

COMPUTERIZED AGRICULTURAL STORAGE MANIPULATION SYSTEM USING IOT TECHNIQUES

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Abstract-- In this paper, a smart storage system is developed for agricultural purpose using IOT in order to observe and maintain storage environment both manually and automatically. Ethernet shield for Arduino is used to store data in MySQL database and the communication with the sensor data and web server is established. The mobility is increased with help of android devices via android app. Observing and scheming can be done from website or android app. Privacy and security issues makes it more secured with the help of web application. The system is verified and tested on current environment and result was as expected.

I. INTRODUCTION

Agriculture, with its allied sectors, is unquestionably the largest livelihood provider in India, more so in the vast rural areas. It also contributes a significant figure to the Gross Domestic Product (GDP). Sustainable agriculture, in terms of food security, rural employment, and environmentally sustainable technologies such as soil conservation, sustainable natural resource management and biodiversity protection, are essential for holistic rural development. Indian agriculture and allied activities have witnessed a green revolution, a white revolution, a yellow revolution and a blue revolution. It helps to meet the basic needs of human and their civilization by providing food, clothing, shelters, medicine and recreation. Agriculture provides food, fiber, fuel, furniture, raw materials, a free fare and fresh environment, plenteous nourishment for driving out starvation, favors companionship by wiping out battles. Freshly harvested agricultural product like potato, vegetables contain 70% moisture as a result these are perishable in nature. These crops cannot be saved from spoilage unless preserved. Farmers usually keep their agricultural product on the elevated platforms erected in their dwelling house. In India, maximum agricultural products are stored indoors under room temperature. Due to high temperature, these products lose their weight gradually and ultimately get shriveled, rotten or sprouted. For example, more than 30% potato is lost in this way. Farmers are struggling and work hard to produce the crops and if we cannot utilize or consume it fully, all the work of farmers will go into vain. A proper storage mechanism should be incorporated to avoid the food wastage. Demand can irrespective of seasons which in turn avoids fluctuation in the price of the product. For large scale commercial preservation of agricultural products, cold storage are used in India. A cold storage is a building or a group of buildings with thermal insulation and a refrigeration system in which perishable food products can be stored for various lengths of times in set conditions of temperature, humidity, moisture, light intensity etc. However, the absence of proper monitoring, controlling and any warning systems could cost huge losses of cold storage owners and farmers as well. Cold storages need to be monitored continuously to avoid unwelcomed situations. A proper alarm system should be deployed in the cold storages which alert the users to unusual conditions. Monitoring can be done by using a web platform which displays the status of the cold storage. Sensors can be used to sense the environment and this data can be presented to the users. Situations can be controlled by the users or it can be automated. Here we developed an Computerized Agricultural Storage Manipulation System Using IoT Techniques.

A. The Concept of IoT

The Internet of Things (IoT) is a system of interconnected computing devices or objects that are provided with unique identifier and the ability to transfer data to each other over a network without human interaction. In simple terms, it is a

network in which physical objects can exchange data internally or with other connected machines. The concept of the Internet of things became popular in 1999, through the Auto-ID-Center at MIT and related market-analysis publications.

The major objective of IOT is to create a smart environment (smart buildings, smart agriculture, smart health, smart transport, etc.) using enabling technologies such as sensors, embedded devices, communication protocols. Physical devices such as microcontrollers, microprocessors, actuators, and sensors cannot directly communicate with the Internet but they do so by using an IOT gateway. Now it is generally considered as a network or system, which interfaces everything with the web by RFID, sensors, global positioning systems (GPS), laser scanners and other information sensing devices. IoT having knowledge of architecture of IoT is required. There are four layers of IoT architecture. They are Interface layer, Service layer, Networking layer, Service layer.

B. IoT in Agriculture

The Internet of Things (IOT) has already brought revolutionary changes in agriculture. In this sector there are so many challenges like high cost of investment, lands limitation, lack of awareness by farmers on better farming methods, imbalanced use of fertilizers, lack of quality seeds, low production and productivity, lack of proper storage knowledge etc. Internet of Things helps farmers or industries to deal with all these numerous challenges which they face. It is expected that by using IOT in this sector the industry must find out the solution for various problems like increasing water shortages, shortage of lands, proper storage system etc. This new innovation has come to address all these issues and helps to increase the quantity, quality, cost effectiveness, Food safety and sustainability of agricultural production.

C. Importance of IoT in Agriculture

Some advantages of using IoT in agriculture are given below:

- ☐ Water Conservation
- ☐ Increased Production
- ☐ Increased Quality of Production
- ☐ Lowered operating Costs
- ☐ Improved Livestock Farming
- ☐ Reduced Environmental Footprint
- ☐ Real-Time Data and Production Insight
- ☐ Remote Monitoring
- ☐ Remote Controlling
- ☐ Sustainability
- ☐ Food safety
- ☐ Increased crop and food quality

II. LITERATURE REVIEW

Research on remote monitoring of cold storages has been started few years ago and got increased when the technologies like Internet of Things, wireless sensor networks emerged. Increased awareness on food waste and storing techniques also paved a way to focus on cold storages. Many researches and theories are being stated by many people.

1. Here are some of the researches that are made international level from last few years but there is no previous work at national level. Elhadi Yahia Kazuz, Jennifer Smolak[1]: This work explains the importance of cold storage in the improvement of the food maintenance system. It provides the statistical information about the loss due to the lack of cold storages in many parts of Asia and Africa.

2. D. Y. Lim, Y. J. Ryoo, J. Y. Gwark, Y. H. Chan g, and C. J. Moon[2]: This paper is on providing remote cold storage monitoring through serial communication. This method is applied for measuring the temperature within the storage.
3. M. Murad, K. M. Yahya, G. M. Hassan[3]: This work is on the use of Wireless Sensor Network using Crossbow's TelosB motes integrated with sensors to measure the temperature and humidity values. Data from these sensors is collected into an online database and this data is accessed from the web application.

From the literature review, we have seen that all of the previous work on about monitoring and manual control. There were very little agricultural storage where automatic control system is implemented. There was also lack of sensor data which we could be useful for our system to perform automatically more efficiently like human.

III. DESIGN AND METHODOLOGY

A. Proposed Framework

In the era of technology advancement, everything requires monitoring and controlling. We proposes an IoT based framework for facilitating food monitoring for protection of the food, so that it would not get contaminated due to surrounding conditions during storage and transportation. In present scenario, the work done is in terms of the sensed values that have been recorded and a detailed analysis has been performed but automated control alternatives are not present. Efficient monitoring is based on temperature, humidity, light and other conditions without being present physically at the location helps us to get a better outcome. Here our main purpose is to observe, control and monitor the cold storage atmosphere, thus making the admin to manage the data in real time. Here the central node which is a web application is responsible for passing information to management mode using computer or mobile phone.

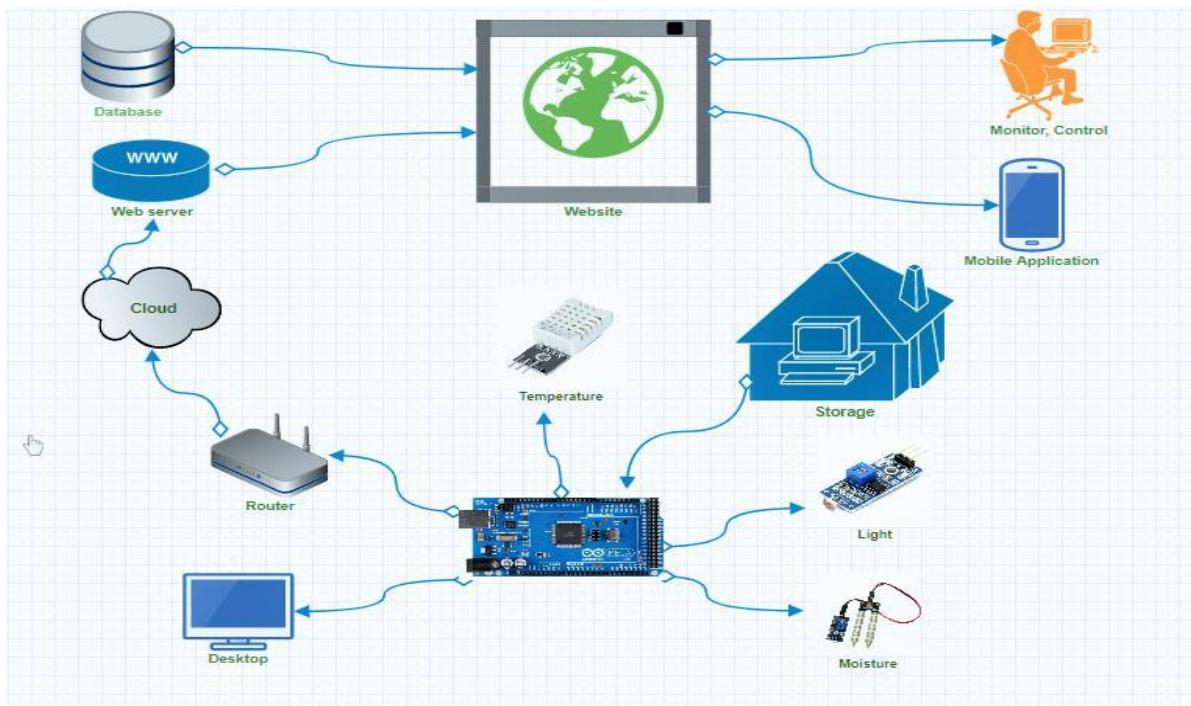


Figure. 1: System overview

B. Communication with web server

The system will be communicating with web server though two ethernet shields where one is used to post sensor data to server and another to get manual control settings from server.

C. Algorithm for automated control

Procedural flow of our automated system is given below:

Step 1: Start the program.

Step 2: Establish connection with web server

Step 3: Retrieve previous control settings

Step 4: Read sensor data

Step 5: If sensor value is not according to optimal value go to step 6. Otherwise go to step 3.

Step 6: Generate warning and adjust related device to get optimal environment and go to step 4.

Step 7: Stop.

IV. MONITORING

The main purpose of the monitoring system is to obtain temperature, humidity, moisture and light sensor readings from the storage to be relayed to a remote user over the internet. These sensor reading are sent back into our control system to enable automated control. The design components of the monitoring system are broken down into two main sections:

A. Hardware

The monitoring system consists of four sensors that interface with the Arduino MEGA microcontroller. These sensors include a temperature sensor, humidity sensor, moisture sensor, light intensity sensor. Sensor data is uploaded to the web server from Arduino using the Ethernet shield.

B. Web server

We used apache HTTP web server for PHP and MySQL as database.

Apache: The Apache HTTP Server is free and open-source cross-platform web server software, released under the terms of *Apache License 2.0*. The Apache HTTP Server is cross-platform; as it can be used in both Windows and Linux operating systems.

MySQL: MySQL (pronounced "My S-Q-L" is an open-source relational database management system (RDBMS).

Procedure:

Temperature and humidity sensors checks if there is any change in temperature and humidity within the warehouse or cold storage facility. moisture sensor is used for checking the moisture and it is very important to save product from loss.

Few products need specific lighting facility in order to maintain their quality; hence LDR sensors are placed at such locations. It generates an output voltage with change in their surrounding environment. These output voltages are fed to pins of ADC unit of microcontroller. This microcontroller processes the incoming voltages from the sensor depending on the program embedded within it.

Output is passed to web app where the user is able to view and control settings. A web application is being created which receives all data from hardware and is being displayed. Here we have a login system for the admin wherein he can view and monitor the environmental conditions of cold storage as shown in flowchart below.

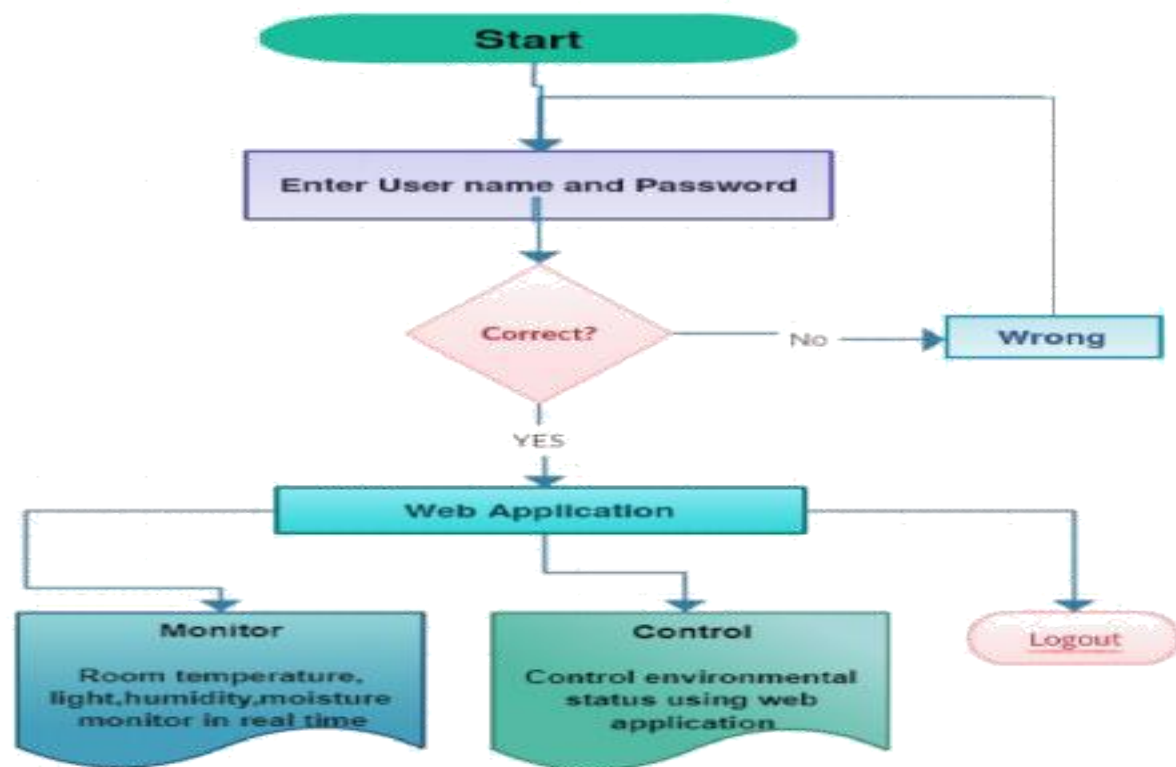


Figure.2: Monitor and Control flowchart

V. CONCLUSION

The IoT based Automated Smart Storage management system is successfully designed and implemented using MySQL, CodeIgniter and APIs that can be considered as an IoT based framework. This system is capable of reading, storing data using sensors and also generates some actions according to data. Storing data in database enables for future research and also determine any abnormality in future which might be avoided to prevent future discomfort.

Web application with a user friendly interface makes it easier to understand and requires no special skills to operate the system. Due to lack of data required for this research to be more effective and accurate but we managed to build a working system which was tested on our normal environment and succeeded according to our created environment.

VI. FUTURE WORKS

Our implemented system is not constructed as our whole plan due to lack of data and time. In the future, this system will be improved and more accurate. It will also send warning text message using GSM feature to authority in case of emergency.

A better automated system will be implemented which can learn from monitoring human interaction with the system. Monitoring system can be implemented with artificial intelligence. Also it may be used as not only agricultural purposes also in every household to maintain a better environment by maintaining temperature, humidity and other facts which makes the residents feel more comfortable. That means system also can be used as smart home.

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