Biometric Based Bank Locker System

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Abstract - *The paper describes development of a microcontroller Arduino based biometric bank locker system with Adhaar card database management in cloud storage, mobile app and webpage, which ensures the security of personal and confidential belongings of a person. In this system, we have used R305 fingerprint module for biometric security which is IOT enabled using HC05 Bluetooth module. The safe lock unlocks itself using servomotor when correct fingerprint or pin is entered. The android mobile application is used to operate the system, which also has a QR code sensor which scans the Adhaar Card of the user and stores the information in a Google sheet, which can be accessed from anywhere with proper username and password. The webpage describes all the major features and advantages of the system and also includes an in-depth video of the working of the system. This webpage is also accessible from the app. Hence, this is user friendly and easy-to-use biometric locker system, wherein an app and a website give all the information regarding the system and its features.*

Key Words: **Biometrics, Arduino, Adhaar Card, Finger print**

1. INTRODUCTION

Bank lockers are popularly used by Indian population; they prefer keeping their valuables in the bank lockers rather than in their homes. Most of the banks' have lockers such that one key is with the user and the bank has a master key. Moreover, they also have password which the user has to tell the bank subordinate before going in the locker room, now if the user loses the key then, it is a big security risk. Common bank lockers do not guarantee full safety of the users' belongings and can easily be opened by any person without the user's consent.

Biometric allows a person to be identified and authenticated based on a set of recognizable and verifiable data, which are unique and specific to them. Biometric authentication is the process in which a person's characteristics are compared with the persons biometric "template", wherein this reference model is first stored in database, and then biometric identification is used to determine the identity of the person using the image of their fingerprint, iris or face. Biometric data are considered as unique for every individual and cannot be copied or stolen. [1]

Fingerprints are the most common biometric technology used in many applications. The fingerprint recognition and matching is one of the simplest ways of verifying a person's identity. It requires the imaging and comparison of the print pattern which includes the ridges and minutiae points. These patterns are unique to every individual. Several studies using fingerprint biometric recognition were conducted to improve locker systems. One among them was the study of Lay, Yang and Tsai (2011) entitled "Biometric Locker System" wherein fingerprint recognition technique was used to open and close the lock of a storage locker system. The system first captured the fingerprint of the locker renter and matched the fingerprint to reopen the locker. This was done to reduce troubles of keys and to ensure the security of the renter [2]. Although there were existing studies about biometric lockers, the present system is developed to enhance security. Here the user has to scan the QR code of their Adhaar Card so that the database is maintained to ensure who opens and accesses the locker. The Aadhar card database implementation makes the management of users' database hassle-free. Moreover, an app is developed to make all the functions of the model easily accessible. A website is designed so that the bank personnel can understand the working of the locker and also the app.

2. OBJECTIVE OF THE STUDY

The system is aimed to develop a prototype of a microcontroller- based locker system that can:

1. Enrol or delete fingerprints of the user and save these patterns in the database.
2. Control the locker using mobile app and send commands to it using the app connected through Bluetooth.
3. Scan the QR code of the Adhaar card to maintain a database
4. If the locker renter whose fingerprint is used to open the locker has a problem with fingerprint scanning due to injury or any treatment then a then pin is also provided for each locker, along with Aadhar details verification.
5. Webpage to provide the working and description of the prototype and application.

3. PROPOSED SYSTEM

Here, we are implementing a Biometric Bank Locker System using Fingerprint Reader and identification, Bluetooth and QR Code. The Adhaar Card has all the important information about the person which includes his name, date of birth, address. The QR code when scanned through the phone camera saves all this information. This system is implemented using microcontroller Arduino Uno, the fingerprint module uses software serial communication to send and receive signal from the Arduino. Bluetooth module HC-05 which uses hardware serial of Arduino is used a communication media between mobile app and Arduino. The system is operated using the app designed for the bank authorities.
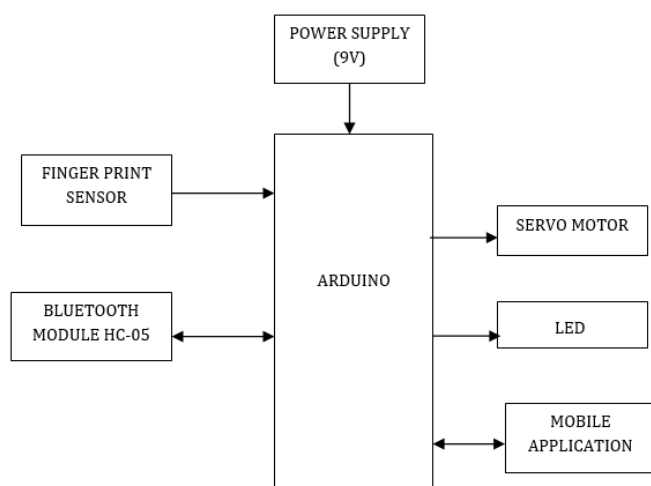

Fig 1: Block diagram of the system

4. SYSTEM DESCRIPTION

4.1 Components of the system

1. Arduino Uno

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It is powered by external 9V power supply. [4]

2. Fingerprint Module

The fingerprint module used is R305 by Sunrom which uses TTL UART interface. The user can store 127 fingerprints, where each fingerprint image is stored in the form of a code. It is directly interfaced with 5V Microcontroller Arduino.

3. Servo Motor

Servo Motor is used for opening and closing of locker. It is used to lock the locker by moving the latch in and out as the fingerprint is correctly identified and confirmed by the software application. It gives precise control of linear position, which can be controlled by giving input from Arduino. The shaft of the motor is connected to a lever rocker, which gives us the linear movement required for the Locker latch. If a circular lock is used, it may be directly attached using a gearing. Here a solenoid based option may be also used,but it may require a current driver circuit between the microprocessor and the drive, due to larger intial current requirement.

All the components are given uniform 5V power supply using 7805 power regulator.

4.2 Mobile App Development

The project implementation has been done using an app developed on MIT App inventor. The app developed is presently for the bank operator side, it can also be extended to the user side to get the notifications about the activity log of the user. The app has mainly two screens. The first screen has a display box which displays information like if the locker is locked or unlocked, or if the user's fingerprint is valid/ invalid, or the pin, allotted to the user, entered is valid or not and instruction for operating the system. Also, the first screen has direct buttons for adding a new user, deleting a new user, for directly verifying the pin and opening the web page designed for the project. Then, there is a button saying "QR code of Adhaar", this button, when pressed, opens the second screen. The second screen has a button 'Scan', which when pressed opens camera for scanning the QR code of the Adhaar card and after scanning the result is shown in the app as well as the Google Sheet is updated with information of user with the time and date of visit for opening the locker system. The app works with the Bluetooth module, making the project IOT enabled.

4.3 Webpage

A webpage in the form of the help manual for showing the operation of the system is made using web development tools like CSS, JavaScript, and HTML. The webpage contains the general information and the advantages of a biometric based locker over a traditional bank locker. It also gives a summary of all the features of the system along with a video of the working system.
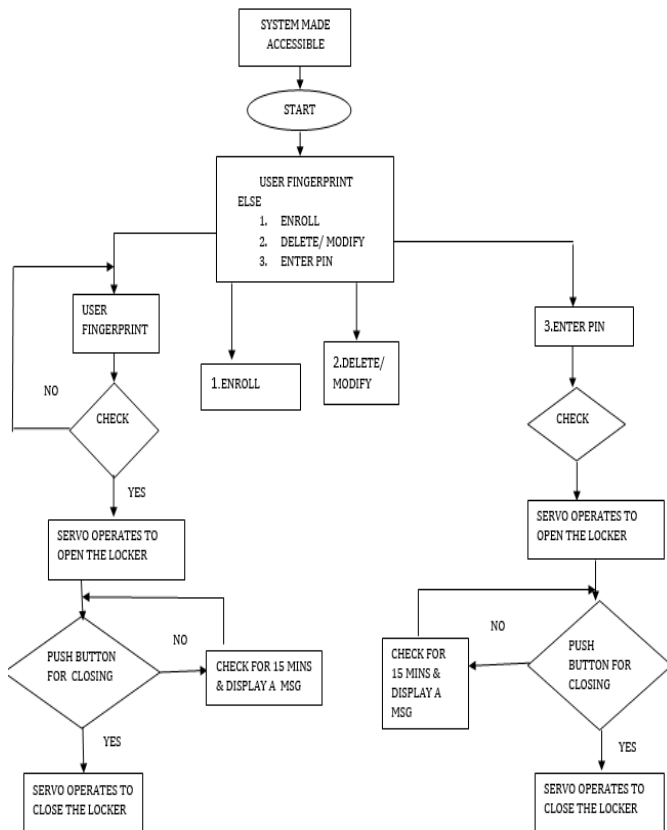
4.4 Working of the system

Fig 2: Overview of the system

Welcome Screen

As shown in fig 2. the authority of the bank has to login to the app with username and password only then the system will start .The welcome message on the app screen indicates that the sensor is properly interfaced and now user is asked to put their fingerprint if they are already enrolled else the user can select options from the app: enrol, delete or modify and check their pin.

Fingerprint Already Created

Referring to fig 2, user is asked to give their fingerprint, if it is correct then a green led glows and the servo opens the latch of the locker opens, the locker remains open until the user doesn't press a push button, this push button is provided so that the user can keep the locker open till their work is not over, once the push button is pressed the locker is locked, the app continuously reminds the user to press the push button and if the locker is open for more than a specified time then the bank personnel is alerted to lock the locker.
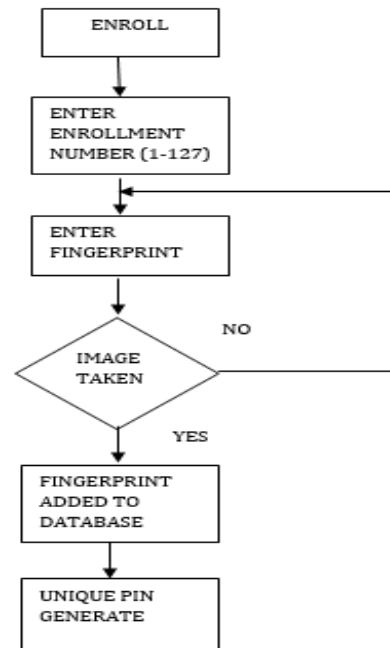
Fingerprint Enrolment

Fig. 3: Flowchart for fingerprint enrolment

With reference to fig 3, the user is asked to first enter a number between 1-127, if the number is already allotted the same will be displayed and user has to enter another number, once the number is created the user is given instructions to keep their finger on the fingerprint module for some time till 'Image Taken' is not displayed, this is done 2 times so that clear image of the finger is captured.

Pin Generation

If the owner of the locker cannot be physically present then an option for opening the locker using pin is also provided, but this is only possible after this option is enabled in the app by the bank authority. The pin is given during the enrolment. The servo opens the latch of the locker if the pin is correct and then the user has to push the push button and the locker will be locked.

Delete/ Modify Fingerprint

Referring to fig. 4, the user is first asked to enter their enrolment number. If the enrolment number exists, then the user is given option for modification or deletion of their account. If the user selects 'Modify' option, then they are asked to enter the enrolment number and then the fingerprint is modified, and if user selects 'Delete' option then, they are sked to enter their enrolment number again so as to confirm if they are sure and then the account is deleted.
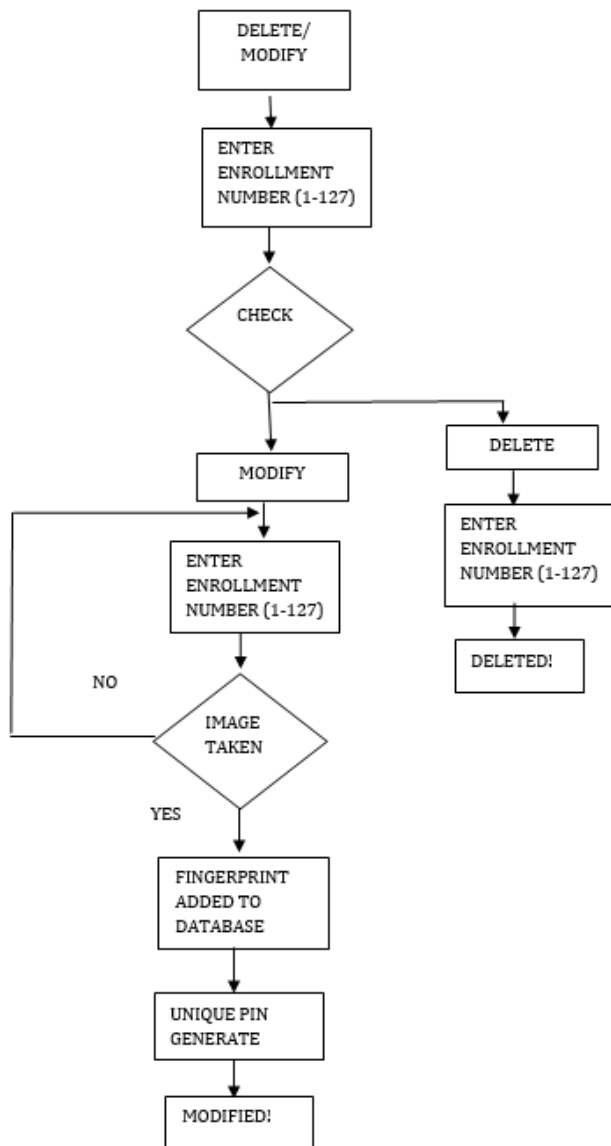
Fig.4: Flowchart for deletion/ modification of enrolled fingerprint

Adhaar Card Database

The app is made for the bank authority now after a correct fingerprint or pin is identified the servo will not open the latch till the Adhaar card of the person opening the locker is not scanned. The app scans the QR code of the Adhaar card and updates the information (Name, Address, and Father's Name) along with date and time on a Google Sheet on real time basis. After this the bank authority has to press the 'Scanned' button on the app, until this the servo will not operate. This enables to keep a record and database of all the people opening the lockers and further increases the security of the system.

5. CONCLUSIONS

All the components of the system were compatible with the microcontroller, the programs were developed, tested and uploaded in the Arduino and Mobile app successfully felicitated their operations. The following functions were successfully implemented and tested:

1). Enrolment, saving of the fingerprint and generation of the pin.

2). Proper identification of correct and incorrect fingerprint or pin.

3). Synchronised working of the mobile application with microcontroller code and hardware including the lock opening and closing mechanism.

4). Proper establishment of the connection between Bluetooth based app and Arduino along with proper scanning of the Adhaar Card and online uploading of the information on Google Sheets.

This system can be further developed with GSM module, so that the user can receive SMS regarding their locker opening and closing times along with the Adhaar card information of the person operating the locker. This module can also be used to provide an OTP whenever the enrolment number is deleted or modified. Moreover elaborate security layers can be added to database system.

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