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Design and Development of a Smart Locker Security System Using Biometric Authentication

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ABSTRACT: A biometric authentication-based smart locker security system is a system that uses biometric data, such as fingerprints, facial recognition to authenticate and grant access to lockers. This type of system is considered highly secure as it eliminates the need for traditional access methods such as keys or passwords, which can be lost, stolen or forgotten. With biometric authentication, only authorized persons whose biometric data matches the stored information can access the locker, making it more difficult for unauthorized access. This type of system can help banks enhance their security measures and provide more peace of mind to their customers. The main goal of this paper is to design and implement a security system based on fingerprints, face recognition and OTP (One Time Password).

KEYWORDS: Arduino microcontroller, Face recognition, Fingerprint & Bluetooth technology

I. INTRODUCTION

Theft is one of the major problem in today's world places like in offices and other public places should not be secured so that issues to make secure our documents and precious things so we have decided to make this type of security system that will be more usable to all the people. Bank lockers are the safest place to store them. Biometrics measures a person's unique physical characteristics to recognize or authenticate their identity. This technique is safe since we don't have to fear about ID card misplacement, stolen or password hacking. So we build a smart bank locker security system which includes face recognition and fingerprints.

II. LITERATURE SURVEY

Biometric authentication is becoming increasingly popular as a security measure for various applications, including bank lockers. In this literature survey, we will explore various research works on biometric authentication-based smart bank locker security systems.

In the paper [1], the authors N. Anusha et al designed a framework of Locker system. The locker system was installed with face recognition and OTP service as security purpose. Eigen face detection methods are used to detect the human face. The technique of face recognition phase is performed accurately, and then OTP was generated and send to the owner by means of SMS. The proposed system was more secured compared to the previous techniques where the user was only able to access the locker either using OTP or locker password or by both. This method can also be used as the home passage security framework with sensors and actuators.

In the paper [2], the authors Prashik Bagde et al introduced a biometric based locker which provides high degree of security. Any authorized user will unable to access the locker. They used fingerprint as the verification system as duplication of fingerprint is like unable. The system is cheap and easy to use. This system can be mounted anywhere, where you need high degree of security the low cost is very important factor. This locker system is very reliable and safe.

In the paper [3], the authors Akash Thomaset et al proposed on fingerprint-based lockers that offer a high level of security. No unauthorized user can access the locker. The system is cheap and easy to use. This system can be installed

wherever a high level of security is required. These locker systems are very reliable and secure. In addition, the Bluetooth module and the vibration sensor provide improved protection.

In the paper [4], the authors P. Pavani Prapurna et al proposed a first-rate function in maintaining the safety of the respective valuables, financial institutions being the utmost priority. The proposed device is reliable, inexpensive with a suitable layout. This undertaking High Protection Voice Identification based Bank Locker Security System with Live Image Authentication ensures to promote encouraging and improvised results, improving the safety and sacredness over the presently present technologies.

In the paper [5], the authors Subhash H.Jadhav et al proposed a smart bank locker security system using RFID, Fingerprint, password and GSM technology. Money, jewellery and any other important documents of an every citizen we can make at safe custody. Using this smart technology an authorized person can only open the lock   and collect the money, jewellery and any other important documents. This is low cost equipment, low in power consumption, compact in size, wide operating range, highly secured and reliable stand-alone unique system.
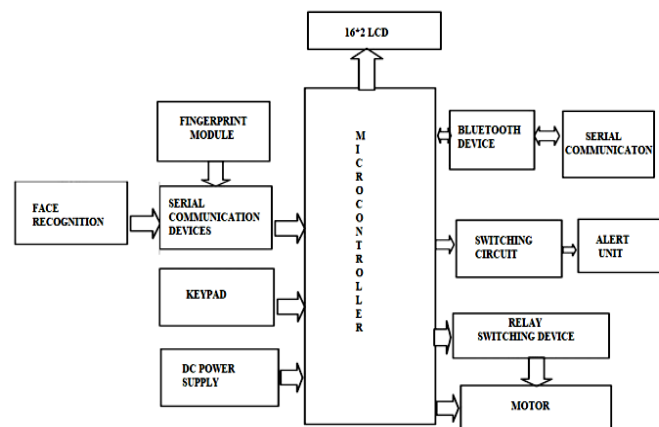
III. METHODOLOGY

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Fig.1 Block diagram of proposed system

In this paper we used the Bluetooth module to show the message of the One Time Password (OTP) and an Arduino controller. First we can connect the Bluetooth terminal using the HC 05, we can get the OTP number. Then we can apply the OTP number in the LCD display using the keypad switch. RS232 helps to send the number to controller. The controller picks the number. After that we can apply our fingerprint using SM630 fingerprint module. The locker closet is appended with camera which will capture the people confront face. The captured image will be checked with the available records in the database. The controller senses the signal and gives the signal to the relay switching device. The relay helps to open the locker using DC motor with the operation of ULN driver due to the action of serial communication device. If the number of the OTP is wrong, we can apply the fingerprint, but controller gives the signal to the alert unit with the help of circuit switching and the buzzer gives the signal to the security system which we protect the locker from the theft processing system. RS232 is a serial communication device used for connecting mobile Bluetooth & the peripheral devices of the circuit. In this paper, LCD is used to display the OTP number and the instruction command.

FINGERPRINT MODULE

Fig.2 Fingerprint module

Fingerprinting is the process of collecting, recording, and analyzing an individual's unique pattern of ridges and furrows on the tips of their fingers. This process is used for identification and verification purposes in various fields such as law enforcement, border control, and biometric security systems.

WEBCAM

Fig.3 Webcam module

A webcam is used to capture individual faces for providing Locker. A 720p/30fps camera or above is required for better accuracy. A webcam is a video camera which is designed to record or stream to a computer or computer network. They are primarily used in video telephony, live streaming and social media, and security.

SERIAL COMMUNICATION

In telecommunication, the process of sending data sequentially over a computer bus is called as serial communication, which means the data will be transmitted bit by bit. While in parallel communication the data is transmitted in a byte (8 bit) or character on several data lines or buses at a time. Serial communication is slower than parallel communication but used for long data transmission due to lower cost and practical reasons.

BLUETOOTH

Bluetooth is a wireless technology standard for exchanging data over short distances (using short wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). Invented by telecom vendor Ericsson in 1994, it was originally conceived as a wireless alternative to RS-232 data cables.

HC-05 - Bluetooth Module

Fig.4 Bluetooth module

The HC-05 has two operating modes other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed. We can operate the device in either of these two modes by, one is the Data mode in which it can send and receive data from using the key pin as explained in the pin description. It is very easy to pair the HC-05 module with microcontrollers because it operates using the Serial Port Protocol (SPP). Simply power the module with +5V and connect the Rx pin of the module to the Tx of MCU and Tx pin of module to Rx of MCU as shown in the figure below. During power up the key pin can be grounded to enter into Command mode, if left free it will by default the data mode. As soon as the module is powered you should be able to discover the Bluetooth device as HC-05 then connect with it using the default password 1234 and start communicating with it. The name password and other default parameters can be changed.
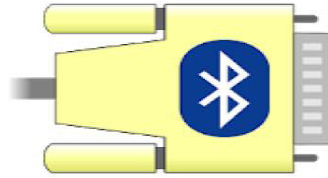
Serial Bluetooth App

Fig.5 Serial Bluetooth App

One kind of App that gives you compatibility with all microcontrollers. All you need is a HC-05 serial adapter connection with serial ports of the controllers. Control any Microcontroller that uses a Bluetooth Module HC 05 App through our smart phone.

ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs that may be communicated to various shields and further circuits. The command given by the user is transmitted to Arduino Uno via the Bluetooth module. Arduino Uno will read and execute the command and send the digital values to the motor driver device.
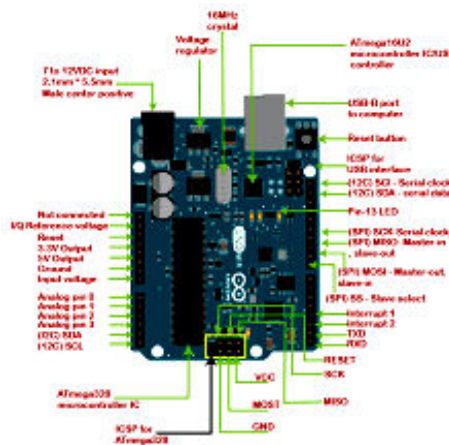

Fig.6 Arduino Uno Board

KEYPAD

Keypads are "pads" of individual keys that are used to support input commands. Some of them only contain numbers, whereas other keypads contain numbers, letters and special characters. Regardless, all keypads contain keys. Each key has a letter, number or special character printed onto it.
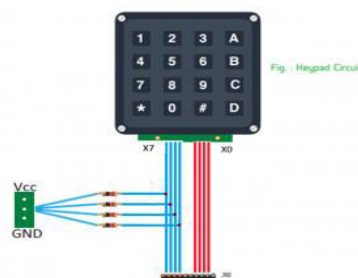

Fig.7 Keypad

LIQUID CRYSTAL DISPLAY (LCD)

Fig.8 LCD Board

Advances in the features, miniaturization, and cost of LCD (Liquid Crystal Display) controller chips have made LCDs usable not only in commercial products but also in hobbyist projects. By themselves, Liquid Crystal Displays can be difficult to drive because they require multiplexing, AC drive waveforms, and special voltages. LCD modules make this driving simpler by attaching hardware to the raw glass LCD to assist in some or all of these rudimentary driving tasks.
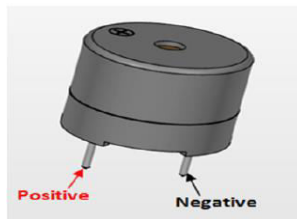
BUZZER

Fig.9 Buzzer

This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF at required time and require interval.

DC MOTOR

Fig.10 DC Motor

The electric motor operated by direct current is called DC electric motor. It converts dc electrical energy into mechanical energy
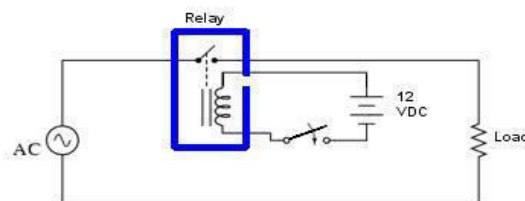
RELAY

Fig.11 Relay circuit

The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. The high end applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors
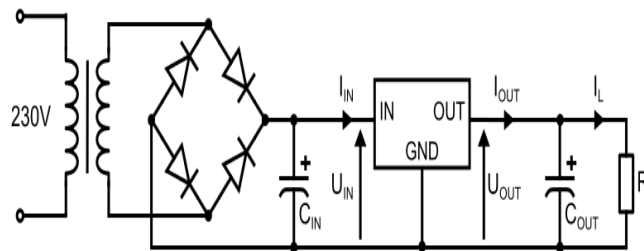
REGULATED POWER SUPPLY

Fig.12 Power supply circuit

Today almost every electronic device needs a DC supply for its smooth operation and they need to be operated within certain power supply limits. This required DC voltage or DC supply is derived from single phase AC mains. A regulated power supply can convert unregulated an AC (alternating current or voltage) to a constant DC (direct current or voltage). A regulated power supply is used to ensure that the output remains constant even if the input changes. A regulated DC power supply is also called as a linear power supply; it is an embedded circuit and consists of various blocks. The regulated power supply will accept an AC input and give a constant DC output. Fig.12 shows the block diagram of a typical regulated DC power supply.
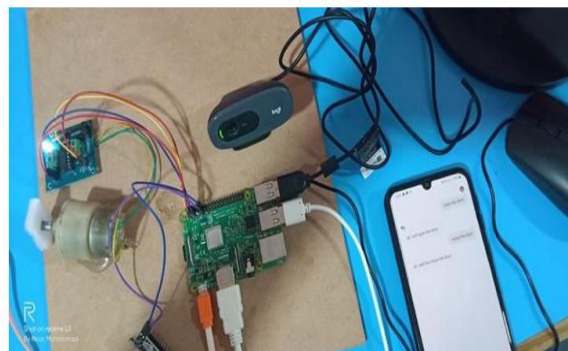
IV. RESULTS AND DISCUSSION

HAEDWARE

Fig.13 Hardware module

The use of biometric authentication in bank lockers has shown promising results in enhancing security. The use of facial recognition technology can be particularly helpful in identifying the person accessing the locker. Facial recognition technology uses a camera to capture an image of the face, which is then analyzed using algorithms to match it against a pre-existing database. This process ensures that only authorized personnel can access the locker.

Fingerprint authentication is another popular biometric authentication technology used in bank lockers. It involves the use of a fingerprint scanner, which captures an image of the person's fingerprint and compares it to a pre-existing database. Fingerprint authentication provides a high level of security since each individual's fingerprint is unique.

The addition of an OTP as an additional security layer provides an extra level of protection against unauthorized access. An OTP is a unique code generated by a server and sent to the user's phone, which they must input to gain access. The OTP ensures that only the authorized user can access the locker.

Finally, the use of biometric authentication-based smart bank locker security systems, including face recognition and

fingerprint, with an additional layer of security, such as OTP, has shown promising results in enhancing security. These systems offer a higher level of security than traditional bank lockers, making them more suitable for storing valuable items. However, the technology is not without its flaws, and it is essential to keep updating the security measures to ensure that unauthorized Technology", access is prevented.

V. CONCLUSION

The main goal of this paper is to design and implement a bank locker security system based on Finger print. This can be organized in bank, offices and homes. In this system only the authenticate person recover the documents or money from the lockers. In this paper we had used the Bluetooth module to show the message of the One Time Password (OTP) and an Arduino controller. First we can connect the Bluetooth terminal using the HC 05 App to get the OTP number. Then we can apply the OTP number in the LCD display using the keypad switch. RS232 helps to send the number to controller. The controller picks the number. After that we can apply our fingerprint using SM630 fingerprint module. The locker closet is appended with the relay helps to open the locker using DC motor with the operation of ULN driver due to the action of serial communication device. If the number of the OTP is wrong, we can apply the fingerprint, but controller gives the signal to the alert unit with the help of circuit switching and the buzzer gives the signal to the security system which we protect the locker from the theft processing system. RS232 is a serial communication device. It is used for connecting mobile Bluetooth & the peripheral devices of the circuit. In this project LCD is used to display the OTP number and the instruction command. A webcam which will capture the people confront face. The captured image will be checked with the available records in the database. The controller senses the signal and gives the signal to the relay switching device.

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