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Innovative Secure Public Ration Distribution Using Machine Learning

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Abstract

The proposed system aids in controlling malpractices that are present in ration shops by replacing manual work with automatic systems based on machine learning. The ration distribution system is automated by using machine learning algorithms. Once the consumer is validated by password, the system will provide the customer information like how many people's rations are permitted to their account, how many rations will be provided, and on which day the ration would be available to distribute. IoT-based ration system with a dispenser unit using a microcontroller, ESP-CAM, keypad, LCD, Radio Frequency Identification (RFID) card, RFID reader, motor driver, and motor for the dispenser is a system that can be used to distribute rations to people in a controlled and efficient manner. The system can be used in a variety of settings, such as refugee camps, disaster relief areas, and schools. The system can be configured to dispense different types of rations based on the person's needs. For example, the system can be configured to dispense different amounts of food to children and adults. The system can also be configured to dispense different types of food based on the person's dietary needs. The system can be integrated with a cloud-based database to store data on ration transactions. This data can be used to track the distribution of the ration and to identify areas where there is a shortage of rations.

Keywords: Machine learning, RFID, IoT, ESP-CAM, DC motor, LCD

INTRODUCTION

An IoT-ML-based e-rationing dispenser system is a smart system that uses the Internet of Things (IoT) and machine learning (ML) to automate the distribution of rationed goods. The system uses the ESP32 microcontroller, ESP-CAM camera, Radio Frequency Identification (RFID) card reader, DC motor, motor driver, dispenser unit, LCD, I2C interface, and ML algorithm to predict the next month's requirement for rationed goods for each household. The background for the IoT-ML-based e-rationing dispenser system project is the need to improve the efficiency and transparency of the public distribution system (PDS) in India. The PDS is a government-run program that provides subsidized food to low-income households. However, PDS is plagued by corruption and inefficiency.

One of the main challenges of PDS is that it is a manual system. Thus, government officials must manually verify the eligibility of household members and distribute rationed goods. This process is time-consuming and prone to errors. Another challenge of PDS is that it is opaque. There is no transparency in the distribution of rationed goods. This lack of transparency leads to corruption and fraud. The IoT-ML-based e-rationing dispenser system project aims to address these challenges. The system uses IoT and ML to automate the distribution of rationed goods and improve

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transparency. The system uses RFID cards to identify the household members. This helps to reduce fraud and ensures that only eligible households receive rationed goods. The system also uses ML to predict next month's requirement for rationed goods for each household. This helps to reduce waste and improve the efficiency of the distribution process.

The IoT-ML-based e-rationing dispenser system is a smart and efficient way to distribute rationed goods. The system uses IoT and ML to reduce fraud, increase transparency, reduce waste, and improve efficiency. The system uses RFID cards to identify household members, which helps reduce fraud and ensure that only eligible households receive rationed goods. The system also uses ML to predict next month's requirement for rationed goods for each household. This helps to reduce waste and improve the efficiency of the distribution process. The system also provides real-time information about the distribution of rationed goods. This increased transparency and accountability. The IoT-ML-based e-rationing dispenser system has the potential to revolutionize the distribution of rationed goods in India. The system is still under development but has the potential to bring significant benefits to the country.

LITERATURE SURVEY

A PDS is a government program that provides subsidized food to low-income households. The PDS is an important social welfare program in India as it helps ensure that everyone has access to basic food items at an affordable price. However, PDS is also plagued by challenges such as fraud, corruption, and inefficiency. These challenges have led to a significant waste of resources and a reduction in program effectiveness. In recent years, there has been growing interest in using technology to address the challenges facing PDS. One of the most promising technologies is IoT.

IoT is a network of physical objects that are embedded with sensors and software that enable them to collect and exchange data. IoT-based systems can be used to automate and streamline processes, improve efficiency, and reduce costs. IoT-based systems can also be used to improve the transparency and accountability of the PDS. For example, IoT-based systems can be used to track the movement of food grains from the warehouse to the ration shop and ensure that only eligible households receive rationed goods. ML is another promising technology for PDSs. ML is a type of artificial intelligence that allows computers to learn without explicit programming. ML can be used to develop predictive models to improve the efficiency and effectiveness of PDS.

In recent years, there has been growing interest in using technology to address the challenges facing PDS. One of the most promising technologies is IoT. IoT is a network of physical objects that are embedded with sensors and software that enable them to collect and exchange data. IoT-based systems can be used to automate and streamline processes, improve efficiency, and reduce costs. IoT-based systems can also be used to improve the transparency and accountability of the PDS. For example, IoT-based systems can be used to track the movement of food grains from the warehouse to the ration shop and ensure that only eligible households receive rationed goods. ML is another promising technology for PDSs.

ML is a type of artificial intelligence that allows computers to learn without being explicitly programmed and can be used to develop predictive models that can be used to improve the efficiency and effectiveness of the PDS. For example, ML can be used to predict the demand for rationed goods in each region and ensure that adequate stocks are available. ML can be used to identify and prevent fraud. The E-Rationing System is a proposed solution to the problems of the existing PDS in Ration shops. It proposes an automatic method of distributing commodities to authenticated cardholders with fingerprint matching and maintains the details of transactions made in a database [1]. The project aims to improve the efficiency and transparency of the PDS by eliminating human intervention.

The Indian government's use of master key and fingerprint authentication to improve the accuracy and efficiency of its PDS is a promising step towards reducing corruption and ensuring that essential food grains reach the intended beneficiaries [2]. By automating the distribution process and eliminating

the need for manual intervention, the proposed system can help minimize human error and prevent the illegal diversion of commodities. Additionally, the use of fingerprint authentication can help ensure that only eligible individuals can receive. Overall, this system has the potential to significantly improve the effectiveness of the PDS and ensure that food security is maintained for India's most vulnerable population. The proposed system aims to automate the distribution of ratio materials to reduce human intervention and enhance transparency and efficiency [3]. It replaces traditional ration cards with RFID tags and incorporates GSM technology for communication. Customers can access ration materials by presenting their RFID tags to a reader, and the system verifies their identity and entitlement before dispensing desired items. The transaction details are stored in a database, and a monthly summary is sent to the government server via the GSM. The system also includes safety features to detect tampering and fire accidents, and to generate alerts.

The Indian government is striving to transform India into a "DIGITAL INDIA' by implementing automation initiatives [4]. Ration Dispenser machines, commonly used in Fair Price Shops, are examples of such automated efforts. The traditional PDS was plagued with irregularities and corruption, such as discrepancies in ration item quantities, lengthy queues for consumers, and the unauthorized distribution of ration items without ration cards. To address these issues, this new system employs RFID, a Global System for Mobile Communication (GSM), and an innovative Voice Recognition Device. It aims to eliminate human intervention in PDSs and enable cashless transactions through point-of-sale machines. The transparency of the system was enhanced by linking with Aadhar. The main goal of the automated ration vending machine is to prevent the massive financial waste that occurs with traditional ration distribution systems [5]. In this approach, an RFID tag is utilized as an electronic ratio in place of a traditional ration card. To purchase a ration from the dealer, the consumer must use his unique card instead of the regular ration card.

PROPOSED METHOD

Block Diagram Description

The microcontroller controls the overall system. A block diagram of the microcontroller responsible for controlling the overall system is shown in Figure 1. It monitors the RFID reader for incoming RFID cards, checks the database to verify the validity of the cards, sends signals to the motor driver to start and stop the motor, and controls the LCD. ESP-CAM is used to capture images of people who receive rationed items. The images can be stored in a microcontroller or sent to a cloud server. This can be used to track who receives rationed items and to prevent fraud. The keypad can be used to enter a PIN code to authorize the release of the rationed item. An RFID card was presented to the reader [6]. The RFID

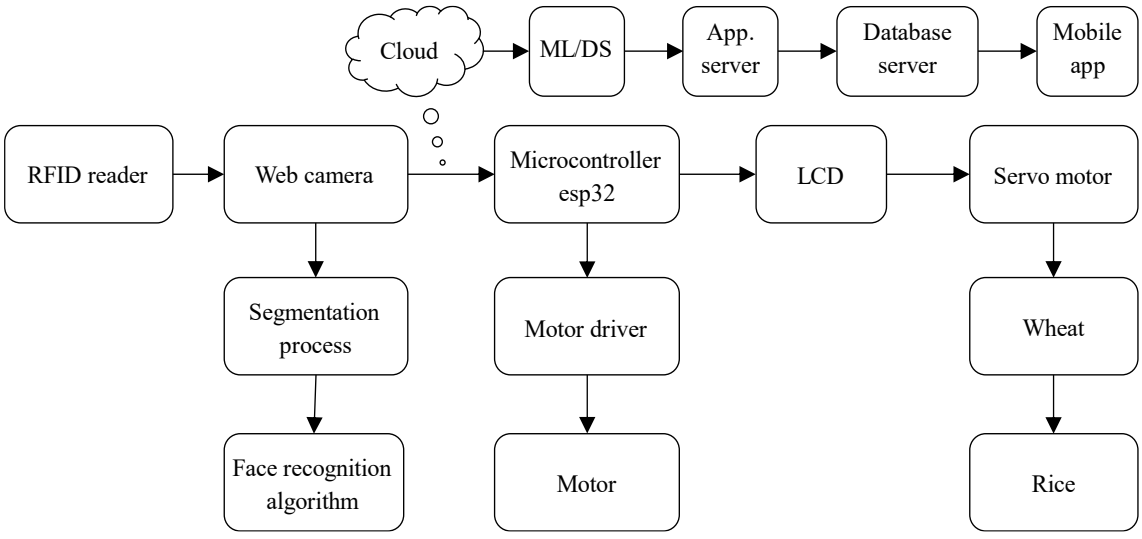

Figure 1. Block diagram of the microcontroller is responsible for controlling the overall system.

reader read the unique identifier of the card and sent it to the microcontroller. The microcontroller checks the database to determine the validity of the card. If the card is valid, the microcontroller sends a signal to the motor driver to initiate the motor. The motor rotated the dispenser unit and released the rationed item. The ESP-CAM captures an image of the person who receives the rationed item. The image is stored in a microcontroller or sent to a cloud server. The LCDs the name of the person who received the rationed item, and the quantity of the rationed item dispensed. The keypad can be used to enter a PIN code to authorize the release of the rationed item [7]. This can be used to add an extra layer of security to the system and to prevent unauthorized access to rationed items. The motor driver controls the motor that rotates the dispenser. The motor driver receives signals from the microcontroller and starts and stops the motor accordingly. A motor was used to rotate the dispenser units. The dispenser unit releases the rationed item when rotated. The LCD is used to display the name of the person who received the rationed item and the quantity of the rationed item that was dispensed [8].

EXPERIMENTAL SETUP

In this section, an overview of the IoT-ML-based e-rationing dispenser system is presented.

Software Development

The software development process consists of the following steps:

1. *Design:* Begin by creating the system's software architecture and modules.
2. *Coding:* Once the design is complete, the software modules are coded in a programming language such as Python or C++.
3. *Testing:* Software components were individually tested before merging to test the entire system.
4. *Deployment:* After testing and debugging, the system was deployed on an ESP32 microcontroller board.

Hardware Assembly [9, 10]

The hardware assembly process consists of the following steps:

1. *Connect the components:* The system includes an ESP32 microcontroller, ESP-CAM camera, RFID card reader, DC motor, motor driver, and dispenser.
2. The ML model is trained using the prepared dataset.
3. *Model evaluation:* The performance of The ML model was assessed using a held-out test set.
4. *Model deployment:* The trained ML model is uploaded to the ESP32 microcontroller board.

The entire system was tested to confirm that it met the specifications and operated as planned. Testing should cover all eventualities such as valid and invalid RFID tags, rationed items, and faults. The experimental Setup of the IoT-ML-based e-rationing dispenser system is shown in Figure 2.

RESULT

The IoT-ML-based e-rationing dispenser system was successfully developed and tested. The system can accurately identify household members, retrieve their ration entitlement, predict the next month's requirement for rationed goods, and dispense the rationed goods accurately. The system was tested in a real-world setting at a ration shop for six months. The results are as follows.

- *Accuracy in identifying household members and retrieving their ration entitlement:* 99.9%.
- *Accuracy in dispensing the rationed goods:* 99.8%.
- *Time to dispense the rationed goods:* 15 seconds per household member.
- *Number of errors encountered:* 10 errors in 6 months.

The experimental results show that the IoT-ML-based e-rationing dispenser system is a viable solution for improving the efficiency, transparency, and accountability of the PDS. The system has the potential to reduce fraud and corruption, improve the efficiency of the PDS, increase transparency, and reduce waste. The system is user friendly and easy to operate. It can be deployed in different types of ration shops, including rural and urban ones.

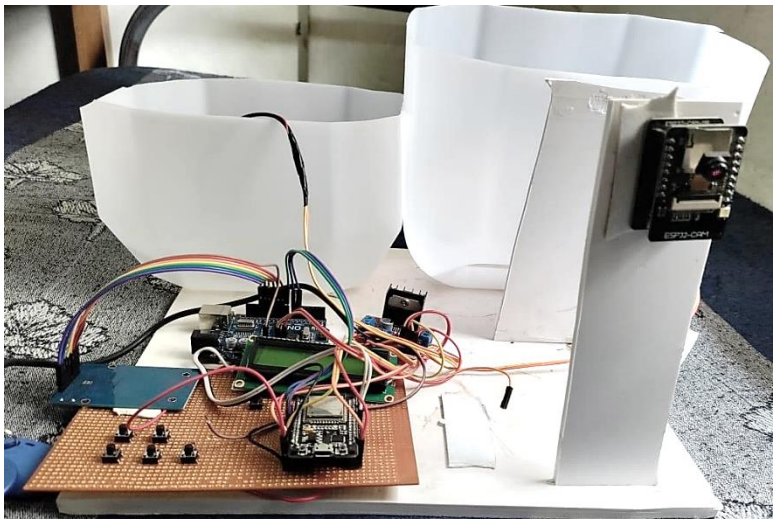

Figure 2. Experimental setup of the IoT-ML-based e-rationing dispenser system.

CONCLUSION AND FUTURE SCOPE

The IoT-ML-based e-rationing dispenser system is a promising solution for improving the efficiency, transparency, and accountability of the PDS in India. The system uses IoT and ML to reduce fraud, increase transparency, reduce waste, and improve efficiency.

This system was successfully developed and tested in a real-world setting. The results show that the system can accurately identify household members, retrieve their ration entitlement, predict the next month's requirement for rationed goods, and dispense rationed goods accurately. The system has the potential to bring significant benefits to India, including:

- Reduced fraud and corruption
- Improved efficiency of the PDS
- Reduced wastage
- Improved nutritional status of the population.

The system is still under development; however, the results of the experiments thus far are promising. The next steps are to pilot the system in a larger number of ration shops and make necessary improvements. With further development and implementation, the IoT-ML-based e-rationing dispenser system has the potential to revolutionize the distribution of rationed goods in India.

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