Ration Dispenser: Modernizing Food Distribution with IoT and RFID Integration

Mrs. M. Shanmugapriya, Assistant Professor, *ECE*
Muthayammal Engineering College, Rasipuram, India

R.Kavin, *Dept: ECE,*
Muthayammal Engineering College, Rasipuram, India

C.Mohanraj, *Dept: ECE,*
Muthayammal Engineering College, Rasipuram, India

Abstract— Ration card plays a vital role for the household details such as to get gas connection, family member details, it acts as address proof etc. In this paper, we have proposed a smart ration card system using Radio Frequency Identification (RFID) Technique and IoT to prevent the malpractices and corruption in the current ration distribution system. In this system conventional ration card will be replaced by a unique RFID tag. This RFID tag will be verified at the fair price shop for the authentication of the user. The user's identity will be verified by microcontroller which is connected to an Amazon Web Services (AWS) database. For added security One Time Password (OTP) is also sent to user's registered mobile number which needs to be entered in the system. If user is found to be authentic then monthly quota of the ration available for the user is displayed. After successful transaction the database will be updated stating the ration content delivered to the user. This system will require very less human efforts for operation and is also very secure. By implementing this system government can keep track of all the delivered ration content very easily.

Keywords – RFID, IoT, Microcontroller, AWS, OTP

I. INTRODUCTION

The project, titled "Ration Dispenser: Modernizing Food Distribution with IoT and RFID Integration," aims to revolutionize traditional food distribution systems by introducing an automated solution.Facing challenges in manual intervention and efficiency, this project leverages IoT and RFID technologies to create a sophisticated Ration Dispenser.By presenting the project's architecture, working principle, features, and benefits, this abstract outlines a comprehensive approach to enhance the overall efficiency and accessibility of ration distribution.The implementation details, results, and future enhancements discussed in the presentation contribute to a holistic understanding of the project's significance in modernizing food distribution.

Ration cards are an official document entitling the holder to a ration of food, fuel, or other goods issued by the Government of India. They are primarily used when purchasing subsidized foodstuffs (wheat, rice, sugar) and kerosene. They are an important subsistence tool for the poor, providing proof of identity and a connection with government databases. India's public distribution system (PDS) is based on the ration card, which it uses to establish identity, eligibility, and entitlement. PDS also known as ration distribution system is an Indian food security system. It is one of the government's largest economic policies in India. The main purpose is to provide subsidized food and non-food items to India's poor people. This scheme was launched in India on June 1947. This system distributes commodities such as wheat, rice, sugar, and kerosene, through a network of Fair Price Shops (FPSs), also known as ration shops, established in several states across the country. A Government-owned corporation, Food Corporation of India procures and maintains the PDS.

II. RELATED WORK

Integrating IoT and RFID in food distribution focus on enhancing supply chain visibility, ensuring product traceability, and optimizing inventory management. These models typically incorporate IoT sensors for real-time monitoring of storage conditions, RFID tags for product authentication and tracking, and cloud-based platforms for data analytics and decision-making.

Reference [5] discusses a system in which RFID tag is used that carries family member details and the customer needs to show this tag at the ration shop. The quantity available to consumer is displayed on display. The user authentication is done using thumb impression on the biometric machine. The information about the delivered ration is sent directly to government and consumer via SMS.

Another system uses RFID tag that carries the family member details and the customer needs to show this tag to the RFID reader. The microcontroller connected to the reader checks for the user authentication. If the

user is found authentic then the quantity of ration to be given to the customer according to the total number of family members is displayed on display device. They claimed that this smart ration card is free from theft as the information about the delivered ration is sent directly to the government without manual feeding using Global system for Mobile Communication (GSM) technique [6].

In order to overcome problems present current PDS the consumers were provided with smart ration cards. The consumer can buy whatever he wants by just flashing the ration card at the RFID reader at the ration store. The user authentication is done by sending a random password text to the user's mobile which has to be entered in a keypad [7]. The purchase is validated by the employee only after the details are entered in a windows application which is connected to the cloud which stores the user's personal and purchase information. Also all the users can always check their purchase details in a dedicated website.

For automatic distribution of ration content another system is discussed in [8]. In this system the smart ration card is given to consumer in form of RFID tag. After scanning the card the user is needed to enter the quantity of the items. Along with ARM7 processor they used Solenoid valve in kerosene dispenser and DC motor in grain dispenser. They stated this project would create the transparency in Public Distribution System (PDS) as the work becomes automatic.

III. SYSTEM COMPONENTS

In recent years, technology has provided various sources of basic items that assist people in meeting their requirements. As a result, the software's and algorithms assist developers in using the package, which is either an open-source platform or a commercial product, to build their own goods, which is helpful for various industries. Such software's and algorithms will be updated periodically to make a better component. The following components are used in this project. They are ESP8266, RFID, RFID TAGS, Stepper Motor.

A. ESP8266

The ESP8266 is a versatile and cost-effective Wi-Fi microchip, widely recognized for its integration capabilities and suitability for IoT (Internet of Things) applications. Initially developed by Espress if Systems, the ESP8266 offers a robust platform for connecting devices to Wi-Fi networks, enabling seamless communication and data exchange over the internet. With its built-in TCP/IP protocol stack, GPIO (General-Purpose Input/Output) pins, and support for various communication protocols, the ESP8266 has become a popular choice among hobbyists, developers, and manufacturers for developing IoT projects, home automation systems, sensor networks, and more. Its compact form factor, low power consumption, and affordability make it an ideal solution for embedding Wi-Fi connectivity into a wide range of devices and applications, bridging the gap between physical devices and the digital world.

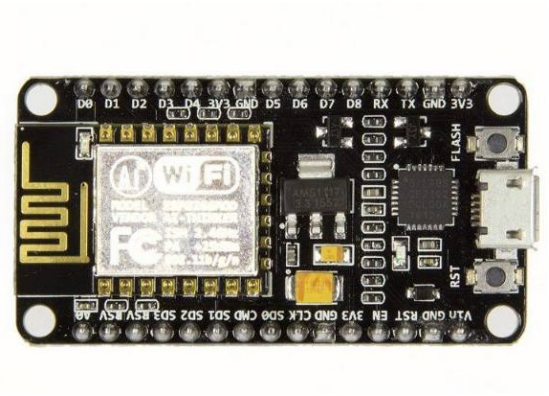


Fig. 1. ESP8266

B. RFID TECHNOLOGY

Radio-frequency identification (RFID) technique uses electromagnetic fields for automatic identification and tracking of tags attached to various objects. The information in tags is electronically stored. To track products in a manner similar to using bar codes for product identification RFID technology can be used, but RFID also carries some additional benefits. Unlike barcode readers RFID does not require line of sight to read the tag, has a longer read range than bar code reader, and tags can store more data than bar codes. RFID readers can be used to simultaneously communicate with multiple tags.

RFID tags are of two types, active tags, which contain an internal power source, and passive tags, which obtain power from the signal of an external reader. Passive tags are more commonly used then active tags for retail purposes, because of their lower price and smaller size. A passive tag consists of a microchip surrounded

by a printed antenna and some form of encapsulation, plastic laminates with adhesive that can be attached to a product or a small glass vial for implantation [4]. The tag reader powers and communicates with passive tags. The tag's antenna conducts the process of energy capture and ID transfer. A tag's chip typically holds data to identify an individual product, the product model and manufacturer.

C. RFID

Radio-Frequency Identification (RFID) is a technology that utilizes radio waves to wirelessly identify and track tags attached to objects or individuals. Consisting of a tag (or transponder) and a reader (or interrogator), RFID systems operate by transmitting data between the tag and the reader through electromagnetic fields. These tags contain electronically stored information, such as unique identifiers, which can be read and processed by RFID readers from varying distances without requiring direct line-of-sight. RFID technology finds applications across various sectors, including inventory management, asset tracking, access control, supply chain logistics, and contactless payment systems. With advancements in technology and decreasing costs, RFID continues to evolve, offering enhanced functionalities, improved efficiency, and expanded capabilities for diverse applications in both consumer and industrial domains.

Fig. 2. RFID

D. RFID TAG

An RFID tag is a small electronic device that contains an antenna and a microchip, designed to store and transmit data wirelessly using radio-frequency signals. Serving as a unique identifier, the RFID tag can be attached to objects, products, or individuals, enabling them to be tracked, identified, and managed within an RFID system. The tag's microchip stores specific information, such as product details, serial numbers, or access credentials, which can be read by an RFID reader when the tag comes within its proximity. RFID tags are available in various form factors, including passive (powered by the reader's signal), active (with an onboard power source), and semi-passive configurations, each offering distinct capabilities and functionalities suited for different applications. As a fundamental component of RFID technology, RFID tags play a crucial role in enhancing efficiency, automation, and data visibility across a wide range of industries and use cases.

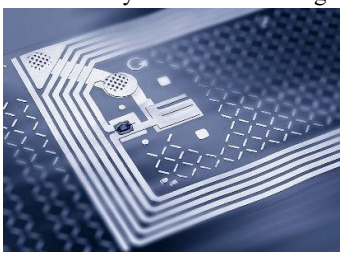


Fig. 3. RFID TAG

E. Stepper Motor

A stepper motor is a type of electric motor that converts electrical pulses into precise mechanical movements, typically in discrete increments or steps. Unlike conventional DC or AC motors, which continuously rotate, stepper motors move in precise increments, allowing for accurate control over position, speed, and rotation. Stepper motors consist of multiple coils or phases and rely on a sequence of electrical pulses to energize the coils in a specific order, generating magnetic fields that interact with the motor's rotor to produce movement. This inherent ability to control movement in discrete steps without the need for feedback

mechanisms makes stepper motors well-suited for applications requiring precise positioning and control, such as CNC machines, 3D printers, robotics, and automation systems. The performance and characteristics of stepper motors, including step angle, torque, and speed, can be tailored to specific application requirements by selecting appropriate motor configurations and drive techniques.

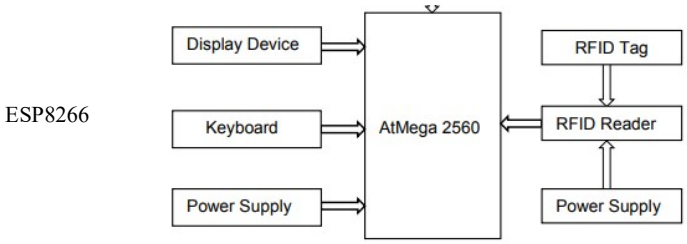
Fig. 4. Stepper Motor

IV. METHODOLOGY

In exploring the integration of IoT and RFID technologies to modernize food distribution via a ration dispenser system, a systematic research methodology was adopted to ensure a comprehensive and in-depth analysis. Initially, a thorough literature review was conducted, encompassing studies, research papers, and industry reports related to IoT applications in food distribution, RFID technology, and automated rationing systems. This literature review provided a foundational understanding of the current landscape, challenges, and potential opportunities for leveraging these technologies in enhancing food distribution efficiency and effectiveness. Subsequently, primary data collection was carried out through semi-structured interviews with key stakeholders, including food distribution professionals, technology experts, and policymakers, to gather qualitative insights, perspectives, and real-world experiences related to the integration of IoT and RFID in ration dispensing systems By employing a multi-dimensional research approach, this methodology facilitated a comprehensive exploration and evaluation of the ration dispenser system's potential to modernize and optimize food distribution through innovative technology integration.

V. SYSTEM AND MODELLING

The block diagram of smart ration card system is shown in fig. 3. In this design, we are using an, RFID reader, RFID tags, ESP8266 Wi-Fi module, 20x4 LCD display, 4x4 alphanumeric keypad and power supplies. In this system the transmitting pin of the RFID reader is connected to one of the receiving pins (RX0) of the Arduino. One transmitting pin (TX1) and one receiving pin (RX0) of the Arduino is connected to the receiving pin and transmitting pin of the Wi-Fi shield respectively. Wi-Fi shield is used for connecting the system to the AWS via internet. Even if you are running applications that share photos to millions of mobile users or you are supporting the projects of your business, a cloud services platform enables access to low-cost IT resources. Cloud computing provides a simple way to access servers, storage, databases and a broad set of application services over the Internet. A cloud services platform owns and maintains the network-connected hardware required for application services, you provision and use what you need via a web application.



VI. EXPERIMENTAL RESULTS

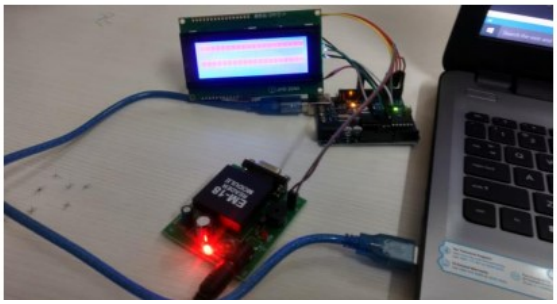


Fig.5.Smart Ration card system in development

The Smart Ration Card system we are working on is shown in fig. 5. Till date we have successfully interfaced 20x4 LCD, RFID reader, Keypad and Wi-Fi module.

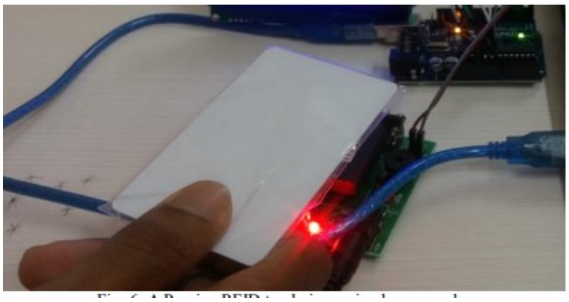


Fig. 6. A Passive RFID tag being swiped over reader

The fig. 6 shows a RFID tag being swiped over RFID reader module. We are using passive RFID tags here, if required active RFID tags can also be used.

VII. APPLICATIONS

The topic "Ration Dispenser: Modernizing Food Distribution with IoT and RFID Integration" presents various potential applications across different sectors and contexts. Here are some applications for this innovative integration are Emergency relief operations, Military deployment, Retail and Grocery chains, Agricultural supply chains, Healthcare facilities, Educational Facilities, Corporate cafeterias and workplace facilities.

VIII. CONCLUSION

In conclusion, the integration of IoT and RFID technologies in the "Ration Dispenser: Modernizing Food Distribution" presents a transformative approach to revolutionizing food distribution systems across diverse sectors. By leveraging these innovative technologies, there is significant potential to enhance operational efficiency, ensure transparent and accountable resource management, and foster equitable access to essential food supplies. The applications spanning emergency relief, military operations, retail, agriculture, healthcare, education, and corporate sectors underscore the versatility and transformative impact of this integration. While the concept holds promise, successful implementation will require collaborative efforts, technological advancements, and stakeholder engagement to address challenges, ensure scalability, and realize the full benefits of modernizing food distribution through IoT and RFID-enabled ration dispensing systems. Embracing this innovative approach signifies a pivotal step towards advancing sustainable, efficient, and inclusive food distribution practices, shaping a future where technology plays a central role in addressing global food security challenges and enhancing quality of life.

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