

# OTP Based Cardless Transaction System Using Face Recognition for Secure Financial Operations

<sup>1</sup>S Waheeda Begum, <sup>2</sup>Shaik Nazia, <sup>3</sup>M Pavan Kumar, <sup>4</sup>G Mohammad Azmal, <sup>5</sup>E Siva Ganesh, <sup>6</sup>R Murali

<sup>1,2,3,4,5,6</sup>Department of Computer Science Engineering (Cyber Security), GATES Institute of Technology, Gooty, Andhra Pradesh, India

E-mail: [shaikwaheedabegum998@gmail.com](mailto:shaikwaheedabegum998@gmail.com), [nazia9676shaik@gmail.com](mailto:nazia9676shaik@gmail.com), [pavandon721@gmail.com](mailto:pavandon721@gmail.com), [gangavaramazmal@gmail.com](mailto:gangavaramazmal@gmail.com), [shivaediga62@gmail.com](mailto:shivaediga62@gmail.com), [r.murali2005@gmail.com](mailto:r.murali2005@gmail.com)

**Abstract** - Banks provide ATM cards for services such as cash withdrawal, balance inquiry, and fund transfer. However, physical cards can be stolen, cloned, skimmed, or damaged. To address these issues, we propose a cardless ATM transaction system using OTP and face recognition. The system supports new user registration with name, account number, and mobile number, and existing user login. Transactions are secured through OTP verification and face recognition, and only proceed if the live face matches the stored encoding. Users can also view transaction history. This approach enhances security and convenience, reducing risks associated with card-based transactions.

**Keywords:** Automated Teller Machine, OneTime Password (OTP), Cardless Transaction, Face Recognition, Secure Banking.

## I. INTRODUCTION

Automated Teller Machines (ATMs) have become an essential part of modern banking, providing customers with convenient access to financial services such as cash withdrawal, balance inquiry, fund transfer, and mini statements, without the need to visit a bank branch. Traditional ATM systems require a physical debit or credit card and a Personal Identification Number (PIN) to authenticate customers. Each card typically contains a Bank Identification Number (BIN), a unique card number, and a check digit for the validation. Payment networks such as Visa, Mastercard, and American Express facilitate transactions across banks, enabling customers to access ATMs of other banks globally.

Although physical cards have made banking more convenient, they are vulnerable to multiple security threats. Cards can be lost, stolen, cloned, skimmed, or damaged, and PINs can be compromised through shoulder surfing or phishing attacks. Additionally, manual banking processes require customers to visit bank branches, which is time-consuming and inefficient. While ATMs offer 24/7 self-

service banking, the dependency on physical cards remains a significant limitation. To address these issues, researchers and financial institutions have explored cardless ATM systems, which eliminate the need for physical cards while improving transaction security. Cardless systems rely on advanced authentication methods such as One-Time Passwords (OTP) and biometric verification. Among biometrics, face recognition has gained significant attention due to its ability to uniquely identify individuals based on facial features, providing secure and convenient authentication.

In this work, we propose an OTP-based cardless ATM transaction system using face recognition. The system consists of two main modules: new user registration and existing user transactions. During registration, the user provides personal details including name, account number, and mobile number. The system generates an OTP and sends it to the registered mobile number for verification. After successful verification, the system captures the user's facial image, performs face detection, and generates face encodings which are stored in

For existing users, the system allows secure transactions such as withdrawal, deposit, and fund transfer. Users log in to the system, select the desired transaction, and enter the transaction amount. An OTP is generated and sent to the registered mobile number for verification. After OTP validation, the system captures a live facial image, performs face detection and encoding, and compares it with the stored encoding using face recognition algorithms. The transaction is allowed only if the live face matches the stored encoding, ensuring robust security. The system also maintains transaction history to provide transparency and accountability.

By combining OTP verification with facial recognition, the proposed system offers multifactor authentication, reducing risks associated with card theft, PIN compromise, and unauthorized access. Moreover, it provides a user-friendly solution for cardless banking, enhancing security and convenience.

## II. RELATED WORK

The increasing usage of Automated Teller Machines (ATMs), researchers and organizations have focused on improving ATM security and developing cardless transaction mechanisms. Several approaches have been proposed to eliminate the need for physical ATM cards and enhance authentication methods.

In 2012, NCR Corporation introduced a cardless cash withdrawal method using a smartphone application. In this approach, the user logs into a mobile application, selects the account and withdrawal amount, and scans a QR code displayed on the ATM screen using the smartphone camera. After successful verification, the ATM dispenses the requested cash. Although this method provides convenience, it relies mainly on a Personal Identification Number (PIN) for authentication, which may lead to security vulnerabilities if the PIN is compromised.

Later, several financial institutions proposed similar cardless transaction mechanisms. In 2013, FIS and Wintrust Financial Corporation introduced smartphone-based ATM withdrawal systems where customers could initiate transactions using mobile banking applications. However, these approaches still depended on single-factor authentication and were vulnerable to attacks such as QR code manipulation and unauthorized device usage.

Another ATM manufacturer, Diebold, proposed an improved approach by integrating a One-Time PIN (OTP) mechanism for transaction verification. In this system, a temporary PIN is generated and sent to the user's mobile device. The user must enter this OTP at the ATM to complete the transaction. This approach improved security by adding an additional authentication factor.

Several researchers have also investigated the use of biometric authentication methods to enhance ATM security. Biometric techniques such as fingerprint, voice recognition, and facial recognition have been explored to uniquely identify users and prevent unauthorized access. Voice-based authentication systems were proposed to improve ATM security; however, such systems may suffer from vulnerabilities since voice signals can be recorded or affected by environmental noise or health conditions of the user.

Recent research has focused on combining biometric authentication with other security mechanisms to provide multi-factor authentication in ATM systems. Face recognition, in particular, has gained attention due to its non-intrusive nature and ability to accurately identify individuals based on

facial features. Integrating biometric verification with OTP-based authentication can significantly improve ATM security by reducing the risk of card theft, skimming, and unauthorized transactions.

Motivated by these limitations in existing systems, this paper proposes an OTP-based cardless ATM transaction system using face recognition to provide a secure and convenient authentication mechanism for ATM users.

## III. PROPOSED SYSTEM

The proposed system introduces a secure cardless ATM transaction method that combines facial recognition and One-Time Password (OTP) authentication to enhance banking security. The system eliminates the need for physical ATM cards and reduces risks such as card theft, skimming, and PIN compromise.

In this approach, the user first verifies identity through an OTP sent to the registered mobile number. After successful OTP verification, the ATM webcam captures the user's facial image. A face recognition algorithm processes the image and compares it with the stored facial data in the database.

If both OTP authentication and facial recognition are successful, the user is granted access to perform banking transactions such as cash withdrawal or fund transfer. If either verification fails, the system denies access, ensuring protection against unauthorized usage.

The combination of OTP and facial recognition provides a secure, reliable, and convenient solution for cardless ATM transactions.

## IV. SYSTEM ARCHITECTURE

The system architecture is designed to perform secure cardless transactions through multiple authentication steps. Initially, the user logs in and enters the required transaction details such as the withdrawal amount. The system then generates a One-Time Password (OTP) and sends it to the user's registered mobile number for verification. After successful OTP validation, the system activates the webcam to capture the user's facial image. The captured image is processed by the face recognition module and compared with the stored facial data in the database. If the authentication is successful, the transaction is completed and the user can view the transaction history. All transaction records are securely stored in the database for future reference and monitoring.

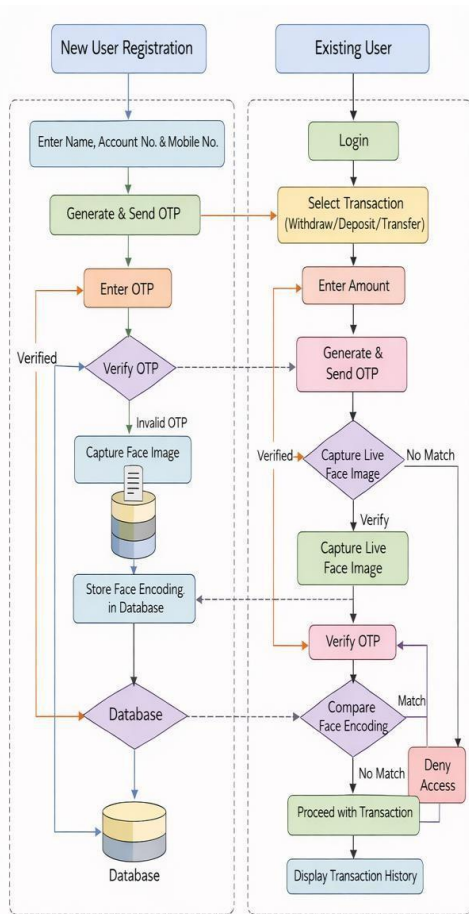


Figure 1: System Architecture of OTP-Based Cardless ATM Transaction Using Face Recognition

The architecture ensures that each authentication step is performed sequentially to enhance system security. The integration of OTP verification and facial recognition provides a multi-layer authentication mechanism. This approach significantly reduces the chances of unauthorized access and improves the reliability of the ATM transaction system.

## V. IMPLEMENTATION

### A. One-Time Password Generation and Verification

OTP acts as a dynamic authentication factor.

It is generated using a cryptographically secure random number generator, ensuring uniqueness and limited validity.

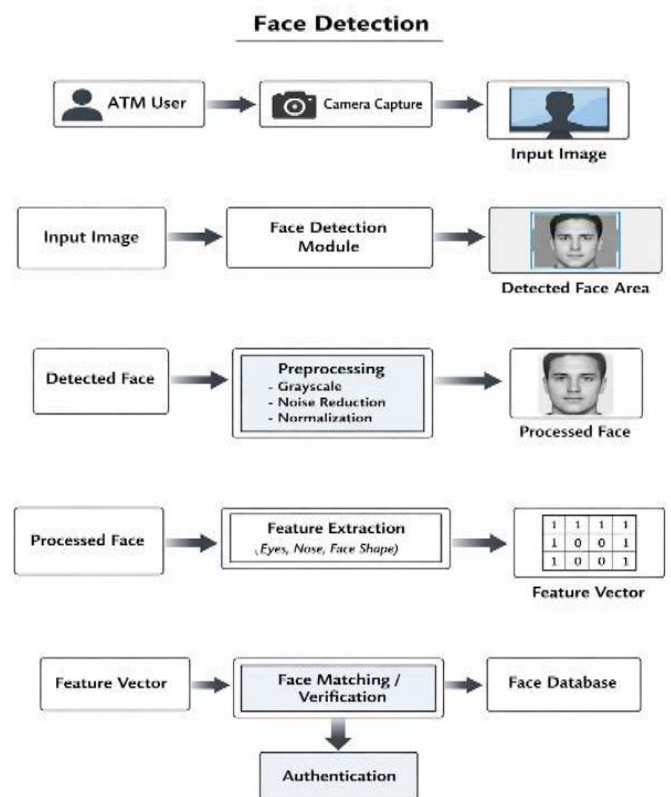
- For new users, OTP is verified twice: during account registration and before initiating any transaction.
- For existing users, OTP verification occurs prior to face recognition.

Incorrect or expired OTPs prevent access, ensuring that even if an unauthorized person has access to the mobile

number, transactions cannot proceed without OTP and facial verification.

### B. Face Detection and Encoding

After OTP verification, the system captures a live facial image using the ATM webcam. Face detection identifies the Region of Interest (ROI), and face encoding converts facial landmarks into a numerical representation. This encoding is robust against minor changes in lighting conditions or facial expressions.



- For new users, facial encodings are securely stored in the database.
- For existing users, the live encoding is compared with stored data for authentication.

Face detection and encoding provide a non-intrusive and real-time method to verify user identity without requiring physical cards.



### C. Face Recognition and Authentication

Face recognition compares the live facial encoding with the stored data in the database. Transactions are authorized only when a successful match is obtained.

- For existing users, OTP verification followed by face recognition allows the transaction to proceed.
- For new users, registration and the first transaction occur only after successful facial recognition.

If recognition fails, the transaction is denied, preventing unauthorized access.

### D. Transaction Processing and History Recording

After successful OTP and facial verification, the system executes the requested transaction, such as cash withdrawal, fund transfer, or deposit.

- Transaction records are encrypted and stored securely.
- Invalid attempts due to OTP failure or face mismatch are logged for auditing purposes.

This mechanism ensures integrity, transparency, and accountability in the transaction process.

### E. Security Features and Advantages

The system provides multi-layered security and addresses limitations of traditional ATM systems:

1. Eliminates dependency on physical ATM cards.
2. Prevents unauthorized access even if PINs are compromised.
3. Ensures biometric authentication tied to the live presence of the user.
4. Enables secure, paperless, and cardless transactions.
5. Logs all transaction attempts, including failures, for auditing and monitoring.

By combining cryptographically secure OTPs with advanced face detection and recognition techniques, the system offers a secure, convenient, and reliable cardless ATM solution.

## VI. RESULTS

The proposed OTP-based cardless transaction system using face recognition was successfully implemented and tested in a secure financial transaction environment.

The system integrates multi-layer authentication including user registration, OTP verification, and biometric face recognition to ensure secure financial operations. The graphical user interface (GUI) was designed to be simple, userfriendly, and secure.

The following sections describe the system results based on the developed interface pages.

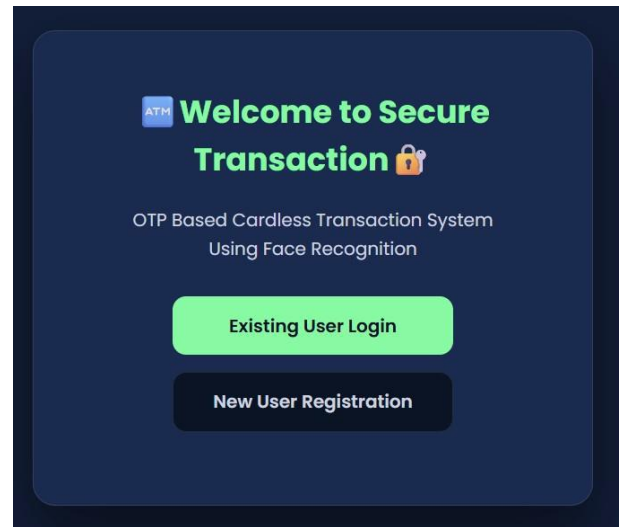


Fig 1: The Landing Page of Cardless Transaction

The first interface page represents the system entry point for users. It provides two main options: Existing User Login and New User Registration.

The page introduces the system as a Secure Transaction Platform that performs OTP-based cardless transactions combined with facial authentication. This interface acts as the primary access control layer that separates registered users from new users.

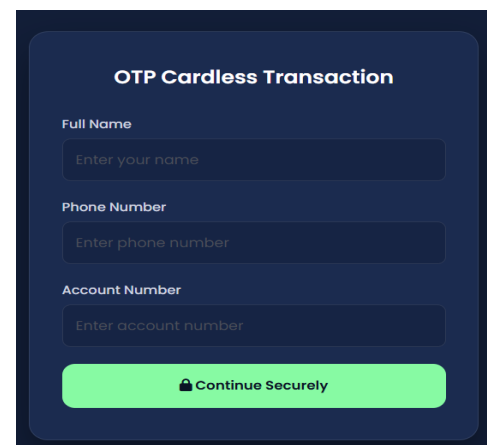


Fig 2: Login Page

The User Registration Page is designed for new users who wish to use the cardless transaction system. In this interface, the user is required to enter basic personal and banking details. The details are securely stored in the system database and are used for future authentication and OTP communication.

Once the user fills the required information and selects Continue Securely, the system registers the user and prepares the account for secure transactions.

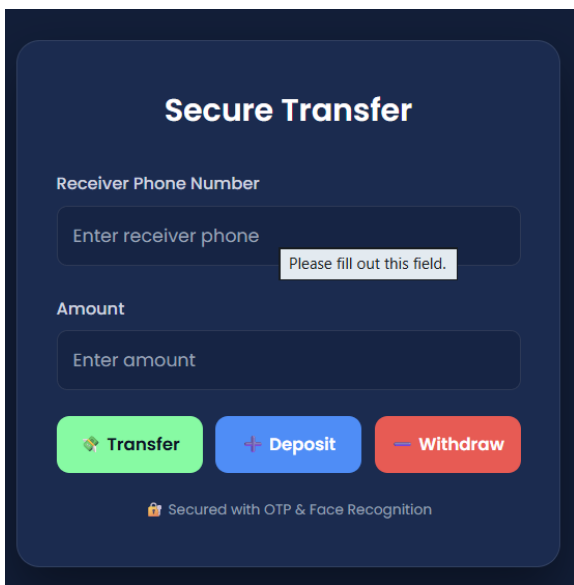


Fig 3: Secure Transaction

After successful authentication, the user is redirected to the Secure Transfer Page, which provides the main financial transaction interface.

This page allows the user to perform banking operations.

Once the required details are entered, the user can select the desired transaction operation. The system then triggers the OTP verification process to confirm the transaction request.

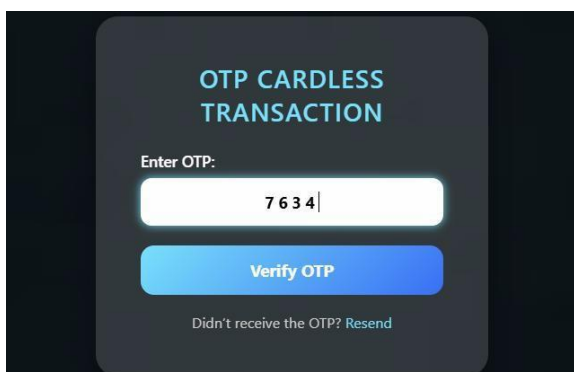


Fig 4: OTP Verification

The OTP Verification Page provides the second layer of authentication. Once a transaction request is made, the system generates a One-Time Password (OTP) and sends it to the registered phone number of the user. The user must enter the received OTP in the verification field and select Verify OTP.

If the OTP is correct, the system proceeds to biometric authentication. If the OTP is incorrect, the transaction request is rejected to prevent unauthorized access.

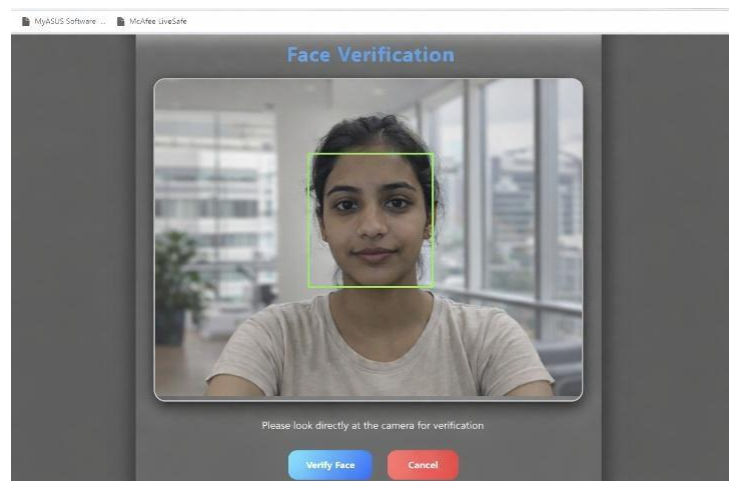


Fig 5: Face Verification

The Face Verification Page represents the final security layer of the proposed system. In this stage, the system activates the camera and captures the user's facial image in real time. The captured face is compared with the previously stored facial data in the system database using face recognition algorithms. A facial detection frame appears around the user's face during the verification process.

If the system successfully matches the facial features with the stored data, the transaction is approved and executed. If the face does not match, the transaction is denied.

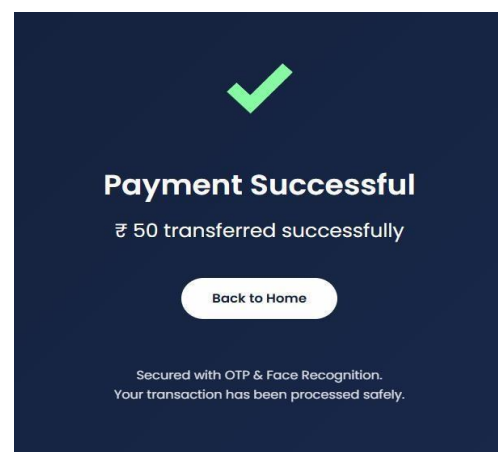


Fig 6: Successful Transaction

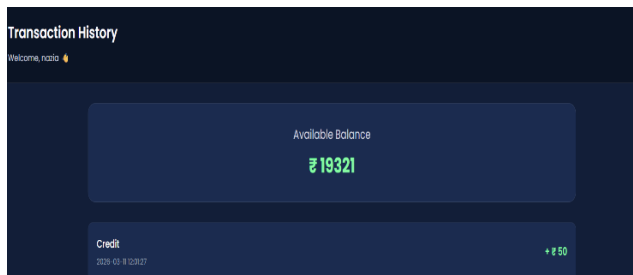


Fig 7: Transaction History

## VII. CONCLUSION

The proposed OTP-based cardless ATM system integrated with facial recognition provides a secure and efficient alternative to traditional cardbased ATM transactions. By combining OTP verification with real-time facial authentication, the system enhances the security of banking operations and helps reduce risks such as card theft, PIN compromise, and unauthorized access. The integration of biometric verification with OTP-based authentication ensures that only authorized users can perform transactions.

The proposed approach eliminates the dependency on physical ATM cards while maintaining a high level of security and usability. Additionally, the system provides a convenient and userfriendly method for accessing banking services without relying on traditional card-based mechanisms. Overall, the proposed system demonstrates a reliable and practical solution for improving the security, efficiency, and convenience of modern ATM transactions in banking environments.

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**Citation of this Article:**

S Waheeda Begum, Shaik Nazia, M Pavan Kumar, G Mohammad Azmal, E Siva Ganesh, & R Murali. (2026). OTP Based Cardless Transaction System Using Face Recognition for Secure Financial Operations. *International Current Journal of Engineering and Science (ICJES)*, 5(4), 7-13. Article DOI: <https://doi.org/10.47001/ICJES/2026.504002>

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