Cloud-Based Ration Card System Using RFID And GSM Technology

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Abstract— **This paper describes the development of a cloud-based ration card system using Radio Frequency Identification (RFID) technology. The existing conventional ration card system has numerous problems. These problems ranges from the basic issues of renewing the ration card every year by pasting excess leaves which has to be done manually by the employees to the malpractices done by the ration store dealers like diverting food grains to open market to make profits. There is another problem of irregularity in opening shops and false announcements of deficit in food grains. All the above problems in the existing ration card system can be tackled by this proposed ration card system using RFID. The user 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 mobile which has to be entered in a keypad. 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. Above all the user can always check their purchase details in a dedicated website.**

Index Terms—**RFID, ration card, cloud, GSM.**

I. INTRODUCTION

The public distribution stores or ration stores use ration cards which are in the form of a book are used for general identification of the customer and holds the user's personal information and purchase history. On successful purchase, the details of purchase are entered in the card and in the purchase register at the employee's side. This is the system which is existing at the ration stores now. This system has a lot of drawbacks. The ration card should be renewed every year by pasting additional leaves in the same card. There is a possibility of the ration card being torn. In some ration stores, dealers involve in malpractices like diverting food grains to open market to make profits. As a result there is a possibility of consumers sent back with a no stock sign even though there are food grains in stock.

Having said the limitations imposed by the conventional ration system, we propose a solution in the form of a ration card system based on RFID and GSM technology. As a first step the user has to flash his ration card at the RFID reader and as a result a random password is generated at the same moment and it will be sent to the user's registered mobile number. Upon entering the password in the keypad provided, the user will be authenticated and the user details are retrieved from the user database from the web server and are updated in the window application which is open in a computer system at the employee side. When the user asks for a particular quantity and type of food grain, the details are entered in the application by the employee and are updated in the web server. Additionally the users can check their purchase history and their details in the dedicated website by entering their registered username and password.

II. SYSTEM DESIGN

The cloud-based ration card system using Radio Frequency Identification (RFID) technology promotes semi-automated and secured ration distribution which is developed for both rural and urban areas. In drawing the system design, a number of web-based methods and frameworks have been reviewed and referred. Some comparisons performed on the different technologies being used in the similar systems were also learnt. Related research on the system-development and testing were also reviewed to provide guidance in customizing and evaluating the process, while learning the disciplined approach in designing the proposed system.

Our proposed system consists of three main modules namely the RFID reader module, Software module and Web server module. Those modules are integrated together in order to allow its full functionality. Each module carries its own functions and special features. The general process flow is illustrated in Figure 1, where all of these components are involved and operational.

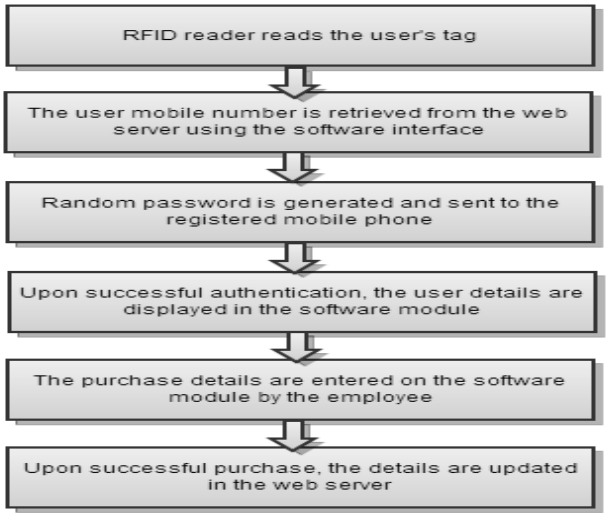

Figure 1: The overall RFID based ration distribution process

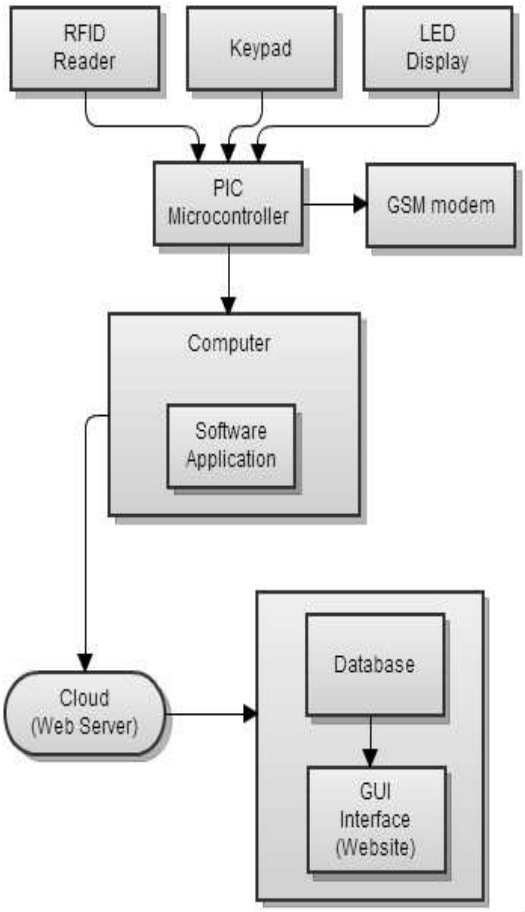

Figure 2: System Architecture of the RFID based ration card system

The overall architecture of the system is illustrated in Figure 2, where the main components are shown. Each of these components will be described in the following sub-sections.

A. *RFID Reader and Tag*

RFID reader is the device capable of reading and retrieving information stored inside the RFID tags. There are two types of RFID reader, which are the active and passive RFID readers. Active RFID reader can detect an active RFID tag while passive RFID reader can only detect passive RFID tag at a few centimeters away from the reader. The RFID reader being used in the system is a low cost reader for reading passive RFID tags. It operates at 0~ 400C temperatures, 20~80% of humidity, 125 kHz frequency and 12V power supply. The effective detection range of the reader is around 5-8cm.

Each RFID tag has a unique serial number or ID. There are three types of RFID tags which are active, semi-passive and passive. The main difference between these RFID tags is that active and semi-passive RFID tags require internal battery. Adapted to our scope of work, the ration cards being used to identify each individual customer are the RFID cards that consist of passive RFID tag, which do not require internal battery. When such cards are passed through the field generated by a compatible reader, they transmit information back to the Reader. Figure 3 illustrates how data transmission is performed between an RFID reader and a ration card.

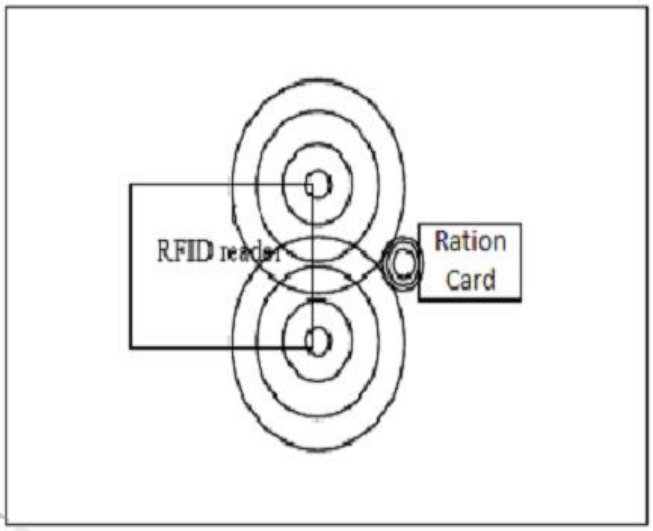

Figure 3: Data Transmission between an RFID reader and a Ration Card

B. *GSM Modem*

The GSM modem is used to send text messages to the user's mobile number. It can accept any SIM card with its own unique phone number. It has a RS232 port to communicate with the PIC Microcontroller. The microcontroller sends a random password and the user's mobile number through the serial port and the password will be sent as a text message to the above mentioned mobile number by the GSM modem.

C. *PIC Microcontroller*

The Peripheral Interface Controller used in this system is used to control the overall input and output operations. The RFID reader, keypad, LED display and the GSM modem are connected with the PIC Microcontroller which is in turn connected with the computer software using the serial port. Since the software is connected to the cloud, this implies that the Microcontroller is connected with the cloud from where the user database can be accessed.

The PIC gets the RFID tag ID from the reader and retrieves the mobile number corresponding to the particular user from the cloud database. Then it generates a random password and sends a text message to the corresponding mobile number, containing the password text with the help of the GSM modem. Once the password text is received the user enters the password in the keypad. The entered details can be viewed in the LED display board which is

connected to the Microcontroller. Now the PIC Microcontroller compares the two password strings. If they are same then an authorization signal is sent to the computer else a no authorization signal is sent to the computer.

D. Software Application

The software which acts as an interface between the RFID reader hardware and the cloud is a windows application and is coded using C# .NET. It is a Graphical User Interface which will only be accessed by the employee of the ration shop. It is designed in a way that even a computer novice can work with it easily. Once the user is authorized, the details of the user such as his personal details are displayed in the application.

The software is designed in a way that nothing is stored in the local computer and all the details are either retrieved from the cloud or updated in the cloud. This ensures the at most security of the data and tackles any sort of malpractices.

E. Cloud

The Cloud or the web server here refers to either hardware (computer) or software (application) that helps to deliver content publicly accessible through the Internet. It provides the web site functionality by accepting requests from the user's browser and responds by sending back HTML documents (Web pages) and files. To enable the system dynamic functionalities, the web server hosts the database and the graphical user interface (GUI) pages enabling online interaction with the system users.

F. Database

A database is defined as an organized collection of data and tailored to our system, our database is employed to mainly store the users's personal and ration information. Secondarily the database is also used to store data gathered from the online web-interface, such as updated personal information, password, email and mobile numbers by the users. In offering more features to the users, our online system can manipulate the user information by querying the database for complex data retrieval. This includes automated operation, such as summarizing an individual's monthly purchase details.

G. Graphical User Interface (GUI)

The GUI component of the system is purposely developed for friendly interaction with the users. All types of users, namely the customers, employees and the system administrators are given unique access to their individual member area, where the customers can access their personal information, purchase details and availability of food grains, while the employees can access their shop details and the administrator can access all the details and he can activate or deactivate the user accounts. The developed GUI is in the form of dynamic web pages, which are database driven. This signifies that the information displayed on the web pages are constructed based on the data extracted from the database. The pages are developed using the Hypertext Preprocessor (PHP) scripting language and compatible with all major web browsers.

III. SYSTEM IMPLEMENTATION

Based on the system design presented earlier, the system implementation was carried out. The overall process flow of system implementation is illustrated in Figure 4, which is composed of 5 main steps.

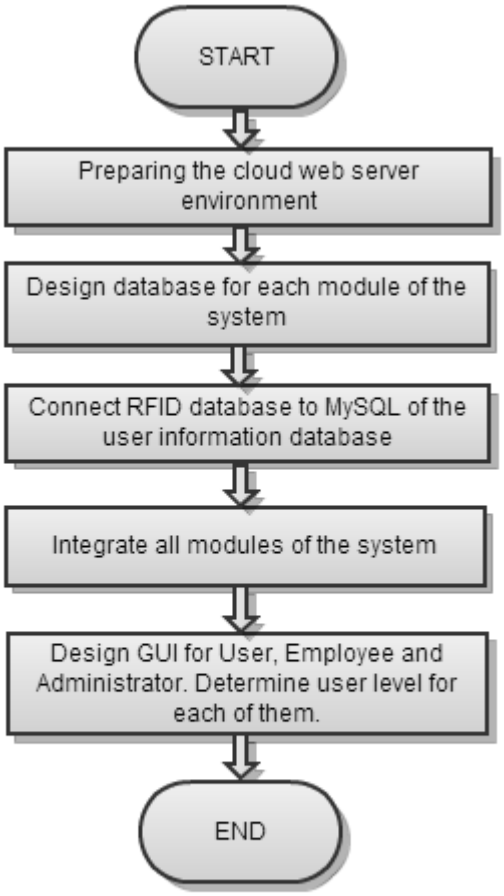

Figure 4: Overall process flow in developing the Cloud Based Ration Card System

A. RFID System Device

The system employs RFID-Mifare terminals as the readers, which can be installed across all ration shops. The reader is connected to the PIC Microcontroller using the RS232 port. On a successful read, the tag information is sent to the PIC Microcontroller as a string through the serial port. The communication

between the RFID reader and the PIC Microcontroller is a half-duplex communication.

B. GSM Modem

The GSM modem is connected with the PIC Microcontroller using the RS232 port. The PIC Microcontroller specifies a random password and the mobile number to which the text message has to be sent. The communication between the GSM modem and the PIC Microcontroller is also a half-duplex communication.

C. PIC Microcontroller

The PIC Microcontroller is connected with the computer using the serial interface. On receiving a tag id from the RFID reader, the PIC Microcontroller sends the tag id to the computer to get the mobile number corresponding to the particular tag. When the mobile number is received, a random password is generated and both the password and the mobile number are sent to the GSM modem. When the user enters the password in the keypad, the PIC Microcontroller compares the two passwords and if they are equal, then the authorization signal is sent and if they are not equal an unauthorized signal is sent to the computer.

D. Web Development

The web application was initially developed on a local host that runs the XAMPP server. Having such web server hosted on the local host allows the PHP scripts to be developed and locally tested and debugged. Besides the web server, a database server is also run on the local host allowing the scripts' connectivity with the database. The database design will be briefly described next.

E. MySQL Database

The cloud-based ration card system is connected directly to a MySQL database. In general, there are two main tables created to store the collected data. A table called the User is used to store all users' logging and personal data paired with the RFID tag information. Another table called the Employee is used to store the details of the employees of the ration store. The table Users consists of columns namely username, address, email, mobile number and etc. It also has the users ration information like the amount of available rice, wheat, sugar and kerosene. A set of pre-defined SQL queries are written into common functions allowing easy data insertions, update and retrievals for web-page displaying purpose.

F. Graphical User Interface (Website) Design

A user is allowed to enter the member area by logging in to the system via a login form. This type of authentication is important in order to prevent access by unauthorized users. The system grants access to 2 different types of users namely the Administrator and User. According to the user type, each user is given the specific level of access. For instance, the Administrator level is given an access not only to view but to moderate and modify data in the system. In contrast, other user levels will be given only limited access to the system.

For easy reference, the GUI is designed with the horizontal style for navigation menu. For administrators, a navigation menu is given that provides links to the main functionalities of the system. This includes the "Activate Ration" function for activating and deactivating the ration account of a particular user. A "Mass Email" function is also available to send emails to all the users in the database in case if the administrator has to inform the users about the availability of food grains. For users, the navigation menu has links to the "User Profile" which has the user's personal information and "Ration Details" which has the user's ration information.

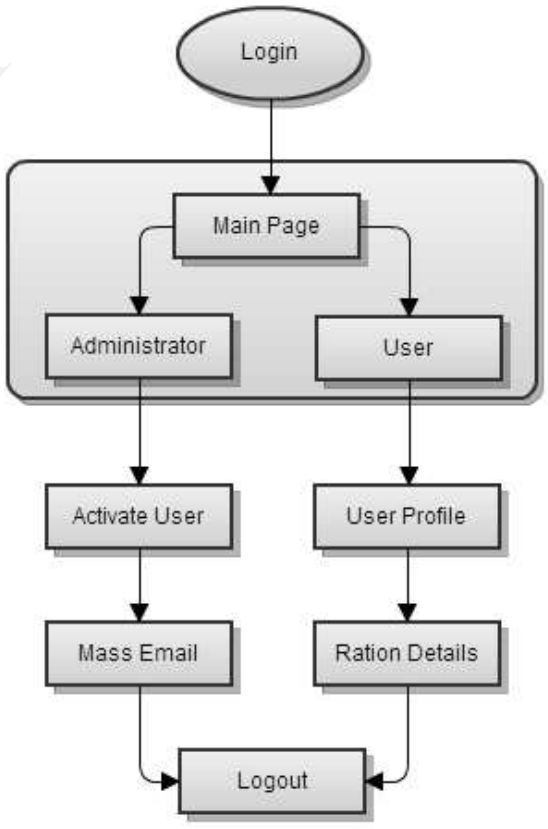

Figure 5: GUI Navigation Menu

IV. SYSTEM TESTING AND RESULT

To ensure the system correctness and completeness, system testing has been performed across the system environment that includes the client-side application, server-side application and the hardware.

A. *Hardware Testing*

RFID Reader was tested by having it to capture the ID and to send it through the serial port. The ID received is displayed in the window application and it is compared with the ID of the tag which is flashed in front of the RFID reader. This is done to make sure that the RFID reader is capturing the correct tag ID.
The next step was to set up the GSM modem component so that it is able to send the password text to a particular mobile number.

The GSM modem can be tested by sending a test mobile number and a random password text to it through its serial port so that it can be sent to the corresponding mobile number. The password text was received in the test mobile. The keypad is tested by connecting it directly to the LED display. The values entered are correctly displayed in the screen. Figure 6 illustrates the process flow of the hardware testing.

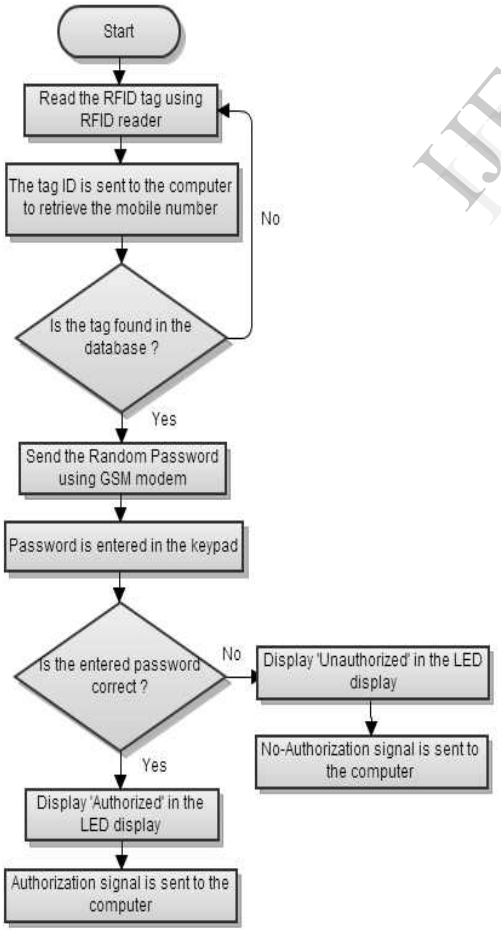

Figure 6: The hardware testing process flow

B. *Software Application Testing*

The testing of the software application is done by supplying it with test strings. In order to retrieve the mobile number from the database a test string which contains a RFID tag data which is already stored in the database is sent through the serial port. When the authorization signal is sent through the serial port, the software displays the user detail which corresponds to the particular tag.

When the purchase details are entered and the information is submitted, the database of the corresponding user is updated in the cloud server. Figure 7 illustrates the process flow of the software testing.

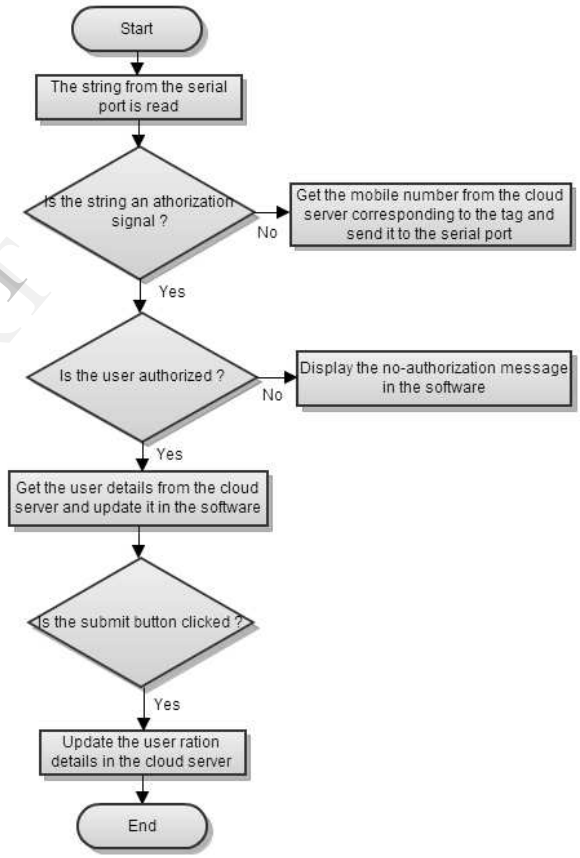

Figure 7: The software application testing process flow

C. *Online System*

Unit testing for each online component was performed by monitoring the outputs they produced through a web browser. Such testing was done while coding each of the defined component. In detailed, after coding a particular function of a particular online component in PHP, the result or output is observed through the web browser. If there was no display or an

error was displayed, the recently coded function will be debugged through a PHP editor. The similar test was performed to validate SQL queries performed onto the database. If an SQL query was found to return a wrong result, then the query would be debugged to attain the desired result.

Once all online pages are correctly displayed, an integrated system testing would be performed between the RFID reader, the software application and the online system together to complete the overall system testing. Figure 8 illustrates the process flow of the online system testing.

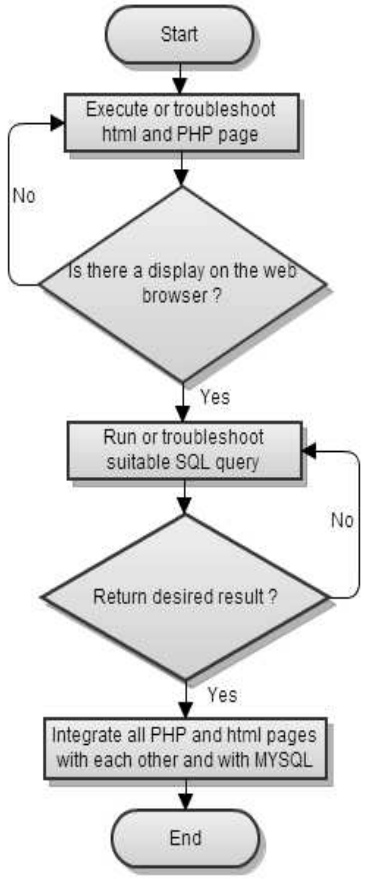

Figure 8: The online system testing process flow

D. System Testing Results

In general our aim to develop a prototype of a Cloud Based Ration Card System was successful. The user-login authentication process was successfully tested, which prevents an unauthorized access into the system. Once a user is successfully logged in, the user is given the access to the main page that displays a menu listing a set of features offered to the user. Figure 9 illustrates the Cloud Based Ration Card System login interface.

Figure 9: Cloud Based Ration Card System login menu

Figure 10 shows the Ration Account Activation page of the Cloud Based Ration Card System, viewable only by the system administrator. On this account activation page, a text box to enter the username of the user to whom the ration account should be activated and an option to select the type of ration card are present.

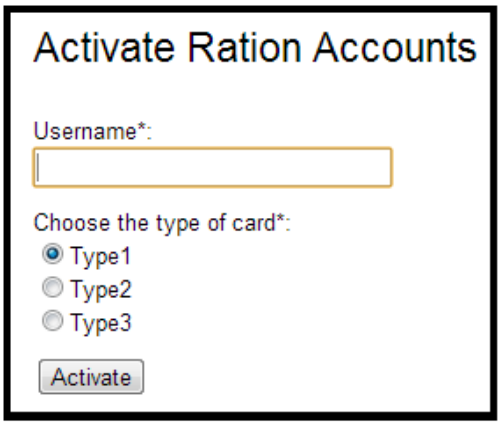

Figure 10: Ration Account Activation Menu

Figure 11 shows a page displaying the amount of food and oil items available in a particular shop. This page can be accessed by all the users. A particular user may only view details of the shop in which they are intended to buy. An administrator can view the details of all the shops. These pages cannot be edited by an user but they can be edited and changed by an administrator.

Figure 11: Ration Shop Details

V. CONCLUSION

The developed Cloud-Based Ration Card System using Radio Frequency Identification and GSM technology will significantly improve the current manual process of ration card system and will reduce the security issues and malpractices.

In addition, a number of other advantages are gained by having an online web-based system, acting as a central repository of user ration and personal information. Firstly the users can view and modify their personal information at any time with ease. Secondly they can view their ration details and the details of the shop in which they are intended to buy. The accessing can be done from any computer via the web browser, as long as they are connected to the Internet. This way, no specific software installation is required. The shopping details are also processed and updated automatically with less risk of data loss, compared to a manual filing approach. The developed system can be improved and upgraded further, e.g. by extending the system with new features and modules or by improving the web-interface layout with new display style. Better yet the system can be enhanced further to offer another significant enhancement where the system can be extended to store users finger prints for improved security.

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