IOT Based Smart Public Distribution System

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ABSTRACT
India being a developing country its main aim is to provide basic common commodities on subsidy to poor families to meet their fundamental requirements. The existing public distribution system in Ration shops requires manual measurement of quantity and maintenance of record of transactions. Many problems are encountered by the existing system such as 1. Ration distribution to unauthenticated card holders 2. Card holders wasting time in queues for collecting ration for hours 3. Lots of malpractices such as hoarding, black marketing and overcharging 4. Human intervention in updating transactions and maintenance of records in ledger is difficult.

In this paper, IOT based smart public distribution system proposes an automatic method of distribution of commodities to authenticated card holders. Also, the details of transactions made are maintained in a database. The users need to access to their account through the Smart phone by entering their ID and password. Once they are successfully logged in, they can view the stock availability. This system uses Raspberry-pi as controller and it is implemented with Minutiae extraction based fingerprint matching algorithm which efficiently works with greater accuracy score. Automatic distribution of commodities is achieved by using DC motors controlled directly by Raspberry pi to open and close the valves.

Keywords
Fingerprint, Raspberry-pi, IOT, PDS

1. INTRODUCTION
Government provides food, oil and fuel to economically challenged people at subsidized rates which are distributed to the public through ration shops. The stocks for these ration shops will be bought from the farmers and then sold at subsidized rates. Every month fresh stock arrives at these shops and that needs to be distributed to public. The owner of most ofthe ration shops resort to malpractices and the allotted amount of ration is not distributed to authorized people. To counter these fraudulent activities this system is developed which incorporates the following features

1. Fingerprint authentication system used to identify a particular user making the system secure.

2. The commodity and its quantity need to be selected using android application.

3. Predefined information about the amount of ration to be distributed.

4. Automatic rations distributing mechanism.

The aim of this system is to build an automatic and convenient system to protect the interests of the public by countering the malpractices. The main purpose of the system is to implement fingerprint matching algorithm for authentication of the user, which in turn reduces the widespread corruption, misuses of cards and to reduce the time complexity of the manual data entries. The system is used to protect the products of fair price shop in black markets.

2. LITRATURE SURVEY
Evolution of public distribution of basic commodities in India had its origin in the rationing system introduced by the British during the World War II. The system was started in 1939 in Bombay and gradually extended to other cities and towns. By the end of 1943, 13 cities had been brought under the coverage of rationing and approximately 771 cities or towns were covered in 1946. Some rural areas, suffering from chronic shortage were also covered. Since there PDS is following the same pattern. There are only little modification is happening inthe field of PDS.

Initially the user is asked to swipe the RFID card. The Raspberry pi compares the unique tag ID with the data base. If the tag ID matches, the user is asked to scan the finger. Once the user identity is authenticated, the commodity and quantity can be selected through voice commands. If the commodity and quantity are valid, the system dispenses the valid commodity. A message is sent to the user giving the details of the transaction. However, if the authentication fails the system waits for valid authentication.

Sana et.al. [1] Presents a transparent and highly scalable Ration Distribution system with biometric authentication. The conventional paper based ration card is replaced by smart card. The system is connected to the server through web. Every time before ration collection each user has to login into the system. The user need not to pay the cash money as the appropriate balance is deducted from user's bank account, so there is no direct involvement of ration shop owner in transaction. The transaction details are sent to users mobile.

Bhalekar et.al. [2] Proposes online smart ration card system using RFID and biometrics. RFID tag will contain the information about family members. RFID tag given to a particular customer needs show to the RFID reader. It will check whether the card is valid or not and if yes, then by using biometrics the customer authentication is performed.

If the customer is authenticated then the monthly quota will get displayed according to the family members. After delivery of ration, records are maintained in the online database.

Ashok Kumar et.al. [3] gave a Comparative Study on Fingerprint Matching Algorithms for EVM. The three matching techniques are direct matching, minutiae matching and matching based on Ratios of distance. By conducting the evaluation on the FVC-2000 datasets and the results were observed by conducting election with the help of these matching techniques and the best matching technique is found.

Agarwal et. al. [4] proposed, the Smart Ration Card System which is implemented based on RFID and GSM Technique. In which RFID tag is read by using the RFID reader and check whether that user is valid or not, If user is valid then the allocated ration is provided to the customer. And message is send to that user by using GSM technique.

Sharath et.al [5] addresses the problem of fingerprint individuality by quantifying the amount of information available in minutiae features to establish a correspondence between two fingerprint images.

2.1 Minutiae Based Matching

This is the most popular and widely used in commercial applications, because of its good performance and low computation time, especially for good quality images. This method tries to align the minutiae of the input image (query template) and stored templates (reference template) and find the number of matched minutiae. After alignment, two minutiae are considered in matching if the spatial distance and direction difference between them are smaller than a given tolerance. Steps involved in matching algorithm are

2.1.1. Fingerprint Image Preprocessing

Fingerprint Image Enhancement:

Fingerprint Image enhancement is to make the image clearer for easy further operations. The fingerprint images acquired from sensors or other medians are not assured with better quality, those enhancement methods, for increasing the contrast betweenridges and furrows and for connecting the false broken points of ridges due to insufficient amount of ink, are very useful for keep a better accuracy to fingerprint recognition.

Histogram Equalization:

Histogram is a process that attempts to spread out the gray levels in an image so thatthey are evenly distributed across their range. It basically reassigns brightness valueof each pixel based on the image histogram. Histogram equalization is to expand thepixel value distribution of an image so as to increase the perceptional information.

Fingerprint Enhancement by Fourier Transform:

The image is divided into small processing blocks (32 by 32 pixels) and performs theFourier transform according to it. The Equation (2.1) used for computing FFT is given by

$$F(u,v) = \sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)\exp^{(-2j\pi(\frac{ux}{M}+\frac{vy}{N}))} \quad (2.1)$$

In order to enhance a specific block by its dominant frequencies, we multiply the FFT of the block by its magnitude a set of times. Where the magnitude of the original FFT is abs (F(u, v)) = |F(u, v)| So we get the enhanced block according to the Equation(2.2)

$$g(x,y) = F^{-1}\left(F(u,v) * |F(u,v)|^{k}\right) \quad (2.2)$$

where $F^{-1}(F(u, v))$ is given by Equation(2.3)

$$f(x,y) = \frac{1}{MN}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} \exp^{(2j\pi(\frac{ux}{M}+\frac{vy}{N}))} \quad (2.3)$$

The k in Equation (2.2) is an experimentally determined constant, which we choose k=0.45 to calculate. A high value of k improves the appearance of the ridges by filling up small holes in ridges, but too high value of k can result in false joining of ridges which might lead to a termination become a bifurcation. The enhanced image after FFT has the improvements as some falsely broken points on ridges get connected and some spurious connections between ridges get removed.

Fingerprint Image Binarization:

Fingerprint Image Binarization is to transform the 8 bit Gray fingerprint image to a 1 bit image with 0 value for ridges and 1 value for furrows. After the operation ridges in the fingerprint are highlighted with black color while furrows are white. A locally adaptive binarization method is performed to binarize the fingerprint image. Locally adaptive binarization method comes from the mechanism of transforming a pixel value to 1 if the value is larger than the mean intensity value of the current block (16x16) to which the pixel belongs.

Fingerprint Image Segmentation to extract the region of interest (ROI):

In this a two-step method is used. The first step in this method is block direction estimation and direction variety check, while the second is intrigued from some Morphological methods.

Block Direction Estimation:

The fingerprint image is divided into blocks of size 16 x 16 pixels (W x W) after which the block direction of each block is calculated according to the algorithm:

I. Calculate the gradient values along x-direction (gx) and y-direction (gy) for each pixel of the block. Two Sobel filters are used to fulfill the task.

II. For each block, use Equation (2.4) to get the Least Square approximation of the block direction.

$$\tan 2\beta = \frac{2\sum\sum(gx * gy)}{\sum\sum(gx^2 - gy^2)} \quad (2.4)$$

For all the pixels in each block the formula is easy to understand by regarding gradient values along x-direction and y-direction as cosine value and sine value. So the tangent value of the block direction is estimated nearly the same as the way illustrated by the following Equation (2.5).

$$\tan 2\theta = \frac{2\sin\theta\cos\theta}{\cos^2\theta - \sin^2\theta} \quad (2.5)$$

After finished with the estimation of each block direction, those blocks without significant information on ridges and furrows are discarded based on the following Equation (2.6)

$$E = \frac{2\sum\sum(gx * gy) + \sum\sum(gx^2 - gy^2)}{W * W * \sum\sum(gx^2 + gy^2)} \quad (2.6)$$

ROI Extraction by Morphological Operations:

Two Morphological operations called OPEN and CLOSE are adopted. The OPENoperation can expand images and remove peaks introduced by background noise. TheCLOSE operation can shrink images and eliminate small cavities.

2.1.2. Minutiae Extraction

Fingerprint Ridge Thinning:

Ridge Thinning is to eliminate the redundant pixels of ridges till the ridges are just one pixel wide uses an iterative, parallel thinning algorithm. In each scan of the full fingerprint image the algorithm marks down redundant pixels in each small image window (3x3). And finally removes all those marked pixels after several scans.

Minutiae marking after the fingerprint ridge thinning:

Marking minutiae points is relatively easy. In general for each (3x3) window, if the central pixel is 1 and has exactly 3 one-value neighbors then the central pixel is a ridge branch. If the central pixel is 1 and has only 1 one-value neighbor, then the central pixel is known as ridge ending.

2.1.3. Minutiae Post processing

False Minutiae Removal:

At this stage false ridge breaks due to insufficient amount of ink and ridge cross connections due to over inking are not totally eliminated. Also some of the earlier methods introduce some spurious minutia points in the image. So to keep the recognition system consistent these false minutiae need to be removed. First calculate the inter ridge distance D which is the average distance between two neighboring ridges. For this scan each row to calculate the inter ridge distance. All we label all thinned ridges in the fingerprint image with a unique ID for further operation using a MATLAB morphological operation BWLABEL.

Minutiae Match Alignment stage:

Given two fingerprint images to be matched, choose any one minutiae from each image and calculate the similarity of the two ridges associated with the two referenced minutiae points. If the similarity is more than a threshold transform each set of minutiae to a new coordination system whose origin is at the referenced point and whose x axis is coincident with the direction of the referenced point.

Match stage:

After getting two set of transformed minutiae points, they were used in the elastic match algorithm to count the matched minutiae pairs by assuming two minutiae having nearly the same position and direction are identical. If the minutiae is to be matched is within the rectangle box placed and the direction discrepancy between them is very small, then the two minutiae are regarded as matched minutia pair. Each minutiae in template image either has no matched minutiae or has only one corresponding minutiae.

3. METHODOLOGY

System Architecture

This section includes a brief overview of all the components used in the system. Fig 1 describes the system in brief in the form of block diagram.

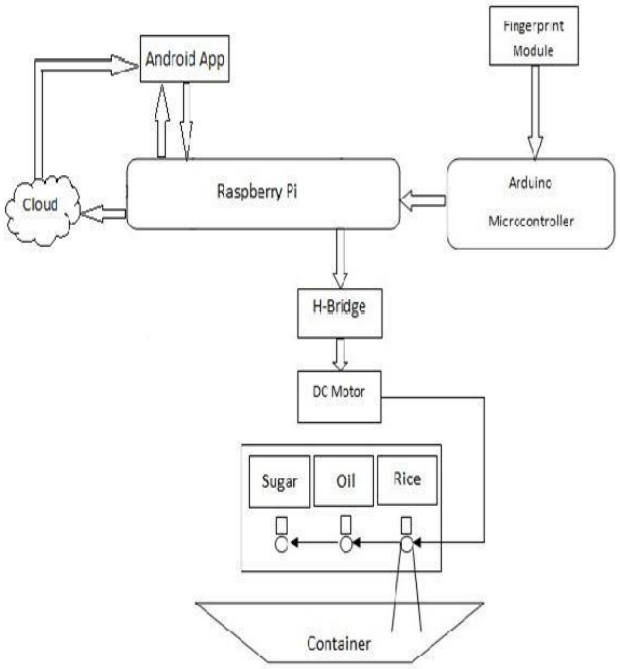

Fig 1: Block diagram of IOT based smart public distribution system.

Finger print module: Fingerprint module is used for enrollment and authentication purpose. A fingerprint module is interfaced with the Raspberry pi. A minutiae algorithm is used to process the fingerprint obtained from the module. Fingerprint processing includes two parts: fingerprint enrollment and fingerprint matching. During enrolling, user needs to enter the finger two times. The system will process the two time finger images, generate a template of the finger based on processing results and store the template.

Raspberry pi: The details of each user of the family are enrolled in the database. Raspberry pi takes the serial number from reader and access

corresponding record in the database in accordance with the thumb print identification.

Motor and Relay circuit: The motors are used to control the valve arrangement (i.e.to open and close the valve). These motors are controlled by relay (timer) circuit. Relay circuit is used for weight measurement as the grain falls through the funnel and when it reaches the required amount the valve will close automatically.

Hydraulic Valve: The purpose of flow control in a hydraulic system is to regulate speed. This valve controls the speed of an actuator by regulating the flow rate. The valve is controlled by electric current which passes through a DC motor. The motor operates the hydraulic valve to dispense the oil to the cardholders.

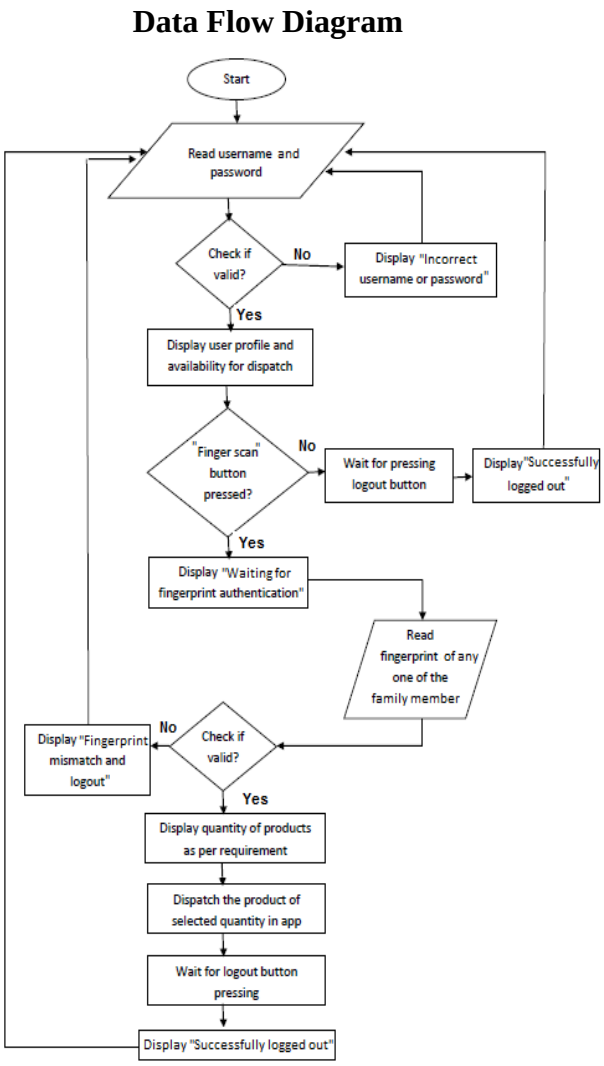

Fig 2: Data flow diagram of proposed system

The Data flow diagram for proposed system is shown in Fig. 2. This system is titled smart public distribution system proposes an automatic method of distribution of commodities to authenticated card holders. Also, the details of transactions made are maintained in a database. User will be informed about the arrival of stocks by a message sent to their mobiles. The user need to access to their account through their Smartphone by putting their username and password. Once they are successfully logged in they can view the stock availability, their use and can also get the commodities on subsidy. This system works using Internet. The proposed system uses Raspberry-pi as controller. A family member is identified by his/her fingerprint template. This makes the system more secure.

Fingerprint processing includes two steps:

1. Fingerprint enrollment

2. Fingerprint matching

At the time of enrollment, user needs to provide two samples of fingerprint. Using these two samples, the fingerprint module generates a template of fingerprint which is used to authenticate the user later. The system is designed to enroll each transaction made by user into a database stored in Raspberry Pi. The user needs to select the quantity and commodity using android application. Automatic distribution of commodities is achieved by using DC motor controlled directly by Raspberry pi to open and close the valve.

The proposed system uses minutiae extraction and matching algorithm for fingerprint authentication. Here, Minutiae are extracted from the two fingerprints and stored as sets of points in the two- dimensional plane. Minutiae-based matching essentially consists of finding the alignment between the template and the input minutiae sets that result in the maximum number of minutiae pairings. The algorithm design description is shown in Fig.3.

The first step in the minutiae extraction stage is Fingerprint Image enhancement. This is mainly done to improve the image quality and to make it clearer for further operations. In proposed system we have implemented three techniques: Histogram Equalization, Fast Fourier Transformation and Image Binarization.

Histogram equalization is a technique of improving the global contrast of an image by adjusting the intensity distribution on a histogram. In Fast Fourier Transform (FFT), we divide the image into small processing blocks (32 x 32 pixels) and perform the Fourier transform according to equation:

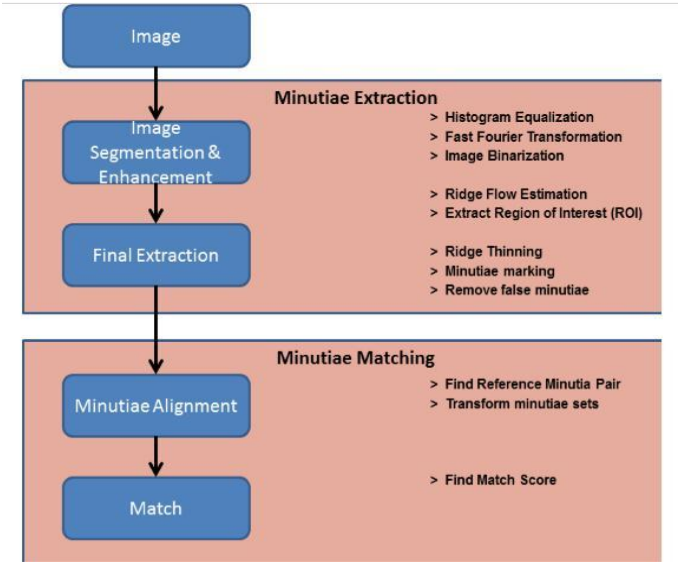

Fig 3: Matching algorithm flow chart.

$$F(u,v) = \sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y) \times \exp\left\{-j2\pi \times \left(\frac{ux}{M} + \frac{vy}{N}\right)\right\}$$

for u = 0, 1, 2, ..., 31 and v = 0, 1, 2, ..., 31.

we get the enhanced block according to the equation:

$$g(x,y) = F^{-1}\left\{F(u,v) \times |F(u,v)|^{K}\right\}$$

where $F^{-1}(F(u, v))$ is given by:

$$f(x,y) = \frac{1}{MN}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} F(u,v) \times \exp\left\{j2\pi \times \left(\frac{ux}{M} + \frac{vy}{N}\right)\right\}$$

For x = 0, 1, 2 …31 and y = 0, 1, 2 ...31.

Similarly, the minutiae extraction is done using sobel filters. After minutiae extraction false minutiae removal is done with the help of seven conditions based on the distance between two ridges. Those minutiae points will be matched with the

fresh fingerprint which is used during authentication of the user.

4. CONCLUSION

IOT based Smart public distribution system is an automation system and it is recompense over the present fair price shops. Fingerprint authentication uses Minutiae extraction based algorithm, which makes the system more secure and accurate. It eliminates fake ration card holders and protects the interest of the common people ensuring the country's food security. By means of its performance one can reduce the corruption level. Selecting the commodity and quantity through the android app will make the system more smart and robust. It will help the country's economy to reach new heights. The automated PDS is easy to implement and requires much less hard work when compared to the other system. Using this system one can avoid the malpractices because there is no manual operations and also all information is stored in a database. So this system will be really helpful to the people. Further in future work voice commands can be used to select commodities and quantity.

5. REFERENCES

[1] Sana A, Qader P, Dube R , "Smart Card based e-Public Distribution System" , International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 5, May 2016.

[2] Bhalekar D, Kulkarni R, Lawande K, Patil V, "Online Ration Card System by using RFID and Biometrics", International Journal of Advanced Research Computer Science and Software Engineering 5(10), pp. 849-851, October- 2015.

[3] Ashok Kumar D, Ummal Sariba B, "A Comparative Study on Fingerprint Matching Algorithms for EVM", Journal of Computer Sciences and Applications, Vol. 1, No. 4, pp:55-60, 2013.

[4] Agarwal M., Sharma M., Singh B, Shantanu, "Smart Ration Card using RFID and GSM Technique" IEEE Conference on the Next Generation Information Technology.

[5] Sharath Prakanti, Prabhakar S, Jain A.K, "On the individuality of fingerprints", IEEE Transactions on Pattern Analysis and iMachine Intelligence, VOL. 24, NO. 8, pp: 1010-1025, 2002.