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A Survey on Monitoring and Control system for Food Storage using IoT

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ABSTRACT: Food safety and hygiene is a big matter of concern in order to prevent food wastage. Quality of food needs to be monitored and prevented from decaying and rotting against atmospheric changes. This research paper is focused on such a food monitoring system which suggests systematic use of various sensors to perform quality and quantity monitoring and control of food materials. Smart food monitoring is a unit which governs control over various parameters causing decay or rotting of food materials, therefore ensuring appropriate quality of food during various atmospheric changes. This unit also keeps the user notified about the quality and the quantity changes in the unit using the Internet of Things technology.

KEYWORDS: Remote sensing, Internet Of Things, Monitoring and Control, Food Monitoring.

I. INTRODUCTION

The job of a control and monitoring systems is to keep an eye on particular thing or activity and to make sure that it stays in the desired manner. Monitoring can be achieved using various electronic sensors. Further these recorded values can be used for the purpose of controlling. The data obtained from sensors can be compared to the desired values. If the sensor readings are found to be unequal to the desired values then the control circuit will come into action to manipulate the assigned activity to keep it in desired manner. We suggest use of this principle for building a system which can preserve raw food. Smart food monitoring system is aimed to monitor and control food materials and prevent it from damages occurring due to atmospheric or climatic changes.

Food hygiene and safety is an important issue for human health. There are many factors leading to food poisoning, typically changes in temperature and humidity are important factors. So the monitoring system capable of measuring temperature and humidity variability during transport and storage is of prime importance[2]. Today almost everybody is getting affected by the food they consume, it's not only about the junk food, but all the packed foods, vegetables, products consumed and used in daily life, as all of them do not offer quality since their temperature, moisture, oxygen content vary from time to time[3]. Also improper storing of food materials can cause lead to wastage of food. Smart food monitoring system focuses on safe storage of food by monitoring and controlling various parameters affecting food materials. This system makes use of storage units implanted with various electronic sensors which can read those parameters affecting food materials. Design of Control circuits so as to tackle the problem of undesirable condition of food storage is the important part of this idea. A control mechanism can be decided to manipulate each of the parameters whenever required.

Monitoring of the quantity will give the exact presence of raw food material in the containers. The data obtained from quality monitoring can be help the user to maintain never ending storage of food. Thus, to keep the user updated about the quality monitoring some or other communication technology is necessary. Thus formation of a wireless sensor network. Various communication technologies are available nowadays. These technologies differ from each other based on the distance of communication, Speed of data transmission, reliability, etc. A communication protocol by which user of this system can acquire the data from any location would be suitable for this system. This way, user can know about the status of storage at any location and if user desires to make changes those changes can take place with user's presence nearby the storage unit. According to the requirements enlisted above, Internet can be the most suitable technology for the data transmission. This can help the user to be updated about the exact content of the food

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material present in the storage being at a remote location. Use of weight sensors for each of the containers can give the exact weight of food present in the particular container. That's how this idea inculcates about Internet of things. Internet of Things is a emerging technology in today's world and using this technology for the purpose of Smart Food Monitoring System is suggested.

II. LITERATURE SURVEY

The requirement for food history management systems is growing due to the increasing importance of food safety problems. The freshness of vegetable, meat, or dairy product is very important. An active RFID tag is attached to the product that requires refrigeration and the temperature/process of distribution is monitored so that product spoilage can be prevented.

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. The proposed solution analyses temperature, moisture, light as these parameters affect nutritional values of food items and makes the analysis results accessible to the user via a mobile application. A web server is used for storage of data values sensed in real time and also for analysis results. User is alerted via messages along with location of the shipment whenever an emergency occurs.

This Smart Food monitoring system will incorporate a set of sensors which will include pressure sensors, weight sensors, Temperature sensors, etc for the purpose of governing various parameters of raw food. This will help us ensuring the appropriate and edible environment and thus quality of food. Smart Food Monitoring will also include storage for all types of food which it will monitor.

III. METHODOLOGY

The task of monitoring is performed using the electronic sensors used to measure various parameters. All these sensors are interfaced with the microcontroller. Each sensor measures a specific parameter and each of these parameters play an important role in maintaining regulated storage conditions of raw food materials. Every parameter has a set of desired values which are suitable for food material placed in that particular compartment. For instance relative humidity of wheat is favourable to be between 45% to 55% for 28 Degree Celsius (approximately equal to room temperature). It can affect the health of the grains and cause increase in germination if the value of relative humidity is not in that range for 28 Degree Celsius room temperature.

To ensure that relative humidity stays in control every compartment will be provided with drying action. The maximum desired value of relative humidity will be provided to microcontroller as a threshold to actuate the drying. In a similar manner, a threshold value for quantity will also be set. Whenever the quantity is found to be less than a certain amount then an alert can be made to keep user notified about it. Vacancy of food material in each compartment can be calculated in terms of weight and a list of these exact vacancies can be sent to the user. On User approval this list will be further sent to the desired grocery store to issue an order of those food materials so as to refill the containers.

Use of IoT for the purpose of communication is proposed in this paper. Using a Wi-Fi Module in the embedded system, the data can be sent to server using internet. This information can be accessed by any device which is interfaced with the server.

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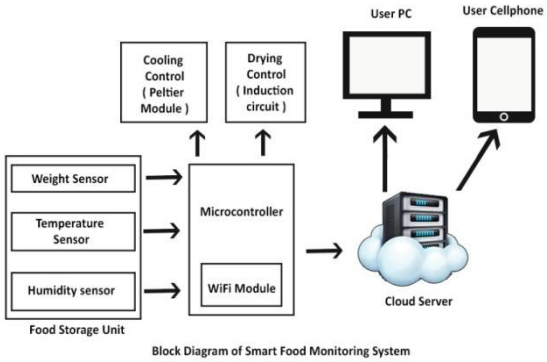

Fig.1 Block Diagram of Smart Food Monitoring System

IV. CONSTRUCTION OF PROTOTYPE

3.1 Cooling Unit

We have successful executed a prototype of Smart food monitoring system. As mentioned earlier the system comprises of a cooling unit which can cool up to a temperature of 10 to 15°C. This storage is not aimed to freeze the foods present inside, It can be used for storage of raw vegetables or edibles which require a low temperature to stay in a good condition. Power consumption of such a unit is less as compared to a refrigerator, Also the construction of such a power unit is very easy as compared to a refrigerator.

Use of a compressor for a building a small prototype is not viable and also increases the complexity of the project, Hence we have used a Peltier module (Peltier tile) for building a prototype. A Peltier tile works on the principle of Peltier effect. Whenever a DC voltage is applied across joined conductors present in the Peltier module a current is generated. When the current flows through the junctions, removal of heat occurs at one junction and cooling takes place. On the contrary, Heat is generated at the other junction. The cooling side of this tile can cool up to 0-2°C if proper heat sinks and insulation against heat is provided.

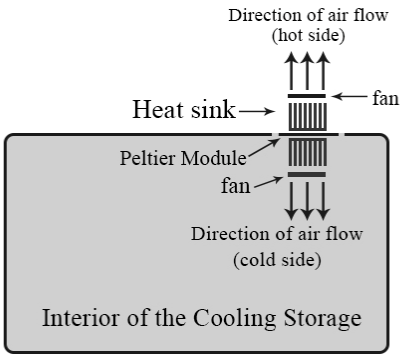

Fig. 2. Construction of Cooling unit

Polystyrene is a bad conductor of heat, thus we have used a Polystyrene box as a cooling storage unit for the prototype. As we can see in the Fig 1. Construction of cooling unit is shown. An Cavity of exact dimensions of the Peltier tile is made on the walls of the storage. The Peltier Module is placed tight in the cavity so as to make the container air tight in order to ensure that the interior is thermally insulated from the exterior of the box. The Peltier tile is placed in such a manner that its cold side is faced towards interior of the box and hot side faces towards the exterior. Heat dissipation at the hot side will cause the cold side to drop down to even lower temperature, Hence using heat sink on the hot side will dissipate the heat generated. Now, the cold temperature needs to be spread inside the box so as to cool the entire environment inside the compartment. Using a combination of fan and heat sink on the interior helps to

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accomplish this goal. A Peltier module consumes power up to 24 watts. So to regulate the power consumption we have interfaced the Peltier module to a microcontroller. This Microcontroller is provided with temperature values inside the storage using temperature sensors. Also two threshold values (temperature values) are added to the program according to which the Peltier tile is switched on and off. This will reduce the total time for which the Peltier is switched on, Thus improvising the power consumption of the cooling unit.

3.2 Regular Storage

Regular Storage unit is the unit built for the purpose to store raw food materials which require to be stored at room temperature, mainly food grains. This unit needs to be both quality and quantity monitored as mentioned earlier.

In the prototype, there exists a temperature and humidity sensor to measure the temperature and relative humidity of the content inside the storage unit. In order to tackle the problem of excess humidity an Induction circuit exists as shown in Fig. 1, Both the induction circuit and sensor is interfaced with the microcontroller. If the relative humidity is found to be greater than the desired range of humidity the microcontroller alerts the induction circuit to switch on and due to heat generated by the induction circuit and exhaust fan present on the Storage the humidity is pulled out. Once the humidity drops down to its desired value the microcontroller orders a shutdown of induction.

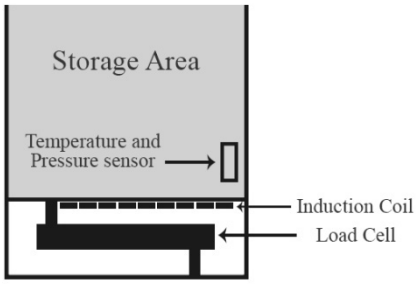

Fig.3. Construction Diagram of Regular Unit

Load cell is used to measure the weight of the content in the container. A low threshold value regarding the minimum weight content of the container is fed to microcontroller. If the weight is reduced below the threshold due to repetitive use of the food material present in that storage, An user alert takes place to notify user regarding low amount of that particular food present in that particular storage. Further on user approval the microcontroller calculates the weight required to refill the compartment. This helps the user to make a list of refilling if multiple compartments are present. Due to this action easy refill of compartments take place and user will never run out of the food resources.

V. FUTURE DEVELOPMENTS

Nowadays technology is emerging on a large scale in the biometric sector. Use of electronics for biological applications has improved the accuracy and security at the same time. Smart food monitoring system can be made more accurate and precise by using biometric sensors. There are various biometric sensors available which can be used to detect the quality and health of the food in detail. For example, Use of pH meter provides the pH of the content. This information can be used to assure purity of Milk or some other beverages. This can lead to addition of storage for liquid foods. Similarly different biometric sensors can be used to detect the biological changes in the food properties which can give an accurate sensing.

Multiple containers with sensing and a larger cooling unit based on compressor technology can lead to a smart storage system suitable for various areas of food industry. Development of this idea from product point of view can be beneficial to mankind

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VI. CONCLUSION

In this paper we have proposed a design of electronic product called as the smart food monitoring system for the purpose of safe storage with the facility of user alerts. Use of basic sensors collectively to monitor different parameters affecting health of raw food and monitoring the quantity of the food and to keep the user updated about the same is primary idea of the study.

We have successfully executed a prototype on this idea and discussed about the construction of the same.

VII. ACKNOWLEDGMENT

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BIOGRAPHY

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