

## **TITLE JUSTIFICATION:**

The term "multi-layered security" refers to the implementation of multiple security measures that work together to provide enhanced protection. In the context of bank lockers, relying on a single security measure can leave vulnerabilities. By combining various security techniques, such as biometrics (fingerprint, voice, face recognition), you create multiple barriers that unauthorized individuals would need to overcome to gain access. This layered approach significantly reduces the chances of breaches.

The integration of IoT technology further elevates the security system's effectiveness. IoT involves connecting devices and sensors to the internet, allowing them to communicate, share data, and perform actions remotely. In the context of bank lockers, IoT can provide real-time monitoring and control. For instance, using IoT you can detect any suspicious activities. This real-time monitoring enables immediate response to any unusual events or security breaches.

## **Scope of the project:**

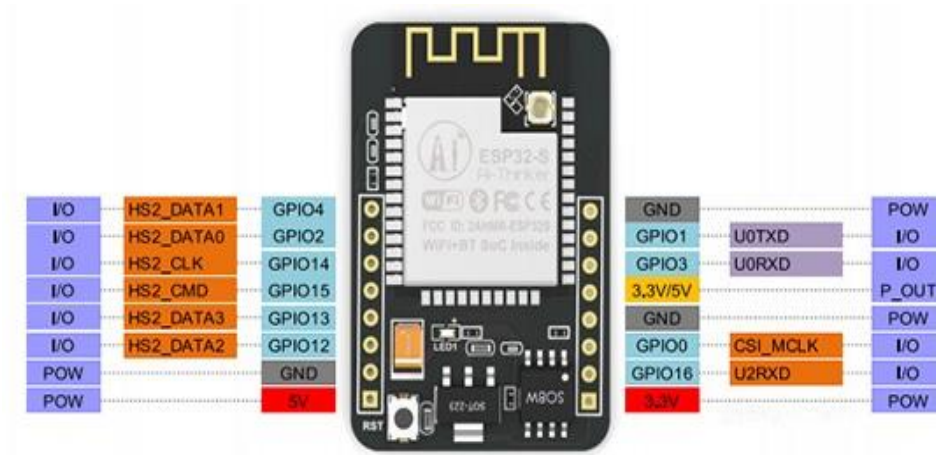
1. Enhanced security measures : The project involves implementing multiple layers of security measures, These measures collectively enhance the security of the bank lockers.
2. Real Time Monitoring and Alerts: The IoT integration allows for real-time monitoring of locker activities. Sensors and cameras can detect any unauthorized access attempts, tampering, or suspicious activities.
3. Remote Management: This project enables remote management of the security system. Administrators can access the system interface from any location and monitor locker activities.
4. Integration with existing infrastructure: The project's scope includes integrating the proposed security system with the existing bank infrastructure, including locker management software and backend systems. This integration ensures a cohesive and efficient security solution.

## **HARDWARE COMPONENTS:**

### **For face recognition**

## ESP32 CAM:(Espressif Systems)

ESP32 is camera module based on ESP32 chip. Besides the OV2640 camera, and several GPIOs to connect peripherals, it also features a microSD card slot that can be useful to store images taken with the camera or to store files to serve to clients. The [ESP32-CAM](#) doesn't come with a USB connector, so you need an [FTDI programmer](#) to upload code through the U0R and U0T pins (serial pins).



There are three GND Pins and two pins for power: either 3.3V OR 5V

GPIO1 are GPIO3 the serial pins. You need these pins to upload code to your board. Additionally, GPIO 0 also plays an important role, since it determines whether the ESP32 is in flashing mode or not. When GPIO 0 is connected to, theGND ESP32 is in flashing mode.

The following pins are internally connected to the microSD card reader:

- GPIO 14: CLK
- GPIO 15: CMD
- GPIO 2: Data 0
- GPIO 4: Data 1 (also connected to the on-board LED)
- GPIO 12: Data 2
- GPIO 13: Data 3

Working:

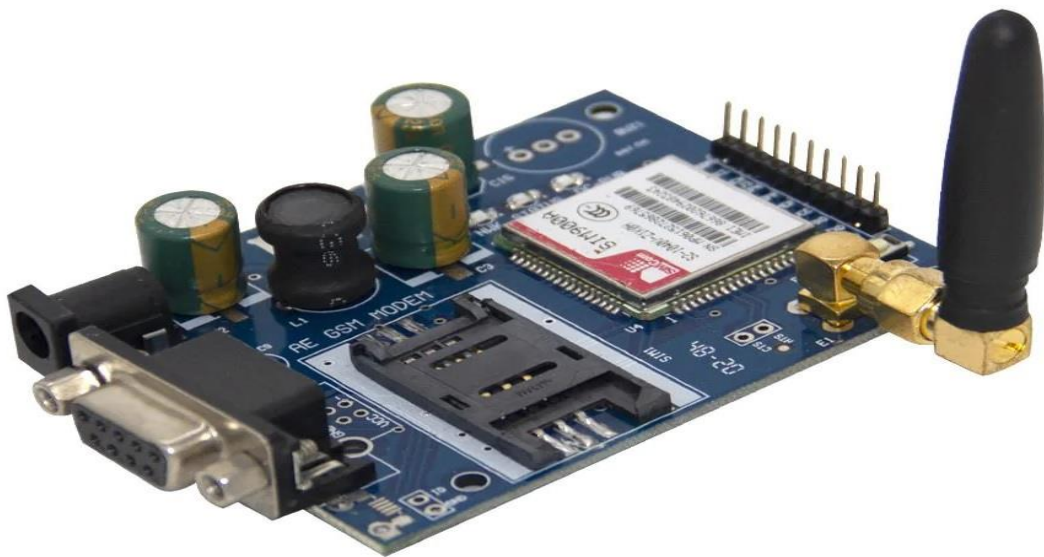
To upload the code connect ESP32CAM with FTDI programmer

After uploading the code, Open the Serial Monitor. The ESP32 IP address should be printed in the Serial Monitor.

Now, you can access your camera streaming server on your local network. Open a browser and type the ESP32-CAM IP address. Press the **Start Streaming** button to start video streaming. Finally, you can do face recognition and detection. First, you need to enroll a new face. It will make several attempts to save the face. After enrolling a new user, it should detect the face later on (subject 0).

It is perfect for many IOT apps. The ESP32-CAM offers a highly competitive, tiny camera module that can function as a basic system independently. In a variety of IOT applications, Ai Thinker ESP32 CAM is frequently used. It is appropriate for home smart devices, industrial wireless control, wireless surveillance, WLAN ID, Wireless Signals and other IOT applications. The solution is suited for IOT applications.

### FOR OTP WE USE GSM TECHNOLOGY:(global system for mobile communication)



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GSM module is a device that allows electronic devices to communicate with each other over the GSM network. A GSM modem is a specialized modem that accepts a SIM card and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator's perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network.

While these GSM modems are most frequently used to provide mobile internet connectivity, many can also be used to send and receive SMS and MMS messages. GSM modem must support an “extended AT command set” for sending/receiving SMS messages. GSM modems can be a quick and efficient way to get started with SMS, because a special subscription to an SMS service provider is not required. In most parts of the world, GSM modems are a cost-effective solution for receiving SMS messages because the sender pays for the delivery. To begin, insert a GSM SIM card into the modem and connect it to an available USB port on your computer

### **FingerPrint Sensor:**

The fingerprint sensor is one kind of sensor which is used in a fingerprint detection device. These devices are mainly inbuilt in the fingerprint detection module and it is used for computer safety. The main features of this device mainly include accuracy, better performance, robustness based on exclusive fingerprint [biometric technology](#). It Is better to [use USB](#) based fingerprint reader or scanner using biometric software for verification, identification, and authentication, that allow your fingerprints to perform similar to [digital passwords](#). These passwords cannot be forgotten, lost otherwise stolen.

### **R305 Fingerprint Sensor Module**



The R305 is one kind of fingerprint [sensor module](#) used in biometrics for security in fingerprint detection as well as verification. These devices are mainly used in safes where there is a high-powered DSP chip used in the rendering of image, feature-finding, searching and calculation by connecting it to any [microcontroller](#) with the help of [TTL](#) serial, & send data packets to get photos,

notice prints, search and hash. The enrollment of new fingers can be stored directly within the flash memory of on board.

## Features of Fingerprint Sensor

The features of this sensor include the following.

- It includes image collection as well as chip algorithm
- The fingerprint reader can perform lesser growth and can be fixed into a range of end products
- Power use is low, excellent performance, small in size, and less cost
- [Optical technology](#) which is used is professional, and exact module developed techniques
- The capabilities of [image processing](#) are good, and can effectively capture pictures up to 500 dpi resolution

## Fingerprint Sensor Working Principle

The working principle of the fingerprint sensor mainly depends on the processing. The fingerprint processing mainly includes two elements namely enrollment and matching. In fingerprint enrolling, every user requires to place the finger twice.

So that the system will check the finger images to process as well as to generate a pattern of the finger and it will be stored. When matching, a user places the finger using an optical sensor then the system will produce a pattern of the finger & compares it with the finger library templates.

## ARDUINO UNO:



Arduino is an open-source platform used for building electronics projects. Arduino consists of a physical programmable circuit board (often called a

microcontroller) and a piece of software, or IDE (Integrated Development Environment), that runs on your computer used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting with electronics, and for a good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (a programmer) to load new code onto the board – you can use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the microcontroller's functions into a more accessible package. The Arduino is a microcontroller board based on the ATmega8. It has 14 digital - input/output pins (of which six can be used as PWM outputs), six analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; connect it to a computer with a USB cable or power it with an AC-to- DC adapter or battery to get started.