

Face Recognition UPI Transaction

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Abstract:

This paper presents a secure web-based application that integrates facial recognition technology with UPI transaction management to enhance online financial security. Developed using Flask, the system utilizes the Haar Cascade classifier for accurate face detection, enabling biometric user authentication. The application supports two roles: Admin for user and account management, and User for secure login and fund transfers. By replacing traditional password-based methods with face recognition, the platform reduces risks of fraud and unauthorized access. This approach offers a convenient, reliable, and efficient solution for secure online transactions, addressing the growing need for enhanced cybersecurity in digital payments.

Keywords:

Online Transactions, UPI, Facial Recognition, Haar Cascade, Biometric Authentication, Web Application Security, Flask, Digital Payments, Cybersecurity, User Authentication

I. INTRODUCTION

The rapid advancement of digital technologies has revolutionized the way financial transactions are conducted, ushering in an era where online payments have become an integral part of daily life. Unified Payments Interface (UPI), mobile wallets, and internet banking platforms have made it possible for individuals to transfer funds instantly, pay bills, and manage accounts from virtually anywhere. This convenience, however, comes with the ever-increasing challenge of ensuring transaction security in a landscape rife with cyber threats, identity theft, and unauthorized access.

As the adoption of digital payments accelerates, so does the sophistication of malicious actors seeking to exploit vulnerabilities in traditional authentication methods. Passwords, PINs, and OTPs, while commonly used, are susceptible to phishing attacks, credential leaks, and social engineering tactics. These risks highlight the urgent need for more robust and user-friendly authentication mechanisms that can provide a higher level of assurance without compromising convenience.

Biometric authentication has emerged as a promising solution to address these challenges. By leveraging unique physiological or behavioral characteristics such as fingerprints, voice, or facial features, biometric systems offer a way to verify user identities with a high degree of accuracy. Among these modalities, facial recognition stands out due to its non-intrusive nature and the widespread availability of cameras on smartphones and computers. Face detection and recognition technologies have matured significantly in recent years, driven by advances in computer vision and machine learning, making them suitable for real-time applications in security-sensitive domains.

The integration of face detection technology with UPI-based transaction systems represents a significant step forward in securing online financial services. Face detection serves as the first layer of biometric authentication, identifying and localizing faces within images or video streams. Once a face is detected, facial recognition algorithms can verify the identity of the user by comparing their facial features against a pre-registered database. This two-step process ensures that only authorized individuals can access sensitive financial operations, thereby reducing the risk of fraud, unauthorized access, and identity theft.

One of the most widely used methods for real-time face detection is the Haar Cascade classifier, a machine learning-based approach that efficiently detects faces in images using a series of simple features. The Haar Cascade method is renowned for its speed and accuracy, making it ideal for applications where quick and reliable face detection is essential. By incorporating Haar Cascade-based face detection into a web-based UPI transaction platform, it becomes possible to offer a seamless and secure user experience that leverages the strengths of both biometric technology and modern digital payment systems.

In the proposed system, users are authenticated through facial recognition before being granted access to their accounts or allowed to initiate transactions. This process not only enhances security but also streamlines the user experience by eliminating the need to remember complex passwords or carry additional authentication devices. The system is designed with two primary roles: Admin and User. The Admin is responsible for managing user accounts, creating facial datasets, and overseeing the integrity of the authentication process. Users, on the other hand, benefit from secure login, easy account management, and the ability to perform UPI transactions with confidence that their identity is protected.

The motivation behind this integration is twofold: to provide a higher level of security for online transactions and to improve user convenience. With cybercrime on the rise and digital payments becoming the norm, the need for innovative security solutions has never been greater. By combining the reliability of face detection with the ubiquity of UPI, the proposed system addresses a critical gap in the current landscape of online financial services.

In summary, this paper explores the design, implementation, and benefits of a web-based application that utilizes Haar Cascade-based face detection for secure UPI transaction management. The following sections will delve into the technical architecture, implementation details, and security analysis of the system, demonstrating how biometric authentication can be effectively leveraged to safeguard online financial transactions in today's digital age.

II. RELATED WORK

An OTP Based Secure Online Transaction Using Face Recognition, Authors- Dr.Mulumudi Suneetha , Lenkala Nithin Reddy , Ale Sai Teja and Manchala Gagan Ghrinesh, This project ensures secure digital transactions by integrating OTP verification and facial recognition. The process begins by retrieving and confirming the sender's details, followed by generating and validating an OTP sent to the sender. After successful OTP authentication, facial recognition algorithms verify the sender's identity through live image capture. Receiver details are then fetched from a CSV file and validated against the provided phone number. Once all credentials are confirmed and the transaction amount is entered, the transaction is executed, with comprehensive metadata—including sender and receiver details, amount, and timestamp—logged for future reference.[1]

Online transaction security using face recognition, Authors- Sankalp Patil, Prakhar Jain, Credit and debit cards are vulnerable to misuse through theft, borrowing, or cloning, as traditional verification methods often grant access solely based on card possession and basic checks. To address these risks, a more secure approach involves embedding a signed facial image of the cardholder on the credit card and verifying it against a live facial image captured during card usage. By comparing these facial images before completing a transaction, the system ensures that only the legitimate card owner can authorize payments, significantly reducing the chances of unauthorized or fraudulent card use.[2]

Face Recognition as Base Protocol in Online Transactions Author- Mohammad Fauzi Aziz, Gavin Sadiya Taraka, Sidharta Sidharta, Fraud and scams in online transactions continue to rise, prompting the need for stronger security measures. This paper systematically reviews the role of face recognition as a base protocol for online transaction authentication, addressing its effectiveness in reducing identity fraud, integration challenges, user acceptance, and regulatory concerns. The results indicate that face recognition significantly enhances security, but technical and legal challenges

remain. Overall, the study concludes that while face recognition is a promising and secure solution, further technological development and adherence to regulations are necessary for its successful adoption in e-commerce.[3]

Secure online payment with face detection, authors- dhanalakshmi.g, jananeeswari.d, jeromi.p, anumulu sadhana, This project enhances transaction security by implementing two-step authentication—face detection and proxy detection—prior to UPI PIN entry. Using the FaceNet algorithm, it extracts 128 unique facial features per user and applies a triplet loss function for accurate identification. Proxy detection through image processing ensures that only genuine users can proceed, effectively blocking fraudulent attempts with fake or proxy faces. This approach significantly strengthens transaction security by combining advanced facial recognition with robust anti-spoofing measures.[4]

Online Transaction Security Using Face Recognition: A Review, Authors: Dr. Ankita Karale, Aman Tiwari, Anay Wadkar, Aditi Patil, Diptesh Waghulde, Facial recognition technology plays a crucial role in enhancing security for online transactions by accurately identifying individuals through unique facial features. It helps protect personal and payment information, reduces fraud, and prevents identity theft. Widely used in security systems, this technology works effectively even in low-light conditions and from different angles, making it a reliable tool to safeguard e-commerce and build customer trust.[5]

"An OTP Based Secure Online Transaction using Face Recognition", Authors- Lenkala Nithin Reddy , Ale Sai Teja , Manchala Gagan Ghrinesh , Dr.Mulumudi Suneetha This innovative online transaction method combines OTP authentication with face recognition to enhance both security and user convenience. Users first verify their identity by entering a unique OTP sent to their registered mobile number, then confirm their identity with a live facial scan, which is matched against stored data. By integrating these two authentication

steps, the system provides a robust, seamless, and user-friendly solution for secure online transactions.[6]

A Review of Face Recognition Technology, Authors: Lixiang Li, Xiaohui Mu, Siying Li, and Haipeng Peng, Face recognition technology uses biometric identification by analyzing unique facial features. This paper reviews its development, related technologies, evaluation standards, and databases, as well as research focused on real-world conditions. With its growing accuracy and wide range of applications, face recognition is seen as a key technology for the future, offering significant potential for various fields.[7]

Face Recognition Based Payment Processing System, Authors- Romano Araujo, Adarsh Potekar, Mayuresh Raikar, Sumedha Mainkar, Salil Salgaonkar, Ashish Narvekar, Yogini Lamgaonkar, With the increasing frequency of card-based transactions in various settings, concerns about theft and the inconvenience of carrying cards or cash are growing. This work proposes an online transaction system that utilizes biometric facial recognition, combined with OTP verification, to enhance security and convenience. By employing techniques like Local Binary Pattern Histogram (LBPH) and HAAR Cascade for facial identification, the system offers a reliable, efficient, and user-friendly alternative to traditional payment methods, reducing the need for memorizing passwords and minimizing the risk of fraud.[8]

Face Detection for Secure Online Payment with Proxy Detection, Authors- Vijayalakshmi C, Metilda Florence S, Gokulakrishnan D, Prakash G, A. Ponmalar, While OTPs are commonly used to secure online transactions, they can be vulnerable if someone gains access to the user's bank details and registered mobile number. To address this, the proposed system incorporates facial recognition for authentication, using the FaceNet algorithm to extract and classify unique facial features with SVM. During a transaction, the system compares the live captured face with the stored model, ensuring that only the legitimate account holder can complete the

payment, thus significantly reducing the risk of unauthorized access and fraud.[9]

Face Recognition for Secure Online payment with Proxy Detection using Face Net Classifier, Authors- M.Praneesh, Dr.D.Napoleon, Most online transactions use OTPs alongside passwords for user authentication, but OTPs can be vulnerable if someone gains access to the user's bank details and registered phone. To address this, the proposed system uses facial recognition as an additional authentication layer. The account holder's face is captured initially, and the FaceNet algorithm extracts unique facial features, which are then classified using SVM. During payment, the system compares the live face with the stored model, and only if there is no proxy and the faces match is the transaction approved, significantly improving security over OTP alone.[10]

III. METHODOLOG

Proposed Methodology

The proposed methodology for "Face Detection-Enabled UPI Transaction System" combines biometric authentication with traditional UPI security measures to enhance the safety and convenience of online financial transactions. The process is structured in distinct phases for registration, authentication, transaction processing, and administration, as detailed below:

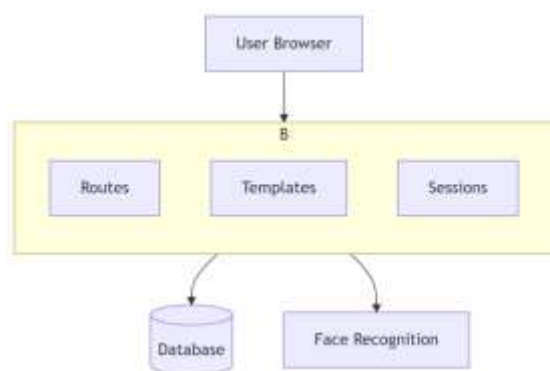


Fig 3.1. Proposed Methodology

3.2.User Registration and Face Dataset Creation

Users begin by registering on the platform, providing essential credentials and contact information. During registration, users are prompted to capture multiple facial images using their device's camera. These images are processed using the Haar Cascade classifier to detect and

extract facial features, which are then stored securely in the system's database as reference templates for future authentication.

3.3 .Secure User Authentication

Upon subsequent logins, users authenticate themselves either through traditional credentials or by using face recognition. The system captures a live facial image and compares it with the stored templates using feature-matching algorithms. Only if the match is successful does the user gain access, ensuring that unauthorized individuals cannot access the account even if they possess the login credentials.

3.4 .UPI Transaction Initiation

Authenticated users can initiate UPI transactions by entering the recipient's UPI ID, amount, and other necessary details. Before proceeding, the system prompts for a fresh facial scan to verify the live presence of the user, adding a second layer of biometric authentication.

3.5 .Dual-Factor Authentication for Transactions

After successful face verification, the user is required to enter their UPI PIN. This dual-factor authentication—combining something the user is (face) and something the user knows (PIN)—significantly enhances transaction security by minimizing the risk of unauthorized transfers, even if one factor is compromised.

3.6.Real-Time Face Detection and Liveness Check

The system employs real-time face detection and liveness checks to ensure that the face presented is not a photograph or video replay. Techniques such as blink detection or random movement prompts may be used to confirm the live presence of the user, thereby preventing spoofing attacks.

3.7.Secure Transaction Processing and Logging

Once both authentication steps are passed, the transaction request is securely processed through the UPI network. All transaction details, along with authentication logs, are encrypted and stored for audit and monitoring purposes, ensuring compliance and traceability.

3.8.Role-Based Access Control and Monitoring

The platform supports two main roles: Admin and User. Admins manage user accounts, review transaction histories, and maintain the facial dataset. They can also monitor system activity for suspicious behavior, ensuring the integrity and security of the platform.

3.9.User-Friendly Web Interface

The entire process is facilitated through an intuitive web application, typically built using Flask. Users can easily register, authenticate, initiate transactions, and view their account history, while admins have access to management dashboards and support tools.

IV. TECHNOLOGIES USED

4.1 Python

Python is a versatile, high-level programming language that supports a wide ecosystem of libraries and frameworks, making it a leading choice for data analysis, scientific computing, machine learning, and web development. Libraries such as Pandas and NumPy are especially popular in Python: Pandas provides powerful and flexible data structures like DataFrames for easy manipulation, cleaning, and analysis of structured data, while NumPy offers efficient operations on large, multi-dimensional arrays and matrices, serving as the computational backbone for many scientific and analytical tasks. Python's extensive standard library, clear syntax, and strong community support further enhance its appeal across a wide range of applications, from prototyping to production-level systems.

4.2. cv2 (OpenCV):

cv2 is the Python interface for OpenCV, a widely-used open-source computer vision library. OpenCV provides comprehensive tools for real-time image and video processing, including face detection, object recognition, and image transformations. With support for multiple programming languages, cv2 enables developers to implement advanced computer vision algorithms efficiently, such as using Haar Cascade classifiers or deep learning models for face detection and recognition tasks.

4.3.base64:

base64 is a standard Python module used for encoding and decoding binary data into ASCII text format. In image processing and face recognition applications, base64 is often used to convert image files into string representations for storage, transmission over networks, or embedding within JSON payloads. This makes it easier to handle image data in web applications and APIs without worrying about binary compatibility.

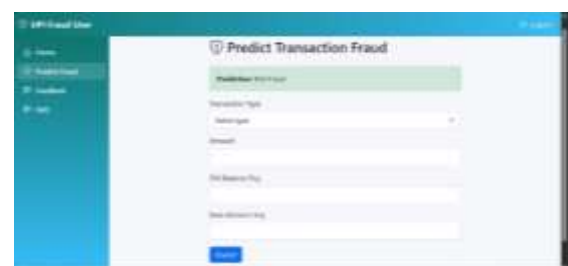
4.4. numpy:

numpy is a fundamental Python library for numerical computing and array manipulation. In computer vision and face recognition projects, numpy is essential for handling image data as multidimensional arrays, performing mathematical operations, and efficiently processing large datasets. It works seamlessly with libraries like OpenCV, enabling fast pixel-wise operations and transformations on images.

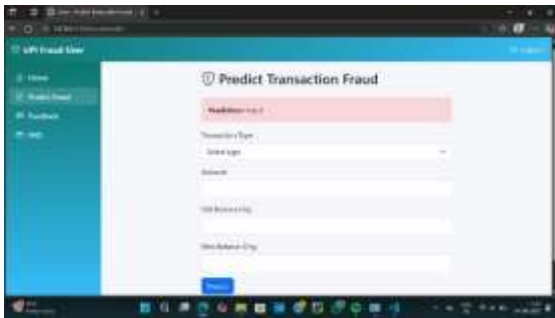
4.5. face_recognition:

face_recognition is a Python library built on top of dlib and OpenCV, designed specifically for easy and accurate face detection and recognition. It provides high-level functions to locate faces in images, extract 128-dimensional face embeddings, and compare these embeddings for identity verification. The library simplifies the implementation of face recognition systems and is widely used for biometric authentication, security, and access control applications.

V. RESULT



We can enter box and we can predict



We can see result prediction was fraud.

V. CONCLUSION

In conclusion, the integration of facial recognition technology with UPI-based transaction systems represents a significant advancement in the security and usability of digital financial services. By leveraging robust biometric authentication alongside traditional PIN verification, the proposed methodology effectively addresses the vulnerabilities of conventional password-based systems and reduces the risk of unauthorized access, identity theft, and financial fraud. The use of real-time face detection, liveness checks, and dual-factor authentication ensures that only legitimate users can initiate and authorize transactions, thereby enhancing user trust and confidence in online payment platforms. Furthermore, the system's design prioritizes both security and user convenience, making it a practical solution for the growing demands of the digital economy. As digital payments continue to proliferate, such innovative approaches are essential for safeguarding user data and financial assets, paving the way for more secure and seamless online transaction experiences in the future.

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