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Research Article

IoT and RFID based Effective Smart Kiosk Ration Card

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Abstract— India's Ration distribution system is one of the world's largest distribution systems. Depending upon the family income the government provides above poverty level (APL) or below poverty level (BPL) ration card to those families which are eligible. Also allocates monthly ration materials to each card user family. Every month the ration materials need to be collected from the government ration distributing centers through manually weighing them. Where there is a lot of leakage happening in manual system while distributing. To overcome this leakage, the smart kiosk system can be used. In this system the ration materials are distributed automatically without human interference for distributing the ration materials. The system will not identify manual script ration cards hence it is replaced by radio frequency identification (RFID) cards. A Proper authentication is provided through 4 digits password for each user. The solenoid valve is used to control the liquid materials distribution and gear motor is used to control the flow of hard materials like rice, wheat etc. A new technique is adopted in accurate measurement of materials while delivering at the outlets. Global system for mobile (GSM) is used to track the details of ration materials arrival in kiosk and customer delivered the materials from the kiosk. Liquid crystal display (LCD) is used to display the options and operations happening in the kiosk. Also the system holds the dropping at the outlet until the customer/user acknowledges the presence of the container at the respective (solid or liquid) dispatcher which may prevents the small leakage during collection. The overall work is implemented by using AT89S52 microcontroller and other peripherals like 16x4 LCD display, relay with solenoid valve, 4x4 keypad, gear motor SIM300 GSM module and RFID reader are also interfaced.

Keywords— Kiosk, RFID card, AT89S52 microcontroller, SIM300 GSM, 16x4 LCD display, relay, solenoid valve, RFID reader, APL, BPL

I. INTRODUCTION

Indian Government provides the food security to their citizen by distributing the ration materials with effective cost and quantity by issuing the ration cards. Depending upon their family annual income either APL or BPL cards are issued. There are numerous government ration distributing centers are situated and various commodities like kerosene, oil, rice, wheat and excreta are distributed by manually weighing through the employees to the card users. In manual distribution there are complaints related to quantity, which card users

receive are most of the times will be lesser weight of materials than that of the actual weight. To overcome this major issue we are approaching with smart ration distribution system using RFID and GSM in this paper. The main objective is to distribute the ration materials automatically with accurate measurement. In this approach, manual ration cards are replaced with RFID cards with proper authentication. Once the payment is done successfully then the proper options are selected to distribute the materials. If card user acknowledges the presence of container in front of dispatcher of the kiosk, then the ration materials start collecting into container with actual measurement. The solenoid valve and stepper motors are used to control the distribution of liquid and solid materials. The GSM helps in tracking the goods distributed by sending the messages to government as well as the card holder's registered mobile number.

In the year 2013, S. Valarmathy et al proposed a paper on automatic ration material distribution system based on GSM as well as RFID Technology. This system was developed by using microcontroller 16F877 and using server based system to track the goods, where the major drawback was to maintain those servers [1]. Again in the year 2013 another author K. BalaKarthik has proposed Cloud-based ration card system using RFID and GSM Technology. This system was proposed using PIC microcontroller and this system consists of three main modules namely the RFID reader module, Software module and Web server module. The problems in this system are high cost, as the servers are to be maintained and database must be updated consequently to the cloud [2]. S. Sukhumar et al. has proposed automatic rationing System using embedded system technology in the year 2013. This system was proposed using PIC Microcontroller. The microcontroller is too expensive and has a complex architecture [3]. In the year 2014, MohitAgarwal et al. has proposed Smart Ration Card Using RFID and GSM technique. This system was proposed using Atmga8 microcontroller. The system removes the forgery by removing the manual filling of the government record diary with the RFID. The main problem of this system was about GSM communications. As they are of paid systems which are going to charge for sending SMS and no confirmation of the sent message delivery and also the range of RFID were less [4]. In the year 2015, KashinathWakade et al. has proposed Smart Ration Distribution and Controlling. This system comprises of PDA device and RFID tag so was called as an e-ration card. The system is proposed using 32 bit ARM 7 RISC type of microcontroller. The problem of this system was Complex architecture and needs more time for development [5]. Again in the year 2015, Vinayak T. Shelar et al. has proposed RFID and GSM based Automatic Rationing System. This system is proposed using LPC2148 microcontroller and Ultrasonic sensors, where the role of ultrasonic sensors was to check the quantity of the ration distributed from the system. The drawback of this system was with use of costly ultrasonic sensors [6]. In the year 2016, PranjalPedwal et al. has proposed Real Time Automatic Ration Material Distribution System. This system was proposed using LPC2148 microcontroller. Its drawback was low processing speed and long waiting time [7]. In the year 2017 the biometric based system was proposed, in this system the only individual person from the family can access the card and use the system. The major drawback was to maintain the servers and costly biometric sensors [8].In the year 2019 the Aadhar enabled ration distribution system was developed. The major drawback was which leads to take more time to fetch the user data from server database [9].

In this paper a Smart Kiosk based ration card is constructed as a prototype to avoid leakages in the present manual ration distribution system. Each card user is provided with the RFID card instead of manual ration card along with secure password to access the kiosk for ration materials distribution with proper authentication. Once the user is verified then kiosk starts requests for payment. If payment is successful then kiosk starts distributing the government assigned ration materials automatically with minimal leakage to card user and messages are sent to user registered mobile number and as well as to government official to track the ration.

II. METHEDOLOGY

In this paper the embedded system based Smart kiosk ration card system is designed using GSM and RFID modules. The prototyping is done by integrating the hardwares externally to the microcontroller and also the proper functioning firmware is flashed to it. The two main functions are required in construction of prototype, they are

A. Hardware integration
B. Software integration

C. Integrated system testing

A. Hardware integration

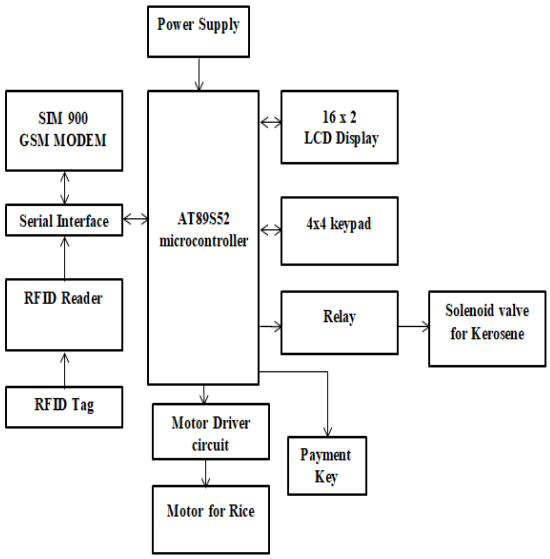

Fig 1: Block diagram of hardwares integration

The Fig 1 shows the block diagram of the hardwares integrated to the microcontroller. The main hardware used here are microcontroller, which controls all the peripheral integrated hardwares. Here we are using AT89S52 module, a family of 8051 microcontroller which is a low powered high performance 8 bit operator with 8Kb of in-system programmable flash memory and also with provide 32 General Purpose Input/Output (GPIO) lines. The GSM module and RFID reader is serially interfaced with microcontroller. The 16x4 LCD is interfaced using GPIO lines to the microcontroller. 4x4keypad is also interfaced using UART interface. The Solenoid value is interfaced through relay circuit module to the microcontroller. The DC gear motor is also interfaced with the microcontroller using GPIO lines. The passive RFID card is used as smart ration card which provides the individual unique ID for the individual card as it is swiped upon RFID reader.

Power supply plays are very much important factor while integrating the different hardwares with different optimum and operating currents and voltages. Here we require 2 different voltages; they are 5volts (v) and 12v. Table 1 represents the required voltages for different used hardwares.

Table 1: Required Voltage for different hardwares

5v	12v
16x4 LCD	GSM module
4x4 Keypad	RFID reader
Relay	DC gear motor
	Solenoid valve

All the hardwares are distributed with the sufficient voltage and current to function properly in this proposed prototype.

B. Software integration

In embedded systems the hardware should work as the software function executes.

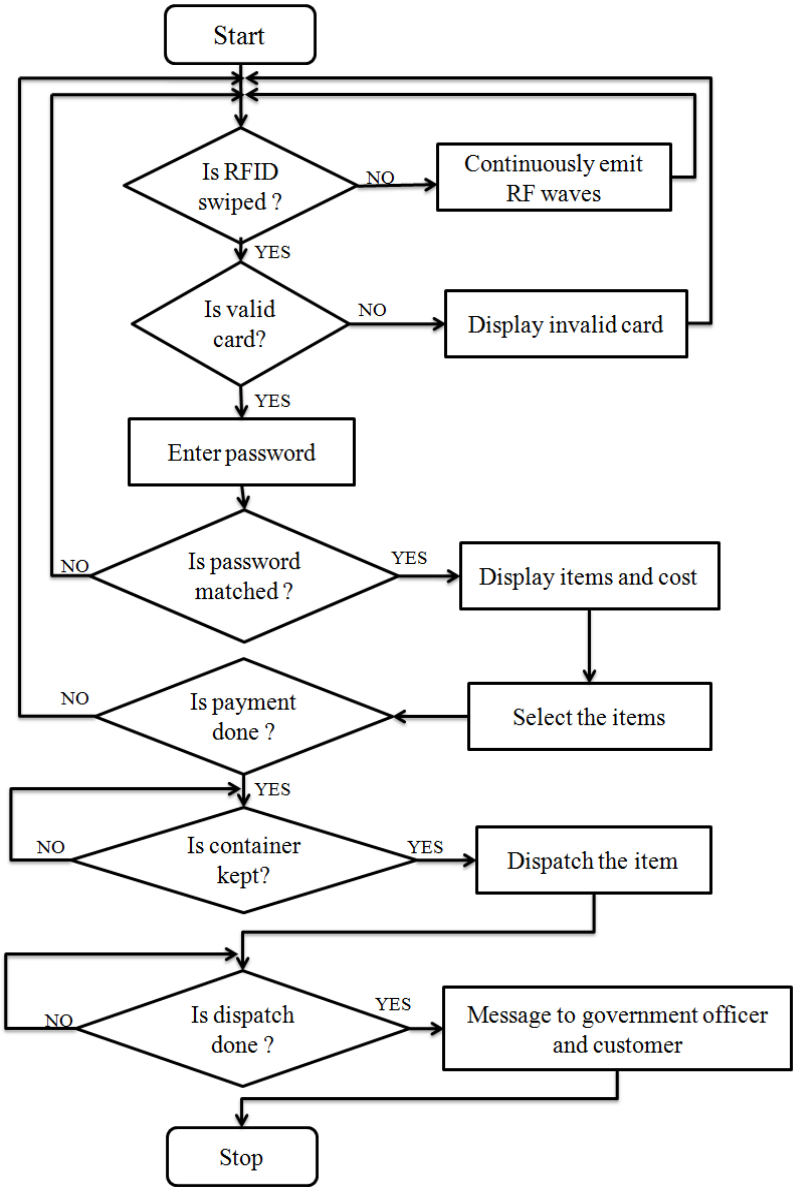

Fig 2: Flow chart of Smart Kiosk ration distribution system

Fig 2 represents the flow chart of Smart kiosk ration distribution system. The program is flashed into the microcontroller. The program is terminated whenever there is invalid entry like, if invalid RFID swiped, if payment is not done and if password does not matched. Once valid RFID, Password and payment is done then the items will be dispatched as per the APL or BPL card limits. The 16x4 LCD will display proper current functioning like requesting to swipe the card, entre the password and payment along with that command and warnings like invalid card, payment fails, invalid password, messages sending to government as well as customer, dispatching material details and quantity then stops. All the controls are being controlled by providing the sufficient time like system waiting for 30 seconds to enter the password once the valid card is entered and if proper password is entered the system waits for 30 seconds to payment, waits for 30 seconds to acknowledge the container presence in front of dispatcher, later the system waits for 30 seconds to switch between the items to be distributed and finally waits for 70 seconds to message acknowledgement. If the system is hanged at anywhere then the system automatically resets and starts functioning from the start.

C. Integrated system testing

Once the hardwares and software are integrated by testing individual peripheral performance then integrated with the microcontroller along with specific working software. If all the peripherals are responding to microcontroller commands then the integration is successful. Then the testing is carried out to validate the system.

The systems is tested and validated for 3 different modes,

- First mode: Invalid card user
- Second mode: valid BPL card user
- Third mode: valid APL card user

First mode: If the distributed card is invalid then the customer might be from another society. Then system displays the message and terminates.

Second mode: In this mode the swiped RFID card is identified as BPL card customer. Then the proper password is accepted with sufficient payment for the required set of materials. The quantity and payment will be lesser to BPL card holder compared to APL card holder. The quantity of materials will be calculated using the formulae

$$\text{Wmat} = \text{Ccont}_{\text{time}}\, x\, time \qquad (1)$$

Wmat = Weight of the material and Ccont = Circumference of the container. If the user acknowledges the presence of container then the ration materials starts dispatching. The DC gear motor is controlled for solid ration material distribution and solenoid valve is controlled for liquid ration material distribution. Then the GSM module will send the messages for authorised government person as well as customer.

Third mode: In this mode the swiped RFID card is identified as APL card customer. Then the proper password is accepted with sufficient payment for the required set of materials. The quantity and payment will be more to APL card holder compared to BPL card holder. The quantity of materials will be calculated using the formulae (1), where Wmat = Weight of the material and Ccont = Circumference of the container.If the user acknowledges the presence of container then the ration materials starts dispatching. The DC gear motor is controlled for solid ration material distribution and solenoid valve is controlled for liquid ration material distribution. Then the GSM module will send the messages for authorised government person as well as customer.

III. RESULTS AND DISCUSSION

The efficient smart kiosk based ration distribution system is constructed as the prototype to avoid leakage in the manual distribution system.

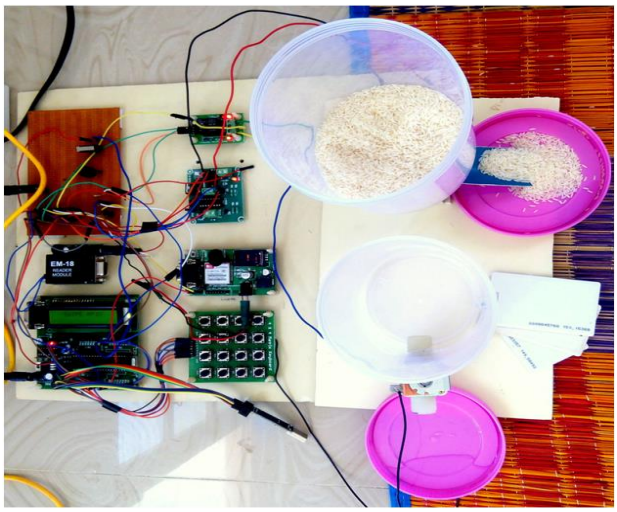

Fig 3: Snap shot of constructed Kiosk prototype

Fig 3 represents the complete view of constructed kiosk based smart ration distribution system along with passive RFID readers as Ration cards.

Fig 4: Display after power up

Fig 4 shows the snap shot of 16x4 LCD display as and when the entire system is powered up.

Fig 5: Requesting to swipe RFID card

Fig 5 shows the snap shot requesting to swipe the RFID card as the smart ration card instead of manual ration card.

Fig 6: Displaying Invalid user card

Fig 6 shows the snap shot displaying invalid user card in 16x4 LCD. This represents the user may be from different society.

Fig 7: Requesting to enter password

Fig 7 shows the snap shot requesting to enter the 4 digit password on 16x4 LCD for proper authentication if the valid card is swiped.

Fig 8: Display regarding payment transaction.

Fig 8 shows the snap shot of payment transaction on 16x4 LCD. First 16x4 LCD block (from left) shows the request for payment. Once payment is done then acknowledge as payment received and displayed as second 16x4 LCD block. If payment is failed the 16x4 LCD will display as third 16x4 LCD block.

Fig 9: Requesting to select required ration

Fig 9 shows the snap shot requesting for selecting a required ration materials to dispatch as 16x4 LCD is indicated.

Fig 10: Requesting to select container presence at the dispatcher

Fig 10 shows the snap shot requesting to confirm a container presence in front of the respective dispatcher. Once the user enters the "yes", then the respective ration will be dispatched by indicating on 16x4 LCD.

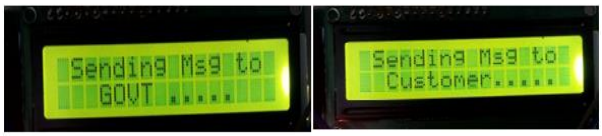

Fig 11: Displaying the messages sending

Fig 11: shows the snap shot showing the messages sending to government concerned person as well as the end customer.

There are several conduction done with respect to the automatic dispatch of the ration goods [2][4], though there is no option that acknowledges the presence of container at the respective dispatcher (solid or liquid) of the ration. But in our attempt we have successfully developed the kiosk to hold the dispatching until the card user acknowledges the presence of the container near at the dispatcher. By adding this option even minute leakages can be avoided.

IV. CONCLUSION

As there is a leakage in the manual ration distribution system which leads to loss for the end ration card users. To avoid this real world problem the Smart kiosk based ration distribution system will be the best solution. In this paper the Smart kiosk construction and working is explained. The manual ration cards are replaced by RFID cards. Each family is provided with the individual RFID card along with secured password for security. Once user access the kiosk with proper RFID card and password then the system will verify and identify the user as either APL or BPL, then the user needs to accept the obtained ration materials from the government and need to pay the amount for the ration materials. If payment is successful and customer acknowledges the presence of container near dispatcher then the system distributes the ration materials automatically by using DC gear motor for solid ration materials and solenoid valve for liquid ration materials and finally messages are sent for both card holder user and as well as government official to track the distributed ration details. Further this system is updated with biometric or iris scanning for authentication. Lost card can be blocked to avoid the misuse of this card. The payments can be made through third party UPI payments or any other digital payments. Cost effective sensors can be placed to detect the presence of container in front of the dispatcher.

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