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IOT Based Fruit Cold Storage Monitoring and Controlling System

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Abstract – *Food industry comprises as one of the most important and huge industries worldwide, it consists of the group of the industries which are directly or indirectly involved in the processing of a food product. Food industries can be related to the production, distribution, preservation, processing, conversation and storage of a food commodity. The Internet of Things (IoT) enables real-time visualization of supply chain business processes, information gathering and monitoring of business development. For the food industry, it helps to maintain safety standards, limit food wastage, manage unpredictable variability, monitor and monitor food quality. It is expected that IoT solutions will affect not only the way food is produced, but also social, environmental and economic concerns. Therefore, IoT systems applied to the food industry are extensively studied in the existing literature. In this project we are mainly focusing on fruit preservation industry and ripening as well as storage of a particular fruit that is Banana . Banana ripening requires a particular temperature as well as a particular gas that is ethylene. Cold storage is considered an important aspect of managing food safety to maintain food quality. The temperature, relative humidity (RH) and air quality in cold rooms (CSR) should be carefully controlled to ensure food quality and safety during cold storage. IoT-based (IoT-BC) control with multifunctional sensors in food technologies provides solutions for post-harvest fruit quality management. For this project the main component requirement is Node mcu 8266. Node MCU is a Lua-based open-source firmware and development card specifically designed for IoT applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Express if Systems, and hardware which is based on the ESP-12 module.*

Keywords- *wireless sensor network; cold storage; environment monitoring*

INTRODUCTION

IoT use in the food supply chain (FSC) is thought to improve quality of life. This essay's goal was to investigate the potential use of IoT in agriculture to trace and monitor the quality and safety of food.

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Consumer Smartphone cameras were used to verify the freshness of food, according to the results of a successful mobile application for food freshness inquiry.

The freezer's performance is tracked by taking continuous temperature readings over a predetermined time period, storing the readings, and then computing the results to inform preventive maintenance procedures. By using the Smart temperature monitoring system, Food and Beverage establishments may appropriately perform preventive maintenance, maintain the quality of food, and also boost the staff productivity. The outcome is shown in a consistent measurement of freezer temperature taken throughout the day as a 24-hour format. When the temperature from the DS18B20 is acquired, the programmer running on the controller ESP32 check it against the temperature threshold and send the temperature data through Wi-Fi to the database.

If an issue arises, it triggers the buzzer and send a short message service to a phone number set in the system. In order to keep track of temperature, the temperature readings are sent to a cloud database through Wi-Fi. Based on the detained temperature history the user can also anticipate the problems by monitoring the operation of freezer.

Maintenance procedure can also be started by the user before the freezer becomes irreparably broken and ceases to work. As an up gradation to the monitoring system the next action that may be performed additionally is sending of notifications by utilizing various messaging systems such as Email, SMS or Whatsapp in order to improve the monitoring system.

For food storage the most recurrent home and kitchen equipment used ubiquitous is refrigerator. The most illustrious area is kitchen for smart appliances, and the refrigerator is one of those gadgets. This appliance is predominantly used for a diversification of tasks including keeping fruits, vegetables and other items. Any old refrigerator may be transformed into a smart, economical machine employing sensors by installing a smart refrigeration module. [2]

The withdrawal of food deterioration, the reduction of sickness, and the creation of better lifestyles for modern individuals are the importance of this study. It is capable of informing people of the food products' current state using an Android app on the phone. The smart refrigerator module has the capability to forewarn the user and supervise the effectiveness of refrigerator from a distance. The user acquires notifications and information from the programme via an Android app. The smart refrigerator is user-friendly and economically sound.

Controlling the temperature of food in the kitchen is crucial. In order to achieve minimal energy consumption, refrigerators are now equipped with thicker insulation and low power compressors. This study compares the findings to those from a survey that was conducted in 1991 on residential refrigerators that are still in use. The report also investigated freezer temperatures in homes.

OBJECTIVE

- To control solenoid value for ammonia gas
- To control air conditioner unit
- As per timer, both systems should work
- Both systems manage online – It has timer values to set it ON and as per timer over the system will turn OFF
- Temperature and humidity parameters should monitor online – If power cut occur time should be noted till the power ON
- Data must be seen on the cloud server

DESIGN & IMPLEMENTATION

DESIGN

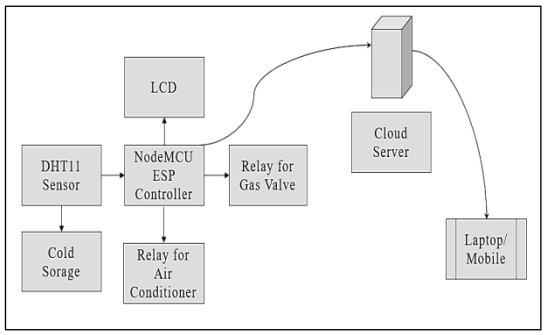

Fig 1. Block diagram for proposed idea

- For monitoring the temperature DHT11 temperature sensor is used.
- Temperature sensor is connected to ESP Controller.
- Temperature sensor records the data which is stored on cloud server to monitor with respect to date and time as well as in the form of graph. So,

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the temperature of cold storage is continuously monitored through IoT.

IMPLEMENTATION

In the above design of the project it provides the outcome in all the conditions whether the patient is normal or suffering from the color blindness such as Red-green color blindness which are categories as Deuteranomaly, Protanomaly, Protanopia and Deuteranopia.

Deuteranomaly : In this type of color blindness Green color looks more Red in color.

Protanomaly: In this type of color blindness Red color looks more Green in color.

Protanopia and Deuteranopia : In this type of color blindness both make you unable to tell difference between Red and Green color.

Tritanomaly : In this type of color blindness hard to tell the difference between blue and green, and yellow and red.

Tritanopia : In this type of color blindness hard to tell the difference between green,purple and red, and yellow and pink.

LITERATURE SURVEY

This work deals with different sensors and sensor cloud that can be used to monitor the status of cold storages. Raspberry pi and hardware designs to connect with the internet. We have used messaging for notification purpose.[1]. This work deals with monitoring and controlling of food storages using Android app. we concluded that using Android app is more efficient when compared with Desktop application.[2]. This works deals with the implementation of IoT-OSMS, and ensured the occupational health and safety and improves working performance in cold storages. Fuzzy Logic and Real-Time positioning are integrated to achieve their goal. They used Bluetooth Low Energy (BLE), a kind of RFID solution to locate and collect accurate information of the workers who are working in cold storages. D. Sulman Farrukh, Muhammad Shahzad, Usman Khan, TalhaChughtai, and Ali Nawaz Khan (2013).[3] .They proposed an economic solution for cold storage management. Sensors are connected and at different levels as the temperature vary at different levels. This leads to the dumping of very accurate and reliable data from the sensors which in turn makes the whole system reliable and robust. E. Mira Trebar (2015)[4].This work deals with the logistic management in cold storages where radio frequency identification (RFID) technology is used. Temperature has been monitored by using prototype UHF RFID data logger, semi passive RFID tag. This tag helps to log the sensor values using the respective time-stamp. The work also includes some features like data protection, automatic sensors signal acquisition, smart power supply. The data is store during innovative analogue nanotechnology architectures. F. Zhao Xiaorong, Fan Honghui, Zhu Hongjin, Fu Zhongjun, Fu Hanyu (2015)[5]

In this paper, a novel IoT architecture based on object named service (ONS) which captures and stores the information in the web has been introduced. High volume products can be tracked using RFID tracks and low volume products can be tracked using bar codes. The data from the sensors, bar codes and RFID tags have been analyzed to obtain the shelf life and product quality. G. Yanan Li, YulinPeng, Lei Zhang, Jiefeng Wei, Dan Li(2015)[6]. This work adopts wireless sensor network and research the performance and integrate mode of the technologies. It is designed to achieve a larger and longer communication distance transmission network. Easy access of product information is done which helps to enhance the product quality and safety.[7]

TEHCNIQUES USED

Hardware Specifications

- IOT
- Temperature and Humidity Sensor
- Mq 3 Sensor
- Mcro controller Node MCU ASP 8266
- Lcd Display

Software Specification

- Arduino IDE

PROPOSED WORK

This project creates a novel method for IOT-based system that can monitor data from numerous sensors and provide report analytical data. It is designed, analysis data from different device, and provides timely delivery.

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It uses wireless protocol to construct a wireless monitoring system. The base station/gateway and internet are integrated to provide a data monitoring system.

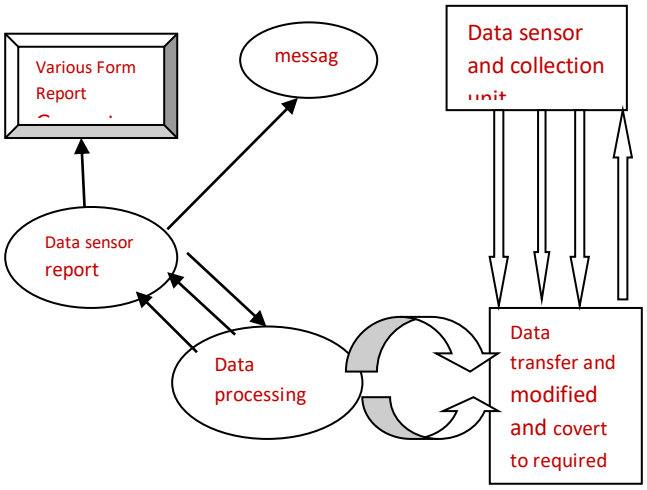

Fig- IOT Based system architecture

APPLICATIONS

- Adequate storage of food helps maintain the quality and nutritional value of purchased food by preventing further deterioration.
- People are busy with their personal lives for which it is difficult for them to go to the market on multiple occasions. They can therefore store their food in a storage system for a certain period.
- Much food is wasted because of inappropriate storage and losses after harvest, so it will reduce food waste.
- The cost of storage in the refrigerator is also significant. We have therefore designed IOT-based food storage system where we can store fruits and vegetables for a few days.
- As a result, we can store our food in a controlled environment by reducing the quality of fruit and vegetable breakdown.

SYSTEM ARCHITECTURE

As is shown in Fig. 1, a network structure is proposed. The architecture of the cold storage environment monitoring system based on wireless sensor networks consist of the common sensor nodes, sink nodes, control center and communications system. A large number of the sensors can be placed in the storage and constructed a self-organized network to monitor the data change including temperature, humidity and gas concentration, etc. To perform a complete and accurate environment monitoring, it is significant to introduce image and video into sensor networks system in some applications [8, 9]. Thus, image devices can be optionally equipped according to the need of application and the cost limitation.

The common nodes will collect the data which transmitted to the sink node. The data is delivered by sink node and stored in the database on control center. The control center can send the control information to any node in the network. Likewise, the remote data could be transmitted to the control center with the sink node. That means sink nodes act as the media of the communication between common nodes and control center, and it can not realized to directly send message between them. We used a CDMA modem to connect the wireless sensor network to the Internet, and then any authorized users can access the data through browser. In this architecture, only one public IP address is required for a sink node zone.

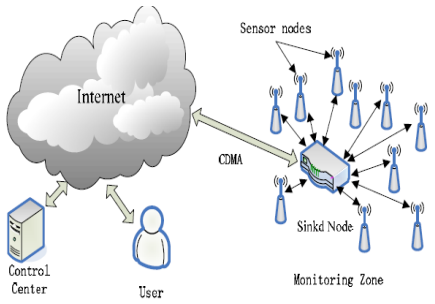

Fig. 1 System architecture

HARDWARE DESIGN OF THE SYSTEM

Sensor node is the basic platform of wireless sensor networks. The sensor node consists of five parts, sensor module, Analog/digital (A/D) conversion module, processing module, wireless communication module and the power module. Sensor module is used to collect temperature, humidity, gas concentration and other parameters. Analog/digital conversion module can convert analog signal comes from sensor module to digital signal which can be recognized by processor unit. The processor module controls the operation of the sensor nodes, stores and processes the collected data, as well as simple computation and analysis. Wireless module communicates with sink nodes, exchanges control information, sends and receives data. In this

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paper, wireless communication module is based on ZigBee technology, which is the et of specs built around the IEEE 802.15.4 wireless protocol. ZigBee devices in a network can communicate at speeds of up to 250Kbps while physically separated by distances of up to hundreds of meters in typical circumstances and greater distances in an ideal environment. Based on ZigBee network communication technology and microprocessor technology, the system can deal with the various operating parameters of the remote transmission, real-time data collection and real-time monitoring. The power modular provides the energy to the sensor module, A/D conversion module, processing module and wireless communication module. The hardware structure of the node is shown in Fig. 2.

As the most important part of a sensor node, processor and wireless chip exploits CC2430. The chip includes 2.4GHz RF transceiver and an industry-standard enhanced 8051 MCU, 32/64/128 KB flash memory, 8 KB RAM and many other powerful features. Thus it can content the need of high performance and low power in 2.4 GHz IEEE 802.15.4 band based ZigBee.

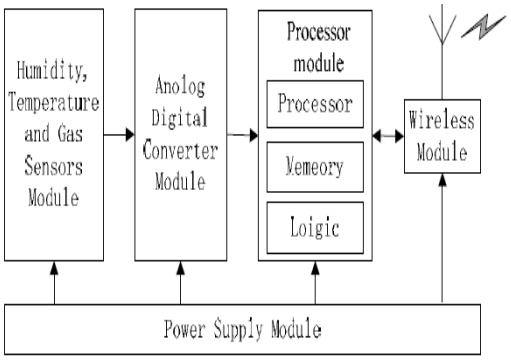

Fig. 2 The block chart of sensor node

The data integration, positioning algorithm and other complex computation are completed by sink node, so a more advanced processor is needed. Samsung's 16/32-bit RISC microprocessor S3C2440 is suitable for these tasks. It is designed to provide hand-held devices and general applications with lowpower and high-performance microcontroller solution in small die size. The S3C2440A is developed with ARM920T core, 0.13um CMOS standard cells and a memory complier. It adopts a new bus architecture known as Advanced Micro controller Bus Architecture (AMBA). The ARM920T implements MMU, AMBA BUS, and Harvard cache architecture with separate 16KB instruction and 16KB data caches, each with an 8-word line length. Its low power, simple, elegant and fully static design.is particularly suitable for cost- and power-sensitive applications.

SOFTWARE DESIGN OF THE SYSTEM

The software architecture of sensor node is divided into embedded operating system kernel layer and API layer. The kernel also provides a low-level node driver of all hardware devices. API layer provides sensor acquisition module and RF communication module. Embedded operating system TinyOS serves as the software platform of the nodes, which is an open-source operating system designed for wireless embedded sensor networks. The TinyOS system, libraries, and applications are written in nesC, a C-like language optimized for the memory limitations of sensor networks. The nesC language supports the TinyOS concurrency model, as well as mechanisms for structuring, naming, and linking together software components into robust network embedded systems. Task debugging module controls the control flow throughout the operating system, which is mainly responsible for the initialization of the wireless sensor and the maintenance of the operating status. The power management module supports processor, RF transceiver, sensors and other parts of the state control of energy consumption. Energy management is able to ensure that nodes wake up at the right time, run in the low-power mode and maximize the use of energy. The software flowchart of sensor node is shown in Fig. 3. The program initializes CC2430 firstly, then opens the power of sensor and initialize protocol stack, begins send signal to add to network, waits for network coordination's answer and assigns network address.

As to sink node, the CC2430 is also initialized firstly, then the protocol stack is initialized and the interrupt is opened. After that program began formatting the network, if the network is formatted successfully, and sink node connect to computer by serial port, we can find the physical address, network ID and channel number by software, and then sink node is in monitoring state. If a sensor node try joining the network, sink node will assign a network number. If data collection node sends some data, it will judge where the data comes from, and sends the message to control centre. The software flowchart of sink node is shown in Fig. 4.

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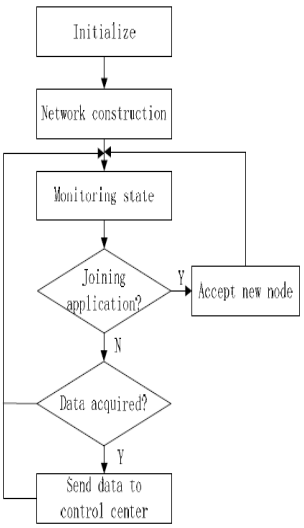

Fig. 3 The software flowchart of sensor node

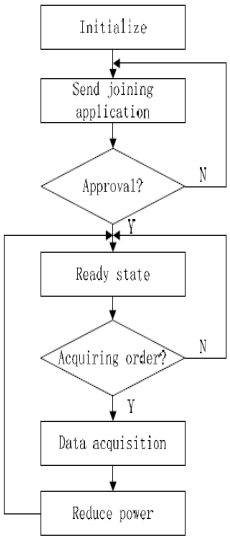

Fig. 4 The software flowchart of sink node

CONCLUSION

The purpose of this protocol model is to monitor the environmental conditions in cold storage warehouses. Internet of Things technology makes it easier to manage these warehouses. The owner continuously and in real time monitors these warehouses.
In this age of automation, the development of new standards and technologies has been significantly influenced by wireless monitoring. Hence, the monitoring system for cold storage prevents the food that is kept there from disintegrating. All tasks relating to food safety require automation of schedules.

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