Digital Locking System

Pratik Bambhania
B. Tech. (ICT)
DAIICT
Gandhinagar, India
201501193@daiict.ac.in

Jakshil Chavda
B. Tech. (ICT)
DAIICT
Gandhinagar, India
201501426@daiict.ac.in

Abstract—**Digital Locking System is a locking system which can be unlocked using fingerprint of the user. One more way to unlock it is using an Android Application installed in the user's smartphone. User needs to connect the smartphone via bluetooth to the bluetooth module of the system. The security of the lock is major concern. For it, the system is backed-up by an OTP-verification system which verifies the user's phone number by sending an SMS containing the OTP sent by the system. It is verified by the system as the OTP received will be entered by the user in the application. Only the genuine user will be allowed to register in the database. Once registered, the user will only need to login using his mobile number and password and can unlock the lock.**

Index Terms—**fingerprint, bluetooth, security, database**

I. INTRODUCTION

A Digital Locking System mainly consists of less features i.e. can be unlocked in a very limited number of ways. Biometrics is a very common way to unlock it using a high level of security[1]. Most biometric locks are using only fingerprint[2] to verify the user which are already implemented and mostly used in banks for security[3]. In a special case in which only bank lockers are considered, biometric unlocking along with GSM is already in use[4].

Also, the system in enabled to have a remote access for the user who wishes only to allow access to a trusted but unregistered person on behalf of him. For this, the user needs to install an Android Application on his smartphone and needs to register himself using his details. For it, the users needs to enter his name, mobile number and password used for logging in everytime. In the next window, an OTP is sent to the user's mobile number, should be entered in it to verify if the mobile number entered is correct or not. If found correct, then his details are registered in the database and eventually, the user is registered.

To access the lock by a remote person who is registered, he just needs to enter his mobile number along with his password. If the entered credentials are found correct, he is granted access to the next screen where he is allowed to unlock the lock. Once the lock is unlocked, the registered user is informed about the same by sending an SMS to the registered mobile number.
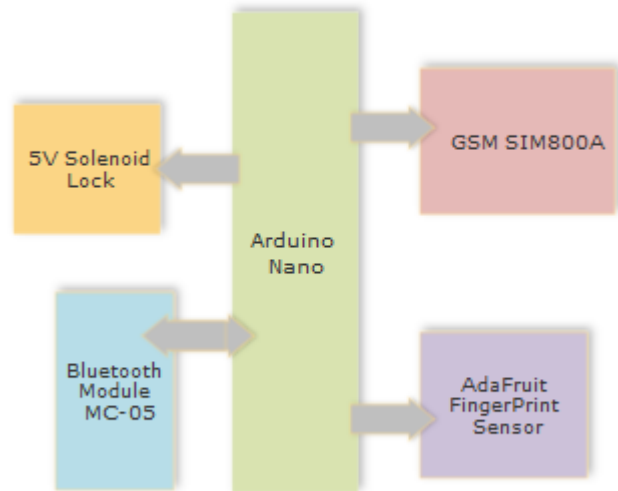

Fig. 1. Block Diagram of Digital Locking System consisting fingerprint module and GSM.

II. WORKING

The Fingerprint Module is connected to Arduino Nano along with Bluetooth Module, GSM Module and Solenoid Lock. The Android Application is connected to the system via bluetooth which works under a limited area of coverage. The whole connection is shown in Fig. 1.

A. Components Used

Arduino Nano based on ATmega328P is used as a microcontroller board. R301T Fingerprint Module is used to register and verify the fingerprints of the user. HC-05 Bluetooth Module is used to connect the system to the smartphone using an android application installed in the smartphone. SIM800A GSM Module with RS232 Interface is used to send SMS containing OTP and informing about the access of the lock by some person. A 12V solenoid lock is used which is be controlled by the arduino.

The microcontroller, Arduino Nano used here, is used to connect all the other components namely Solenoid Lock, Bluetooth Module, GSM Module and Fingerprint Sensor. It sends and receives data from bluetooth module. Arduino Nano
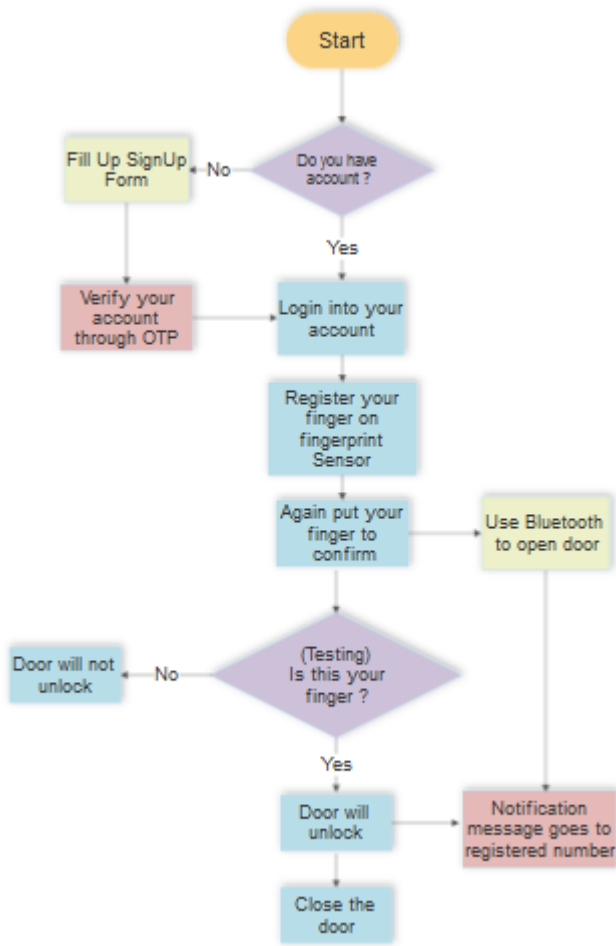
Fig. 2. Flowchart of Digital Locking System with detailed registration and login process.

Fig. 3. Outlook of the registration window.

controls all other components based on commands received from the android application via bluetooth module. The step-by-step process is explained in Fig. 2.

B. Registration of the User

Registration of the user is only done via android application. The registration window is shown in Fig. 3. The android application needs to be installed in the smartphone of the user. The user then needs to select the Signup option after launching the application. The user then needs to fill-in the details asked i.e. Name of the user, Mobile Number of the user and password as per the user's choice needed to login. Entering these details, the user is then directed to the next window where an OTP is required to be entered which is in the SMS received by the user. The system then checks the OTP entered by the user to the OTP sent by the system. If both the OTPs are matched, the details filled by the user is then registered in the database.

Now, the user is asked to register fingerprint for which, the user is asked to place the finger on the fingerprint sensor attached to the system. After detecting a fingerprint, the system again asks the user to place the finger on the fingerprint sensor.

If both the fingerprints are matched, the fingerprint of the user is registered otherwise the user is asked to do this process of registering the fingerprint again.

C. Accessing the Lock

Only the registered user can access the lock using one of the following two ways:

1) Using the Fingerprint: The user can use the registered fingerprint on the lock to open it. The fingerprint sensor is active all the time. When a finger is placed on it, it takes a print of it and tries to match it with the fingerprints registered in the system. If any of them matches with the current fingerprint, the user is granted access and the lock is opened. An SMS is sent to the registered mobile number of the user informing that the lock is accessed by a user.

2) Using the Android Application: Another way to unlock the lock is via android application. The login window in the application is shown in Fig. 4. The user's smartphone is required to be connected via bluetooth to the bluetooth module. Then, the user is required to select the Login option which directs the user to the next window where the mobile number and password is asked to be entered. The system the matches the password entered to the password registered by the user. If it matches, the user is directed to a window shown in Fig. 5. and is granted access and the lock is opened. An SMS is sent to the registered mobile number of the user informing that the lock is accessed by a user.
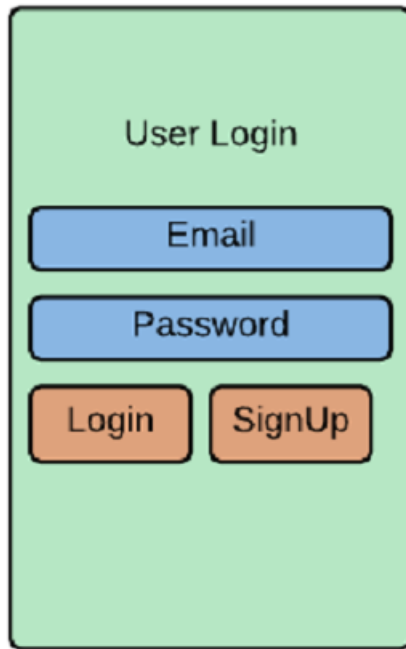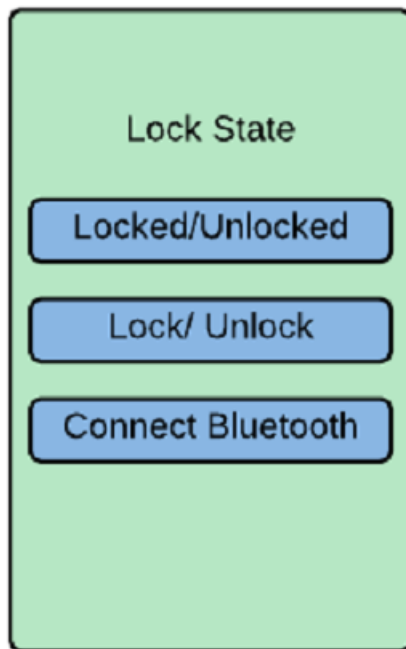
Fig. 4. Outlook of the login window.

Fig. 5. Outlook of the unlocking window.

The SMS sent to the user when the lock is opened by a user is just to inform the user and make aware that the lock is opened by some user.

III. APPLICATIONS AND USES

Due to the modularity of the components used in the system, This system is very easy and requires less time to install at many places depending upon its use. The components can be rearranged and/or replaced by similar components according to the requirement.

A. Bank Lockers

Bank Lockers are a place where this Digital Locking System is installed which will make them more secure, easy and convenient to use. The use of fingerprint to unlock it is a very fast and easy way to access it. But in case of non-availability of the customer at that place but needed to grant access to a trusted person, the function of remote unlocking can be used here. When the trusted person is at the lock, the registered user then unlocks the lock via android application. This saves time and money along with providing more convenience to the customer.

B. Scientific and High Security Laboratories

Scientific and High Security laboratories are places where security is a major concern. Each and every person accessing it should be recorded as any data can be stolen and misused. So, the verification of the person accessing it is a core thing to be taken care of. Also, the persons who were granted access need to visit one room to another where they are required to open the doors in a fast, easy and secure way. This is the place where the fingerprint unlocking function of the system is used in a convenient manner. Also, the remote unlocking function is required here as a trusted person maybe required to grant access in case of any emergency or in similar cases by a registered person.

C. Security Control Rooms

Security Control Rooms are a place where the security of a site is maintained controlling from security staff to CCTV cameras and fire and safety systems. Here no misconduct takes place is taken care of. For this, high security is needed as this what it works for it. Only the controllers are granted access to the systems and the doors of the rooms where in both places, this locking system can be used. Verification of the user is a thing this locking system possess along with remote access is a good sign of this system to be used in this place. Guards often require to grant access to the person they want to allow where remote access can be used in a very convenient manner.

D. Smart Luggages

As this system can be made compact as per the use and requirement of it, this system can be installed in smart luggages, purses, etc. where a miniature version of it is required to be installed. A smaller version of fingerprint sensor needs to be used here. Arduino Lilypad can be used here instead of Arduino Nano used in the model. This saves space and makes

the locking system more compact. Also, a smaller version of GSM Module can be used if remote access function is required. If the remote access function is not required, the GSM Module can be eliminated which creates more space and makes the system more compact. Also, the batteries used here will be substituted by small button cells. This way, whole system is reconstructed using smaller versions of the components.

E. Day-to-Day Applications

Other day-to-day applications include it's installation in doors of home or office entrances where the access is granted to a limited amount of people. Also, the remote unlocking is the best feature to be used here where the user needs to open the door and grant access to the trusted person. Other place where this system can be installed is at main gate of home or offices where fast and secure move of the people is required as there are many people accessing the same gate. This is the place where fingerprint unlocking is a better option than the remote unlocking but remote is also used in situations where it is needed. For eg., a family member or relative is required to grant access to it in case they are not registered. Doors of cupboards can be secured by using this system where the fingerprint unlocking is of more use than remote unlocking as remote unlocking is not frequently used as fingerprint unlocking.

IV. LIMITATIONS

Every system has its own limitations which needs to be taken care of and compromised by the user. Our system also have some as follows:

- As the android application is connected to the system via bluetooth, it has limited coverage and thus, the user needs to be in the area of coverage. User cannot control the system outside its coverage. This thing user needs to be taken care of.
- Constant power supply is needed to keep the system working. If due to any situation like battery failure or any electronic component failure. This needs to be taken care of as there is no other backup option available as of now to unlock it in such situations.
- Manual Unlocking using keys as a backup option is lacking in this system. Under any circumstances where fingerprint and remote unlocking option is not working, the lock cannot be unlocked which would result into disaster. Anyone cannot bear to break open the lock in such situations.
- As the fingerprint sensor used here is not so secure, any intruder may get access using some spoofing techniques, generating fake fingerprints and similar other attacking techniques[5].
- One may force the user to unlock the system using fingerprint or remote unlocking and get access which should be kept in mind by the user beforehand.

V. FURTHER IMPROVEMENTS

Due to the modularity of the components used in making this system, this system can be used in a large number of areas. Every area has its own particular requirement according to which the number of features of this system can be increased or decreased. This system has a good amount of features but also can be extended by adding some new features to give a better ease and use to the users. Some of them can be as follows:

- While using it as a door lock whether of home, office, high security laboratories, scientific laboratories, security control rooms, bank lockers and similar places, a database can be used to store the records of users as it can be observed as which particular user has accessed the lock at what date and at what particular time. These records can be used when any misplace of data or item occurs and one can have a track of people accessing it.
- We can also add a keypad along with the fingerprint module which will also add a function to be unlocked via a PIN. This will make our system more vulnerable to attacks leading to question the security. For it, a limited number of attempts or similar security techniques.
- We can also extend our connection from bluetooth to internet connection so that remote unlocking will not be distance bounded. User can control the lock from any corner of the world.
- A manual unlocking option using keys can be intervened in the current solenoid lock in case of emergency or other situations like power cut, battery failures, electronic component failures, injured finger, unavailability of mobile phone, etc.

VI. CONCLUSION

In this internship, we got to learn new things on how electronic components can be controlled using codes and applications. We faced many problems and errors and step-by-step solved each and every bit of it. This helped us improve our knowledge on how to implement theoretical features into a real-life working model. This thing fascinated us and motivated to work on the project in detail.

VII. ACKNOWLEDGEMENT

REFERENCES

[1] Sachin S. Malode, Dr. S.B. Patil, "Highly Secured Locker System Based On Biometric Identification," International Journal Of Pure and Applied Research In Engineering And Technology - Volume 04 Issue 09-2016.

[2] Ajinkya Kawale, "Fingerprint based locking system," International Journal of Scientific & Engineering Research - Volume 04 Issue 05-May 2013.

[3] Atar Nasrin, Awatade Vidya, Hegadkar Rani, and Bansude Vijaysinh, "Fingerprint Based Security System for Banks," International Research Journal of Engineering and Technology (IRJET) - Volume 03 Issue 04-Apr 2016.

[4] Sachin Sr. S. B. Patil, "Advanced Security System for Bank Lockers Using Biometric and GSM," International Research Journal of Engineering and Technology (IRJET) - Volume 04 Issue 12-Dec 2017.

[5] Mahesh Joshi, Bodhisatwa Mazumdar, and Somnath Dey, "Security Vulnerabilities Against Fingerprint Biometric System," 18 May 2018