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IoT-Based Emergency Supply Chain Optimization Framework for Natural Disaster Management

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ABSTRACT

Nowadays, customer's health awareness is of extreme significance. Food can become contaminated at any point during production, preparation and distribution. Therefore, it is of key importance for the perishable food supply chain to monitor the food quality and safety. Traceability system offers complete food information and therefore, it guarantees food quality and safety. The current study proposes IoT-based traceability system that utilized Node MCU based sensors. The Node MCU is used to measure temperature and humidity during storage and transportation. The results displayed that compared to the traditional methods.

INTRODUCTION

Food safety is presently considered to be a central issue for all stakeholders in food production. Due to the growing consumer health awareness, food quality and safety have gained much attention. Thus, it is of crucial importance for the food industry to upgrade quality assurance, food product integrity, food

safety guarantees, and associated transparency along with the complete food supply chain. A traceability system can be used as a solution for the perishable food supply chain (PFSC) as it provides track and trace for the complete food information in an efficient and trustworthy manner, thereby ensuring food quality and safety. The Internet of Things (IoT) needs a few essential components to allow communication between devices and objects. The use of IoT sensors has significantly increased and exhibited potential for enhancing the quality of life in the community. IoT devices such as raspberry pi can be utilized as a flexible

gateway to collect and forward data received from different sensors to the internet or server program. Previous studies have revealed that temperature is the most critical factor influencing perishable food safety and quality. Consequently, a temperature monitoring system is compulsory to monitor perishable food quality in the supply chain and IoT sensors could be utilized for this temperature monitoring system. Environmental conditions such as temperature and humidity can be

gathered with the help of Node MCU based sensors. Accurately forecast the changes in temperatures is important, so that controlled environment can be achieved. The present study proposes an IoT-based traceability system by utilizing IoT and Node MCU based sensors.

LITERATURE REVIEW

The literature survey is provided in this paper for the development of the schemes utilizing block-chain technology to provide information security. A core requirement is identified and then the author proposed generalized security architecture based on block-chain. On the studied schemes, detailed cost analysis has been conducted. The drawbacks in existing research are also uncovered by the comparative analysis. A model is proposed in this paper by the authors to uplift the traditional agriculture field to smart farming in which blockchain is considered with the IoT technology. The equal opportunity to all stakeholders is provided by the system in the food supply chain. To reduce human interference, IoT devices are added for data collection and verification. The presented system is also compared with the scheme which only utilizes the IoT devices in the monitoring field without block-chain. As the food safety is becoming serious in the worldwide, so food safety issues are tackled the from the technical aspect and from the systems that can monitor the whole lifespan of food production. The system includes the processes of food raw material cultivation/breeding, transporting, warehousing, and selling etc.

The blockchain and IoT technology based open and ecological food traceability system is proposed. All parties of a smart agriculture ecosystem are involved in the system even if they may not trust each other. The manual recording and verification are replaced by the IoT devices in which human intervention is effectively reduced to the system.

EXISTING SYSTEM

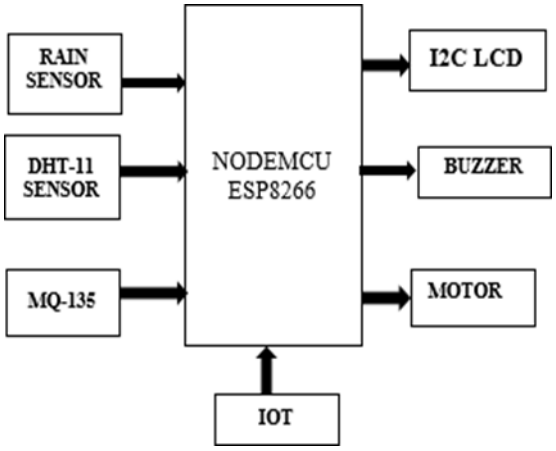
Spoiled food can be very harmful for people and should therefore not be consumed. Often, the growth of spoilage organisms results in the loss of whole batches of food. Food safety and quality has been a major challenge in the food supply chain, stores and warehouses. It is the responsibility of all food service establishments, stores and ware houses to ensure proper safety and quality of food to ensure the health of their customers. Their primary focus should be on implementing the required quality assurance guidelines and standards resulting in process monitoring systems and preventive control measures

PROPOSED SYSTEM

This project proposes a system to analyse the ambient conditions under which the food item is being stored and transported. The

proposed solution senses the temperature, humidity, gas sensor and rain sensor parameters of surrounding environment as these parameters affect nutritional values of food items. This system makes use of storage units implanted with various electronic sensors which can read those parameters affecting food materials.

BLOCK DIAGRAM



HARDWARE DESCRIPTION

Fig: 1 NODE MCU

Node MCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

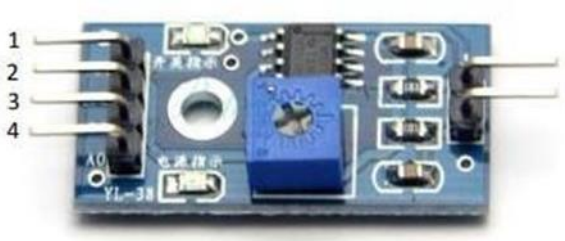


Fig: 2 RAIN SENSOR

A rain sensor is one kind of switching device which is used to detect the rainfall. It works like a switch and the working principle of this sensor is, whenever there is rain, the switch will be normally closed.

Fig: 3 DHT-11 SENSOR

DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor. This sensor is used here to monitor the humidity variation of the environment where the crops are cultivated. This is a digital sensor and measures the humidity value in percentage format.

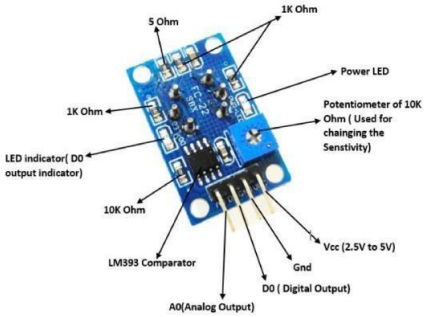


Fig: 4 GAS SENSOR (MQ 135)

The MQ-135 Gas sensor can detect gases like Ammonia (NH3), sulfur (S), Benzene (C6H6), CO2, and other harmful gases and smoke. Similar to other MQ series gas sensor, this sensor also has a digital and analog output pin. When the level of these gases go beyond a threshold limit in the air the digital pin goes high. This threshold value can be set by using the on-board potentiometer. The analog output pin, outputs an analog voltage which can be used to approximate the level of these gases in the atmosphere. The MQ135 air quality sensor module operates at 5V and consumes around 150mA. It requires some pre- heating before it could actually give accurate results.

Fig: 5 I2C LCD

The I2C 1602 LCD module is a 2 line by 16 character display interfaced to an I2C daughter board. The I2C interface only requires 2 data connections, +5 VDC and GND to operate Viewable area Adjustable by potentiometer on I2c interface 80mm x 36mm x 20 mm.

Fig: 6 BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

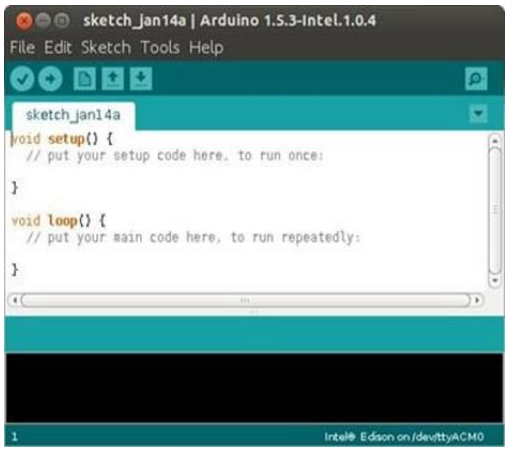
Fig: 7 MOTOR

A machine that converts DC electrical power into mechanical power is known as a Direct Current motor. DC motor working is based on the principle that when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force.

SOFTWARE DESCRIPTION

Arduino Software (IDE)

Arduino is an open source, computer hardware and software company, project, and user community that designs.



The Arduino software is developed using the Arduino IDE to control the NodeMCU-based traceability system. The program initializes temperature and humidity sensors such as DHT11 or DHT22. Sensor data is periodically read using appropriate libraries. The NodeMCU processes raw sensor values and converts them into meaningful units. Wi-Fi connectivity is established to transmit data to a cloud server or IoT platform. Threshold values for temperature and humidity are predefined in the code. When limits are exceeded, alerts are triggered automatically. The software supports continuous monitoring through loop execution. Data transmission is performed using HTTP or MQTT protocols. Error handling routines ensure reliable operation. The program supports real-time visualization through dashboards. Power-efficient coding practices are followed. The software allows easy modification of parameters. Calibration routines improve sensor accuracy. The code structure is modular and readable. Secure communication protocols are used. The software enables data logging for traceability. Firmware updates are supported. Debugging is done using serial communication. Overall, the software ensures reliable system performance.

CONCLUSION

The proposed IoT-based traceability system effectively enhances food quality and safety monitoring in the perishable food supply chain. By using NodeMCU and environmental sensors, real-time temperature and humidity data are continuously tracked. This approach minimizes the risk of food contamination during storage and transportation. The system provides improved transparency and traceability compared to traditional monitoring methods. Real-time alerts help in taking immediate corrective actions. Data logging ensures accountability across the supply chain. The solution is cost-effective and easy to deploy. It reduces food spoilage and wastage. The results confirm better monitoring accuracy. Overall, the system improves consumer trust and food safety management.

FUTURESCOPE

The system can be extended to include additional sensors for gas, pH, and microbial detection. Integration with GPS can enable real-time location tracking of food products. Blockchain technology can be incorporated for secure and tamper-proof data storage. Mobile applications can be developed for user-friendly monitoring. AI-based analytics can predict spoilage trends. Cloud platforms can enhance large-scale data management. Energy-efficient designs can improve battery life. Integration with cold-chain logistics is possible. Multi-node

scalability can be explored. The system can be adapted for pharmaceutical and medical supply chains.

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