IOT-BASED SENSOR SAFE FOOD WAREHOUSE SYSTEM

[1]Mrs.V Nithya Poorani, [2]Mrs.M.Sathya
[1,2]Assistant Professor, Department of Electronics and Communication Engineering
Sri Bharathi Engineering College for Women, Pudukkottai-622303, Tamil Nadu, India
[1]aswinkarthick1605@gmail.com, [2]malardaksat@gmail.com

***Abstract* - manufacturers, intermediaries, merchants, consumers, etc. all utilize Storehouses. Farmers lose a great deal of money every year as a result of the issue with storehouse storage requirements. This results from inadequate food storage monitoring and inadequate refrigeration equipment. Numerous antiquated storage techniques were used, necessitating a labor-intensive and ineffective manual process. This research describes a smart IOT-based food monitoring system for storehouses that employs a Raspberry Pi and a number of sensors to continually check the many elements that might have an impact on the quality of the food. Adafruit serves as a cloud that facilitates data visualization. Popsql is used to manage a database, and a login page is made to assist the warehouse administrator.**

INTRODUCTION

India is the nation where the economy is mostly based on the agriculture sector. Due to storage regulations and inadequate food storage monitoring, farmers deal with a number of issues each year. Storage needs are met by warehouses. The state-run [1] warehouses only hold a small portion of the food grains. There are inadequate storage facilities for a significant portion of the Tomatoes, Onion, Radish and Cucumber are all produced worldwide. However, the country loses annually as a result of incorrect storage because of the variations in market availability from season to season and year to year.

The natural contamination of food grains is influenced by a number of environmental conditions, including temperature, humidity, light levels, pH, and type of storage structure. Food will become less valuable the longer it is stored. Food safety becomes an issue as a result. [2, 3]. A number of antiquated storage techniques were used, necessitating a labor- intensive manual process that is both time-consuming and inefficient. The lack of a multi-parameter monitoring system was another disadvantage. Therefore, the Internet of Things (IoT) based food grain monitoring system not only seeks to create a multi-parametric system that aids in reducing loss against many causes including moisture, aging, and decaying, but it also does so in a time- and money-efficient manner.

1. LITERATURE SURVEY

Rajesh Kumar Kaushal et. al [4]proposed an IoT framework to prevent food from getting contaminated during storage and transportation. System architecture.K Mohan Raj et. al proposed [5]an IoT based smart warehouse monitoring system. Varioustypes of sensors used in the system are vibration, humidity, temperature, fire sensors etc. Alexandru Popa et. al [6]proposed a method of integrated food monitoring. The system is suitable for vacuum-packed foods. Sipiwe Chihana et. al [7] proposed and developed a real-time intrusion and tracking system. Soumya T K et.al proposed [8] a multi-parameter monitoring system using wifi. Saleem Ulla Shariff proposed a system [9] for monitoring food grains at home. The information related to the food and storage is sent to the owner using the auto SMS and email alert system.

Sazia Parvin et. al proposed [10] a grain storage system with monitoring and controlling. Qinghua Zhang et. al proposed an IoT based system framework for the monitoring of the warehouse environment. Li Lijuan et.al [11] present a wireless transceiver and microcontroller-based monitoring system.The system described in the literature survey shows efforts taken by the researchers in the area of food management. However, the food management system needs to be continuously monitored to check the temperature and humidity.

2. WORKING PRINCIPLE

The suggested system's primary goal is to offer an Internet of Things-based warehouse monitoring system. A system that runs in the cloud is suggested to improve the characteristics. Additionally, the system keeps track of any deviations from the sensor limits. There are three components to the system:

Sensor Subsystem

Three sensors make up the sensor network: the DHT 11 sensor, the LDR sensor, and the MQ 3 sensor. Temperature and humidity are both measured by the DHT 11. It has a thermistor and a humidity detecting component. It will keep an eye on the food's storage area's humidity and temperature all the time. For the same, a threshold has been set.

The two electrodes of the humidity sensor component are separated by a substrate that retains moisture. As the humidity varies, so does the resistance between the electrodes. Similar to this, the thermistor—a variable resistor whose value essentially changes with temperature—is used to measure temperature. The nitrogenous gases released by rotting food are picked up by the MQ 3 sensor. The existing sensitive material's conductivity.

The resistivity of an LDR sensor is dependent on the amount of light that is incident upon it. These sensors' resistance reduces with light and reaches its maximum in the absence of light. The sensor features an integrated ADC that provides the output voltage in digital form, along with a potential divider circuit.

Processing Unit

The primary processor is a Raspberry Pi 3. The system architecture's block diagram is displayed in Fig. 1. A tiny computer is called a Raspberry Pi. It contains a built-in Wi-Fi module in addition to CPU, GPU, RAM, and video outputs.Raspberry is preinstalled on the NOOBS (New Out of the Box Software). Included are Python, Scratch, and more.

Python is a high-level, object-oriented programming language. This research project's whole algorithm was created in Python. Real-time data on the warehouse's environmental conditions is sent to the WebApp. Hypertext Mark-up Language is used to construct web applications (HTML).

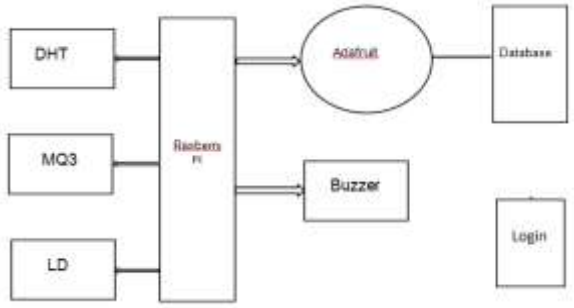


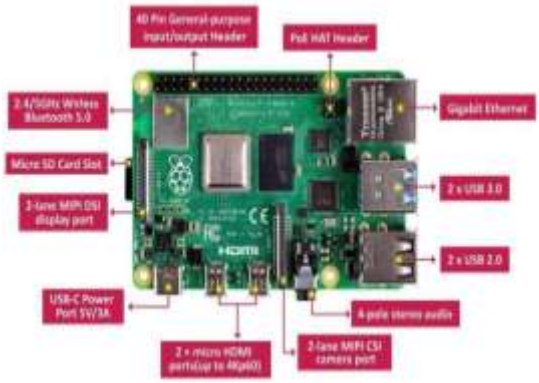
Figure. 1 Block diagram of system architecture

Web service

A Web service is an electronic connection between two devices over a network. To access the dashboard, the user is given a web URL. The service is accessible via a laptop and PC as well as a mobile device. Adafruit provides a cloud-based IoT analytics platform solution for realtime data stream visualization and analysis [12, 13]. For more sophisticated investigation, the Adafruit als o supports MATLAB coding. Adafruit is utilized in this project for data analysis and visualization.

3. SYSTEM REQUIREMENTS

Fig.2: Raspberry Pi Board



Rassperry Pi : The Raspberry Pi is a very cheap computer that runs Linux, but it also provides a set of GPIO (general purpose input/output) pins, allowing to control electronic components for physical computing and explore the Internet of Things (IoT).

Fig-3:DHT11Sensor

DHT11 Sensor: This sensor mainly consists of two parts capacitive humidity sensor and thermistor. It converts the analog data to digital signal which indicates the humidity and temperature.

Fig-4:LDR Sensor

LDR Sensor: It is a light intensity sensing sensor. The resistance of the sensing material changes based on the light intensity. The change of resistance causes change in voltage, which is used to determine the light intensity.

MQ3 Sensor: It is used to sense the presence of alcohol using SnO2 as the sensitive material. The concentration of alcohol gas in the environment increases the conductivity of the sensing material,

Fig-5:MQ3 Sensor

using which the alcohol presence in the environment can be determined. 4.

RESULTS AND DISCUSSION

Critical environmental elements including temperature, humidity, light, and moisture are monitored by the wireless sensor unit. The Raspberry Pi receives temperature and humidity readings from the DHT-11 sensor at the warehouse. The digital value obtained from the analog value conversion process is compared to the threshold value. The buzzer will activate and alert warehouse management if the parameter is over or below the threshold value. Adafruit Cloud is used to depict environmental parameters that are continually observed. It gathers data and creates a graph based on that data. Taking daily, weekly, and monthly reports for data analysis is made easier by this.

The ideal temperature range needed for the crops is displayed in Table 1.

TABLE -1: Favourable temperatures for Vegitables

	Optimal	Maximum Centigrade	Minimum Centigrade	Season (days)
Tomatoes	12 -18	21- 24	10	50-85
Cucumbers	16-24	32	10	50-70
Radish	10-20	25	5	20-30
Onion	13-24	30	4-10	130-160

An IoT device must be put in a warehouse, grocery shop, etc. It begins reading data from the interfaced sensors as soon as it is linked to the internet. Every two seconds, the DHT11 sensor obtains a real-time readout of the temperature and humidity. The supply voltage that the sensor needs to function is between 3.5 and 5.5V.Likewise, the LDR and MQ3 sensor values are captured and sent to the Rasberry Pi for additional processing.

The Raspberry Pi serves as the system's primary hub, managing every operation. Its job is to operate in response to inputs received from the sensor's outputs. On the Cloud server, data is uploaded for monitoring and presentation. The Rasberry Pi converts the analog output to a digital value. The web service is in charge of the display portion. Python is a programming language that is available as open source. For Internet of Things connections, the Raspberry Pi's inbuilt wifi module is utilized. Every sensor's threshold value is stored in an internal SD slot.

The controller utilizes a buzzer to sound a warning in the event that there is any fluctuation in range. You may connect using HDMI to monitor this as well.

5. CONCLUSION

In this study, we have successfully interfaced the Raspberry Pi with many sensors, including the MQ3, LDR, and DHT 11 sensors, to monitor and manage the ambient conditions in warehouses in order to prevent food commodities, namely wheat, rice, and maize, from rotting. Additionally, the device has a buzzer that functions as an alarm and will sound as soon as the sensor's threshold value exceeds a predetermined threshold. To the Adafruit server is transferred data.

Adafruit provides users with updates on food grains. To provide secure database access, a login page is put in place. By uploading the data to the Adafruit cloud computing server via Internet of Things (IoT), the system not only helps to monitor the different characteristics of the warehouse.

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