IoT BASED FOOD MONITORING SYSTEM IN WAREHOUSES

Shivani Bhandari[1], Pooja Gangola[2], Shivani Verma[3], Surekha K S[4]

[1,2,3]B.E Student, E&Tc Department, AIT, Pune, Maharashtra, India
[4]Faculty, E&Tc Department, AIT, Pune, Maharashtra, India

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Abstract - *Warehouses are used by producers, middlemen, traders, customers etc. Every year, farmers face a huge loss due to the problem of storage requirements in warehouses. This is due to improper monitoring of the food stored and the inability to provide proper refrigeration systems. Various traditional storage methods were initiated which forced a huge manual approach which is time-consuming and inefficient. This paper presents a smart IOT based food monitoring system in warehouses using Raspberry pi and various sensors that continuously monitor the various factors which may affect the food quality. The ThingSpeak is used as a cloud that helps in the visualization of data. A database is maintained using Mysql and a login page is created which helps the warehouse administrator for the continuous surveillance of temperature and humidity.*

Key words: *Food monitoring, IoT, Sensor.*

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. Warehouses are used for storage purposes. Only a small part of the food grains are stored in the state run [1] warehouses. A large part of the crops is left without proper storage facilities. The global production includes maize, wheat and rice. But 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.

There are various environmental factors that influence the natural contamination of food grains such as type of storage structure, pH, moisture, temperature, sufficient light, humidity, etc. As the storage time increases, the food will lose its value. This results in the problem of food safety. [2, 3]. Various traditional storage methods were initiated which forced a huge manual approach and requires more time and is also less efficient. Another drawback was the absence of a multi-parameter monitoring system. So the IoT based system for monitoring of food grains not only aims at implementing a multi-parametric system which helps in preventing the loss against various factors like moisture, aging and decaying but also consumes less time and cost-effective.

2. 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. Various types 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 et. al 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.

3. WORKING PRINCIPLE

The main objective of the proposed system is to provide an IoT based warehouse monitoring system. A cloud-based system is proposed to enhance the features. The system also monitors the variation in the limit set for the sensors. The system is divided into three parts:

3.1 Sensor Subsystem

The sensor network comprises of three sensors: DHT 11 sensor, LDR sensor, MQ 3 sensor. The DHT 11 measures both humidity and temperature. It has a humidity sensing component and a thermistor. It will continuously monitor the temperature and humidity conditions where the food is stored. A threshold is set for the same. The humidity sensing component has two electrodes with moisture holding substrate between them. The resistance between the electrodes changes as there is variation in the humidity. Similarly for the temperature, the thermistor is used which is a variable resistor whose value basically varies with the change in temperature. The MQ 3 sensor detects the nitrogenous gases which come from the food when it is rotten. The conductivity of the sensitive material present in the MQ 3 is lower in clean air. As the concentration of ethanol gases increases, its conductivity increases. When the target explosive gases exist, the sensor's conductivity increases more and more with the increase in the concentration of the gases.

LDR sensor is a light-dependent resistor whose resistivity depends on the incident light radiations. When light falls on these sensors their resistance decreases and is maximum in the dark. The sensor has a potential divider circuit and has an in-built ADC which gives the output voltage in digital form.

3.2 Processing Unit

Raspberry Pi 3 is used as the main processing unit. Fig. 1 shows the block diagram of the system architecture. Raspberry Pi is a mini-computer. It has CPU, GPU, memory, Video outputs along with the in-built Wi-Fi module.

The software part consists of an operating system known as NOOBS (New Out Of the Box Software). The NOOBS is equipped with Raspbian. It contains python, Scratch etc.

Python is an object-oriented and high-level programming language. The entire algorithm of this research work is designed in python. The environmental conditions of the warehouse are transferred to the WebApp in real-time. Web applications are created using Hypertext Mark- up Language (HTML).

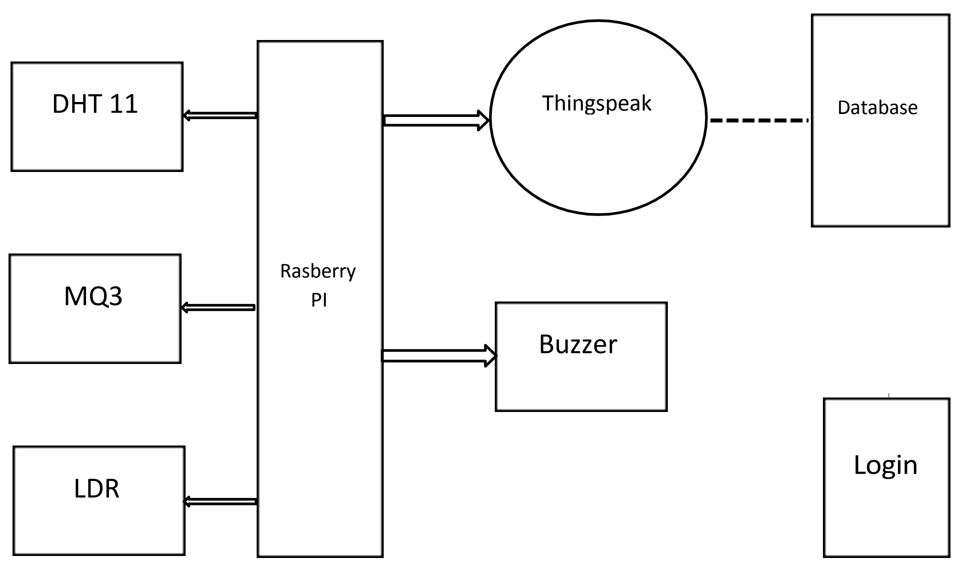

Figure. 1 Block diagram of system architecture

3.3 Web service

A Web service is a communication between two electronic devices over a network. A web URL is assigned to the user to access the dashboard. One can use the service either on a cell phone or a laptop and computer. ThingSpeak is an IoT cloud-based [12,13]analytics platform service to visualize, and analyze live data streams. The ThingSpeak also supports MATLAB coding to perform more advanced analysis. In this work, ThingSpeak is used for visualization and analysis of data.

4. RESULTS AND DISCUSSION

The wireless sensor unit is used to monitor the critical environmental parameters like temperature, humidity, light, moisture etc. DHT- 11 sensor senses the humidity and temperature at the warehouse and gives it to the Raspberry Pi. It will convert the analog value into a digital value and is compared with the threshold value. If the parameter is above or below the threshold value, the buzzer will turn on and notify the warehouse administration. ThingSpeak cloud is used to show the continuously monitored environmental conditions and it will collect the data and plot the graph. This helps to take daily /weekly/monthly reports for data analysis. Table 1 shows the favorable temperatures required for the crops.

TABLE -1: Favourable temperatures for crops

	Optimal	Maximum Centigrade	Minimum Centigrade	Season (days)
Corn	22-25	32-34	20	99-130
Wheat	20-25	38	5	95-110
Rice	30-33	37-40	18-22	98-107

IoT device needs to be installed in a food store, warehouse, etc. Once it is connected with the internet, it starts reading data from the interfaced sensors. DHT11 sensor reads the real-time temperature and humidity readings every 2 seconds. The supply voltage required for the operation of the sensor is between 3.5 to 5.5V.In a similar fashion, the readings of the LDR and MQ3 sensors are recorded and are sent to the Rasberry Pi for furtherprocessing.

Raspberry Pi acts as a central unit and takes care of all the activities of the system.Its role is to take action based on the inputs provided by outputs of the sensor. For displaying and monitoring, data is uploaded to the Cloud server. The analog output is converted to a digital value by the Rasberry Pi. The display part is handled by the web service. The open-source language python is used for programming. The internal wifi module of the Rasberry Pi is used for IoT connection. The internal SD slot stores the threshold value of each sensor. If there is any variation in the range, the controller sends an alert using a buzzer. This can also be monitored by connecting with HDMI.

5. CONCLUSION

In this paper, we have successfully interfaced with various sensors such as MQ 3, LDR sensor, DHT 11 sensor with Raspberry Pi to monitor and control the environmental conditions in warehouses to prevent decaying and rotting of food items mainly wheat, rice and maize. The system also supported by buzzer as an alarm system which will activate as soon as the threshold value of the sensor crosses a specific value. Data is sent to the ThingSpeak server. The user can get updates related to food grains through ThingSpeak. A login page is implemented for secure access to the database. The system is helpful to monitor the various parameters of the warehouse and also it will inform the Warehouse Corporation by uploading the data on the cloud computing server (ThingSpeak) using IoT.

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BIOGRAPHIES

	Pooja Gangola BE E&Tc Army Institute of Technology, Pune, Maharashtra, India