Efficient Food Storage Using Sensors, Android and IoT

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Abstract:

Agriculture, one of the main occupations of India, accounts for about 16% of the GDP. Despite agriculture losing its share in GDP, it is as yet the biggest monetary division. Lately, agriculture has been regaining its sheen, with the legislature and private substances appreciating building up the segment. However, the agriculture production network in India experiences wasteful aspects in the inventory network, prompting substantial misfortunes of items all through the nation because of absence of appropriate stockpiling and transportation offices. It is evaluated that 20% of the sustenance grains are demolished every year due to poor storerooms.
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The greatest difficulty lies in interfacing the remote towns of India to the vigorous supply chain with the goal that wastages can be alleviated to the degree conceivable. This project demonstrates how technology can be utilized in warehouse for preventing loss of food grains and food products. An android app is developed that receives information from the sensors By using this android app the food products can be preserved in a nutritional environment. The smart food storage uses IoT and is cost effective, economical & uses friendly.

Keywords: Food storage, Temperature, Humidity Smoke, Sensor

I. INTRODUCTION

Global food losses have recently been documented to be in the order of 25 percent to 50 percent of production volumes, caloric content and/or market values depending on the commodity. A great number of organizations all over the world such as UN Food and Agriculture Organization (FAO) are studying this enormous problem of postharvest food losses. Much of the developing world in general lacks access to affordable refrigeration systems for precooling, refrigerated transport, cold storage, or freezing during postharvest handling and distribution of perishable foods. The sustenance misfortunes happen for the most part amid the period from collection to retail promoting and are because of changes in physical volume or monetary esteem, and regularly result in loss of healthful esteem, shorter timeframe of realistic usability as well as traded off nourishment wellbeing between the season of gather and last retail showcasing. Consequently, to turn away such misfortunes innovation puts an imperative part in the conservation of Agro and Non-Agro sustenance items.

Effective observing of temperature, humidity and other ecological conditions inside a distribution center has turned out to be one of the vital field in innovative work in many creating countries over the world. In this venture, we show how innovation can be used in distribution center for forestalling loss of nourishment grains and sustenance items.
Computer communication systems and especially the Internet are playing an important role in the daily life. Utilizing this information numerous applications are possible. Home computerization, utility meters, apparatuses, security frameworks, card peruses, and building controls, which can be effectively, controlled utilizing either uncommon front-end programming or a standard web program customer from anywhere around the globe it's rely on upon the customers. Web access functionality is embedded in a device to enable low cost widely accessible and enhanced user interface functions for the device. A web server in the device provides access to the user interface functions for the device through a device web page by using internet.

II. RELATED BACKGROUND

Traditionally, warehouses in India were broadly classified into public-private, bonded, government and cooperative warehouses. Lately, the concepts of cold chains, container freight stations (CFS) and inland container depots (ICD) have been gaining importance. Increasing post-harvest losses have propelled the development of cold storages to enable the storage of agricultural produce almost throughout the year.
Historically, logistics has been considered an issue deserving modest priority in each organization; it was just viewed as a cost part. These days (particularly in the created world), logistics is seen as a value adding process that directly supports the primary goal of the organization, which is to be competitive in terms of a high level of customer service, competitive price and quality, in terms of compliance with rules and regulations, in terms of being able to satisfy extensive qualitative service and information requirements imposed by consumers and other stakeholders of the supply chain and finally in terms of flexibility in responding to market demands .

In this modern era, human being is used to deal with technology or we can say it as internet of things (IoT). As we look around ourselves we see modernization with superior technology, for example cell phones, kitchen, appliances and many more[1]. Smart appliances include washing machine, television, refrigerator etc. With advancement in sensors, the proposed system will be made stronger in sensing status of the all types of food items and also helps to send message at different phases of items stock [3].

Global System for Mobile communications (GSM): originally from Groupe Special Mobile) is the most prevalent standard for cell phones on the planet. Its promoter, the GSM Association, assesses that 82% of the worldwide portable market utilizes the standard. GSM is utilized by more than 3 billion individuals crosswise over more than 212 nations and territories.

Food and nutrition monitoring and surveillance involves continuous description of the components of the food and nutrition system for the purposes of planning, policy analysis, program evaluation and trend forecasting[4].The colossal wastage of perishable sustenance happen because of elements like: absence of pre-cooling and storerooms, deficiency of refrigerated transporters, divided supply chains, poor rare utilization of most recent apparatuses and advances, poor item information and absence of experts. There is additionally needed to get effectiveness in existing frosty chain systems. Without a productive store network there is a high cost of wastage for the organizations. The cold chain system can be made proficient by advancement of essential foundation.

With mechanical headway and enhanced gear, and proceeds with change of cool chain administration, the coordination's of moving perishables around the globe will be extraordinarily improved .

The greatest difficulty lies in interfacing the remote towns of India to the vigorous supply chains with the goal that all partners get profited and wastages can be alleviated to the degree conceivable. By building a productive and powerful store network utilizing cutting edge methods it is conceivable to serve the populace with esteem included sustenance at the same time guaranteeing profitable costs to the agriculturists. Lack of availability of technically qualified people to support efficient operations. Supervisor can get information about the system, regarding sensor values on android app and control them remotely, which many researchers have not considered.

The proposed method of our paper is a special case of introducing an android app using which the various environmental conditions like temperature, smoke, humidity, light can be sensed and can be stored in a database.

III. PROPOSED METHOD

Many embedded systems have substantially different designs according to their functions and utilities. In this project design, structured modular design concept is adopted and the system is mainly composed of a single microcontroller, temperature sensor, humidity sensor, smoke sensor, LDR, GSM, Android cell phone (Control node) and Database(Management node). Apart from the database, the entire unit is placed within warehouse.

The microcontroller located at the center of the block diagram forms the control unit each node. Embedded within the microcontroller is a program that helps the microcontroller to take action based on the inputs provided by the output of the sensors.

The temperature and humidity sensor checks for any change in temperature and humidity within the warehouse facility, whereas smoke sensor is used to detect gases emitting from rotting or decaying food or food products. Certain food products such as food grains need proper lighting facility for maintaining of their quality, hence LDR sensors are placed at such locations. The sensors generate an output voltage with change in their surrounding environment. These output voltages are fed to the pins of ADC unit of the microcontroller.

The microcontroller processes the incoming voltages from the sensor depending on the program embedded within it. The output of the microcontroller is passed to Android cell phone via GSM. From the Android cell phone the data is then send to the local server (laptop) via Wi-Fi network. A database is created using MySQL software, which maintains the data on the local server. Java coding using Eclipse, along with Android 4.0 SDK is utilized to create the front-end of the server.

In the block diagram in Figure-1 LCD is utilized to demonstrate the working of the entire unit.
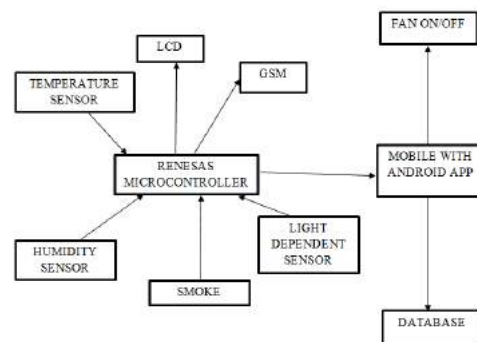

Figure 1: Block Diagram

The Hardware Requirements for the project are Renesas microcontroller (RL78 series) ,Temperature Sensor ,Humidity Sensor ,Smoke Sensor ,Light Dependent Resistor, GSM ,Android cell phone ,LCD display.

RL78 is Renesas Electronics' new-generation microcontroller family combining advanced features from both the 78K and R8C Families to deliver low power consumption and high performance.RL78 is based upon 16 bit CISC architecture with analogue rich functionality. The platform line-up will include general purpose, LCD and ASSPs including lighting and automotive microcontrollers.
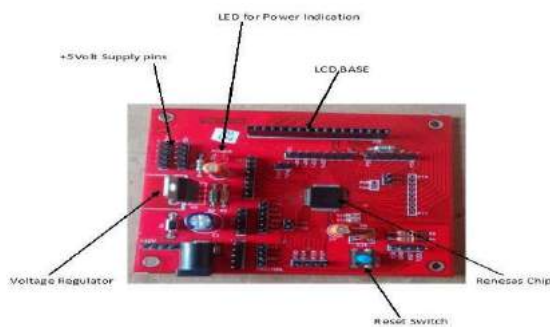
Fig 2: **Renesas Microcontroller Board.**

In electronics, an **analog-to-digital converter** is a system that converts an analog signal, such as a sound picked up by a microphone or light entering a digital camera, into a digital signal. An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number proportional to the magnitude of the voltage or current. ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter,8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The converter features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8-single-ended analog signals.
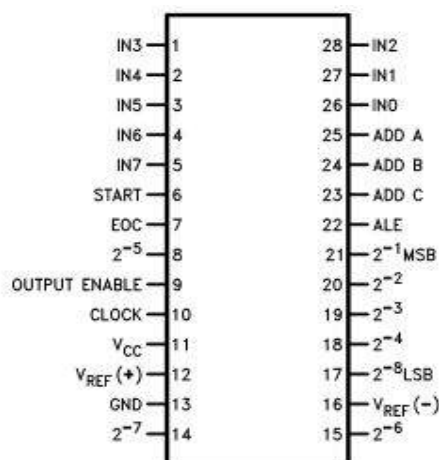

Fig 3: Pin diagram of ADC0809

A temperature sensor is a device, typically, a thermocouple or RTD that provides for temperature measurement through an electrical signal. A thermocouple (T/C) is made from two dissimilar metals that generate electrical voltage in direct proportion to changes in temperature.
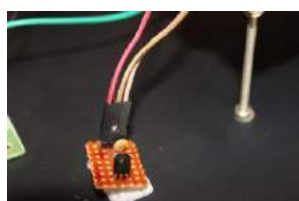

Fig 4: Temperature sensor

A smoke detector is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as smoke alarms, generally issue a local audible or visual alarm from the detector itself.
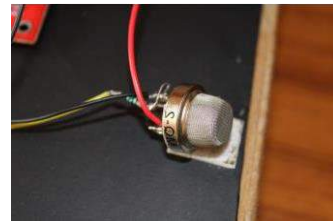

Fig 4: **Smoke detector**

Humidity is the presence of water in air. The amount of water vapor in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapor also influences various physical, chemical, and biological processes. Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. Hence, humidity sensing is very important, especially in the control systems for industrial processes and human comfort.
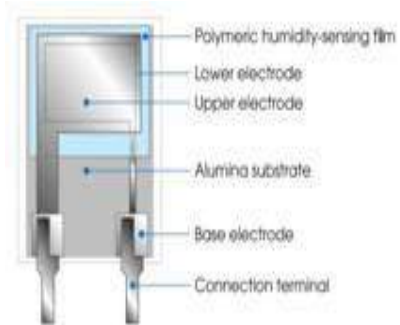

Fig 5: **Humidity Sensor**

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

The software requirements of the systems are:
➢ CubeSuite+
➢ Renesas Flash Programmer
➢ Android 4.0
➢ MySQL

Renesas Software and Tools. CubeSuite+ (IDE) for Renesas MCUs. Powerful support for all aspects of embedded application development. CubeSuite+ bundles all the basic software necessary for Renesas MCU software development in one convenient package, ready to use [5].

Creating a project using CubeSuite+ is shown below

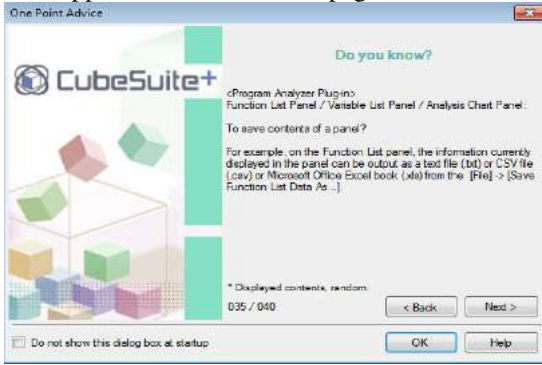First appearance of cube suite page CLICK OK

Fig 6:cube suite +

IV. SIMULATION AND RESULTS

The proposed project uses cubesuite+,android, MySQL using which a mobile android app is developed .The embedded unit has various sensors .The embedded unit that makes use of temperature sensor, Humidity sensor, smoke sensor ,light detector is given in the figure below.
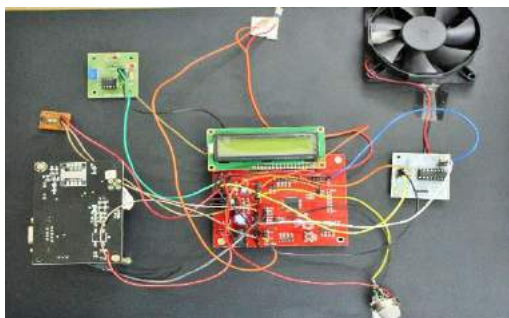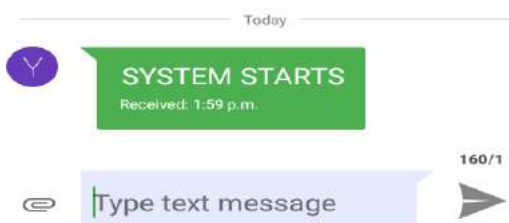

Fig7. Embedded unit with sensors

Fig 8: System Start Notification.

Fig 9: Registration Screen
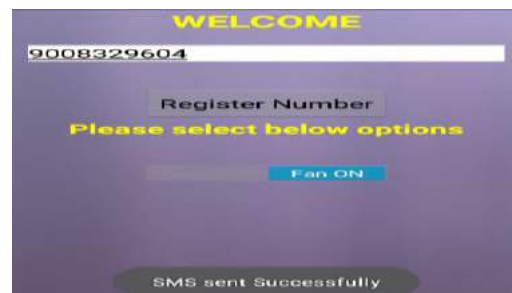

Fig 10: Login Screen

Fig11: Set Fan ON (F=1)

Fig 12: Smoke and LED Detected

V. CONCLUSION

This project is designed for managing items stored in the warehouse. The business system is tuned to food habits

and convenience of rural and urban folks of the previous generation. The safety and nutritional quality of frozen products is to be emphasized only when high quality raw materials will be used, good manufacturing practices to be employed in the preservation process, and the products kept in accordance with specified temperatures.

Various sensors are embedded to form the smart food storage system. The temperature sensor is used to sense the raise in temperature .Beyond a particular range of temperature the message is sent through the server to the mobile and the mobile user can switch on/off the fan present in the warehouse .Humidity sensor is used to see the percentage of humidity present in the warehouse. Some food requires the light to so we make use of LDR sensor. If LDR is 1 then light is detected and SMS to be sent. On detection of smoke, the smoke sensor helps in detecting smoke inside the warehouse and sends messages. On using android app manager receives information about temperature , humidity , LDR and smoke inside the warehouse.

FUTURE ENHANCEMENT

The smart food storage is cost effective, economical & user friendly. Going further, most of the units can be embedded within the controller such as android application, with change in technology thereby improving the detection system. The factors identified may further be empirically tested and validated on the F&V supply chain of different states. A similar empirical study may further be carried out for the supply chain of various related sector like food processing unit, beverages industry, cold chain industry.

In future we can use different sensors such as moisture sensor, chemical sensor which can be helpful to preserve the food. In future the information can be received through various means like Email. The future smart IoT smart food storage can use the gas sensor to check the freshness of food item and also use the CCTV camera for visualization of all activities inside the warehouse and display it to the user in real time.

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