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IoT Based Smart Bank Locker Security System Using Two-Way Authentication

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***Abstract*—** An IoT based smart bank locker security system using two-way authentication is a technology-driven solution for enhancing the security of bank lockers. This system involves the integration of IoT sensors, microcontrollers, and other hardware components to create a smart locker security system. The system uses two-factor authentication methods, such as face recognition, fingerprint scanners, combined with a password or PIN, to provide enhanced security. The software design manages the entire system, including the authentication process, communication with IoT sensors, and data encryption to prevent unauthorized access. The system also sends alerts via email or SMS in case of any security breaches. This solution provides a secure and efficient way for authorized users to access bank lockers while preventing unauthorized access, thus ensuring the safety of valuable items stored in the bank lockers.

Keywords*—Iot, Bank Locker Security System, Face Recognition, Fingerprint Scanner, Sensors, Aurdino Uno.*

I. INTRODUCTION

In today's industrialised society, the Security System is essential. Anyone with valuable possessions is required to be protected for at least a longer period of time. Our project focuses mostly on designing to reduce the risk of vulnerabilities to priceless assets or items. In this advanced world, the user must first provide the correct security code using face recognition, followed by a fingerprint, in order to enter the locker. When the microcontroller has read the code, it alerts the user and sends a signal to unlock the door.The bank offers us a variety of We utilise bank lockers for security and safety since the security of cash and other papers is crucial. These days, there is a greater need for this because security worries are growing. To detect movements in front of the camera, a PIR sensor is employed. The image is captured using a camera module. This approach has been around for a while and is the fastest and most accurate real-time object detection model. Images are frequently provided and examined using models of preserved data bases. The cloud module is used to distinguish between the saved authorities after the image has been captured in real time. Data is kept in the cloud in order to distinguish between a number of photos.

IoT, is a network of interconnected physical devices, vehicles, home appliances, and other objects that are embedded with sensors, software, and other technologies to collect and exchange data. The IoT allows for the seamless transfer of data between devices, enabling the automation of various tasks and improving efficiency in several industries. The devices in an IoT network collect and exchange data through various communication protocols, such as Wi-Fi, Bluetooth, NFC, and cellular networks. As such, IoT security measures, such as data encryption, secure communication protocols, and access control, must be implemented to ensure the safe and secure use of this technology. Access control, intrusion detection, and incident response are just a few of the security-related duties that may be automated thanks to the usage of IoT in security systems, which can increase the effectiveness of security operations. IoT devices may also gather and analyse a lot of data, which helps security professionals gain knowledge and make wise choices. Access control, intrusion detection, and incident response are just a few of the security-related duties that may be automated thanks to the usage of IoT in security systems, which can increase the effectiveness of security operations. IoT devices may also gather and analyse a lot of data, which helps security professionals gain knowledge and make wise choices.

Face recognition and fingerprint scanners are biometric authentication methods that can be used in bank locker security systems. Biometric authentication is a highly secure method of verifying the identity of an individual based on their unique physical characteristics.Face recognition technology uses algorithms to identify an individual by analysing their facial features, such as the distance between the eyes, nose, and mouth. The technology compares the facial features of an individual to a stored image or a database of images to verify their identity. Face recognition technology is becoming more advanced and accurate, and it can be used in bank locker security systems to provide highly secure access control. Fingerprint scanners are another popular biometric authentication method that is widely used in various security systems, including bank lockers. Fingerprint scanners use the unique patterns and ridges on a person's fingertip to identify and verify their identity. Fingerprint scanners can be integrated into bank locker security systems, and they are highly accurate and reliable. Both face recognition and fingerprint scanners provide highly secure access control for bank lockers, and they are difficult to fake or duplicate. These technologies eliminate the need for traditional authentication methods, such as keys, passwords, or PINs, which are vulnerable to security breaches. Face recognition and fingerprint scanners are also user-friendly and convenient, as they do not require individuals to carry additional items or remember passwords. Overall, the use of biometric authentication methods in bank locker security systems provides enhanced security and convenience.

II. RELATED WORKS

In paper [1] is to implement a approach for the safe engine opening the system. This essay's major focus concentrated on implementing smart a security mechanism to prevent theft. To begin with, if we wish to open the car door as well as to start the car. User must provide his In order to do that, they need your fingerprint. utilised R305 fingerprint sensor for module aids in fingerprint scanning as already mentioned. The TTL to serial converter connected to the fingerprint reader. They likewise utilised a Raspberry Pi 3b+ model Ethernet, Bluetooth, wireless LAN, and crime Secure digital, scene

analysis Multimedia in high definition, the interface interface as well as the Sim's GSM module to send the SMS using the SIM 900A GSM mobile phone network. As soon as the user gets into the car, the Raspberry Pi camera starts taking pictures. In general, they have suggested this way to enhance the security system for car engines. This proposed methodology would assist users in preventing their automobiles from being stolen because it may be used to safeguard their vehicles. New advancements are made every day. Therefore, utilising the R305 fingerprint module, the user must first scan his finger to enter any vehicle door. When the authorised person's fingerprint matches one stored on the Raspberry Pi that it has received in the form of a digital signal, it compares the test fingerprint that will be scanned with that data.

In paper [2] was to construct a Creating a gadget that will perform the function of face detection is part of the security system for bank lockers that allows the authority person to handle the locker.an individual and compares it with the database. The manager will receive informed if there is a mismatch. They used a programme called Net-beans, a Java IDE, to access the PIR and IR Sensors, which detect any obstructions in the line of sight and signal the detection of the obstacle by blinking an LED. They also used the Arduino IDE to create Android applications in case there was a fire in the bank. . If so, the smoke sensor will detect it and send a message or notification to the mobile app. With the help of this technology, banks can guarantee the safety of their clients' lockers.

Paper [3] They have outlined an approach for using the image comparing technology in this publication. The major noteworthy feature of this technology is that it saves the real-time data of the accesses, which may include the time at which a user wants to access, the date on which a user has attempted to unlock the door, and the quantity of times a user has accessed a bank locker. Because most banking institutions haven't adopted cutting-edge technology, theft may result. So they created this process with improved security in mind. As a result, whenever a user attempts to enter his locker, his face will first be taken using an image processing approach, and it will then be processed.

So they created this process with improved security in mind. As a result, When a user goes to access his locker, the face is first recorded using an image processing technology, delivered to the PC where the picture has been saved, and then compared using installed Met Lab software. The door will be open if the test image matches the saved image; else, the door will remain closed and the alarm will buzz. The following parts were utilised in this project: MICROCONTROLLER ATMEGA32, which was used for communication purposes as well as to power additional hardware sensors. The second one will be a fingerprint scanner that uses an NITGEN optical sensor to compare a test fingerprint to one that has already been stored. This will be followed by an LCD interface for display and a serial interface for communication. They are able to assess the data image and fingerprint by employing image processing technique and fingerprint authentication hardware. They were also able to restrict access; for instance, when the limit is reached, the alarm will automatically buzz to inform of a theft. Due to this methodology, the bank's locker system is automated.

In paper [4],A solution that employs IoT technology to assure bank locker safety is proposed. The system operates in a step-by-step fashion; initially, the user must boot up and make an appeal for request; following receipt of an email with an OTP, the user will be allowed to unlock his or her locker. The system includes a facial recognition sensor that assists in identifying the user's face and carrying out subsequent steps. The system is unlocked using the OTP given via email after the image sensor first detects the face of the user. The system will not send the user an OTP through email if it identifies more than one face. Additionally, a more precise temperature sensor is used in the system. The iot face recognition method a crucial and central position in the system.This paper made the argument that a smart locker is superior to a regular key because it can be unlocked without a key. This is thought to be the most trustworthy approach to guarantee the protection of our possessions.

In paper [5], they concentrated on upholding security by spotting movement and recognising unwelcome faces in front of the camera. When a person moves in front of the camera, a photo is automatically taken and stored in this system. The picture is then utilised as a reference in the future. Cloud technology will be used to transmit the image to remote territory control rooms. The highly guarded bank locker room area is the subject of this project. Cloud technology will be used to transmit the image to control rooms in distant territories. The highly guarded bank locker room area is the subject of this project. Any unauthorised person or obvious exerciser in front of the camera is photographed three times; if the same image is taken more than three times, the authorised person is notified that a theft has occurred. In this approach, lockers can be accessed or unlocked if the image that was captured matches the image that was previously stored. The main person will receive an alert message if the image is not one that has been approved.

In paper[6], The design is built on preventing theft by protecting precious items. For locking and opening the locker and to verify for matches and mismatches in the system-stored data, this design uses digital locks and biometric locks. Anytime there is movement close to the sensors, the controller will notice it and make a beeping sound. The protective mechanism is created active around-the-clock, regardless of day or night, to make this usability advanced and safe. The job of bank officers will be decreased as a result of using this system, and it is made available to work both during the day and at night, on working and nonworking days. The bank locker area is secured with sensors placed next to the lockers, which will alert the bank to any movement in the vicinity of the locker. As a result, the locker will be significantly and properly guarded.

In paper [7], A comprehensive facial recognition system has been developed, and since it is simple to construct, cost-efficient, and successful, anyone may use it. Getting an alert message or information when the person visits home is the key goal. It can be provided in sectors including manufacturing, offices, and air storage. If a match is made, a notification regarding the visitor's identity, timing, etc. is sent to the property owner, who is then asked whether or not to allow guests. If there is a mismatch, a new visitor's image is automatically saved to the new bank so that it may be recognised if the same visitor shows up again. The purpose of this project is to use IoT to provide the owner with information about visitors, whether they are new or returning. The system can be used in a variety of settings, including homes, workplaces, businesses, and airports.

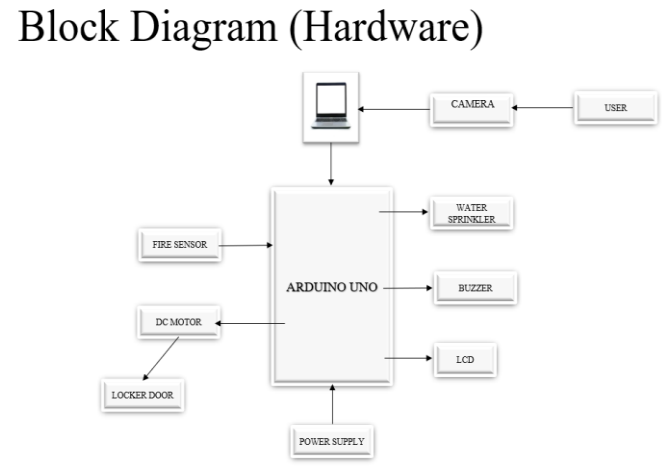
In paper [8],The system's main goal is to improve security for existing locker systems at reasonable costs so that everyone

can have access to inexpensive security. With the use of sensors, actuators, and a combination of technologies like face recognition and OTP services, a well-designed plan is formed to design the framework using IOT. Artificial intelligence is needed since the hardware system is interconnected with sensors and embedded systems. The input image is taken first. The computation Viola-Jones, which is already connected to the image present in the databases, is used to match the facial features. Later, using the Gabor filter bank, GLCM (Grey Level Co-Occurrence Matrix), and HOG (Histogram of Oriented Gradients), the features of the faceare retrieved. When using the Gabor filter bank, an OTP is generated and given to the owner through SMS. The frequency and orientation representations of the Gabor filters used in this technique are almost identical to those of the human visual system.

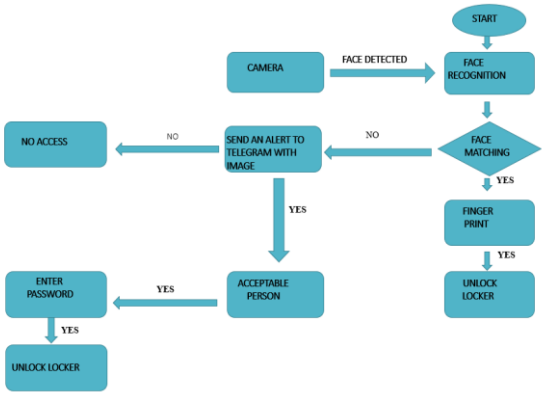
III. PROPOSEDWORK

The methodology of this System is simple.

- The proposed face recognition system overcomes certain limitations of the existing system.
- It is based on extracting the dominating features of a set of human faces stored in the database and performing mathematical operations on the values corresponding to them.
- Hence when a new image is fed into the system for recognition the main features are extracted and computed to find the distance between the input image and the stored images. Thus, some variations in the new face image to be recognized can be tolerated.
- When the new image of a person differs from the images of that person stored in the database, the system will be able to recognize the new face and sends alert notification to the main person.
- Haar classifier is used which is a machine learning object detection algorithm. So when the image is fed into the system it selects the features in three types:- Edge, Line and Rectangular
- The second way of authentication implemented is fingerprint technology
- Fingerprints remain constant throughout life. In over 140 years of fingerprint comparison worldwide, no two fingerprints ever been found to be alike, not even those of identical twins.
- Good fingerprint scanners are install in PDAs like the I-PAQ Pocket PC; so scanner technology is also easy. Might not work in industrial applications since it requires clean hands.
- Fingerprint identification involves comparing the pattern of ridges and furrows on the fingertips, as well as the minute points (ridge characteristics that occur when a ridge splits into two, or ends) of a specimen print with a database of prints on file.



Block diagram for the bank locker security system



Flow chart for the bank locker system system

A. Hardware Components

1. ARDUINO UNO

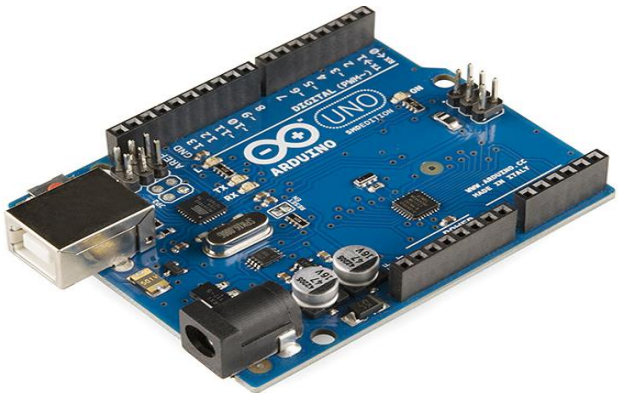


Fig 3.1.1. ARDUINO UNO

The Arduino Uno is a popular microcontroller board that is widely used in the maker community and for prototyping projects. It is based on the ATmega328P microcontroller chip and has a variety of built-in features that make it easy to interface with electronic components.The Arduino Uno has an integrated USB connector that makes it simple to connect to a computer and use the Arduino IDE to program the board.The Arduino Uno is a flexible and user-friendly microcontroller board that is great for learning about electronics and programming as well as developing projects.

2. LCD

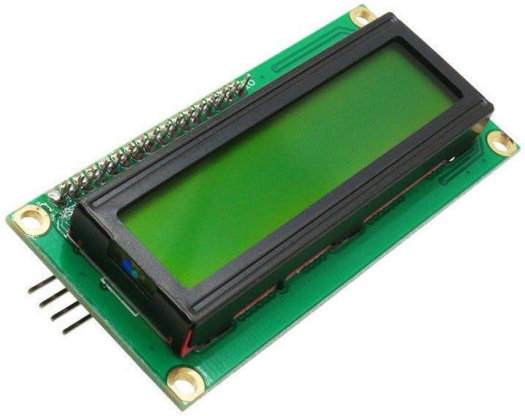


Fig 3.1.2 LCD

Liquid Crystal Display is referred to as LCD. Electronics like calculators, digital clocks, smartphones, televisions, and computer monitors frequently employ LCDs.As a display for microcontrollers and other embedded systems, LCDs are frequently used. The Arduino Uno is one of many microcontroller boards that includes built-in support for operating LCD panels.Due to its low power consumption, good dependability, and affordability, LCDs are still frequently utilised.

3. BUZZER

Fig 3.1.3.BUZZER

A buzzer is an electronic device that produces a continuous or intermittent sound. It is often used as an audible alarm or warning signal in various applications. Buzzer devices are widely used in different types of electronic equipment such as clocks, timers, alarms, doorbells, and games.

4. FIRE SENSOR

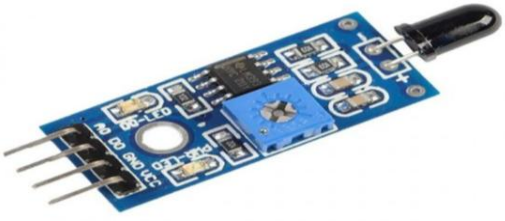


FIG 3.1.4 FIRE SENSOR

A fire sensor, also known as a smoke detector, is an electronic device that detects the presence of smoke or fire and triggers an alarm to alert occupants of the building. Fire sensors are an essential component of fire protection systems in residential, commercial, and industrial buildings.

5. SMOKE SENSOR

FIG 3.1.5 SMOKE SENSOR

A smoke sensor, also known as a smoke detector or smoke alarm, is an electronic device that detects the presence of smoke in the air and triggers an alarm to alert occupants of the building. Smoke sensors are a crucial component of fire protection systems in residential, commercial, and industrial buildings.Smoke sensors use different detection technologies to detect the presence of smoke.

4. FINGERPRINT SCANNER

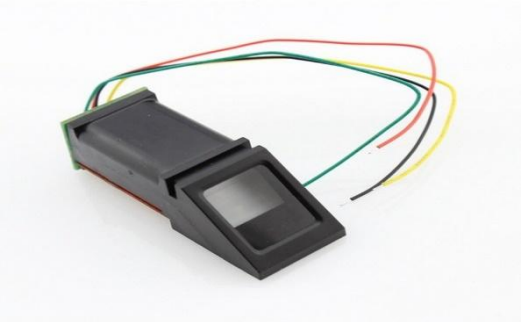


FIG 3.1.6 FINGERPRINT SCANNER

A fingerprint scanner, also known as a biometric scanner, is a type of electronic device that is used to capture and authenticate an individual's unique fingerprint. It is a security system that uses biometric technology to identify and verify the identity of an individual based on their fingerprint pattern.Fingerprintscanners use sensors that capture a high-resolution image of the ridges and valleys on a person's fingertip. fingerprint scanners provide a high level of security and convenience in a wide range of applications, from access control to mobile device security.

IV. RESULT ANALYSIS

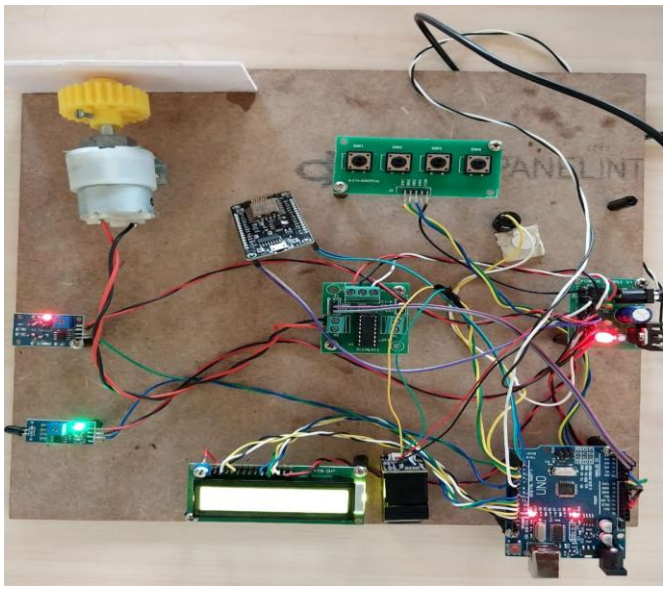


FIG 4.1 MODEL FOR BANK LOCKER SECURITY SYSTEM

Inventions of bank locker security system. IOT is used to develop this model. This model gives high security to the lockers and also used for theft protection .

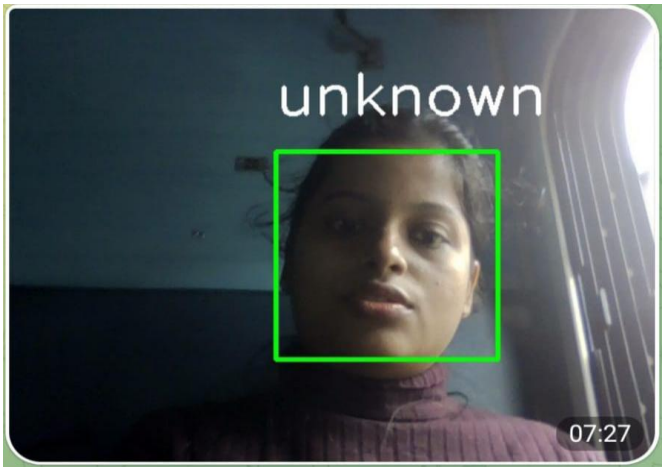


FIG 4.2 FACE DETECTION

If any unauthorised person trying to access the locker first it will compare the captured image with the stored image in the database.When captured image is not matches with the stored imagesystem will able to recognize it and shows as unknown person.

FIG 4.3 FINGERPRINT DETECTION

When authorised person face is detected next step is to the fingerprint authentication. Fingerprint identification involves comparing the pattern of ridges and furrows on the fingertips. After the fingerprint scanner locker will open.

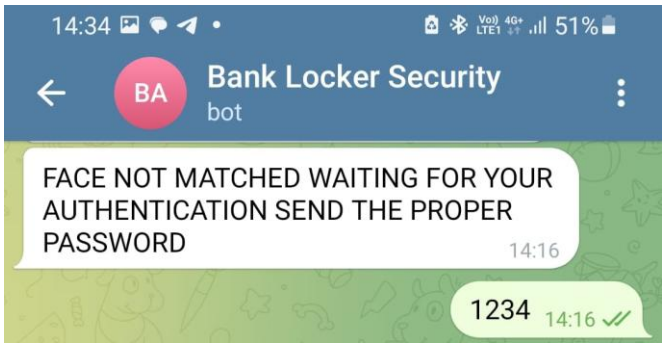


FIG 4.4 TELEGRAM NOTIFICATION

When face is not matched with the database system will recognize and sends the alert notification to the telegram for the proper password. If the person is a acceptable person then the password is entered by the person after that locker will open.

CONCLUSION

A thorough overview of the several strategies that have been developed for detecting theft was provided by the literature review on the bank locker security system utilising image processing. Ingeneral, IoT and image processing approaches can be successful at finding bank theft. A cutting-edge and useful security feature has been suggested. This suggested device has a really good layout, is reasonably priced, and is both. People who are blind can use this technology since the iris is unharmed. The iris security system has a backup in the effective use of Open cv.

The two-way authentication method used in this system involves two-factor authentication, such as face recognition or fingerprint scanners, combined with a password or PIN. This ensures that only authorized users can access the locker. The face recognition or fingerprint scanner identifies the user, and the password or PIN verifies their identity.The IoT sensors integrated into the system provide real-time monitoring of the locker, detecting any unusual activity.The IoT-based smart bank locker security system using two-way authentication is highly secure and provides a convenient and efficient solution for managing bank lockers. It eliminates the need for traditional authentication methods that are vulnerable to security breaches and provides real-time monitoring and alerts, enabling quick response to any security breaches.

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