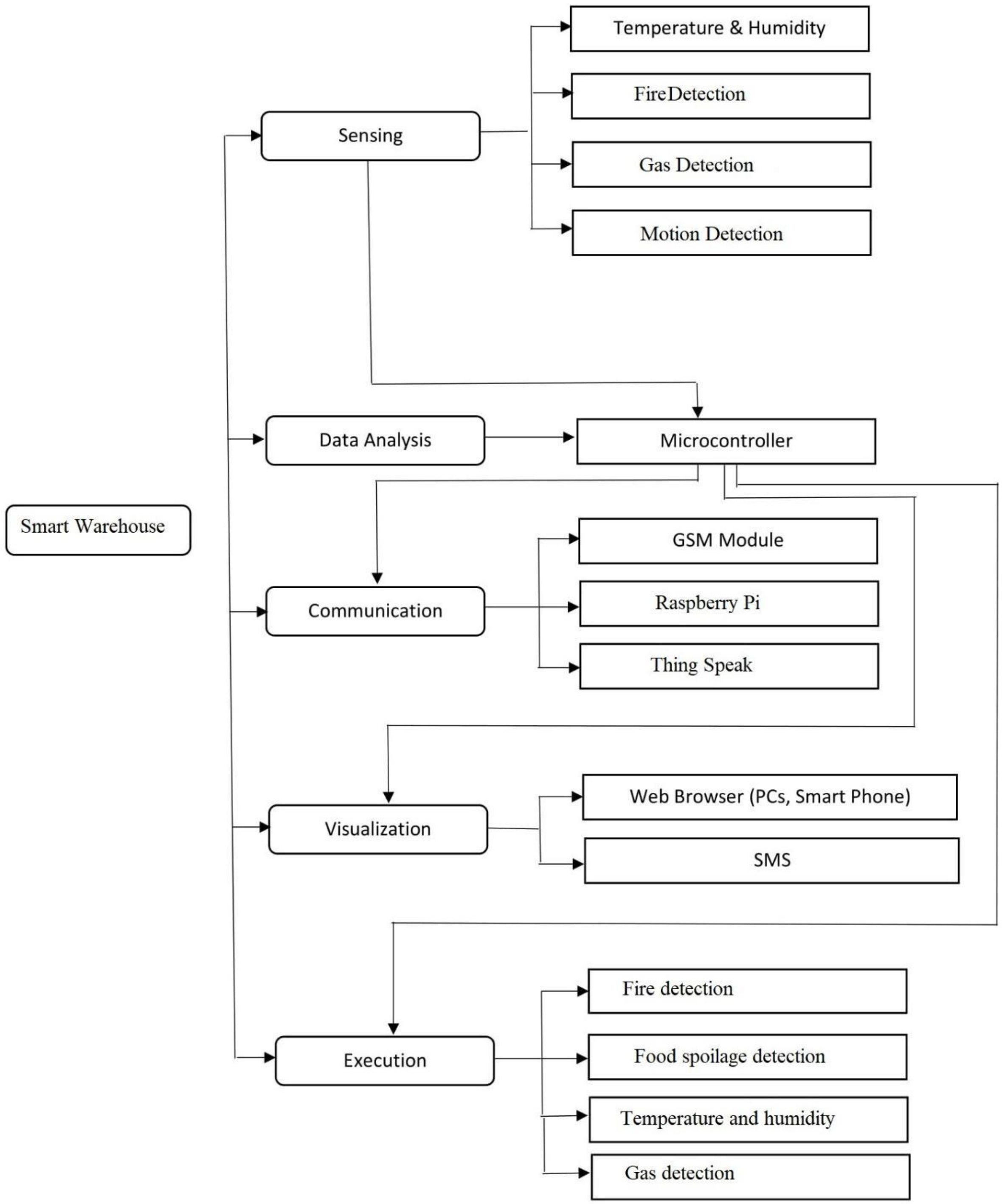
- **CYBER INSURANCE** Cyber Insurance allows victims to protect themselves from various cyber risks. However, cyber insurance policies in food storage have lagged in the coverage of cyber incidents and events.

4. Design Description

4.1 Master Class Diagram



5. State Diagram

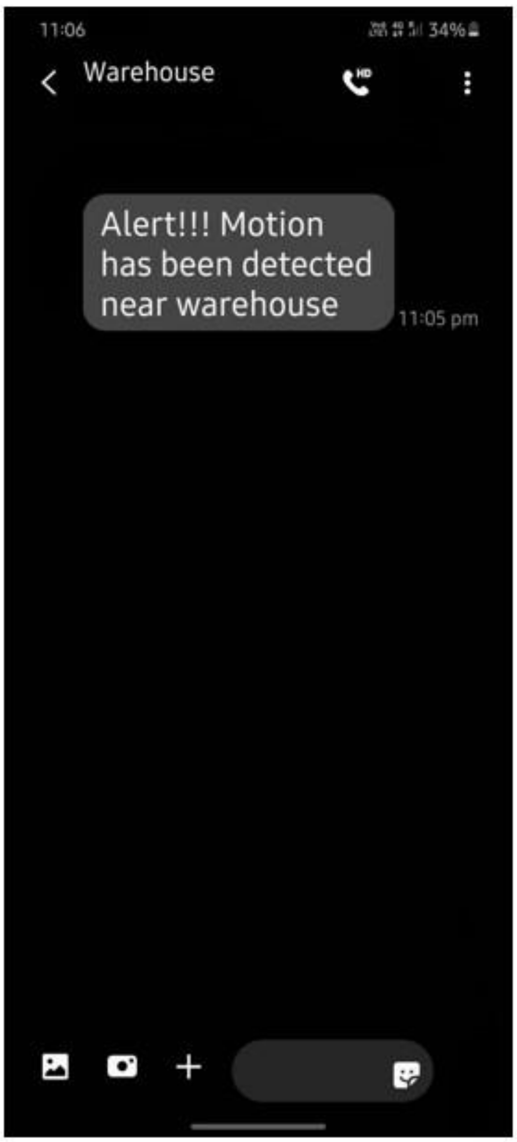


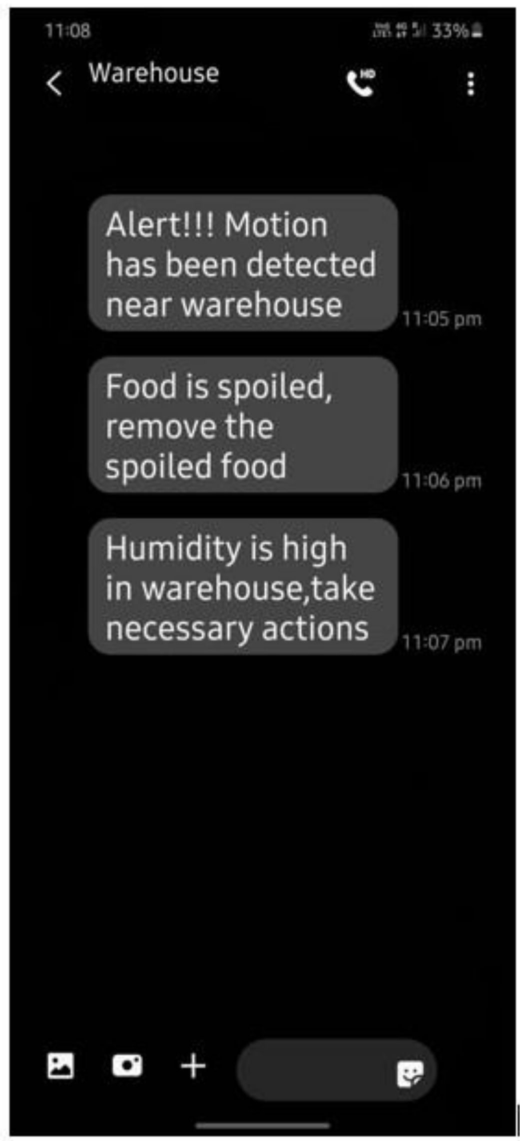
6. User Interface Descriptions

Login.html - the first page of the UI, where the user logs into his profile

FrontPage.html - Display the different projects and tasks currently run by the user

The system sends an Alert message when any motion and it will also send alert messages when food is about to spoil or spoiled, temperature goes below the requirements or humidity goes above the requirement.





7. Report Layouts

Introduction: Smart Warehouse is an emerging concept that refers to managing food using modern Information and Communication Technologies to increase the quantity and quality of products while optimizing the human labor required. ...

Design Consideration: Design goals are to build a system capable of Sensing, data Communication, data analysis and also this section explains about the background work-Circuit Design, physics Implementation, Architecture Choices, pros and cons of architectural choices, Constraints and risks of the project.

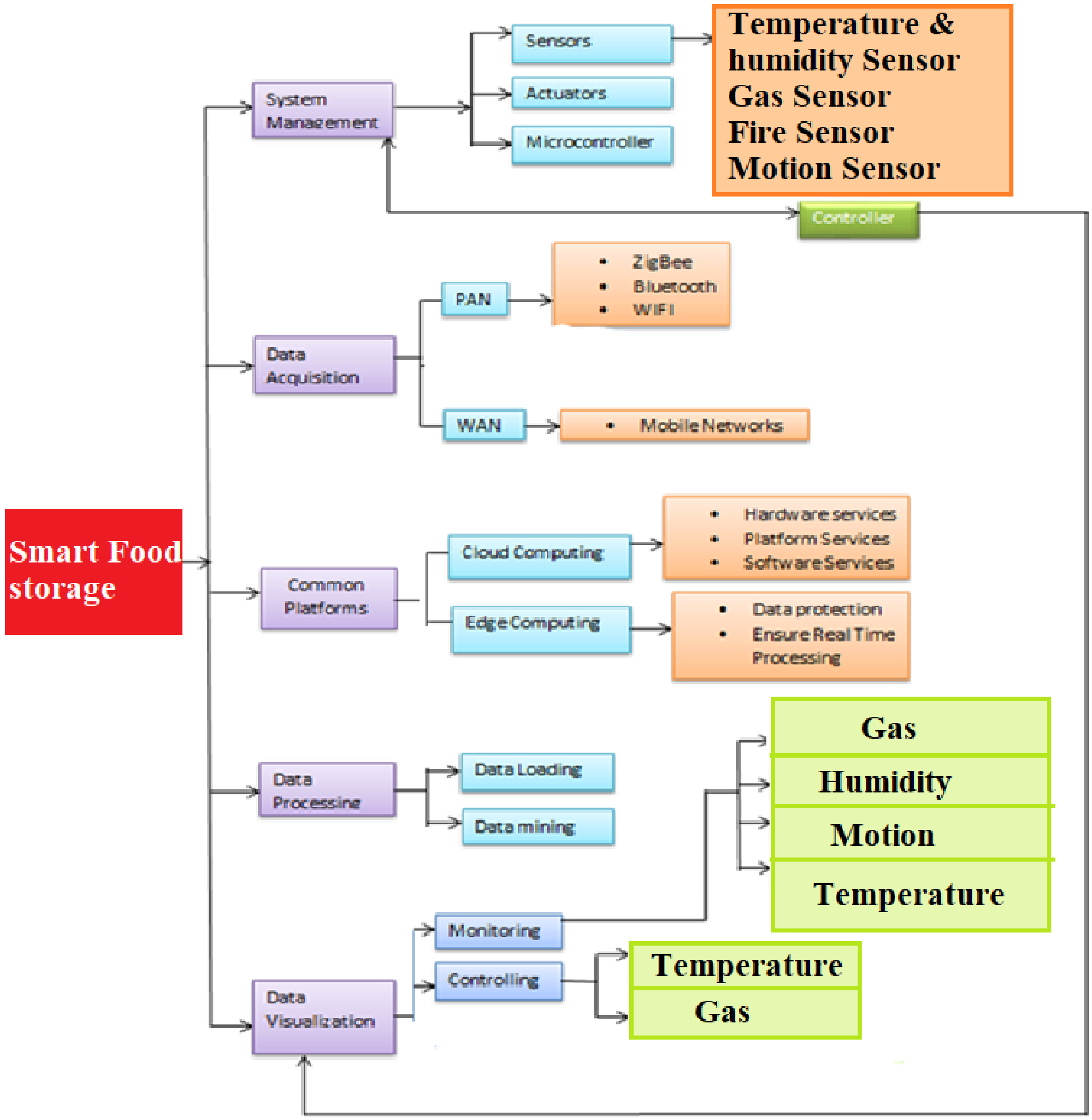
High Level System Design: This section explains about the system design-UML, Runtime Diagram, Security.

Design Description: This block helps us to understand the design and process in a clear view by providing us the master class diagram and state diagram, Package and deployment diagram.

Help: This section gives a brief description about the technical, hardware help planned to the system.

Design Details: It provides the characteristics of the process, systems we considered for the project.

8. Packaging and Deployment Diagram



9. Help

Power Consumption: Limited battery life, Large distances to cover makes the iot devices indispensable. So, the solution for this is to use low power consumption devices.

10. Design Details

10.1. Security

Adoption of IoT in the warehouse has innumerable benefits. However, there are several security and privacy issues associated with it. Since a huge amount of information is stored in the IoT systems, it becomes really difficult to protect the data.

Cyber security threats such as data attacks, cloud data leakage, malware injection, data fabrication, third party attacks are some of the major security challenges that the managers can face in smart farming. Any hacker can easily steal their raw data from their system. So proper care should be taken that all data is protected as best as possible, this normally would mean using encryption when transmitting and storing the data, but it also applies to the methods used to interchange the data - hardware and software.

10.2. Reliability

Reliability is critical for efficient IoT communication, because unreliable sensing, processing, and transmission can cause false monitoring data reports, long delays, and even data loss, which would reduce people's interest in IoT communication. Therefore, the rapid growth of IoT communication demands high reliability. However, these deployments, as IoT implementations, depend heavily on the Internet connectivity, therefore on the network infrastructure.

10.3. Maintainability

In order to achieve optimal cost in the life cycle of the IoT, maintainability must be considered in the design phase of the IoT. Maintainability refers to the ability for an intelligent system to be seamlessly and easily uncoupled, fixed and modified without causing an obstruction in the system processes or functionality. To evaluate the maintainability property of the IoT system, in case of a problem, the system should allow easy replacement of faulty components without loss of service. Therefore, to characterise IoT systems as highly maintainable, they have to enable maintenance tasks to be completed effectively, efficiently and with satisfaction.

Appendix A: Definitions, Acronyms and Abbreviations

HTML: Hypertext Markup Language is the standard markup 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.

PIR: A passive infrared sensor.

Appendix B: References

- https://ijrti.org/papers/IJRTI1706080.pdf /2017
- http://www.ijresm.com/vol1%2Ciss4%2CApril18/IJRESM14_38.pdf /2018
- https://ieeexplore.ieee.org/document/8403537 /2018
- https://medcraveonline.com/MOJFPT/monitoring-food-storage-humidity-and-temperature-data-using-iot.html /2018
- https://www.ijsr.net/archive/v8i3/ART20196559.pdf /2019
- https://www.ijeat.org/wp-content/uploads/papers/v8i6/F9355088619.pdf /2019
- http://nebula.wsimg.com/4ce7d6b9a18e1399174c5fceab0326e4?AccessKeyId=DFB1BA3CED7E7997D5B1 disposition=0&alloworigin=1 /2019
- http://www.ijstr.org/final-print/dec2019/Automated-Granary-Monitoring-And-Controlling-System-Suitable-For-The-Sub-saharan-Region.pdf /2019
- https://ieeexplore.ieee.org/document/9231104 /2020

- https://ieeexplore.ieee.org/document/9073248 /2020
- https://www.irjet.net/archives/V7/i4/IRJET-V7I41124.pdf /2020
- https://ieeexplore.ieee.org/abstract/document/9198549/authors#authors /2020

Appendix C: Record of Change History

[This section describes the details of changes that have resulted in the current High-Level Design document.]

#	Date	Document Version No.	Change Description	Reason for Change
1.				
2.				
3.				

Appendix D: Traceability Matrix

[Demonstrate the forward and backward traceability of the system to the functional and non-functional requirements documented in the Requirements Document.]

Project Requirement Specification Reference Section No. and Name.	DESIGN / HLD Reference Section No. and Name.