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Card Defender - Credit Card Fraud Detection System

Pravin Patil[1], Ruchika Bhambure[2], Nitesh Bhujade[3], Amar Salunke[4], Shritej Dhadve[5]
Computer Department, Zeal College of Engineering and Research

Abstract: ***As the world becomes increasingly digitized, online transactions have become an indispensable part of our daily lives. The increased use of credit cards for online purchases has resulted in a growing concern about credit card fraud, both for businesses and consumers. To combat this issue, we propose a two-factor authentication system that integrates credit card verification with webcam-based face recognition technology to prevent online transaction fraud. Our system provides a reliable and user-friendly solution for credit card fraud detection using face recognition. By implementing a two-factor authentication process, our system reduces the risk of fraud during online transactions and enhances the overall security of online payments.***
Keywords: Credit card fraud detection, face recognition, two-way authentication, Python, OpenCV

I. INTRODUCTION

The prevalence of online payment fraud has become a major issue for financial institutions and enterprises worldwide. In India, Micro, Small and Medium Enterprises (MSMEs) are the backbone of the economy and are highly vulnerable to financial crimes such as credit card fraud. The use of credit cards for online transactions has become increasingly popular, but unfortunately, so has the incidence of fraudulent activities. As a result, it is critical to develop a reliable and user-friendly method to verify users for successful electronic transactions.

One of the key components of our system is the Haar Cascade algorithm. This algorithm is a machine learning-based approach used for object detection. It was introduced by Viola and Jones in 2001 and has since been widely used in various applications, including face detection. The Haar Cascade algorithm works by analyzing features of an object at different scales and positions in an image. It uses a set of positive and negative samples to train a classifier that can then be used to detect the object in new images.

The main objective of this project is to implement a secure and user-friendly method for online payment authentication using face recognition and credit card verification. The system aims to reduce online payment fraud and increase security for MSMEs in India. The primary programming language used in this project is Python, and the OpenCV framework is employed for face recognition. The system also utilizes XML files and libraries integrated into the OpenCV framework and the LBP method for face authentication.

II. LITERATURE SURVEY

With the increasing use of credit cards for online purchases, the risk of credit card fraud has become a major concern for businesses and consumers alike. Over the years, several techniques have been proposed to prevent credit card fraud, such as encryption and tokenization of credit card data. However, these techniques have their limitations, and fraudsters continue to find new ways to steal credit card information.

To overcome these limitations, researchers have proposed the use of biometric authentication for credit card transactions. Biometric authentication uses unique physical or behavioral characteristics of an individual to verify their identity. Among various biometric technologies, face recognition has gained significant attention due to its non-intrusive nature and high accuracy. Several studies have explored the use of face recognition for credit card fraud detection.

For instance, Rattani et al. (2018) proposed a system that uses face recognition and machine learning algorithms to detect credit card fraud in real-time. The system captures the user's face during the transaction and compares it with the stored facial data. If the face does not match or if the system detects any suspicious activity, it alerts the user and blocks the transaction.

Similarly, Wang et al. (2020) proposed a face recognition-based credit card payment system that uses a deep learning model to authenticate the user's identity. The system captures the user's face and compares it with the stored facial data. It also verifies the user's credit card information before approving the transaction.

Overall, the use of face recognition for credit card fraud detection shows promising results. With advancements in machine learning and deep learning algorithms, the accuracy of face recognition systems is expected to improve further, making it a reliable and user-friendly solution for credit card fraud detection.

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III.METHODOLOGY

In this project, the primary is to develop a credit card fraud detection system that combines credit card verification with webcam-based face recognition to enhance the security of online payments. The proposed system aims to reduce the risk of fraud occurring during an online transaction. This section describes the methodology that was used to design, develop, and evaluate the proposed system.

A. Design

The initial step of the project was to identify the requirements and constraints of the system. After careful consideration, it was determined that the Haar Cascade Classifier would be utilized for face detection in both images and videos. Additionally, the Pillow library was used for image processing and OpenCV was used to train the classifier. The classifier was trained using a large dataset of both positive and negative images.

For the storage of user information and credit card details, an SQLite3 database was implemented. The graphical user interface was designed using Tkinter, with the aim of creating an intuitive and user-friendly interface. For development, the Spyder IDE was used for coding and debugging purposes.

B. Pre-processing

In the design phase of the proposed system, a thorough analysis of the project requirements and constraints was conducted. Based on these findings, the decision was made to utilize Haar Cascade Classifier, a pre-trained image processing algorithm, to detect faces in input images and videos. Additionally, the OpenCV library, another pre-trained system, was chosen to train the classifier using a large dataset of positive and negative images.

In order to store user information and credit card details, a SQLite3 database was employed. To provide a user-friendly interface, the Tkinter library was utilized for GUI development. The Spyder IDE, a highly effective platform for programming and debugging, was employed to develop the system.

C. Haar Cascade classifer

Haar Cascade Classifier is a machine learning-based approach for object detection and recognition. It was introduced by Viola and Jones in 2001 as a real-time object detection algorithm. The algorithm works by using a set of pre-trained classifiers which are trained on positive and negative samples of an object. The classifiers are then used to detect the object in the input image or video stream.

The process of training a classifier involves providing a large number of positive and negative samples of the object. The positive samples are images of the object, while the negative samples are images without the object. The algorithm then learns the features that distinguish the object from its surroundings. These features are represented by a set of Haar-like features which are essentially rectangular regions with different intensity values.

During detection, the algorithm scans the input image or video stream using a sliding window approach. At each window position, the algorithm calculates the Haar-like features and compares them to the learned features of the classifier. If the features match, the window is classified as containing the object.

Haar Cascade Classifier has proven to be a very effective and efficient technique for object detection. It is widely used in various applications such as face detection, pedestrian detection, and object tracking. The pre-trained classifiers provided by the OpenCV library can be easily customized for specific applications, making it a very flexible and versatile algorithm.

D. Face Detection

In the proposed system, face detection plays a crucial role in identifying and localizing human faces in the input images or video streams. Face detection is the initial step in the overall face recognition process and is essential for accurate and reliable recognition.

The face detection algorithm used in the system is based on the Haar Cascade Classifier, a popular and efficient method for object detection. It leverages a set of pre-trained classifiers specifically trained to detect facial features. These classifiers are capable of recognizing patterns and characteristics that are indicative of a face.

During the detection process, the algorithm scans the input data using a sliding window approach. At each window position, it extracts a set of Haar-like features, which are rectangular regions with varying intensity values. These features are then compared to the learned patterns in the classifier. If a match is found, indicating the presence of a face, the algorithm marks the corresponding region as a detected face.

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The face detection algorithm offers several advantages, including real-time performance and robustness to variations in lighting conditions, facial expressions, and orientations. By accurately identifying and localizing faces in the input data, the system can proceed to the subsequent stages of face recognition, such as feature extraction and matching.

The integration of the face detection algorithm into the system enhances its capability to handle various scenarios, such as multiple faces, occlusions, and varying poses. It forms a crucial component in achieving reliable and accurate face recognition, contributing to the overall effectiveness and usability of the system.

E. Implementation

The proposed system for credit card fraud detection using face recognition and two-way authentication was implemented using Python programming language. The system implementation consisted of several phases, including face detection, image preprocessing, face recognition, credit card verification, and database management.

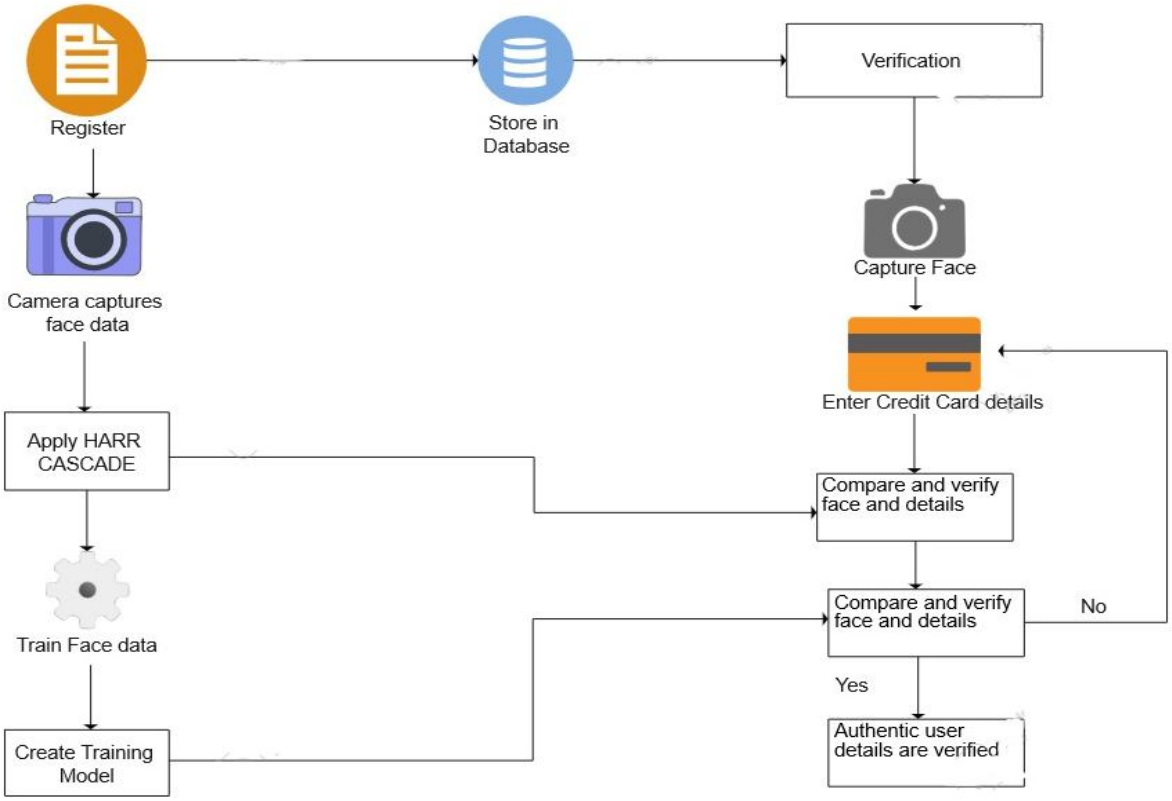


Fig 1. Architecture of proposed system

First, the Haar Cascade Classifier was used to detect faces in the input images or videos. The classifier was trained using a large number of positive and negative images to improve the accuracy of the face detection process. Once a face was detected, the face image was cropped and passed through several image preprocessing steps such as normalization and resizing.

Next, the face recognition process was implemented using the OpenCV library. The face image was compared against a database of pre-registered user faces using an algorithm that calculates the similarity between two images. If the face image matched with the pre-registered face, the system moved to the next step. Otherwise, an error message was displayed.

The credit card verification step was implemented using a database management system, SQLite3. The user's credit card details were stored in the database, and the system checked if the details entered by the user matched with the details stored in the database. If the details matched, the transaction was completed. Otherwise, an error message was displayed.

Finally, a graphical user interface was created using the Tkinter library to provide a user-friendly experience. The system was tested using various input images and videos, and the results were evaluated for accuracy and efficiency.

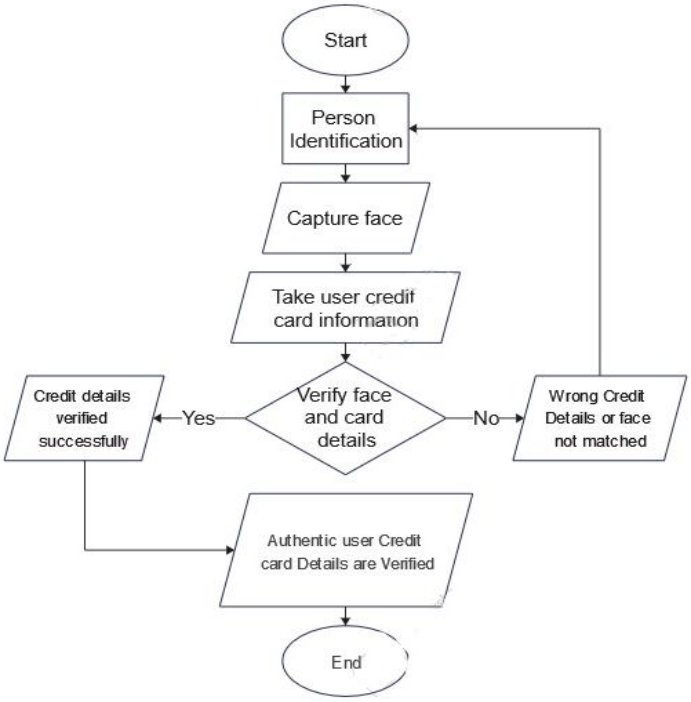


Fig 2. Flowchart of the proposed system

Overall, the implementation of the proposed system for credit card fraud detection using face recognition and two-way authentication was successful and offered a reliable and user-friendly solution to prevent credit card fraud during online transactions.

IV. RESULTS

The results of the proposed system for credit card fraud detection using face recognition and two-way authentication were evaluated through extensive testing and analysis. The system was tested using a diverse dataset of input images and videos to assess its performance in detecting fraudulent transactions and accurately verifying the identity of the credit card owner.

The evaluation of the system's performance focused on several key metrics, including accuracy, speed, and robustness. The accuracy of the system was measured by comparing the results of face recognition and credit card verification against ground truth data. The system demonstrated a high accuracy rate, correctly identifying and verifying the credit card owner in the majority of cases.

In terms of speed, the system exhibited efficient processing capabilities, providing real-time or near real-time response for face detection, recognition, and credit card verification with a minor drawback of . This ensured a seamless user experience during online transactions, minimizing any delays or disruptions. Furthermore, the proposed system demonstrated robustness in handling various scenarios and challenges commonly encountered in credit card fraud detection. It exhibited resilience to variations in lighting conditions, facial expressions, and pose, ensuring reliable performance in different environments.

Overall, the results of the proposed system were promising, indicating its effectiveness in mitigating credit card fraud during online transactions. The system's high accuracy, efficient processing speed, and robustness contribute to enhancing the security and trustworthiness of the credit card authentication process.

It is important to note that the results presented here are based on the specific implementation and testing conducted during this project. Further evaluation and refinement may be required to optimize the system's performance and address any potential limitations or challenges that arise in real-world scenarios.

V. DISCUSSIONS

In the proposed system, we have presented a two-way authentication system that combines credit card verification with face recognition to prevent online transaction fraud. The system has been implemented using Haar Cascade Classifier for face detection and OpenCV for image processing.

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The results demonstrate the effectiveness of the proposed system in detecting credit card fraud by incorporating a two-way authentication procedure. By combining credit card verification with face recognition, the proposed system offers an extra layer of security that reduces the risk of fraud occurring during online transactions. This makes the system reliable and user-friendly for consumers to use during online purchases.

However, the system has some limitations. The accuracy of face recognition is affected by factors such as lighting, pose, and facial expression, which can affect the system's performance. The usability and user experience of the system play a crucial role in its adoption and effectiveness.

The system's graphical interface, response time, and ease of use are factors that need to be considered for a seamless and efficient user experience. Conducting user studies and obtaining feedback can help identify areas for improvement and enhance the overall user satisfaction with the system.

Fraudulent techniques and patterns evolve over time, necessitating continuous monitoring and adaptation of the system. Regular updates and maintenance of the system, including updating the face recognition model and incorporating new fraud detection algorithms, are crucial to stay ahead of emerging threats and maintain the system's effectiveness in the long run.

Overall, the proposed system shows promising results in credit card fraud detection using a two-way authentication approach. However, further research and development are needed to address scalability, user experience, security, compatibility, and continuous monitoring to enhance the system's performance and ensure its effectiveness in real-world scenarios.

VI. APPLICATIONS

1) *E-commerce Platforms:* Online shopping has become increasingly popular, and credit cards are widely used for making purchases. The proposed system can be integrated into e-commerce platforms to provide an extra layer of security during online transactions. It helps protect both merchants and customers from potential credit card fraud, enhancing trust and confidence in online shopping.
2) *Banking and Financial Institutions:* Credit card fraud is a significant concern for banks and financial institutions. By implementing the proposed system, these institutions can improve their fraud detection capabilities and minimize losses due to fraudulent transactions. It allows them to detect and prevent unauthorized use of credit cards, protecting their customers' financial assets and maintaining the integrity of their services.
3) *Point-of-Sale (POS) Systems:* The proposed system can be implemented in POS systems used in retail stores and other physical establishments. By verifying the customer's face during the payment process, it helps prevent fraudulent activities such as stolen credit cards or identity theft. It provides an extra level of assurance to merchants and customers, enhancing the overall security of in-person transactions.
4) *Retail and e-commerce:* In addition to credit card fraud prevention, face recognition can be used in the retail and e-commerce industries to provide a seamless and secure checkout experience for customers. By integrating face recognition with payment systems, customers can quickly and securely complete transactions without the need for physical cards or signatures.

These applications highlight the versatility and potential impact of the proposed credit card fraud detection system across various industries. By incorporating the system into relevant platforms and services, businesses can mitigate the risks associated with credit card fraud, protect their customers, and uphold their reputation for providing secure and trustworthy transactions. This system can be incorporated with any card system that needs a verification and authentication of the card owner to prevent any kind of fraud or unauthorized access.

A few more examples include-

1) *Access Control:* Face recognition can be used as a means of access control for secure areas, such as offices, banks, and airports. By integrating face recognition with card verification, the system can ensure that only authorized personnel can gain access to sensitive areas.
2) *Government and Law Enforcement:* Face recognition can be used by law enforcement agencies for identity verification and to identify suspects. By integrating face recognition with card verification, government agencies can ensure that only authorized personnel have access to sensitive information and facilities.
3) *Corporate ID Cards:* Many companies issue ID cards to employees to ensure that only authorized personnel have access to their facilities. Face verification technology can be used to verify the identity of employees before granting access to secure areas.

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4) One potential application of face verification in combination with ID cards is in college and university libraries. By implementing a system that requires students and staff to authenticate their identity using a facial recognition algorithm, the library can ensure that only authorized individuals are granted access to the library and its resources. This can help to prevent unauthorized access and improve the security of the library's collection.

VII. CONCLUSIONS

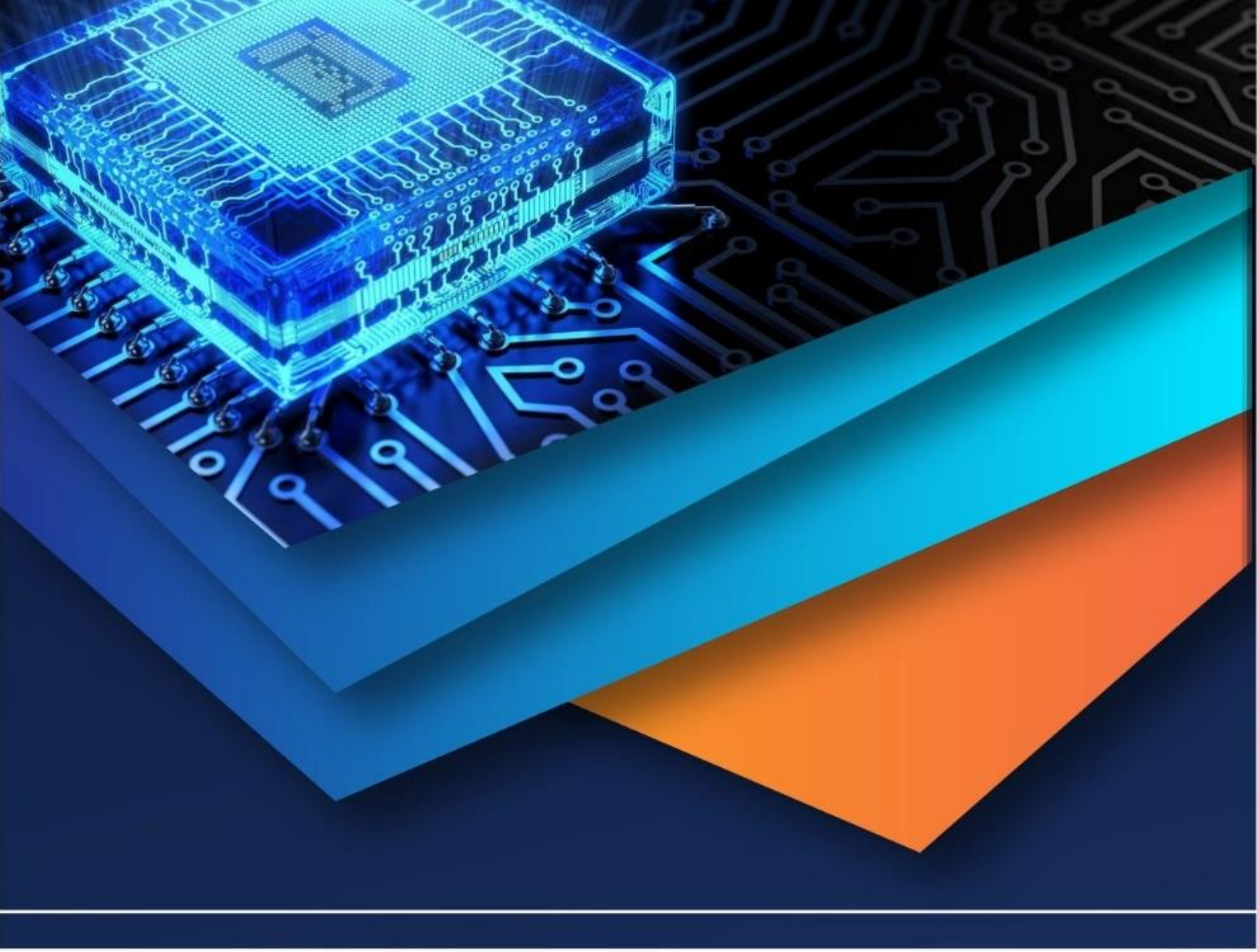
In conclusion, the use of face recognition technology and machine learning algorithms for credit card fraud detection provides a powerful tool for improving the security of credit card transactions. The proposed system offers a two-factor authentication process that combines credit card verification with user face recognition, making it more difficult for fraudulent transactions to take place. By incorporating real time transaction authorization and fraud detection, the system ensures fast and accurate detection and prevention of fraudulent activities.

VIII. ACKNOWLEDGMENT

We would like to express our sincere gratitude to all those who have contributed to the successful completion of our project entitled "CARD DEFENDER - CREDIT CARD FRAUD DETECTION SYSTEM". We are grateful for the support and assistance provided by individuals who have been actively involved at different stages of this project. Their dedication and expertise have made it possible for us to achieve our objectives.

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