Two Factor Authentication Based Locker System

Shraddha Kulkarni[1], Deepti Narke[2], Siddhesh Bolke[3,] Ashutosh Deshpande[4]

[1]*B. Tech Student, Dept. of Electronics and Telecommunication, KIT's College of Engineering, Kolhapur, India*
[2]*B. Tech Student, Dept. of Electronics and Telecommunication, KIT's College of Engineering, Kolhapur, India*
[3]*B. Tech Student, Dept. of Electronics, KIT's College of Engineering, Kolhapur, India*
[4]*B. Tech Student, Dept. of Electronics and Telecommunication, KIT's College of Engineering, Kolhapur, India*

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Abstract - *The main objective of this paper is to implement a locker system based on two-factor authentication that improves the safety and security of lockers. In this system only, the responsible person recovers the possessions from the lockers and the two independent authentications used, which are fingerprint biometric which acts as the basis of identification and one-time password sent over GSM network. The fingerprint identification can deliver a high level of security by not requiring the need of remember PINs, multiple password and no necessity of carrying keys and identify proof. The one-time password is required to be entered once the fingerprint is identified to access the locker. The program was developed with the use of Arduino and 8051 microcontroller board.*

*Key Words***:** Arduino, 8051 microcontroller, Fingerprint, GSM, OTP

1. INTRODUCTION

In today's world people are very concerned about their valuable possessions that they own which contains various expensive things like cash, jewellery and important documents etc. The lockers are the safest place to protect them. But in recent years, robberies have increased due to easy access and security errors. The two-factor authentication system is used in bank transactions and web-based login systems such as Gmail provides the two-factor authentication for their users, and also Facebook, Instagram that is evolving technology. The idea of two factor authentication system for Locker is enabled, to ensure the security and movability of the information of possessions. Therefore, two factor authentication system which includes OTP and Fingerprint identification will be a solution for above mentioned problem that can minimize the debility of existing traditional lockers. In terms of security, significant solutions can be implemented in this system.

2. LITERATURE SURVEY

It is a very low cost and efficient locker system. This system has two modules: GSM module and the Fingerprint module. As the heart of the system, the Arduino UNO microcontroller (At mega 328p) which is capable of functioning as an interface for all the hardware components. All communication and controls in this system pass through the microcontroller. The project is mainly focused on eliminating the unauthorized access. The fingerprint identification and one-time password authentication is implemented in this system. The accuracy of fingerprint scanner is depended on fingerprint sensor identification. More accuracy of fingerprint sensor will provide strong fingerprint authentication which cannot be forged. The one-time password is based on the method of random number generation.

This is the layout of the present theory and practices of the proposed system.

Comparison parameters	Advanced Locker system based on fingerprint technology	Proposed Locker System based on two factor Authentication
Type of authentication used	Password +Fingerprint	OTP (One-Time Password) +Phone + Fingerprint
One-Time Password	Fixed passwords with no expiration time need to be remembered always.	PIN is generated with time expiration and is randomly generated. The PIN is sent to user's phone via message
Microcontroller	P8V51RD2	Arduino (atmega328) + 8051 microcontroller
Fingerprint module	R303A scanner	R307 scanner
GSM Module	Not Applicable	SIM900 GSM module

2.1 PROBLEM DEFINITION

Lockers play an Integral part in everyone's life and it is considered the safest place to store possessions like jewellery, documents, important documents and certificates etc. The existing methods used for most of the houses are based on manual lock and PIN number/ fixed password

which are not very secure. The major disadvantage of such systems is lack of security because the key can be copied. This would result in thefts. The password, Personal Identification Number (PIN) or RFID (Radio-Frequency Identification) tags/cards are used for personal identification to access lockers. However, the smart cards can be lost or stolen, the password and PIN numbers can be forgotten or can be tried by someone else. These are the problems associated with the traditional lockers and thus lead to thefts. Taking safety as the most important consideration these locker systems should be provided utmost security yet in the simplest ways possible and this two-factor authentication system will make that happen.
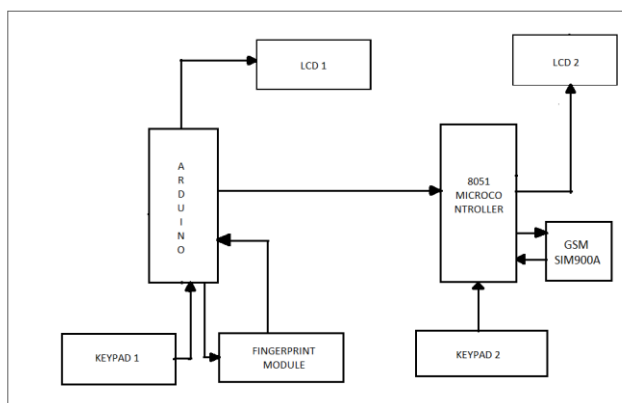
3. PROPOSED SYSTEM DESIGN

Figure -1: Proposed system architecture

In this proposed system the two-factor authentication technique is used which contains two controls i.e. Fingerprint biometric and one-time password. Firstly, the two microcontrollers are used i.e. Arduino and 8051 microcontroller. And two displays are used LCD1 and LCD2 respectively. And correspondingly two keypads are used keypad 1 and keypad 2. So firstly, the fingerprint module is configured as a programmer for Arduino. So, when the fingerprint is scanned the program starts to execute. This fingerprint is interfaced to the Arduino atmega 328. Keypad1 is used to change the Fingerprint according to our requirements i.e. we can edit, save or remove it from the system. So, when the fingerprint matches which is processed in the Arduino, the signal in the system becomes high i.e. 0 or 1. So when the signal is high the signal is processed in the 8051 microcontroller. After this, the 8051 microcontroller will communicate with the GSM module to send an OTP (One-time password).

3.1 HARDWARE AND SOFTWARE REQUIREMENTS

SOFTWARE

ARDUINO programming with the help of C coding language.

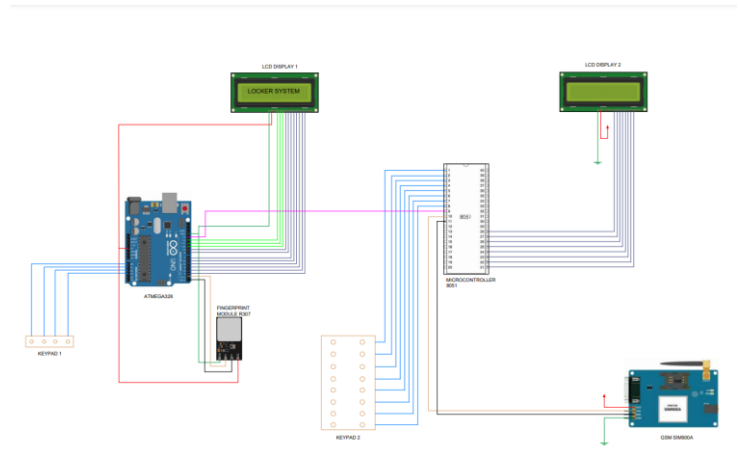Assembly language programming for 8051 microcontroller.

Figure -2: Circuit Diagram

HARDWARE:

AT mega 328P

The system uses ATmega 328P microcontroller as a master controller. A DC source is given to the Microcontroller ATmega 328P.This microcontroller will be interfaced to every **sensor** and control unit. All the sensors are connected to ATmega 328P All the sensors operate through this microcontroller and it is the Heart of this projects. ATmega328 is an 8-bit, 28-Pin AVR Microcontroller, manufactured by Microchip, follows RISC Architecture and has a flash-type program memory of 32KB. It has 8 Pins for ADC operations, which all combine to form PortA (PA0 – PA7). It also has 3 built-in Timers, two of them are 8 Bit timers while the third one is 16-Bit Timer. It operates ranging from 3.3V to 5.5V but normally we use 5V as a standard.
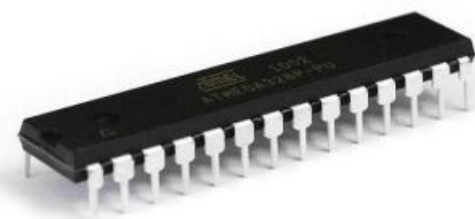
R307 FINGERPRINT SCANNER

This is the R307 Optical Fingerprint Reader Sensor Module. R307 fingerprint module is a fingerprint sensor with a TTL UART interface for direct connections to microcontroller UART or to PC through MAX232 / USB-Serial adapter. Good image processing capabilities can successfully capture an image up to resolution 500 dpi.

SIM900A GSM Module

The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications allowing you to benefit from small dimensions and cost-effective solutions. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption.

16x2 LCD Module Display Screen

16x2 Character LCD - Black on Green is 16 characters wide, 2 rows character LCD module. It utilizes industry-standard controller, works in 4/8- bit parallel interface. Display area is LED back-lit in yellow color. This alpha-numeric display can be easily interfaced with any host controller such as 8051 derivatives, PIC Series, AVR, ARM series of controllers or using development boards such as Arduino or Raspberry Pi. It fits in quite well for any electronic device design.


Lock style solenoid (12V)

A solenoid designed for bank locker door. It is made out of a big coil of copper wire with a metal in the middle. When the coil is heated, the slug is pulled into the middle of the coil. This lets the solenoid to pull from one end. When 9 - 12 VDC is applied, the door can be opened. The solenoid is used for bank locker door electronic access to open and close.

Keypad

A keypad is a set of buttons arranged in a block or "pad" which usually bear digits, symbols and usually a complete set of alphabetical letters.
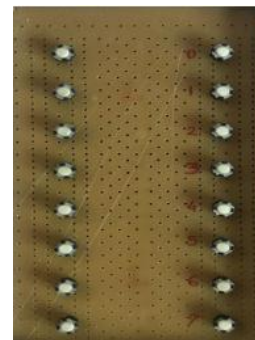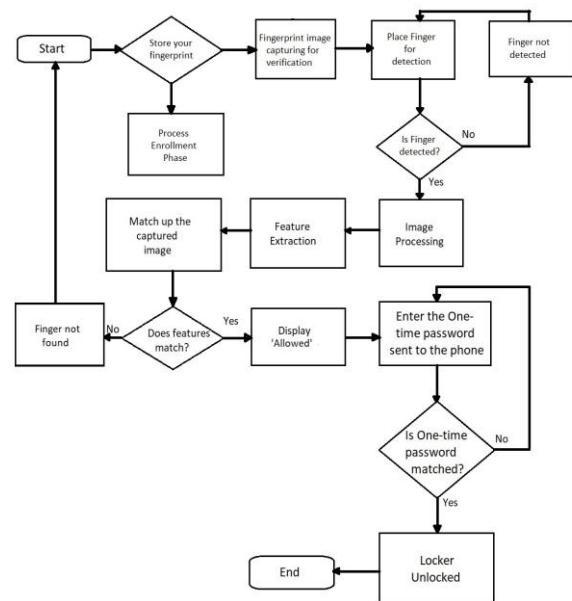

3.2 FLOWCHART OF THE SYSTEM

Figure 3: Flowchart

4. RESULTS AND ANALYSIS

Once the complete set up is completed, the system is tested. This system is expected to make sure that the product is actually solving the needs that are addressed nowadays. The main objected would be to get the expected output and removing all the bugs of the system. If the system works, this

would lead the locker system to provide utmost safety and service to the customers. The following photos are the result of final testing of our proposed locker system.
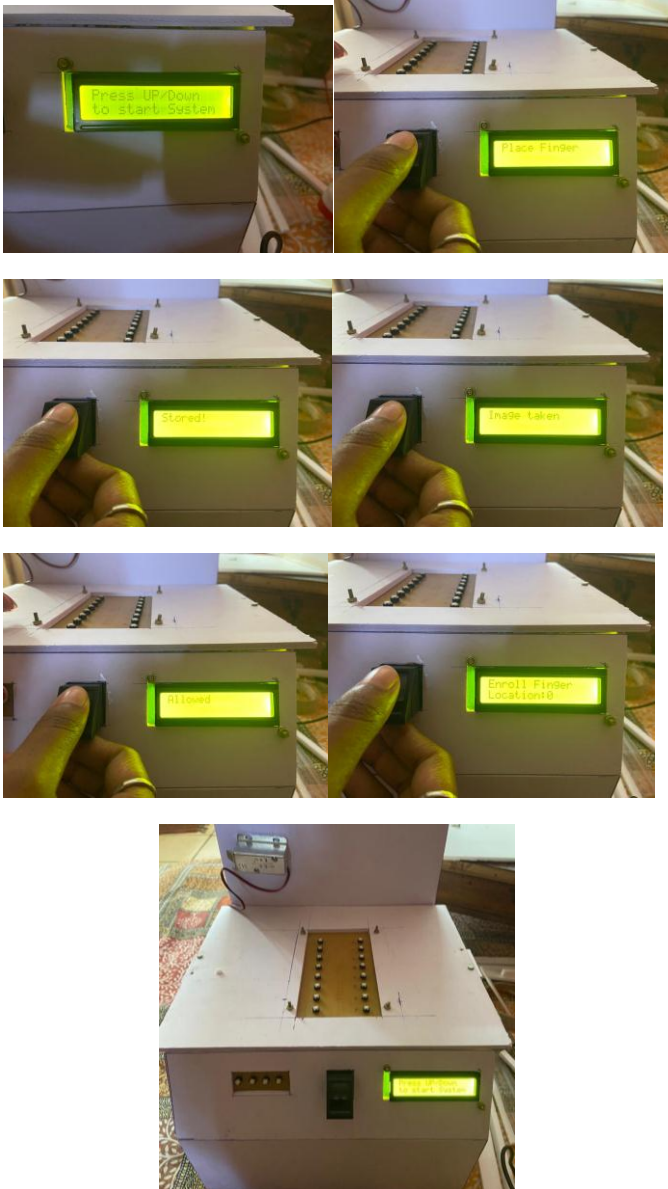
5. CONCLUSION AND FUTURE SCOPE

Nowadays with all the thefts and robberies around, one will always find highly secure ways to store their valuable things. This proposed system will definitely provide the same. This system promises high security because of its fingerprint control which is unique to every individual and provided great efficiency and portability. And the other authentication technique i.e. is the one-time password generation which is randomly generated along with time expiration cannot be traced by anyone. This also eliminates the need of carrying keys or remembering passwords.

Moreover, to adopt new technology as it comes, to provide more services additional tools can be added to this system. This will also enhance the scope of this system. The access details of Locker system can be merged with internet and the data can be uploaded to own cloud. A web server can be used and the hardware can be interfaced and controlled via website. Rather than fingerprint biometric authentication, the facial recognition can be used with "one-time password" generation. The face recognition is one of the popular biometric technologies these days and widely used in various systems or even phones. Additionally, voice recognition can also be used in case the people who are visually impaired can also access this system and for the people who do not know a specific language, multiple language facility can also be incorporated. 3D image scanner can also be used for scanning fingerprint to provide more accuracy.

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