International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 04 | April - 2023 Impact Factor: 8.176 ISSN: 2582-3930

Food Processor Scada by Using Blockchain Technology

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Abstract

This paper presents an abstract for a food processing SCADA (Supervisory Control and Data Acquisition) system that utilizes blockchain technology. The proposed system aims to enhance food safety and traceability by securely recording and sharing data across the food supply chain. The system integrates SCADA technology to monitor and control the processing of food products, while blockchain technology provides an immutable and transparent ledger to track and verify the movement of food products from farm to fork. The use of blockchain technology also enables the implementation of smart contracts, which can automate certain processes and enforce rules and regulations related to food safety and quality. The proposed system can potentially provide benefits such as improved food safety, reduced food fraud, and increased consumer confidence in the food supply chain. Food safety and traceability are critical issues in the food industry, as consumers increasingly demand greater transparency and accountability in the food supply chain. However, current food supply chain systems often suffer from a lack of transparency and accountability, which can lead to food fraud, contamination, and other safety issues.

Keywords:- Food safety, Tracebility, Scada, Blockchain, Smart contracts, Transparency, Tamper-proof, Decentralized, Automation, Quality Control, Supply chain management, Public health, Consumer confidence, Data recording, Auditablity

Introduction:-

Food processing is a critical aspect of the food industry, and ensuring the safety and quality of food products is paramount to protecting public health and consumer confidence. In recent years, advances in technology have enabled the development of various systems and tools to monitor and control the processing of food

products, such as Supervisory Control and Data Acquisition (SCADA) systems. SCADA systems use sensors and control algorithms to monitor and control critical process parameters, such as temperature, pressure, and pH, to ensure the safety and quality of food products.

However, despite the use of such systems, the food industry still faces challenges related to food safety and traceability. Traditional paper-based or electronic-based systems for tracking food products have limitations in terms of security, efficiency, and transparency. The use of blockchain technology has emerged as a potential solution to address these limitations and enhance food safety and traceability across the food supply chain.

Blockchain technology is a decentralized and tamper-proof ledger that can record and share data across the food supply chain. Each block in the blockchain contains a unique digital signature, and once a block is added to the blockchain, it cannot be altered or deleted. This provides a transparent and auditable record of the movement of food products from farm to fork, which can enhance transparency and accountability across the food supply chain.

The proposed food processing SCADA system using blockchain can be implemented in different stages of the food supply chain, from the farm to the processing plant to the retail store. SCADA technology can be used in the processing stage to monitor and control critical process parameters, such as temperature, pH, and pressure, to ensure the safety and quality of food products. The data generated by the SCADA system can be securely recorded on the blockchain, providing a transparent and auditable record of the processing conditions. In addition, the proposed system can incorporate smart contracts, which are self-executing agreements that can automate certain processes and enforce rules and regulations related to food safety and quality. For example, a smart contract can be programmed to automatically trigger an alert when a certain threshold for a critical process parameter is exceeded, or to block the transfer of a food product if it does not meet certain quality criteria.

Related Work:-

Here are some possible related works for a project on food processing SCADA using blockchain:

1. "Blockchain in the Food Industry: A Review of Applications, Opportunities, and Challenges" by Iqbal et al. (2021) - This paper provides an overview of blockchain technology in the food industry, including its potential applications, benefits, and challenges.

2. "Blockchain for the Food Chain: An Exploration of Critical Factors" by Simeone et al. (2019) - This paper explores the critical factors involved in the application of blockchain technology in the food industry supply chain, including trust, transparency, security, and traceability.

3. "Application of blockchain technology to improve transparency, traceability, and trust in food supply chain management: A systematic review" by Kumar et al. (2021) - This paper provides a systematic review of the application of blockchain technology in food supply chain management, including its potential benefits and challenges.

4. "Blockchain for food traceability - A systematic literature review" by Batista et al. (2019) - This paper presents a systematic literature review of the use of blockchain technology in food traceability, including the benefits and limitations of this technology.

5. "Smart Contract-based Traceability in Food Supply Chain Management: A Review" by Xu et al. (2019) - This paper reviews the use of smart contracts in food supply chain management, including the potential benefits and challenges of using this technology.

6. "Blockchain-Based Traceability in the Food and Beverage Industry: A Review" by Tian et al. (2021) - This paper provides a comprehensive review of blockchain-based traceability in the food and beverage industry, including the potential benefits and challenges of this technology.

Objective

The objective of integrating blockchain technology into a food processing SCADA (Supervisory Control and Data Acquisition) system is to improve the transparency, traceability, and security of the food supply chain. By implementing a blockchain-based SCADA system, food processing companies can ensure that the data collected during the production process is secure, tamper-proof, and accessible only to authorized parties.

The blockchain technology can create a decentralized system where all the stakeholders in the food supply chain, including farmers, processors, distributors, retailers, and consumers, can access real-time information about the food products. This will help to reduce the risk of fraud, counterfeiting, and foodborne illnesses by ensuring that the food products are authentic, safe, and comply with the required standards.

Additionally, by using smart contracts and blockchain-based payment systems, the food processing SCADA system can streamline the payment process, reduce the transaction costs, and improve the efficiency of the supply chain. This can lead to higher profits for the food processing companies and lower prices for the consumers.

Overall, the objective of integrating blockchain technology into a food processing SCADA system is to create a secure, transparent, and efficient food supply chain that benefits all the stakeholders involved.

Proposed System:-

A proposed system for integrating blockchain technology into a food processing SCADA system would involve the following components:

Data Collection: The first step in the proposed system would be to collect data about the food products at each stage of the supply chain, including information about the ingredients, production processes, and distribution channels. This data would be collected by sensors and other monitoring devices, which would be connected to a centralized data management system.

2. Blockchain Integration: The next step would be to integrate a blockchain-based system into the SCADA system, which would create a secure, tamper-proof ledger for storing the data collected during the production process. This would involve creating a decentralized network of nodes that would verify and validate the data, ensuring that it is accurate and up-to-date.

3. Smart Contracts: Smart contracts would be used to automate the payment process and other transactions within the supply chain. These contracts would be triggered automatically when certain conditions are met, such as when a shipment of food products is delivered to a retailer.

4. Access Control: Access to the blockchain-based SCADA system would be controlled through the use of cryptographic keys and other security measures, ensuring that only authorized parties can access the data. This would help to prevent fraud and other malicious activities within the supply chain.

5. Traceability and Transparency: The blockchain-based SCADA system would provide a high level of traceability and transparency throughout the food supply chain, allowing stakeholders to track the movement of food products from farm to table. This would help to improve the quality and safety of the food products, as well as increase consumer confidence in the supply chain.

IoT Devices: IoT devices, such as sensors and RFID tags, can be used to track the movement of food products through the supply chain. This allows for real-time monitoring of the food products and ensures that they are stored and transported in the appropriate conditions.

SCADA System: The SCADA system is the core component that monitors and controls the food processing operations. It collects data from various sensors and devices, such as temperature sensors, humidity sensors, and process controllers.

Data Analytics: Data analytics can be used to analyze the collected data and generate insights that can help to optimize the food processing operations, improve quality control, and reduce waste.

Overall, a proposed system for integrating blockchain technology into a food processing SCADA system should include a robust SCADA system, a secure blockchain platform, smart contracts to automate processes, IoT devices for tracking and data analytics for optimization.

System Architecture:-

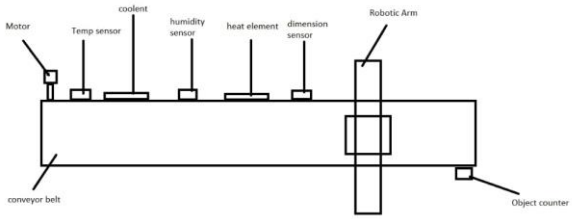

Fig. System architecture

Required components:-

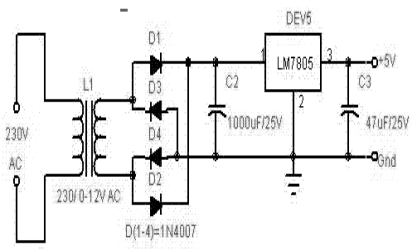

Fig. Circuit diagram of power supply

STEP DOWN TRANSFORMER

Transformers are static device which convert the electrical energy from one circuit to another circuit without any change in frequency and power. Step down transformer means the transformer which reduces the supply voltage to the desired value. In our project we need 12 volt DC supply, therefore in this project 12-0-12, 500mA transformer is used.

RECTIFIER CIRCUIT

Rectifier is a circuit which converts the AC electrical energy into Dc electrical energy. For operating of semiconductor devices used in this project we need regulated DC supply. In this project we use centre tap full wave rectifier. Full wave rectifier circuit is capable of converting sinusoidal input into a unidirectional output. The circuit diagram is as shown in the figure.

FILTER CIRCUIT

It is seen that the output of the rectifier is not pure DC, because it contain some amount of AC component which is called as ripple factor which gives the fluctuation and hence to minimize the ripple in the output the filter circuit is used. This circuit is connected after the rectifier circuit. In our project capacitor input filter is used. The circuit is as shown in the figure. The capacitor is connected in parallel to minimize the ripple factor.

REGULATOR CIRCUIT

In our project for the operation of IC we need +5 volt regulated supply is necessary therefore a voltage regulator circuit is used. A voltage regulator is a circuit that supplies constant voltages regardless of change in the load current. IC voltage regulators are versatile and generally used. The 78xx series consist of three terminal positive voltage regulators. These ICs are designed as fixed voltage regulator and adequate heat sink. It can be deliver output current in access of 1A. These devices do not required external component.

These ICs has internal terminal overload protection and internal short circuit and current limiting protection.

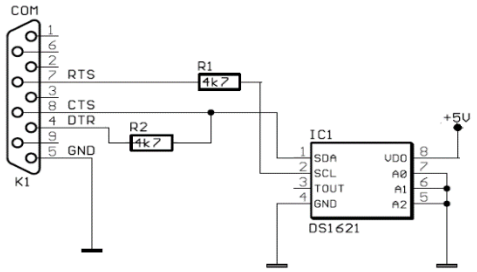

Fig. Temperature sensor circuit

TEMPRATURE WORKING

The key component is the Dallas Semiconductor's DS1621 temperature sensor. This tiny 8 pin IC needs only +5 volts to measure the temperature and to send it out via its IIC bus output. Since many IIC bus devices can be connected in parallel, three address inputs (A0, A1, A2) are provided to select one out 8 addresses the

device will respond on. This way, up to 8 sensors can be connected in parallel. I have set the internal temperature sensor to address 0 and the external one to address 1. If you plan to use only one sensor connect it as address 0.

Interfacing the IIC bus to the RS232 com port is a matter of adapting levels. IIC works on 0..5V signals, RS232 uses -12V .. +12V. The trick here is that, altough specified for -12V..+12V, almost all PC com port I know work equally well with 0..5V signals. This eliminates the need to raise the IIC output to RS232 levels, and the SDA data line connects directly to the PC CTS line. On the opposite way, the RS232 signals can damage the IIC inputs, so I placed voltage limiters (R1, DZ2, R2, DZ1) on the SCL clock input and SDA data input. (note that SDA is *bidirectional*: receives from the DTR line and transmits to the CTS line).

Since the circuit draws very little current, there is no need to add an external power supply. The +12V from the RS232 lines are conveyed to the regulator by diodes D1, D2, filtered by C1 and regulated to +5V by the LM2936-Z5. Don't replace it with an ordinary 78L05 regulator unless you want to add an external 9V battery: the LM2936 is capable to regulate even with input voltages near to 6V, as is the case of many serial ports.

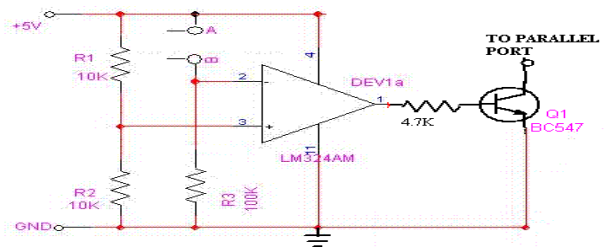

Fig. Humidity Sensor Circuit

HUMIDITY WORKING

The Project presented here waters your plants regularly when you are out for vocation. The circuit comprises sensor parts built using op-amp IC LM324. Op-amp's are configured here as a comparator. Two stiff copper come in contact with the material to sense the whether the material is dry. The Computer was used to control the whole system it monitors the sensors and when more than two sensors sense the dry condition then the computer will switch on the heater and it will switch off the heater when all the sensors are in wet. The computer does the above job it receives the signals from the sensors, and this signals operated under the control of software.

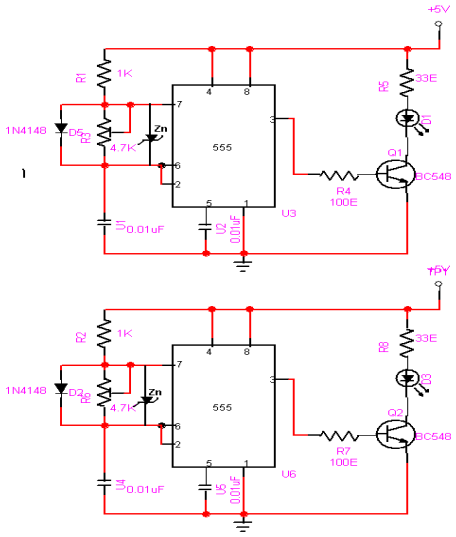

Fig. IR Transmitter

IR TRANSMITTER

IC 555 is used as an Multivibrator. This is a free running oscillator and the frequency can be adjusted using 100k preset (variable resistor). Free running oscillator means, it is itself starting circuit which outputs a waveform that repeats itself without being either triggered or re-triggered. The output of the oscillator is periodic (i.e. repeats itself regularly) pulse or wave train. In a periodic signal the wave repeats itself indefinitely until the circuit is either turned off or otherwise inhibited.

In this mode of operation, the capacitor charges and discharges between 1/3 Vcc and 2/3 Vcc. As in the triggered mode, the charge and discharge times and therefore the frequency are independent of the supply voltage.

In this circuit value of capacitor C = 0.1µf is constant because we cannot vary the value of capacitor whereas 100k is a variable resistor with the help of this frequency is adjusted between 38 kHz for obtaining the stable square wave and it is transmitted through infrared LED.

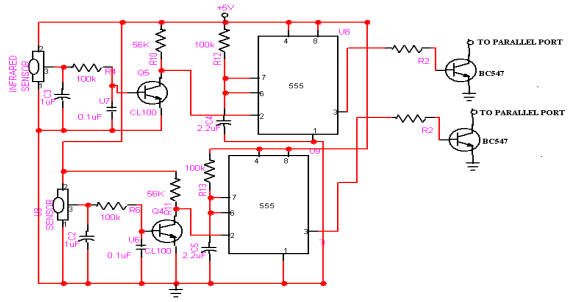

Fig. IR Receiver

IR RECEIVER CIRCUIT

when IR signals does not falls on the TSOP 1738 its output pin no.3 goes high. R14 resistance is used to limit the current at the output of the TSOP and fed to pin1 of the NOT gate ic which has internal 6 not gate. 1st not gate invert its output and its output is again inverted by another not gate and increases its output current to switch the switching transistor 2N2222A or SL100 which is NPN switching transistor. the ground signal is generated by the transistor is fed to the PC parallel port to process data.

Receiver circuit operated at 5V DC and it is drive from power supply circuit. Transformer converts 230V AC to 12V AC and the 12V AC is converted into DC by Diode D1 & D2 it filtered by Capacitor C1, IC3 gives. Regulated 5V DC to other circuit. Infra-red receiver module detected 38 kHz signal this is transmitted from transmitter circuit. When transmitter is on I/R sensor does not generate signal and its out put go to high level. This out put level is fed to Computer Circuit.

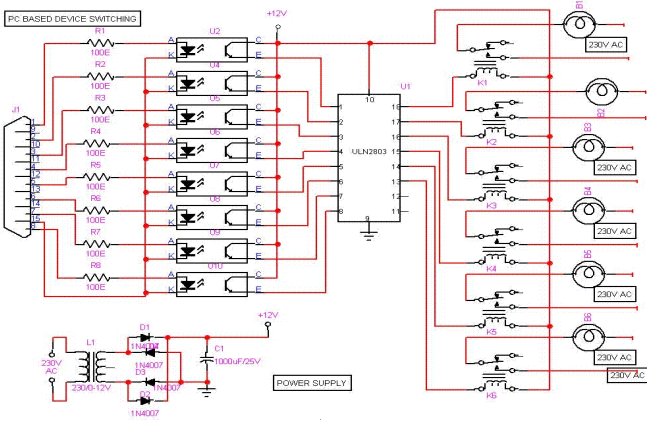

Fig. Motor Control

MOTOR CONTROL

SWITCHING THROUGH OPTOCOUPLER

When High Signal Means 5volt Reaches To The MCT2E An Internal LED Blow. Light Falls On The Phototransistor And Current Flows Through The Transistor, Then Signal Is Reaches To The NPN Switching Transistor 2N2222A Which Actuate The Relay Which Tends To Drive The Motor . The 100E Resistance Is Used To Limit The Current Which May Damage To The Optocupler MCT2E And 2.2k Resistance Is Also Used To Limit The Current To Properly Switch The Transistor And Preventing Damage To The Transistor.

Result:-

The use of blockchain technology in food processing SCADA (Supervisory Control and Data Acquisition) systems can provide several benefits, including increased transparency, traceability, security, and efficiency in the food supply chain. These benefits can lead to improved food safety and consumer trust. Some specific results of using blockchain technology in food processing SCADA systems.

Conclusion:-

In conclusion, the use of blockchain technology in food processing SCADA (Supervisory Control and Data Acquisition) systems can provide several benefits such as increased transparency, traceability, and security. By implementing blockchain, the entire supply chain can be tracked from the farm to the table, ensuring the safety and quality of the food. Blockchain can also prevent fraudulent activities such as counterfeiting, mislabeling, and adulteration of food products. Additionally, the immutable nature ofblockchain ensures that all data and transactions are secure and tamper-proof, reducing the risk of data breaches and cyberattacks.

Overall, incorporating blockchain technology into food processing SCADA systems has the potential to revolutionize the food industry, improving safety, transparency, and trust between producers and consumers. However, implementing such a system would require collaboration between various stakeholders in the food industry, including farmers, processors, distributors, and retailers, to ensure the seamless integration and adoption of the technology.

Future scope:-

The future scope for food processing SCADA using blockchain is vast and promising. With the increasing demand for safe and quality food, blockchain technology can help to establish trust and transparency in the food supply chain. Here are some potential future applications of food processing SCADA using blockchain:

1. Improved supply chain management: Blockchain can be used to track and manage the movement of food products from farm to table. This can help to ensure the quality, safety, and authenticity of food products, and reduce waste and inefficiencies in the supply chain.

2. Better food safety: Blockchain can help to identify and trace the source of foodborne illnesses, making it easier to contain outbreaks and prevent future occurrences. By implementing blockchain, it is possible to quickly identify the source of contamination and remove the affected products from the supply chain.

3. Enhanced consumer trust: Consumers are becoming increasingly concerned about the safety and quality of their food. By using blockchain technology, food processors can provide consumers with a transparent and secure system that assures them of the quality and safety of the food products they consume.

4. Smart contracts: Smart contracts can be used to automate food supply chain processes such as payment processing, product tracking, and quality control. This can help to reduce transaction costs, increase efficiency, and improve overall supply chain management.

5. Integration with IoT: Blockchain can be integrated with Internet of Things (IoT) devices to track and monitor food products throughout the supply chain. IoT sensors can collect data on temperature, humidity, and other environmental factors that can affect the quality and safety of food products. By integrating blockchain with IoT, food processors can ensure that their products are stored and transported under optimal conditions.

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