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DESIGNING OF SMART AND SECURE SINGLE ATM CARD FOR MULTIPLE BANK ACCOUNTS

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Abstract: In this project, a smart and secure single ATM card system with multi-factor authentication that can access various bank accounts is designed and implemented. An Arduino Mega microcontroller is used in the system, along with an RFID module, fingerprint sensor, keypad, LCD display, GSM module, and many auxiliary parts. Users can select between using their fingerprints or entering their password to validate their identification when they swipe an RFID card. Following authentication, users can choose from a number of connected bank accounts and carry out financial tasks including checking their balance and making cash withdrawals. After transactions, the system refreshes and shows the remaining amount. In the event of successful withdrawals or unauthorised access, it also sends out alert messages via GSM. By combining different bank access into a single smart card system, this project improves banking security and ease while supporting numerous users with separate credentials.

Keywords: ATM card system, RFID card, alert messages.

I. INTRODUCTION

The proliferation of multiple accounts across different financial institutions has created both convenience and complexity for users. A unified solution that allows seamless access to multiple bank accounts through a single physical token would simplify daily financial interactions and reduce cognitive load on users. Traditional ATMs rely on static PIN-based authentication, which can be compromised through skimming devices or shoulder-surfing attacks. The proposed system leverages an Arduino Mega as the central controller, interfacing with an RC522 RFID reader, AS608 fingerprint sensor, 4x4 keypad, 16x2 LCD, SIM900A GSM module, and a buzzer. The RFID reader uniquely identifies the user's card, the fingerprint sensor and keypad provide secondary authentication, the LCD offers a user-friendly menu display, and the GSM module delivers instant notifications. The system accommodates multiple users by mapping each RFID card to unique fingerprint templates, PIN codes, and individual bank balances. The integration of the GSM module strengthens security through alerts and enhances user confidence by providing immediate feedback on all critical operations.

II. OBJECTIVES

The objectives of the project are:

- Authenticate users using RFID, fingerprint, or keypad for secure access.
- Allow users to select a bank from multiple options (e.g., SBI, ICICI).
- Enable withdrawal requests after verifying sufficient balance.
- Provide balance information and withdrawal details via SMS alerts.
- Support multiple users with separate accounts and transaction records.

III. METHODOLOGY

A. BLOCK DIAGRAM

The Arduino Mega system initializes various modules, including a 16x2 LCD display, SIM900A GSM module, RC522 RFID reader, AS608 fingerprint sensor, 4x4 keypad, and buzzer. The system checks the user's RFID card ID against the stored database and offers two options: fingerprint or keypad. If the fingerprint matches, access is granted, and the user can proceed to bank selection. If the keypad option is selected, the user enters a numeric password, which is compared with the stored password. If the password is incorrect, the system sends an alert message to the account owner.

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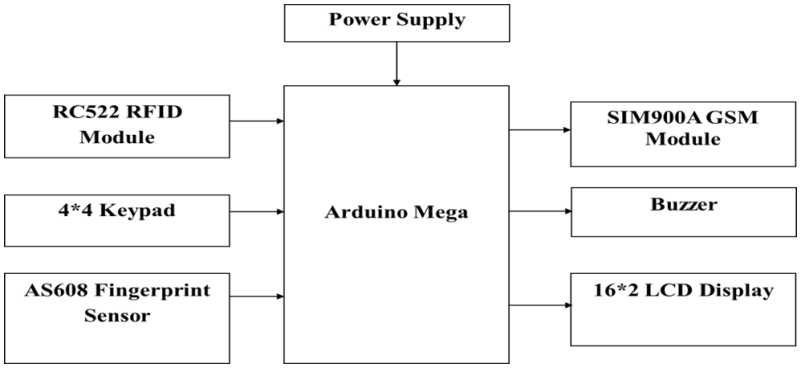

Figure 1 Block diagram

The system uses secondary authentication through fingerprint or keypad to display four bank options: SBI, IOB, ICICI, and HDFC. Users select a bank and then choose between "Withdraw" and "Balance." If the balance is sufficient, the requested amount is subtracted from the existing balance, and a message is sent to the owner's mobile number. If the balance is insufficient, the system does not process the transaction. The system supports multiple users by recognizing different RFID cards linked to specific fingerprints, passwords, and bank account details, ensuring secure, personalized transactions.

B. FLOW DIAGRAM

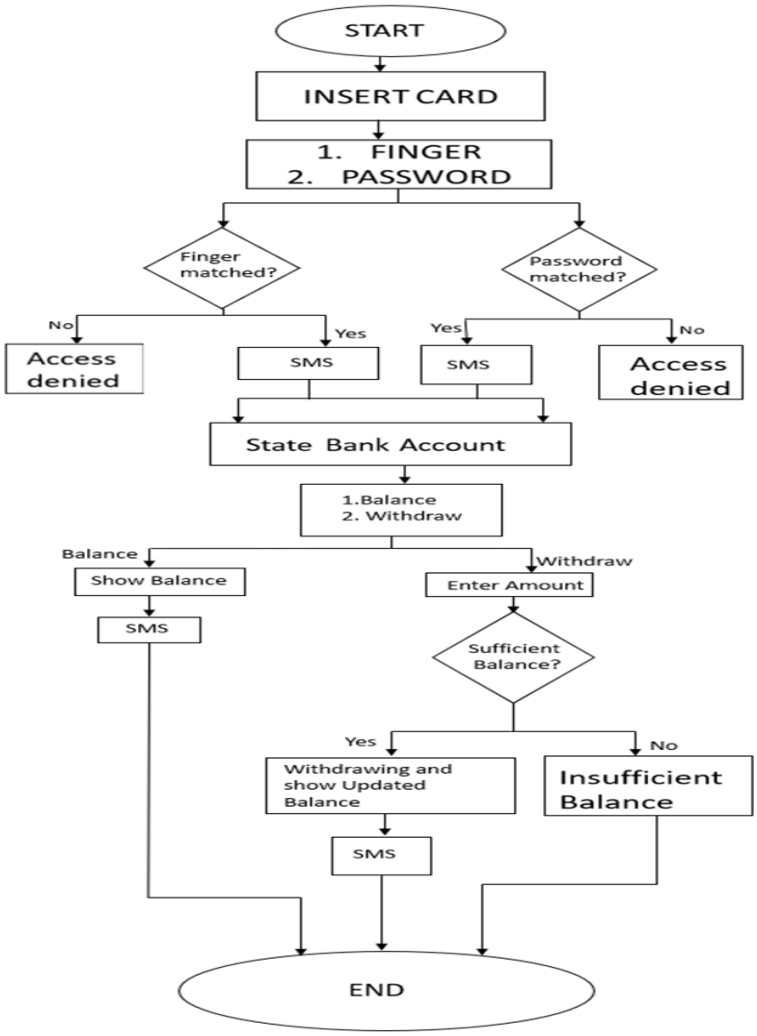

Figure 2 Flowchart

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The flowchart outlines the steps of an automated teller machine (ATM) transaction, starting with the user initiation and requiring two forms of authentication: a finger and a password. The process then branches into two decision points for authentication: "Finger Matched?" and "Enter Password?" If both the finger and password match, the transaction is denied. If both match, an SMS notification is sent, indicating successful authentication. The user then selects a bank account and is presented with two primary transaction options: "Balance" or "Withdraw." If "Balance" is selected, the system displays the balance screen and sends an SMS notification. If "Withdraw" is selected, the user enters the amount they wish to withdraw and must decide if the account has a sufficient balance. If so, the transaction ends. The process concludes with an SMS notification, ensuring security and guiding the user through various transaction scenarios.

C. SCHEMATIC DIAGRAM

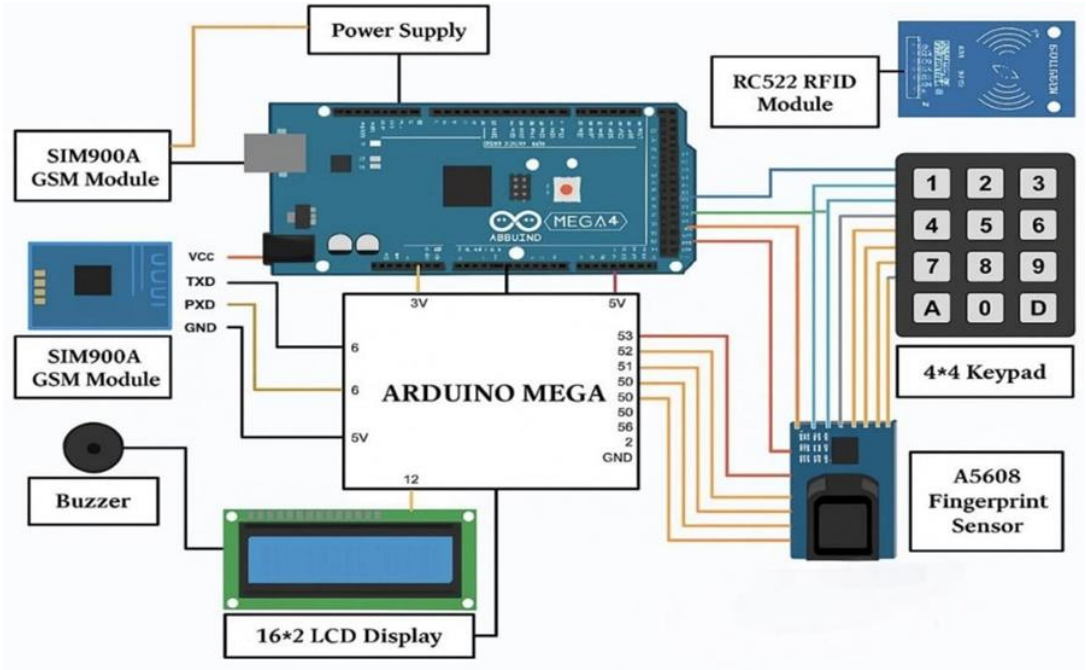

Figure 3 Schematic Diagram

The schematic diagram shows a secure ATM or access control system using an Arduino Mega as the central controller. It integrates multiple authentication and communication modules, including an RC522 RFID module for reading RFID cards, a 4x4 keypad for PINs, and an A5608 fingerprint sensor for biometric verification. A SIM900A GSM module sends SMS alerts for unauthorized access or emergencies. The system is ideal for applications requiring high-level security and real-time communication, such as ATMs, smart lockers, or restricted access areas.

IV. HARWARE REQUIREMENT

1. Arduino Mega

The Arduino Mega is a powerful microcontroller board based on the ATmega2560, designed for complex and large-scale projects that require multiple I/O connections. It operates by executing user-uploaded code through the Arduino IDE, enabling it to read inputs—such as signals from sensors, keypads, RFID modules, or fingerprint sensors—and control outputs like buzzers, LCDs, and relays accordingly. In operation, it continuously loops through the programmed instructions, monitoring sensor states and user interactions in real-time. Its multiple serial ports make it ideal for managing several devices simultaneously, allowing smooth communication with modules like SIM900A, AS608, and RC522 without conflict or delay.

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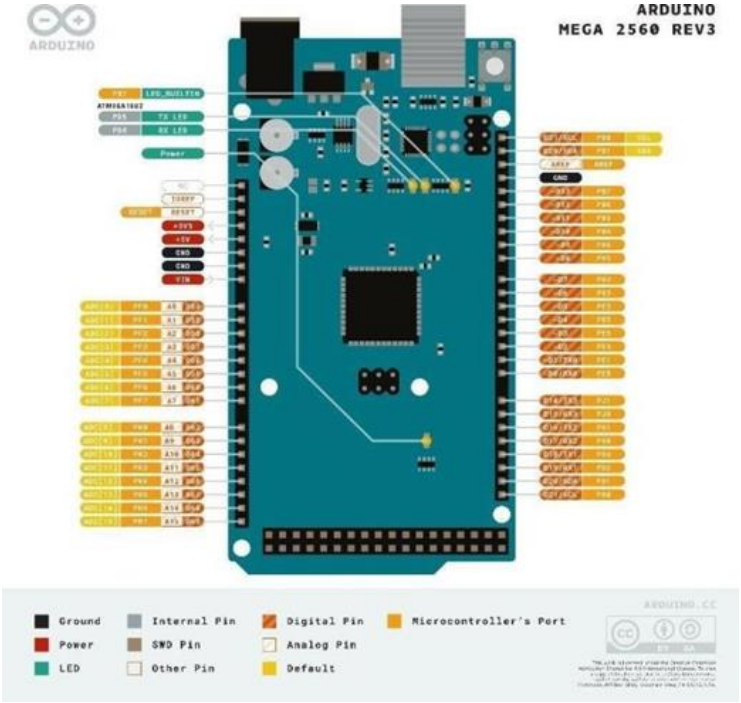

Figure 3 Arduino Mega

2. RC522 RFID MODULE

The RC522 RFID module is a low-cost, contactless communication device used for reading and writing data to RFID cards operating at a frequency of 13.56 MHz,as shown in figure 4. It works by generating an electromagnetic field through its antenna to power passive RFID tags or cards when they are brought close to the module. The module then communicates with the RFID tag using the ISO/IEC 14443 protocol to retrieve the unique identification (UID) stored on the card. The RC522 is efficient, fast, and suitable for access control applications due to its secure data transmission and small form factor.

Figure 4 RC522 RFID module

3. AS608 FINGERPRINT MODULE

In a multi-authentication ATM system, once the user swipes their RFID card and selects fingerprint verification, the AS608 scans the finger and sends the result to the Arduino. If the fingerprint matches, access is granted to the next step; if not, access is denied and an alert message is sent. The AS608 is preferred in embedded security projects for its high accuracy, fast recognition, and easy integration with Arduino.

Figure 5 AS608 Fingerprint module

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4. 4*4 KEYPAD

The 4x4 keypad is a 16-button matrix used for numeric or password input in embedded systems. It connects to specific rows and columns, detected by a microcontroller. In an ATM multibank system using Arduino Mega, users can manually input a password, which is compared with stored values. This simple interface is reliable for small secure input systems.

Figure 5 4x4 keypad module

5. SIM900A GSM MODULE

The SIM900A GSM module is a reliable microcontroller that sends and receives SMS messages or calls over a GSM network. It operates using AT commands and is integrated into ATM card projects for alerts and successful withdrawals. It supports quad-band GSM, making it suitable for remote alert systems and mobile-based communication in embedded applications.

Figure 6 SIM900A GSM module

6. 16*2 LCD MODULE

The 16x2 LCD module is a character display used in embedded systems for real-time data and messages. It receives data from microcontrollers like Arduino Mega and operates in 4-bit or 8-bit mode. In smart ATM card systems, it guides users through transactions, offers authentication options, and displays success messages. Its low power usage and clear visibility make it a popular choice.

Figure 7 16*2 LCD Display

7. I2C BOARD

The I2C board is an interface expansion board that enables LCD communication with a microcontroller using only two wires, SDA and SCL. It uses the I2C protocol for efficient data transmission and reduces GPIO pins, making it useful for complex projects like ATM card systems. The board includes a PCF8574 I/O expander chip for parallel output and a built-in potentiometer for easy contrast adjustment.

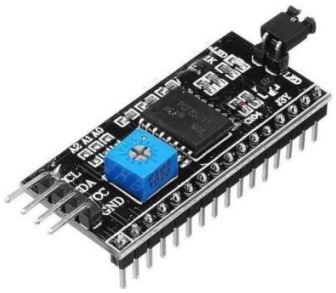

Figure 8 I2C Board

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8. BUZZER

Buzzers are audio signaling devices used in electronic systems to provide audible alerts. In embedded projects like smart ATM cards, they are controlled by Arduino Mega output pins. They activate briefly to provide feedback on user actions, enhancing security and user experience. Buzzers are easy to implement and require minimal power.

Figure 9 Buzzer

V. SOFTWARE REQUIREMENT

1. Arduino IDE Software

Arduino is an open-source prototype platform built on user-friendly hardware and software.

A circuit board, also known as a microcontroller, is its programming component, and the Arduino IDE (Integrated Development Environment) is pre-made software that is used to develop and upload computer code to the actual board.

The Arduino IDE is a software that allows users to create, manage, and install Arduino projects on various operating systems. It features a Library Manager for easy access to third-party libraries, a Board Manager for selecting and configuring Arduino boards, and a Serial Monitor for communication with the board. The IDE also enables compiling and uploading code via USB, enabling the board to execute the code and upload it to its microcontroller memory.

Figure 10 Arduino IDE

VI. RESULTS AND DISCUSSION

The proposed system integrates RFID card scanning, fingerprint recognition, and keypad input for secure access to user bank accounts. It uses an LCD display for clear instructions and facilitates transactions. Secondary verification can be done using fingerprint scans or keypads. The system's GSM module alerts account owners of unauthorized access attempts. It supports multiple bank accounts per user, providing real-time balance updates and withdrawal capabilities.

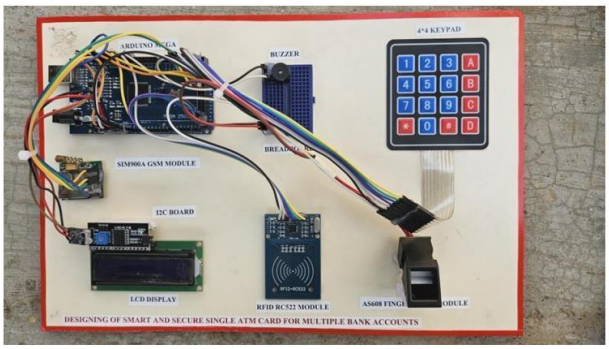

Figure 11 Proposed Prototype

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Below figures displays an ATM system's user interface, showing various stages from login (PIN/fingerprint) to balance inquiry and withdrawal. It highlights options for different banks, withdrawal amounts, and alerts for incorrect login attempts and successful transactions.

Figure 12 Results

VII. ADVANTAGES

Some of the advantages are: Provides secure multi-level authentication using RFID, fingerprint, and password. Allows access to multiple bank accounts with a single card. Sends real-time SMS alerts for all transactions and access attempts. Reduces the need to carry multiple ATM cards. Prevents unauthorized access with immediate alerts on failures. Supports multiple users with individual authentication and bank data.

VIII. DISADVANTAGES

Some of the disadvantages are: If the RFID card is lost, unauthorized access attempts may occur. System failure can block access to all linked bank accounts. GSM network issues can prevent alert messages from being sent.Limited storage on Arduino Mega may restrict user and bank data.

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IX. APPLICATION

Some of the applications are:
1. Multi-Bank ATM System: Enables users to access and manage multiple bank accounts (like SBI, ICICI, HDFC, etc.) us
ing a single card, reducing the need to carry multiple debit cards.
2. Enhanced Security Access: Uses RFID, fingerprint, and password-based multi-layer authentication, ensuring only authorized users can access their bank accounts.
3. Personalized Banking Interface: Provides users with transaction options like balance inquiry and withdrawal through a user-friendly keypad and LCD interface.
4. Fraud Detection and Alerts: Sends real-time SMS alerts via GSM module on unauthorized access attempts or transactions, adding an extra layer of safety.
5. Useful for Smart Banking Systems: Can be integrated into smart ATMs, banking kiosks, or secure access systems in financial institutions to enhance customer convenience and security.

X. CONCLUSION

A robust, user-friendly solution for consolidated, secure banking operations, the smart multi-bank ATM system seamlessly integrates RFID, fingerprint, and keypad authentication to ensure secure access. It guides users through bank selection, transaction options, and balance management on a simple LCD interface; it sends real-time SMS alerts on withdrawals or unauthorised attempts; it supports multiple users with unique credentials; and it dynamically updates each account's balance.

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