

DIGITALIZATION OF FOOD RATIONING

A STEP FORWARD TO SMART CITY

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Abstract

Food Rationing or the Public Distribution System (as called in India) over the years has not only helped in stabilizing food pricing but has also contributed towards avoiding hunger and famine by supplying food from surplus regions of the country to the deficient ones. Moreover, this system of minimum support price and procurement has also contributed to increase the food grain production. However, despite the granaries being full, instances of hunger and poor quality of entitlements occur frequently. This points to certain lacunae or inefficiency in the system. The GOI has distributed the households based on their socio-economic status as Above Poverty Line (APL), Below Poverty Line (BPL) and Anthyodaya Anna Yojana (AAY) to distribute the PDS entitlements. Irrespective of the strict classifications the system is dysfunctional. While studying the performance and problems of the public distribution system, particularly in India, it has been assessed that the major problems lie in the mortgaging of ration cards, poor quality of entitlements, corruption, rural and urban bias and poor performance of fair price shops. PDS shop owners in collusion with government officials divert the subsidized food supply and petroleum to the black market. The weight of the material (food) may be inaccurate due to human mistakes and if not bought within the stipulated time till the end of the month, they sale to others without any intimation to the government and customers. In order to overcome the problems in the system, a Smart Public Distribution System is proposed that with the help of digital recognition, precisely RFID's, uniquely identifies each consumer along with the concerned rationing thereby striking out the drawbacks in the system. An RFID tags is provided to the customers instead of ration cards. The people have to show the card before the scanner and it communicates with the microcontroller there by with the server, which shows complete details of the customer. The microcontroller is attached with the load cell and a dedicated liquid submersible pump for kerosene. Load cell measures the required quantity of item for a customer automatically and similarly the kerosene is pumped by the liquid submersible pump and poured in the customer's vessel. As everything happens automatically there is no chance of irregularity.

Index Terms – Public Distribution System, Arduino Mega, GSM Modem, Load Cell, Submersible Pump, Liquid Monitoring.

INTRODUCTION

PDS have revealed several gaps in implementation. These challenges pertain to the inaccurate identification of households and a leaking delivery system. Expert studies have shown that PDS suffers from nearly 61% error of exclusion and 25% inclusion of beneficiaries, i.e. the misclassification of the poor as non-poor and vice versa.

1. The most serious flaw regarding the system at present is the lack of transparency and accountability in their functioning.
2. There is a huge diversion of commodities from the PDS due to misuse and duplication of ration cards. According to some estimates around 30 per of the food grains and other commodities allocated for poor families do not reach them.
3. A number of instances where benefits are being availed in the names of rightfully entitled families without their knowledge. This shadow ownership is possible due to inefficiency in ration card issuance, distribution and record keeping.
4. Another challenge is the leakage of food grains during transportation to the ration shop and from the ration shop itself into the open market.

A system has been proposed that takes into consideration all the flaws and tries to overcome them. Every home is given a unique RFID card that contains the necessary data about the members of the house and this RFID card is connected to the web server. Necessary information includes the Aadhar number, monthly income and quantity of wheat, rice, etc. allocated to the family. The quantity of items taken by the consumer is measured and supplied by the

system in real time. This is subtracted from the allocated amount in the consumers RFID card as well as is updated on the web server. This amount along with the quantities taken by all the consumers from the PDS is summed up and gives the exact quantity supplied to the consumers in the whole month. This brings transparency, accountability and removes the concept of black marketing. By connecting the RFID card with the Aadhar card, people living above the BPL will be automatically removed from the list of homes to be benefitted by PDS.

HARDWARE COMPOSITION

The system uses Arduino Mega, Load Cell, HX711 IC, GSM Module, Esp8266, LCD 16*2, RFID Reader, RFID Cards, Pump, Liquid Flow Sensor, Keypad.

SOFTWARE AND PROGRAMMING USED

Arduino IDE
Embedded C/C++

PREVIOUS ANALYSIS

Before the opening of the depot, the ration card-holders are found standing outside it in long queues. People try to make separate queues depending on what they want, e.g., separate queue for wheat, rice. Generally, there are three or four workers at every ration. The first worker takes the card from the customer, enters it in a register, takes the payment and issues a slip indicating the quantity of the commodities to be supplied. The second worker receives the slip and supplies the correct quantity of the commodities. The remaining one or two workers look to it that the supplier does not run short of any commodity or attend to the complaint or problems of the customers. If the worker who supplies the commodities is seen running out of an item, a new sack from the store nearby is made available to him immediately. In case of certain commodities, the government sells them at subsidized rates to prevent price rise or scarcity in the open. The Public Distribution System has been very beneficial to the common man. Still it needs improvement, particularly at the level of ration depots.

METHODOLOGY

The whole idea revolves around the concept of food rationing. When a customer needs to get something from the Fair price shop, FPS, he takes his RFID card instead of ration card. The card is swiped in the FPS which has all the necessary information needed. Needed information includes, number of members in a family, quantity of rice, wheat etc, allotted to the family, quantity of supplies taken till now and quantity that can be still taken by the customer. On swiping the card, Arduino sends the tag received from the RFID card to the esp8266 wifi module that further sends it to the web server. Server in response sends the details of the customer as well the quantity of supplies that can be taken by the customer. A keypad is attached to the microcontroller that is used by the customer to select the item that he needs. A 20*4 LCD is connected to Arduino that displays all the items present in the FPS. A load cell and submersible pump are connected to the Arduino. In case customer needs solid items like rice, wheat etc, load cell is used to weight the quantity and in case kerosene is needed, submersible pump is used along with the liquid monitoring sensor. On selecting the item, Arduino waits for the weight to be put on the load cell. LCD helps the customer to see the item he has selected and the real time weight of the item that is measured by the load cell. When a required quantity is put on the load cell, the customer presses a button on the keypad that tells the Arduino that this much quantity is needed and the same amount is reduced from the card of the customer. This quantity is bound to be less or equal to the quantity allocated to the customer. In case kerosene is needed, customer uses keypad to enter the quantity of kerosene in litres and Arduino commands the pump to supply the kerosene that the customer collects in a container. Liquid Monitoring Sensor measures the quantity of kerosene passed through it and when it matches with the amount entered by the customer, Arduino commands the pump to stop further supply of kerosene. After the customer receives the item, an SMS is generated and sent to the customer that contains all the information about the items taken by the customer as well the quantity that can be taken in future. Every other item can be taken in the similar way. Arduino regularly updates the web server about the items taken by the customers.

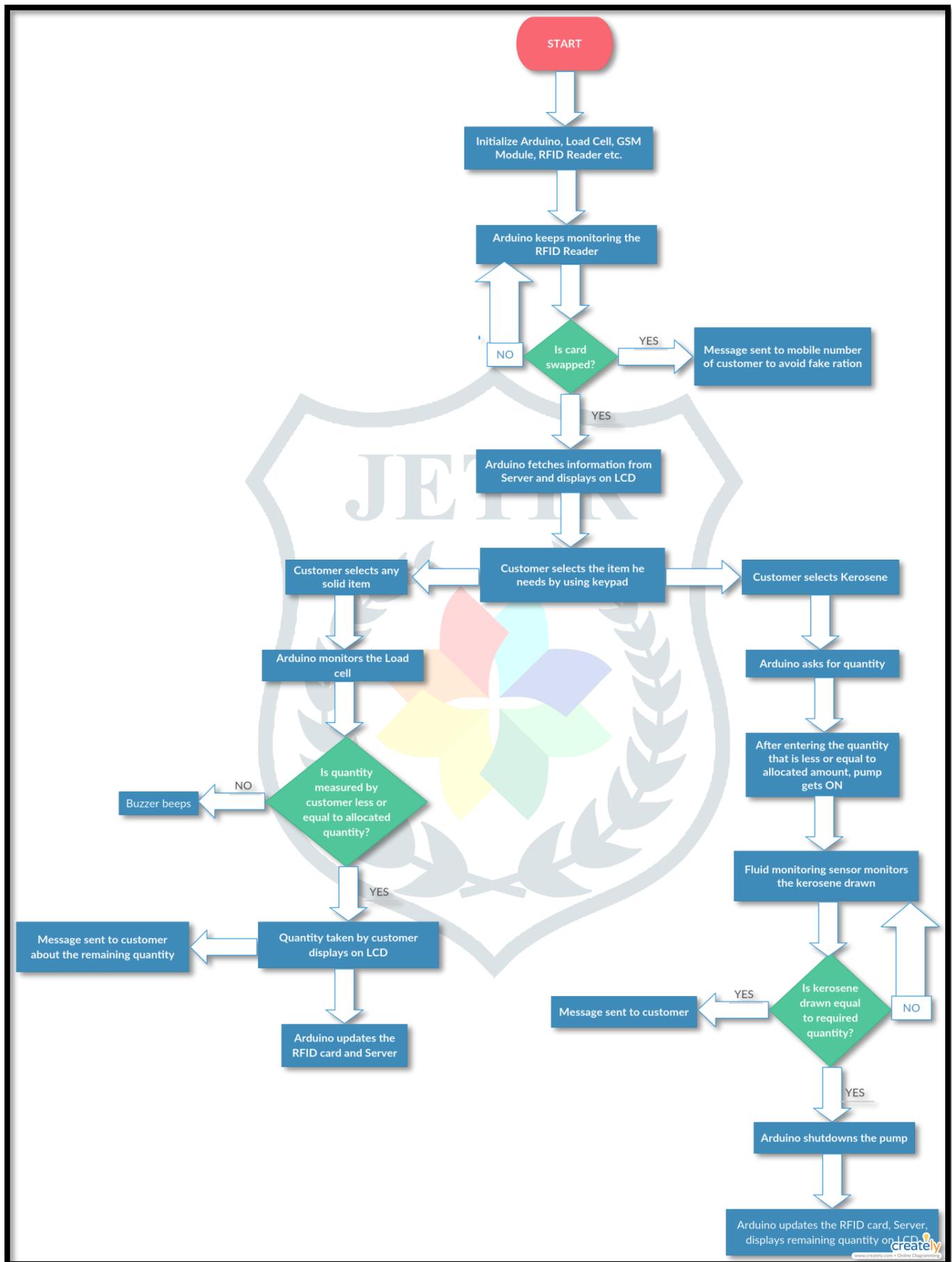


FIGURE I: Flowchart of the system

I. Arduino Mega

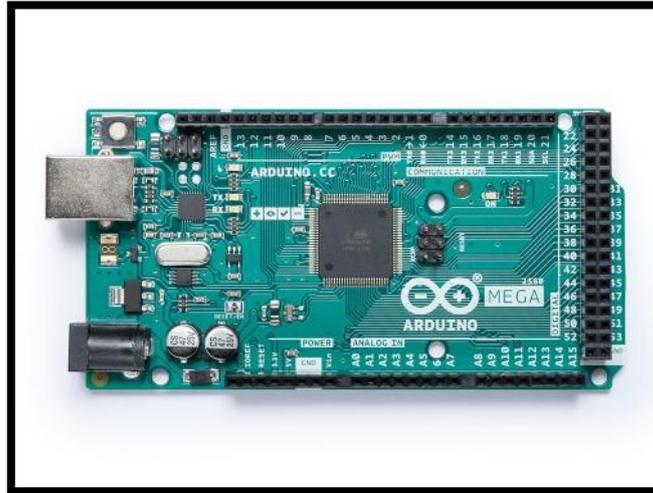


FIGURE II: Arduino Mega

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, four UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. In our project, Arduino acts as the brain. Load Cell, GSM Module, esp8266, LCD, RFID, Pump, Keypad and Liquid flow sensor are all controlled by Arduino. RFID card when swiped transfers a tag to Arduino that it compares with the data present on the web server. For this purpose Arduino uses esp8266 that gives it the internet connectivity. In response the server sends the necessary information that Arduino displays on the LCD. Keypad is used to select the item that the customer needs and Arduino then keeps monitoring the Load Cell and Liquid Monitoring sensor. Arduino also commands the pump to release or stop the kerosene.

II. Submersible Water Pump

Each pump is connected to Arduino through n-channel MOSFET (IRF540n). A digital pin of Arduino is connected to the GATE of MOSFET and when Arduino signals a HIGH voltage at the GATE, water pump gets ON (Hassan, Aslinda & Bing Sheng, Siah & Md. Shah, Wahidah & Bahaman, Nazrulazhar. (2018)) [4]. When a customer needs kerosene, he inputs the required quantity via keypad to the Arduino. Arduino commands the pump to release the kerosene and customer collects it in a container.

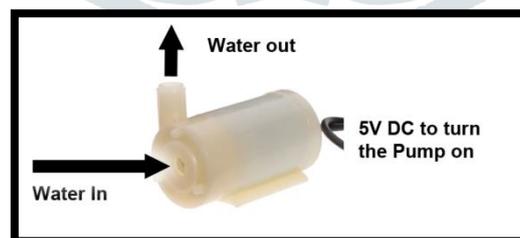


FIGURE III: Submersible Water Pump

III. GSM900A

GSM900A works on frequencies 900/ 1800MHz. The Modem comes with RS232 interface, which allows us to connect PC as well as microcontroller with RS232 Chip (MAX232). The baud rate is configurable from 9600-115200 through AT commands. The GSM/GPRS Modem has an internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows us to connect wide range unregulated power supply. (Masi, Faiz & Husain, Kurban. (2019)) [2]. In our project, GSM is used to send SMS to the customer at two instances. One at the time when the RFID card is swiped at the FPS and after the items are taken so that a customer keeps a record of items taken and still left in his account.

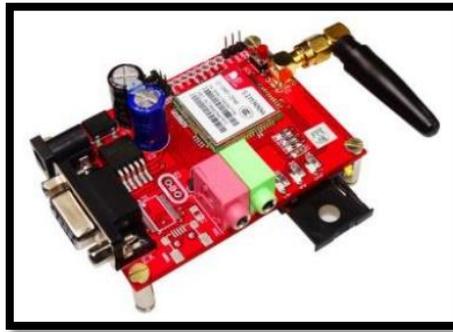


FIGURE IV: GSM900A Module

IV. Load Cell

The heart of any weighing system is the load cell. Load cells are designed to sense force or weight under a wide range of adverse conditions; they are not only the most essential part of an electronic weighing system, but also the most vulnerable. The sensing or spring element is the main structural component of the load cell. The element is designed in such a way that it develops a strain, directly proportional to the load applied. Sensing elements are normally made of high strength alloy steels (nickel plated for environmental protection), precipitation, hardened stainless steels, heat treated aluminium alloys, or beryllium copper alloys. (**Arduino-based intelligent gases monitoring and information sharing Internet-of-Things system for underground coal mines. (2019)**) [1]. By bonding strain gages to a precisely machined element, the force applied can be identified in terms of resistance change. The strain gages, usually four or a multiple of four, are connected into a Wheatstone bridge configuration in order to convert the very small change in resistance into a usable electrical signal. Passive components such as resistors and temperature depending wires are used to compensate and calibrate the bridge output signal.



FIGURE V: Load Cell

V. Keypad

Matrix keypads use a combination of four rows and four columns to provide button states to the host device, typically a microcontroller. Underneath each key is a pushbutton, with one end connected to one row, and the other end connected to one column. (**Parmar, Urvashi & Rajkotwala, Fatema & Pandya, Samir. (2019)**) [3]. In order for the microcontroller to determine which button is pressed, it first needs to pull each of the four columns (pins 1-4) either low or high one at a time, and then poll the states of the four rows (pins 5-8). Depending on the states of the columns, the microcontroller can tell which button is pressed.



FIGURE VI: Load Cell

Keypad is used to select the item that the customer needs. In case of kerosene, quantity is also input by the keypad.

VI. LCD (16*2)

The 2 line, 16 characters LCD screen is used to display the customer information, real time weight of the food and quantity taken by the customer.

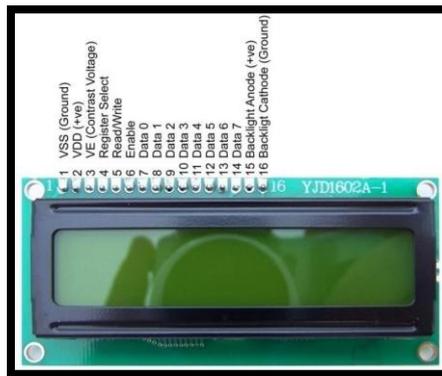


FIGURE VII: LCD

VII. RFID

RFID means radio-frequency identification. RFID uses electromagnetic fields to transfer data over short distances. (Salih, M.H. & Teng, L.H. & Ismail, S.N.. (2019)) [4]. An RFID system uses:

- tags attached to the object to be identified. Each tag has his own identification (UID).
- two-way radio transmitter-receiver, the reader, that send a signal to the tag and reads its response.

In our project, RFID is useful to identify the customer. Each customer/family is given a electromagnetic card.

CONCLUSION

The following conclusions were drawn from the present innovation.

1. This idea can bring authenticity in the system by benefiting only those people belonging to BPL category.
2. The distribution process is automated using microcontroller, so the government facilities can reach people properly.
3. Black marketing is the major problem which can be avoided using this system. The computerized database maintained avoids wrong entry of the product by the officials and provides authenticated transportation and distribution.
4. This will help replace manual handling of data with automatic processing.
5. This will also help curb corruption to a great extent.

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