IoT Based Food Grain Wastage Monitoring And Controlling System

Kaviya Devi V[1], Annapoorani B[2], Maalavika S[3], Mathivanan S[4]
[1]Assistant Professor, Dept of CSE
[2, 3, 4]Dept of CSE
[1, 2, 3, 4]Sri Ramakrishna Institute of Technology

Abstract*- The Internet of Things (IoT) is one of the effective platforms for putting massive data analytics tasks into practise. This includes how to use networking, detecting, big data, and computerised reasoning technology to deliver comprehensive frameworks for a good or service. When applied to any sector or company, these frameworks enable greater clarity, command, and execution. In this we'll talk about how losses caused by air moisture that exceeds a certain threshold cause infestation and other harm to grains of food. With the help of various sensors to monitor the condition of food grains kept in the Central Warehousing, those losses can be effectively decreased. The programme shall conduct suitable data analyses based on the moisture and temperature data collected and promptly notify CWC personnel who may need to take mitigation and remedial action as a result of the moisture and temperature inside the warehouse. The use of IoT by centralstorage centres to prevent grain losses is highlighted in this research.*

Keywords- Grain, Internet of Things, Warehouse

I. INTRODUCTION

The ability of humanity to meet the needs of an ever-large global population is being put to the test. By 2050, there are projected to be 9.1 billion people on the planet, meaning that an additional 70% of food must be produced to feed everyone. A significant percentage of this population growth is attributed to developing countries, some of which are currently dealing with concerns of hunger and food insecurity. Worries about rising nutrient demands are made worse by growing urbanisation, environmental change, and land usage for non-sustenance purposes. As part of their adaptations to meet this rising need for food over the last few decades, a lot of countries have focused on improving rural generation, arrival utilisation, and population management. In any event, postharvest misfortune (PHL), a fundamental problem, does not receive the necessary attention, and in prior years, less than 5% of consideration for subsidising has been given to this problem. A steady 33% of the food provided (or roughly 1.3 billion tonnes), worth around US $1 trillion, is wasted everywhere during postharvest activities.When compared to increasing harvest production to meet the demand for food, the solutions to reduce post-harvest losses typically involve modest effort and can result in large yields. A warehouse company is called CWC (Central Warehousing Corporation). The government gains from this project since it is challenging to manage a huge volume of commodities from many industries.As we all know, there are a large range of perishable goods, industrial raw materials,completed goods, and agricultural produce that all have significant storage loss. With quality control procedures such as chemical treatment, sanitation, age analysis, routine inspection, and many more, this kind of storage loss of quality outcome of food grains and perishable items can be prevented. Storage loss can occasionally also be seen when air moisture levels exceed threshold levels.So, an ideal low-cost IT solution revolves around the Internet. We are developing an IOT dashboard that will contain all data pertaining to moisture, temperature, fire, insects, and rodents as part of the solution.

1.1 BACKGROUND HISTORY:

Grain storage has been necessary since people first began gathering and milling grains. Residential and commercial farmers can keep crops all season long, feed livestock with them, or hold onto them until they can sell them for the highest possible market price. This is made possible by the capacity to store grain. Grain must be stored in a dry, airy space that is elevated off the ground and weatherproof. The product's quality is also greatly influenced by other variables, like temperature and the environment. Sadly, the agricultural society today does not have access to the same breakthroughs that early farmers and hunter-gatherers did. From baskets, jars, and sacks to increasingly complex grain storage bins, small-scale storage has evolved. Over time, advancements have further enhanced grain bin efficiency, with features like perforated floors for converting current crop storage to new ones, moisture and temperature control devices and changing bin depths. Moreover, these developments have increased grain storage accessibility for a variety of properties, including residences and businesses. Modern technology has made it simpler than ever to store grain effectively and safely. Farmers that operate on a commercial or residential basis can choose among silos, bins, elevators, bunkers, or sheds. Other techniques, such as earthen pots, grain bins, mud-and-thatch rhombuses, bamboo homes, or underground pits lined with husk and straw and covered with protective wood or plastic, are employed in some nations.Moreover, storage capacity has increased; in the United States, on- and off-farm storage capacity for grain reached nearly 25 billion bushels in 2018. In response to rising crop production, this capacity expands. Although a faster increase in storage capacity is doubtful, there is a greater emphasis on enhancing the quality of that storage, such as interior conditions and farmer safety.Off-farm storage has become more common and now makes up 46% of all grain storage in the United States, compared to traditional on-farm storage. This is probably a result of the flexibility offered by off-farm storage, such as managerial support. On their own properties, some farmers are even renting grain storage optionsto maximise their farms' profits from grain production without making a full-scale investment in storage system construction**.**

1.2 PROBLEM STATEMENT:

Food grains have been thrown out in significant quantities all around the world as a result ofinadequate warehouse management, especially during times of lockdown. Several people became hungry as a result of human monitoring's incapability. Hence, in order to reduce amount of wastage of food grains automated method employed for monitoring. Warehouses are fitted with sensors for monitoring the climatic, temperature, and environmental conditions of the grain storage house, which will reduce food grain losses if information about the condition of the warehouses is communicated to a centralised person at the appropriate time. The CO2 content of the air is checked to see if food grains in the storage building are decomposing, and if any animal activity is seen, it is photographed and sent to a centralised system for processing. The system performs a number of functions based on the data received from the sensors to assist in the safe long-term storage of the grains with the least amount of loss. The centrally located individual may keep track of every action taken to safeguard the food grains and exert control over it as necessary. The Owner is sent a warning message whenever a problem is discovered, and a web application can simply access it.

1.3 SCOPE OF THE PROJECT:

To put in place an automated system based on the Internet of Things (IoT) to cut down on grain waste. To design a website that illustrates the monitoring and controlling procedures carried out inside warehouses. To inform the warehouse manager of the monitoring procedures carried out inside the warehouses during an emergency.

1.4 EXISTING SYSTEM:

If there is any departure from the ideal level, the central control unit will generate a warning notification and show the values in real-time on a web page. The control device will send an SMS to the registered cell phone number asking immediate action if any of the values exceed the critical level. Wi-Fi connectivity allows authorised users to access the website from anywhere in the storage building. By simply connecting the current network with the internet, the storage building may be accessible from any location.The team chose to use readily accessible software and hardware tools in view of the conditions present in the Sub-Saharan region. The following parameters were taken into consideration when choosing the electronics and related software tools. To effectively and efficiently manage various activities, the microcontroller should be able to meet the computing needs of the system, such as data processing speed. The primary controller should work with all sensors and actuators.Accuracy, durability, and a quick response time are required for sensors and actuators. All of the components must to be open source, accessible, and in their most recent version.In the climatic conditions, every component ought to be able to operate correctly.

1.5PROPOSEDSYSTEM:

The added features of the suggested system include several controlling features, such as a cooling fan, illumination light, alert, and repellent devices. As a result, the system is far more effective than the previous one. Thismethod makes use of theArduino Uno, a product that is equally affordable and yields distinct outcomes. The output of the system has been presented in an easy and appealing manner through a web application. The controlling commands are also carried out using the application that was created, and notifications are also sent to the application when high temperatures or humidity are detected. All the necessary things are continuously monitored from the warehouses, and the stored data is received as an alert

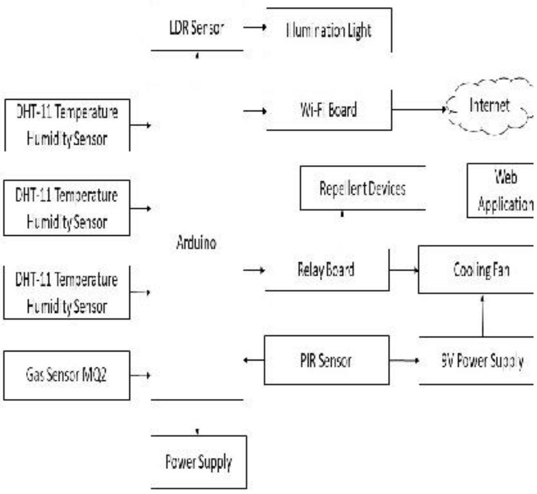

Fig.1.1. System Architecture

1.6 WORKING:

The proposed system is used to monitor and protect the food grain storage area form varies factors. Factors such as Temperature, insects, rodents, rain, decomposition of grain due to high temperature. Various type of sensor is used to prevent the grain storage area from various factors. All the sensors are mainly connected to Arduino UNO microcontroller and it continuously check the sensor values and update to Ubidots through the wi-fi moduleESP8266.DHT11 temperature & humidity sensor is used to detect the Temperature and Humidity in the grain storage area. When temperature sensor valueexceeds the parameter value, Arduino automatically turn on the fan using relay and send the notification is send to the user from Ubidots.Ultrasonic senor is used to detect the insect in the grain storage area. When Ultrasonic sensor detects the insects, Arduino automatically on the repellent device and send the notification to the user from Ubidots. PIR sensor is used to detect the motion in the grain storage area. When PIR sensor detect any motion in the grain storage area, Ubidots send the notification to the user. MQ 9 sensor is used to detect the gas in grain storage area. If any gas detects in the grain storage area, notification is sent to the user via Ubidots. LDR sensor is used to detect the presence of light in the grain storage area. If light is not detecting in the storage area, Arduino automatically turn on the light.

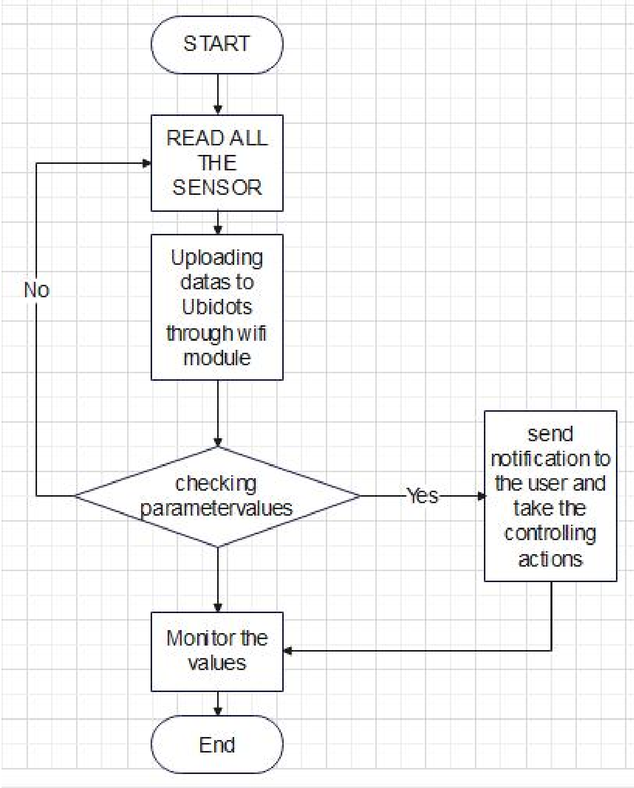

Fig.1.2. Flowchart

The proposed system that employs two approaches to prevent the grain storage area: a mobile application that notifies the user and an automated system that activates the relay when a predetermined value is reached.

II. REQUIREMENT SPECIFICATIONS

2.1 HARDWARE COMPONENTS

- Arduino Uno
- ESP8266 Wi-Fi Board
- DHT11 Temperature and Humidity Sensor
- PIR motion detector
- MQ – 9 Gas Sensors
- Rain sensor
- LDR sensor
- Ultrasonic repellent devices
- Relays

2.2 SOFTWARE COMPONENTS

- Operating System: Windows 7 (minimum)
- IDE: Arduino IDE
- Programming Language: C++
- Ubidots

2.3 SYSTEM COMPONENTS:

2.3.1 Arduino Uno

A microcontroller board is the Atmega328-based Arduino Uno. It has a USB port, a power connector, an ICSP header, six analogue inputs, a 16 MHz crystal oscillator, and reset buttons. There are 14 digital input/output pins total, with 6 of them being PWM outputs. Everything needed to support the microcontroller is included; all you need to do to get started is connect it to a computer with a USB connection, power it with an AC-to-DC converter, or use a battery.

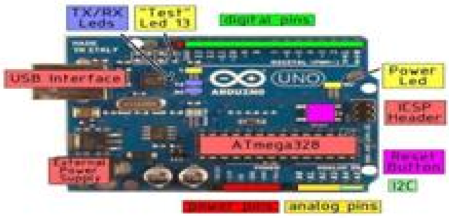

Fig.2.1.Arduino uno

2.3.2 ESP8266 Wi-Fi Board

The ESP8266 is a self-contained Wi-Fi networking device that can execute independent programmes and serves as a bridge between Wi-Fi and current microcontrollers. Both a built-in USB connector and a wide range of pin-outs are included with this module. Similar to how Arduino is easily flashed, you may connect the Node MCU devkit to your laptop via a micro USB cable. Furthermore, it is right away breadboard compatible.

Fig.2.2.ESP8266 Wi-Fi Board

2.3.3 DHT11 Temperature and Humidity Sensor

The DHT11 Temperature & Humidity Sensor has a temperature & humidity sensor complex with a calibrated digital signal output. By combining temperature and humidity sensor technology with a special digital signal collecting method, it provides excellent long-term stability and remarkable reliability. This sensor combines a resistive-type humidity measuring component with an NTC temperature measurement component, connecting to a high performance 8-bit microprocessor. It offers high quality, rapid reaction, interference resistance, and economic performance.

Fig.2.3.DHT11 Sensor

2.3.4 PIR motion detector

The HC-SR501 is an automatic control module based on infrared technology. It uses the LHI778 probe design, which was imported from Germany and has high sensitivity, high reliability, and an ultra-low-voltage operating mode. It is primarily utilised in battery-powered automatic controlled devices.

Fig.2.4.PIR motion detector

2.3.5 MQ – 9 Gas Sensors

The MQ-9 gas sensor's sensitive component is SnO_2, which has a reduced conductivity in clean air. It uses a cycle of high and low temperatures to accomplish the detection and picks up CO when the temperature is low (heated by 1.5V). Both the sensor's conductivity and the gas concentration are increasing. It cleans the other gases adsorbed under low temperature and detects combustible gases like methane, propane, etc. at high temperature (heated by 5.0V).

Fig.2.5.MQ – 9 Gas Sensors

2.3.6 Rain sensor

A switching device that is triggered by rainfall is known as a rain sensor or rain switch. With rain sensors, there are two major uses. The first is a water-saving gadget that is attached to an automated irrigation system and forces it to turn off during a downpour. The second item is a rain shield for car interiors that also supports automated windscreen wiper operation.

Fig.2.6. Rain sensor

2.3.7 LDR sensor

A photo-conductive cell, also known as an LDR, is a passive part that lowers resistance when brightness (light) is received on its sensitive surface.When the strength of the incoming light rises, a photoresistor's resistance decreases. A photoresistor may be used in switching circuits that are light-activated, dark-activated, and light-sensitive since it is a resistance semiconductor. A photoresistor can have a resistance as high as several megaohms (M) in complete darkness, compared to a resistance as low as a few hundred ohms under complete illumination.

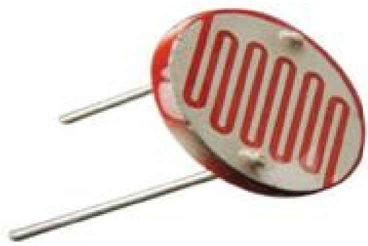

Fig.2.7. LDR sensor

2.3.8 Ultrasonic repellent device

Ultrasonic repellent devices Ultrasonic sounds (sound above 20000Hz) are nearly silent to humans and most animals. Walls and locked doors cannot be penetrated by ultrasound. These hard surfaces cause the signals to ricochet as they pass through them. Because soft items like curtains, furniture, and carpet absorb ultrasonic waves, the efficiency of the device is lowered. Larger pests like rats and birds can be repelled by sonic noises since they are audible, lower frequency sounds. The protection of greater regions is effective with these lower frequency noises.

2.3.9 Relay

Relays are electrical switches that may be operated remotely and are controlled by another switch, such as a horn switch, or by a computer, as in a power train control module. Relays enable a lower current circuit to regulate a greater current circuit. Relay designs include 3-pin, 4-pin, 5-pin, and 6-pin devices with single switches or twin switches.

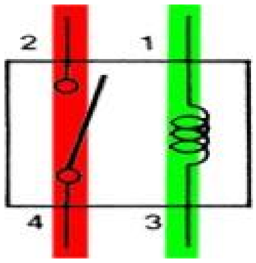

Fig.2.8.Relay

2.3.10 LCD Display

An LCD (Liquid Crystal Display) is a kind of flat panel display that operates primarily using liquid crystals.LCD is used to display the details and values of sensors connected with the Arduino.

2.4 EXPERIMENTAL RESULTS:

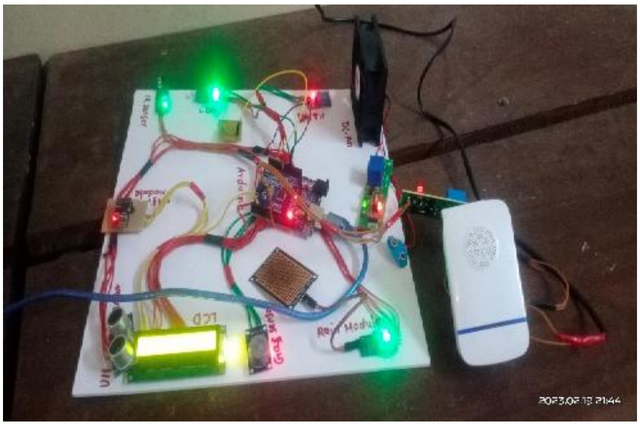

Fig 2.9. Experimental Setup

In the above figure 2.9 shows the experimental setup of the project. It contains all the requirements of the project to protect the grain storage area more efficiently. And this project provides a solution for our problem statement and achieve the scope of the project.

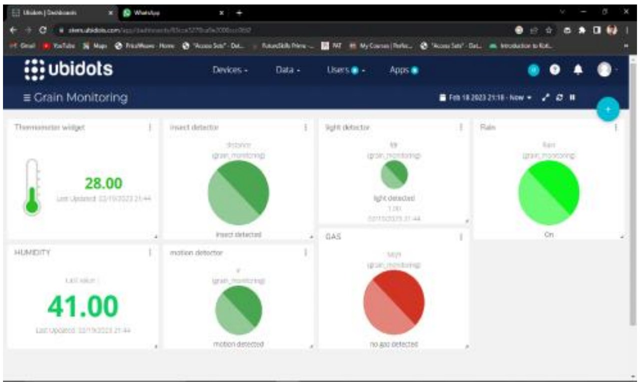

Fig 2.10. Grain Monitoring Dashboard

In the above figure 2.10. shows the dashboard of grain monitoring system. The dashboard shows the information about the sensors in the grain storage area. Using this dashboard, grain storage area can be easily monitor from anywhere.

III. CONCLUSION

3.1 SUMMARY:

The creation of an automated system for granaries in the Sub-Saharan area has been illustrated in this study. The method was developed by considering the region's present socioeconomic and meteorological characteristics. On the basis of this idea, the hardware and software tools were chosen. The created system generates real-time data updates on a website while also providing round-the-clock monitoring of the grain storage facility. The web application was created to be safe and simple to use. The aeration system was created to properly control the granary's microclimate. Moreover, the automation algorithm modifies itself in response to input received from users via the web application.Simulated triggers were used to test the automated process, and positive results were seen. The suggested technology is simply adaptable to use in the majority of grain storage facilities in the Sub-Saharan area and is scalable.

3.2 FUTURE WORKS:

The application of machine learning algorithms in the existing framework, needs to be conducted to make the system smarter and fully autonomous.

The proposed system provides better performance in real time. The proposed algorithm extends the scalability and reliability of the system and the system can be enhanced further by adding some other parameters and including advanced algorithms So, as to make the system to fully automatic and smart.

REFERENCES

[1] Temesgen Belay Tedla, Joe Joe L. Bovas, Yonas Berhane, Maxim Nikolaevich Davydkin, Shaji James P," Automated Granary Monitoring and Controlling System Suitable for The Sub-Saharan Region", international journal of scientific & technology, volume 8, issue 12 ,2019.

[2] Mir Sajjad Hussain Talpur ,Soofia Khan, Ammar Oad , Raheel Sarwar , Akhtar Hussain Soomro , Hina Rehman , Fauzia Talpur ,Abida Luhrani , Shakir Hussain Talpur , Erum Saba Chang ," IoT based Grain Storage monitoring with anroid application ", International Journal of Advanced Trends in Computer Science and Engineering, volume 10 ,2021.

[3] ShivaniBhandari, Pooja Gangola, Shivani Verma, Surekha K S, "IoT based food monitoring system in warehouse", International Research Journal of Engineering and Technology ,Volume 07, Issue 04,2020.

[4] Ravi Kishore Kodali, Jeswin John, Lakshmi Boppana,"IoT monitoring System for Grain Storage"IEEE,2020.

[5] Aseem Sindwani, Akhilesh Kumar, Dr. Chitra Gautam, "Prediction and monitoring of stored food grains health using IoT enable nodes", IEEE, 2020.

[6] AS Keerthi Nayani, CH.Sekhar, Aruna Kokkula,"Effective food grain loss reduction technique using IoT", International Journal of Creative Research Thoughts (IJCRT), 2018.

[7] Sazia Parvin, Amjad Gawanmeh, Sitalakshmi Venkatraman, "Optimised Sensor Based Smart System for Efficient Monitoring of Grain Storage", IEEE, 2018.

[8] Susmita Banerjee, Anil Kumar Saini, Himanshu Nigam, Vijay, "IoT Instrumented Food and Grain Warehouse Traceability System for Farmers", International Conference on Artificial Intelligence and Signal Processing (AISP), 2020.

[9] Lydia J, Leones Sherwin Vimalraj S, Monisha R, Murugan R, "Automated food grain monitoring system for warehouse using IoT",2022.