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IoT Based Smart Rationing System

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Abstract: In developing countries like India, the poor people meet their fundamental needs through subsidy provided by the government for basic domestic commodities. The prevailing public distribution structure in Ration shops involves labour intensive measurement of quantity. This current system also requires transaction record maintenance. Numerous difficulties are met through this prevailing system. Some of the major issues are ration distribution to unauthorized card holders, excess time spent by the public in the queue for collecting the ration, involving in the transgressions like hoarding, overcharging and black marketing by the authorities and human interference in transaction updating and ledger maintain process. In order to overcome such issues, Internet of Things based smart card system is proposed in which automatically dispenses the basic commodities to genuine card holders after verifying the card holder details. This system also helps in maintaining the transaction details in a separate database in order to prevent any transgression.

Keywords: Internet of Things, Smart Card System, Biometric System, Raspberry Pi, Android Application.

I. INTRODUCTION

India holds second place in population. Public Distribution System (PDS) in India has experienced drastic transformation from the rationing scheme introduced at the time of Second World War to a significant public safety program to guarantee food security to the citizens of the country. Under PDS, Government offers vital commodities at fair and fixed prices. At the beginning Government offered a numerous item like palm oil, ghee, iodized salt etc. through PDS. However, at current scenario, government offers few cereals, kerosene oil, wheat, sugar and rice at a fair prize. Currently India has more than 5,50,000 ration stores all over the country making it the major dispersal system in the world.

In India, economically challenged people receives the domestic commodities like food, oil and fuel from the Government through ration shops at subsidized prize based on the card type such as Antyodana Anna Yojana (AAY) or Below Poverty Line (BPL) or Above Poverty Line (APL).

Domestic commodities will be distributed to people every month. Most of the ration shop owners indulge in fraudulent activities and prevent the goods reaching the economically challenged people. Ration shop owners will also update the transactions wrongly if it is carried over manually. The precise quantity of ration received by the people is not updated accurately in the database maintained by the Government due to the inefficient automation in the existing scheme. In order to avoid the ration forgery, the smart ration card is used in which it is based on automation.

To avert such malpractices, this system introduces and incorporates the following features.
a) Fingerprint verification scheme is used to prevent unauthorized access.
b) The product and its quantity are selected using Android application to confirm the details of product to be purchased.
c) Automatic ration distributing mechanism is introduced to avoid fraudulent activity.

The goal of this scheme is to create an automatic and expedient system to prevent the malpractices at ration shop. The key purpose of this scheme is to device a fingerprint matching algorithm for confirmation of user details and to atomize the delivery of the products to the people. In addition to it based on the quantity selected and received by the people, automatic updating process is carried over in Government database.

Internet of Things (IoT), means numerous amounts of physical devices connected via internet, which are capable of gathering and sharing the data. IoT has already marked its benchmarks in major fields like Agriculture [17-18], Military [15] and Industries [16]. It plays a major role in monitoring the activities, sharing the data and updating the collected information. Hence by introducing IoT into the smart ration card system will make the work progress look simple and smart.

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II. RELATED WORKS

Due to fraudulent activities, food grains and other resources provided by Government do not reach the poor people. In order to prevent these activities numerous methods have been developed. To eradicate direct human involvement in the ration card system, RFID cards are presented, which comprises the basic information about people like validity of the card, list of family members, card type etc. This RFID technique averts fraudulent activity like local ration shop seller may trade the products to other people and receives the profit and set wrong record [2–4]. E-ration techniques with the support of biometric devices are introduced to offer details connected to consumers. This technique also supports in recording the transaction in two types of databases.

One database is for the products and another database is for consumers. In order to add security to such technique RFID based password and OTP verification system is also introduced [5–7]. Few techniques have been introduced to check consumers purchase details in dedicated website. In these techniques, the ration card is totally replaced by smart card [8–10]. Individual case-based reasoning mechanism along with RFID technology was introduced to make the transactions transparent. This technique also provides SMS and e-mail feedback scheme inform the grievances from user side and ration shop seller side using separate login facility [11–14].

QR code based Public Distribution System [15] was introduced to provide security for the Smart card holders. This system also updates the payment transaction in the website automatically. All these schemes provide security to card holders and update the transaction automatically which removes fraudulent activities in both transactions updating process and providing food products to genuine consumers. But still some ration shop seller involves in malpractices when consumers buy less quantity of product than the actual quantity allotted to them. In order to eradicate this issue along with above sited problems an IoT based Smart Ration Card System is implemented.

A. Limitations of existing system
a) No authentication, security is available in the existing system.
b) Accuracy in measurement is very low.
c) RFID Card based system can carry only the basic information about people like validity of the card, list of family members, card type etc.
d) In GSM based system a message is sent to the user giving the details of the transaction.

III. PROPOSED SYSTEM

Here a Fingerprint module is used in IoT based Ration card System. It is used for enrolment and verification purpose. It is used to get an image of the finger using optical scanning process. In order to process the obtained finger print minutiae algorithm [1] is used which is explained in figure 3. This module is connected to Raspberry- pi. The family member's details are collected and stored in database already. Raspberry pi cross checks the obtained finger print with the finger print available in the database. After authenticating the validity of the user, now the system is ready to dispatch the products as per their requirement. The dispatching process is performed by DC motor. DC motor is used to ON and OFF the valves for automatic dispersal of rice, sugar and oil. Hydraulic valves are used here to regulate the speed of an actuator. This is performed by regulating the flow rate. It is used to dispense the oil to the card holder. Figure 1 explains about system architecture of IoT based smart ration card.

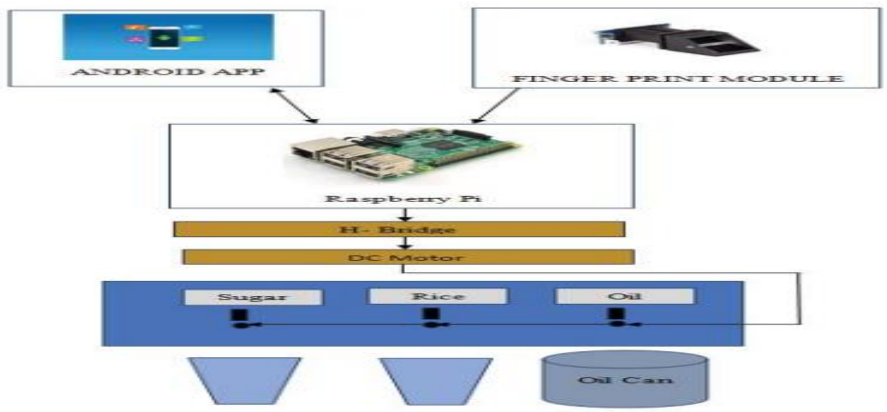

Fig. 1. IoT based Smart Ration Card System

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The overall procedure is explained below:-
Step 1: Primarily the user must give ID and Password in the App.
Step 2: Entered ID is compared with the database by Raspberry-pi. Once the ID is matched, the user can see their profile. The profile will display the details of their transactions.
Step 3: Now the user can scan the finger. When the user authentication is completed, the commodity and its quantity are selected by the user.
Step 4: If the entered commodity and its quantity are correct then the system distributes the entered commodity to the user automatically.
Step 5: After dispatching the products it updates in the website automatically and a message is sent to the user.

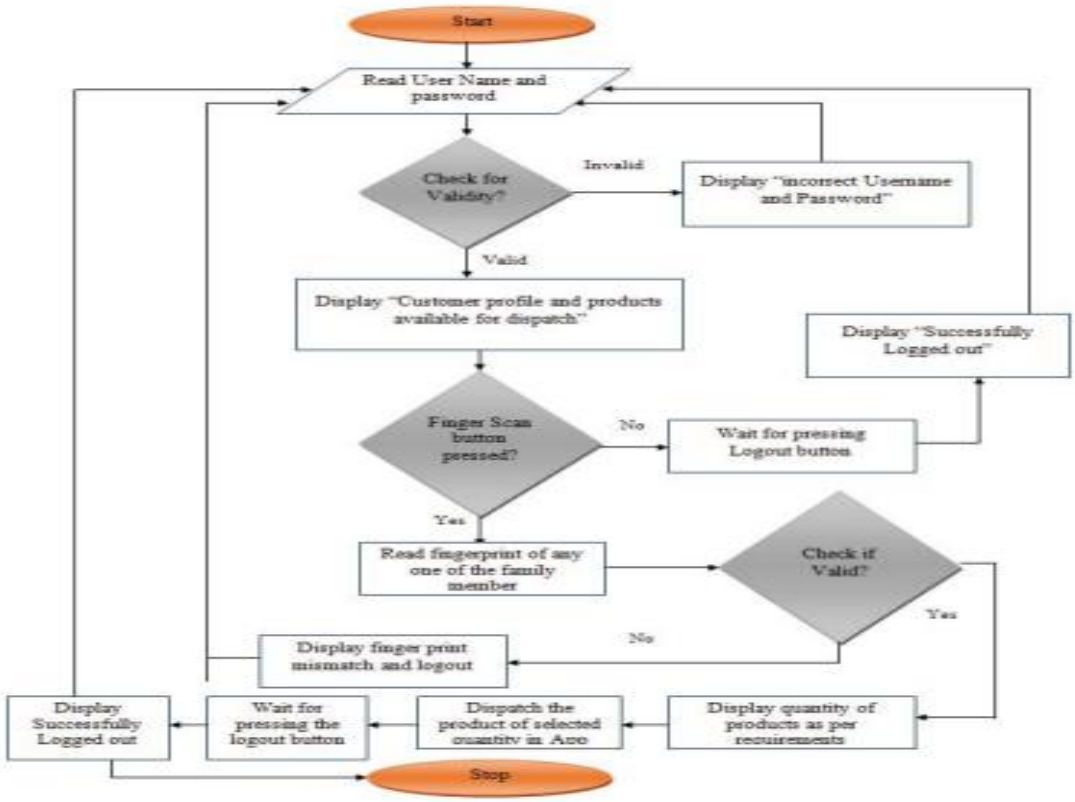

Fig. 2. Flow diagram of IoT based Smart Ration Card System

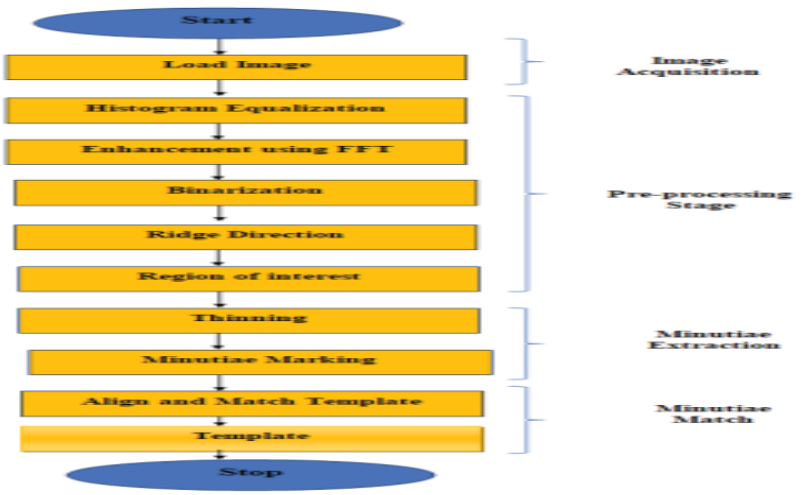

Fig. 3. Steps involved in Fingerprint recognition

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VI. RESULTS AND DISCUSSION

Figure 4 shows the dispatching vessels for three commodities. The commodities like rice, sugar and palm oil are dispensed once the authentication of the user is verified using Fingerprint module. DC motors are connected to rice and sugar containers for dispatching the commodities to consumers. Here hydraulic valve arrangement is used for dispatching of oil. Every unit is controlled by Raspberry-Pi. Figure 5 (a) shows consumer login page, in which the consumer has to enter his user name and password to login in to public distribution system. Figure 5 (b) shows various options available to the consumer. Consumer can view the profile by clicking on view button. Consumer can enrol their fingerprint by clicking into enrol option and then consumer can fill their basic details. By clicking on purchase option, the list of option available for that particular person's family will be available using which the exact quantity of food products can be selected based on the limit available for them. Using delete option, a particular person's detail or wrongly entered data can be deleted.

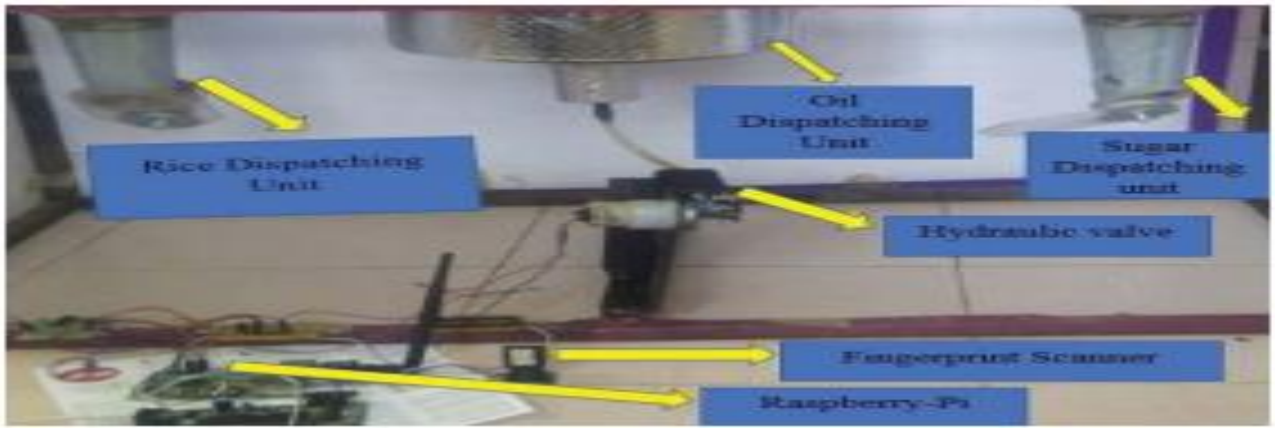

Fig. 4. The overall system setup

Fig. 5(a),(b),(c). Screen Shot of Android App

Figure 6 shows the SMS being sent automatically after the commodities are dispatched to consumers.

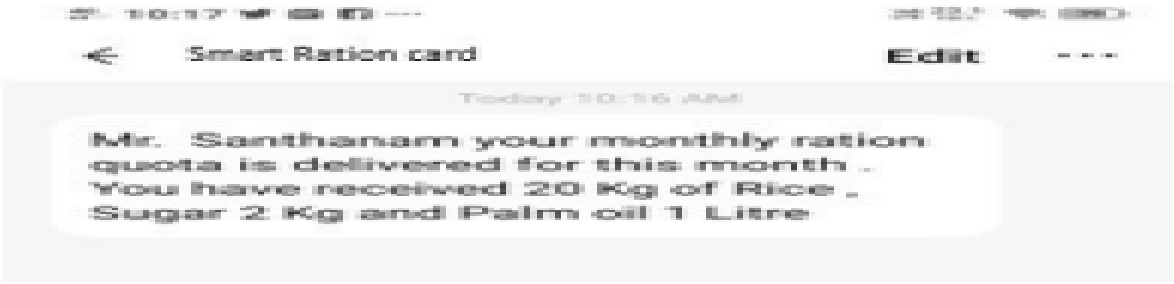

Fig. 6. SMS intimating about the food product delivery

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A. Quality Analysis

The quantity analysis of various products is given in Table 1 and Table 2. The error in measurement for rice is found to be 0 gram to 30 gram and for sugar it is found to be 0 gram to 10 grams. In case of oil error is found to be around 10ml - 20 ml.

TABLE I. ERROR MEASUREMENT TABLE FOR RICE AND SUGAR

Commodities	Actual Quantity (in Kg)	Measured Quantity (in Kg)	Error (in Kg)	Previous Error (in Kg)
Rice	1	1	0	0.01
	2	1.97	0.03	0.02
Sugar	1	1	0	0.01
	2	1.98	0.02	0.01

TABLE II. ERROR MEASUREMENT TABLE FOR OIL

Commodities	Actual Quantity (in Litre)	Measured Quantity (in litre)	Error (in litre)	Previous Error (in litre)
Oil	1	0.99	0.01	0.01
	2	0.98	0.02	0.01

The chosen amount of product is dispatched by the system is calculated by calibrating the delay of valve opening and closing. The delay is evaluated by means of trial-and-error scheme. Table 3 displays samples of various alignment of same fingerprint and it is compared with one other and similarity percentage among them is tabularized depending on minutiae points. The same result is also depicted in the figure 7. As there may be alignment changes in the fingerprint, resemblances among the input image and reference image reduces. Similarity % is calculated using the equation 1.

$$Similarity\ \% = \frac{\text{Minutiae points of input sample}}{\text{Minutiae points of refrence sample}} * 100 \quad \text{------ (1)}$$

TABLE III. SIMILARITY % CALCULATION

Authenticated Users	Reference minutiae points	Minutiae points	Similarity %
1	42	38	90.47
2	38	31	81.57
3	43	32	74.41
4	38	27	71.05
5	42	34	80.95
6	40	33	82.5

Table 4 displays the accurateness of algorithm. Since the database is improved from 100 to 1000, accuracy reduces and processing time of the images increases. Same results are depicted using Figure 8 and Figure 9.

TABLE IV. DATABASE ACCURACY ANALYSIS

Number of Fingerprints	Computation Time (Sec)	Accuracy %
100	2	90.1
200	2.3	87.3
300	2.6	83.2
400	3.1	78.2
500	3.7	75.3
600	4.1	73.2
700	4.7	71.6
800	4.9	70.8
900	5.2	69.7
1000	5.6	67.5

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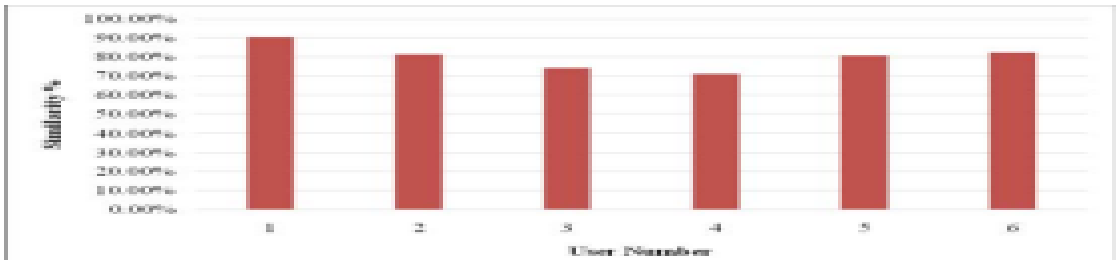

Fig. 7. Similarity %

Fig. 8. Computation Time vs Number of Fingerprints

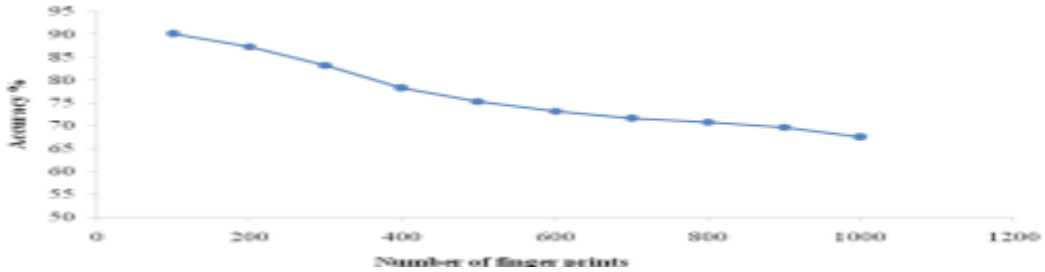

Fig. 9. Accuracy % vs Number of Fingerprints

IV. CONCLUSION

IoT based Smart Ration Card system is an automated scheme, which uses fingerprint validation process. In order to provide security and accuracy to this scheme, Minutiae extraction-based algorithm is used in fingerprint validation process. This process eradicates forged ration card users and prevents them from participating in any further transgression. Picking the goods and quantity by the means of android application, the system becomes smarter and robust. By means of implementing this system, one can evade the misconducts since there is no manual process involved in it and the system also stores all details in a database.

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