IoT Based Grain Storage Monitoring with Android Application

Mir Sajjad Hussain Talpur[1], Soofia Khan[1], Ammar Oad[2], Raheel Sarwar[1], Akhtar Hussain Soomro[1], ,
Hina Rehman[1], Fauzia Talpur[3],Abida Luhrani[1], Shakir Hussain Talpur[1], Erum Saba Chang[1]
[1]Information Technology Centre, Sindh Agriculture University, TandoJam, Pakistan,
mirsajjadhussain@sau.edu.pk
[2]Faculty of Information Engineering, Shaoyang University, Shaoyang 422000, China,
ammar_2k309@yahoo.com
[3]Usindh Laar Campus Badin, fozia.g.talpur@gmail.com

ABSTRACT

The agriculture sector plays a pivotal role in Pakistan because agriculture is the source of food production that provides direct cultivation to the state and, as we are all familiar with that, the most challenging task is to provide grains during droughts and pandemic situations. Grains are essential among food products because of their large contribution to food for the country's population. Thus, automatically making grain storage equally important, but the grain storing system in Pakistan is very poor currently. And because of that poor system, we lose a considerable amount every year in the storing process. We are in such a period that, along with the population, the need for food is steadily rising, so we do not have the luxury of wasting anything that we produce to feed. To effectively maintain and overcome grain damage, it is critical to design or develop a grain storage monitoring system based on current research and proposed technologies. The design and development of grain storage monitoring system is achievable with the deployment of IoT sensor IoT technology. Furthermore, this research deals with deployments of sensors in the grain storage monitoring area which ensures the accumulation of real-time data and then analyze and come up with a decision to overcome abnormal situations which happen in the grain storage area. It's a wifi-based monitoring system that uses esp32 embedded with multi-sensors that must be helpful during grain storage in the warehouse. A device in the warehouse will be installed, which will provide information about the on-going conditions of the stored grains and will also send alert notifications with a buzzer through the android application by an associated device that makes stored grains easily monitored and manageable. It may prove to be helpful for sustaining the quality of grains & preventing any potential damage. It can also be very effective for the workers in the warehouse because it will enable them to manage grains easily by monitoring the current condition of stored grains.

Key words : Internet of things, Grain storage, Android, Sensors.

1. INTRODUCTION

As we all know, agriculture plays a vital role in the economy of Pakistan. About 25% of the economy depends on agriculture, and if you think about it, the economic contribution of 25% is immense, and these four major agricultural crops are the key contributors of that 25%, which are: (wheat, rice, cotton, and sugar). Aside from rice, another important benefactor crop is wheat. Wheat has a higher consumption rate than any other crop in Pakistan, as it can be used to make bread, chapatti, biscuits, cookies, porridge, macaroni, sweets, and many other items. However, due to low maintenance in its storage area, the grains of this important crop are moving more to the west these days. Due to its large stored quantity, the storage keepers are able to precisely define where the issue in these wheat grains occurs. Grains should be able to maintain high quality as the most difficult issue with wheat, since after the harvest farmers have no way of knowing which grain or grains are affected by moisture or fungus and that contributes to the birth of molds that slowly begin to rot wheat grains. Wheat grains are put in the same region as other grains that are processed to improve the damage caused by fungus. In addition, worms and fungi are not only the cause of grain destruction, but also the reason for shorter storage times. Because these customers face a shortage of wheat flour and its high market prices, the government faces losses that are not reasonable for the economy because of these problems, so it is necessary to track stored wheat grains for the need for maintenance and maintenance Improvement of efficiency and improvement. At any time they like, the suggested definition would be very helpful in tracking stored grains. This device will help them get live updates on the health of wheat grains that have been processed.

The Internet of Things (IoT) offers a secure solution for real-life requests. IoT features make the system more effective and demonstrate it distinct from other related systems, enabling us to link 'things' to the Internet. These items or objects may exchange data between them and transmit or receive information to other devices and systems. Annually around the globe More than 2 billion tons of grains are produced. There are various containers available for grain storage like bags, warehouses, silos etc. These stored grains can be managed by an individual unit or group of units. Proper estimates of lost grains are not available, but approximately 1-2% of grains are lost in developed countries due to well-functioning facilities, while 20-50% of harvested grains are lost in less developed countries due to poor management and underdeveloped facilities. A significant amount of knowledge has been accumulated to get the gist of a proper framework in order to develop optimal grain storage systems. With careful monitoring, stored grains can be protected for a long period of time. There is a rapid need to incorporate the status of available comprehension to give better supervision for future research and growth in order to reduce the post-harvest grain losses around the globe.

In the field of agriculture, IoT technology plays an enormous role. This research introduces an IoT based monitoring system that allows a handheld terminal to communicate and provides a forum for daily updates on the situation of stored wheat grains. Through using this monitoring device, the proposed system would serve as an assisting government side, which can easily take care of its stored grains. There are many shortcomings in the traditional grain storage system, such as temperature, humidity, and grain storage room CO2 monitoring. Temperature, humidity, and CO2 are significant environmental variables in the process of grain storage that can directly affect grain quality. Effectively monitoring the temperature, humidity, and Co2 of the grain storage room are key issues. Designing or developing IoT-based grain storage monitoring with an Android application is very important to solve these problems.

2. RELATED WORK

In 2017, India had a population of approximately 133.92 crores and it has been stated in this research that India grows and provides for its whole population, which is huge in numbers, but it can not provide them with food consistently [1]. The reason is about 7% of its food production is wasted every year and that 7% of food adds up to a big sum of 58,000 crores. Food waste happens during processing, transporting, harvesting, retailing, and consumption. To decrease the amount of wasted food, appropriate storing techniques are required to preserve the production and make sure that it gets to people who are in need. And, for that purpose, iiot can be very useful by continuously monitoring and keeping track of incoming food products that arrive at the warehouse using microcontrollers and sensors. These microcontrollers and sensors can accumulate info about the humidity, temperature, food quality and provide this info to clients while also taking proper measures to make sure that the food or produce is kept in the best environmental conditions.

Monitoring grains with high accuracy in less time is usually a hard job to do and to make it fast and easy, an online monitoring system based on 3d laser technology was created for experiment. It was an experiment to see how accurate a 3D laser scanning technology could calculate the volume of grains [2]. After a good amount of testing, the overall results were positive. The system promised good stability, high accuracy, and was easy to operate, with only a 1% minimum chance of error. As a result, it can be extremely beneficial in measuring grain volume in granaries because effective implementation will save a significant amount of time and effort [2]. Various countries have prioritized food waste research in order to improve food preservation. The food wastage stems from two main elements. 1. environmental conditions 2. consumption factors. The wastage of food can take place in various stages of the food supply chain such as, farm production, processing, packing, transporting, at retailers etc. till it arrives at the consumption phase. Due to the lack of standard collecting data, the proper amount of food waste can be hard to describe, but according to reports, approximately about one-third of produced food is wasted globally, in numbers which equate to around 1-trillion $USD. In this research, a smart auto-monitoring and controlling system is suggested by leveraging cyber physical systems that can be utilized to monitor grain storage systems [3]. [4] In this research, a wireless sensor network system based on zigbee protocol was developed to be tested as an alternative to the cable system for the purpose of measuring stored grain temperature, moisture and the drop of pressure in air. The conclusion revealed it had better efficiency in both time and cost during installation and maintenance in comparison to a cable system. [5] In this study, a storage monitoring system based on a wireless sensor network and CAN was developed. According to the location of storage, the entire wireless network was divided independently. The main focus of each independent network was to transfer the grain temperature from other nodes to the CAN bus outside the storage with the use gateway. [6] In this research, it has been stated that smart agriculture can really take agriculture to another level because it can help decrease the amount of waste, which can be utilized for the optimal usage of fertilizers, thus, overall, resulting in an increase in crop yield. In this system, sensors are used to monitor the following elements (temperature, humidity, light, soil moisture) & also automate the irrigation system. The collected info will be sent to a web server database via wireless transmission. If the temperature or moisture of fields falls under the brink, the notifications will be generated and sent to farmers. It also enables farmers to monitor fields from anywhere. It is also stated that it is about 92% more efficient than the standard approach. Early identification of insects in stored grains is necessary because of the major potential harm threat these insects possess. In

this system, an image processing approach and related application is embedded in smartphones is suggested to point out and count the current insects. Insect images can be acquired by mobile phones [7]. After releasing their non-uniform brightness, these images are connected to a domain-based histogram for counting and identifying the present insects in grains. It has been demonstrated that the proposed approach is applicable for dissimilar random insect images from mobiles with an accuracy rate of 95%, outperforming the usual conventional approach [7]. It is stated that security is required at every stage of cultivation. After considering this, an IOT based system is suggested which is able to brainstorm the info provided by sensors and send that to the user. This device upgrades security and can be controlled from a remote location. The purpose of this paper is to make agriculture smarter and more secure by utilizing IOT technologies. This system can help with temperature and humidity maintenance and pesticide detection. It can be managed remotely via the internet by a remote device that interfaces with a Raspberry Pi and a microcontroller [8]. Because automation is essential in the agricultural system these days, this paper proposes an automated system for irrigating fields.ESP-8266 is used to connect system to the internet. Several types of sensors are utilized to check the content of moisture in the soil. The water can be supplied with a motor pump in the soil. IOT here is used to provide info to farmers about the water supply to soil via an android application. Every time the water is given to the soil, farmers will be informed [9]. This project research on smart products such as data acquisition, low-power sensors, wireless communication. This system has the ability to adapt to water transport mode and public railroad while the whole process can be monitored with intelligent sensor, Lora, GPS and 3G/4G [10]. It continues to provide information and consistently remains traceable in grain transportation, ensuring that food transport quality is maintained [11, 13].

3. RESEARCH METHODOLOGY

The intended IoT project is a smart grain storage monitoring system that aids in the efficient storage of grains in large godowns. It indicates the deliberate services of grain storage monitoring such as humidity, light, temperature, fire, rain and many more things that are necessary for the storage monitoring purpose. The system is comprised of two components: hardware and software. The hardware consists of an ESP32 microcontroller, and all of the sensors such as temperature, humidity, light, fire, and rain are embedded with the ESP32. On the software side, we do android programming, create sensor interfacing, and design an android application for handled terminal to receive notifications about the ongoing conditions of grains sown.
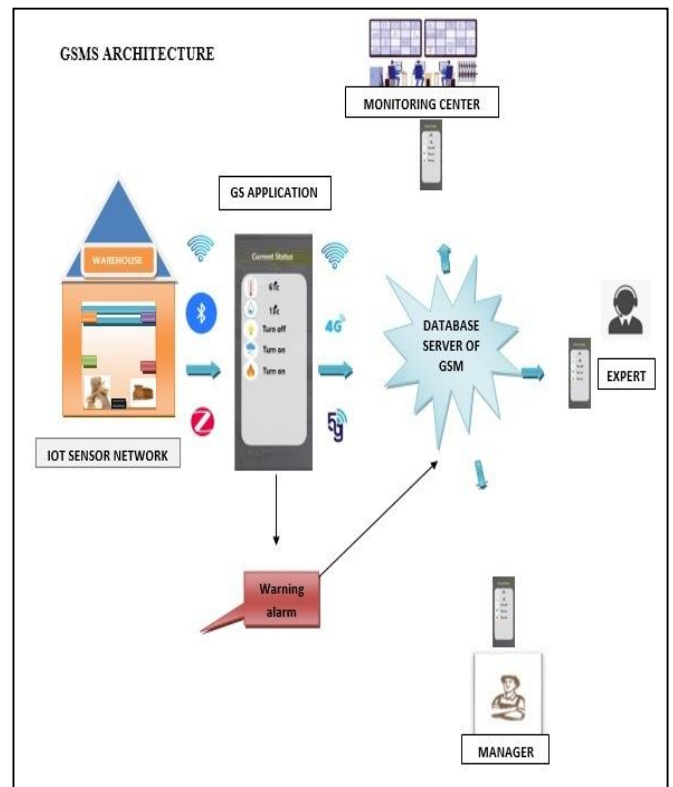

Figure 3.1: Grain Storage Monitoring System Architecture

The designed architecture consists of two components which are given below;

3.1 HARDWARE COMPONENT

Hardware component is the key component of designed system which consist of smart IoT sensors such as Temp, Humidity, Fire, Rain and Light sensors. These sensors acquire the data or information from the grain storage room and forward it to the base station analysis the obtain data from the sensors, if the data cross the threshold value, then automatically generate alert for monitoring center in order to manage the abnormal situation and also forward the same data to grain storage monitoring data server.

3.2 SOFTWARE COMPONENT

Software component is one of the major components of this system Arduino programming used for managing or control the design board. furthermore, android programing we use for design and development of android application for Grain storage monitoring system behind algorithms were linked with application for making the critical decision.

4. RESULTS

Figure 4.1: GSMS Login

After the installation of the Grain Storage Monitoring application, you will see the simple and easy to understand interface with login and Sign up options. Now click the Sign up button to create your account.
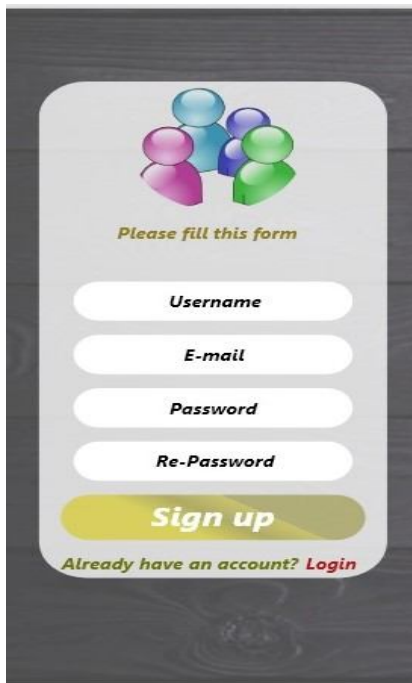

Figure 4.2: GSMS Login Details

Simply create a new, unique username, enter your email address and password, and then retype your password to confirm. After adding the details, click on sign up.

Figure 4.3: GSMS Login Authentication ID

Now go to the login page and enter your username and password. Then click the login button.

Figure 4.4: GSMS Application Functions

As you can see, we have entered the application, so here's the menu where we have current status, monitoring center, alarm, about, contact us, and log out options, and to check the condition of stored grains just go into the current status, Now, stored grain temperature must be between 40-60 Centigrade, while humidity below 12 light should be turned on to reduce the moisture between grains. When it detects any dangerous condition like fire and water, it shows an alert alarm of emergency and sends it to the monitoring center to get timely control over it.

Figure 4.5: View of GSMS Sensors Normal Situation

This status shows that the condition of stored grains is normal.

Figure 4.6: View of GSMS Sensors Abnormal situation

This status informs about the abnormal situation of stored grains which requires urgent treatment, generates an alert, and directly sends it to the monitoring center. That is how your stored grains will be safe and secure because you will get notified with the help of an alert alarm.

Figure 4.7: Alert of Abnormal Condition

How it will inform you, As shown in the figure 4.7, the GSMS application will notify you.

5. CONCLUSION

This project is primarily for the Grain Storage Monitoring System, which endures a lot of wear and tear. We are attempting a little bit through this venture so that, at any rate, they can control the anomalies that are happening in the grain storage area. We also intend to improve this venture by better demonstrating the benefits of IoT sensors such as temperature, humidity, and light that detect an abnormal situation. If a situation becomes abnormal, then the system successfully gives alert to the monitoring center in order to manage the abnormal condition. We have successfully designed two major components of the system, namely the Hardware section and the Software section. We have intelligently deployed sensors in the grain storage area which detect the situations inside the grain storage area and forward to the GSMS database via short range and long range communication technologies such as Bluetooth, Zigbee, Wifi and 4G, 5G Once the information arrives at the central database, then Grain storage monitoring actors such as Grain Store Area Manager, Agriculture Expert, Grain Storage Owner and Monitoring Center can view, modify, forward, and also Agriculture experts can give their advice for both normal/abnormal situations. We have effectively designed the Android Application by using the Android Platform which works according to our designed algorithms. The Designed Application is Smart because it works according to our designed instructions.

ACKNOWLEDGEMENT

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