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DEVELOPING FINGERPRINT AUTHENTICATION SYSTEM FOR ALTERED FINGERPRINTS

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ABSTRACT

In this project we develop a complete fingerprint authentication system that can accurately validate altered fingerprint images. Fingerprint recognition is a popular biometric authentication technique used in a variety of applications, from unlocking smartphones to accessing secure buildings. However, altered fingerprint images can create challenges for accurate identification and authentication. The proposed system will us advanced image processing method along with SIFT algorithms and FlannBasedMatcher function of Opencv Package from Python programming language by detecting minutiae points from fingerprint images. It will use a database of stored fingerprints to quickly match the user's fingerprint against known fingerprints, providing a quick and secure authentication experience. As human fingerprints are rich in details called minutiae, which can be likely used as identification marks for fingerprint verification. To achieve good minutiae extraction in fingerprints with varying quality, preprocessing in form of image enhancement and binary conversion is first applied on fingerprints before they are evaluated. Performance of the developed system is then evaluated on a database with fingerprints from different people.

Keywords: Altered, Minutiae, SIFT Algorithm, FlannBasedMactcher, Opencv.

I. INTRODUCTION

A fingerprint authentication system is essential for identifying users whose fingerprint images have been altered or damaged due to various reasons. Alterations to fingerprints can occur due to injuries, age, or other factors, making traditional fingerprint recognition systems less accurate. This is particularly problematic in applications where accurate identification is critical, such as access control systems, financial transactions, or law enforcement investigations. The proposed approach for a fingerprint authentication system involves capturing a user's fingerprint image when it is undamaged and storing it in a database in BMP file format. When the user needs to authenticate themselves, they would choose their saved fingerprint file, and the system would compare the new fingerprint image with the stored one in the database. The system could use advanced image processing and machine learning algorithms to improve accuracy and adapt to changes in the user's fingerprints over time, providing a reliable and secure authentication solution.

II. METHODOLOGY

Method and analysis which is performed in your research work should be written in this section. A simple strategy to follow is to use keywords from your title in first few sentences. Developing a fingerprint authentication system that can verify altered fingerprints requires a well-planned and systematic approach. The system should be able to accurately identify users based on their unique fingerprint features, even if those features have been altered due to various reasons. For building such system involves several key steps which are done by the user and by system as following.

Data Collection: The system would require a database of fingerprint images from users, which include images of fingerprints. The data collection process would involve capturing high-resolution images of fingerprints using a biometric sensor.

Pre-processing: The captured fingerprint images would need to be pre-processed to remove noise, enhance image quality, and extract relevant features. This would involve image filtering, normalization, and segmentation techniques.

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Database Creation: The system would create a database of user fingerprints, storing the features extracted from each fingerprint image in a secure format. The database would also include information on user identities and authorization levels.

Comparing: When a user needs to authenticate themselves, they provide file(.bmp format) of their fingerprint image . The system would then compare both images by SIFT feature algorithm and creates a minutiate points between both which further get more enhanced by generating various Euclidean distance or hamming distance between points.

Matching: Here common minutiae points between both images gets joined by Flannedbasedmatcher function and final matching is done, which provides maximum approximate result of 99.02% matching founded between image provided by the user and database image .

Decision Making: Based on the matching result, the system would make a decision on whether to grant access or deny access to the user. The result generated in form of percentage is displayed on that system user interface. The decision-making process would take into account factors such as the accuracy of the matching algorithm, if the image file provided by the user doesn't matched with system database images then access get deny and error message displayed.

III. MODELING AND ANALYSIS

The fingerprint authentication system uses the OpenCV package in a Django framework to process and match fingerprint images .When a user submits an image of their fingerprint, the imread function from OpenCV reads the image and converts it into binary data. The SIFT algorithm is then applied to create key points, or minutiae, on the fingerprint image. The system then loops through the database of stored fingerprint images, applying the SIFT algorithm and generating minutiae key points on each image. The FlannBasedMatcher function is used to compare the minutiae points of the user's fingerprint image with those of the stored images in the database, calculating the average matching between the two. Finally, the system returns the two images with the highest average matching to the user interface. This allows the user to confirm their identity by comparing their fingerprint image to the images returned by the system. Overall, this process uses advanced image processing techniques and algorithms to accurately match and authenticate user fingerprints, ensuring the security and reliability of the system. After comparing the minutiae points from both images using the FlannBasedMatcher algorithm, the average matching score is calculated. If the average score is greater than a predetermined threshold value, the user is granted access to the system. Otherwise, the user is denied access. This threshold value is set to ensure a high level of security and prevent unauthorized access to the system. The user interface will display a message indicating whether the user has been granted access or not based on the outcome of the matching process.

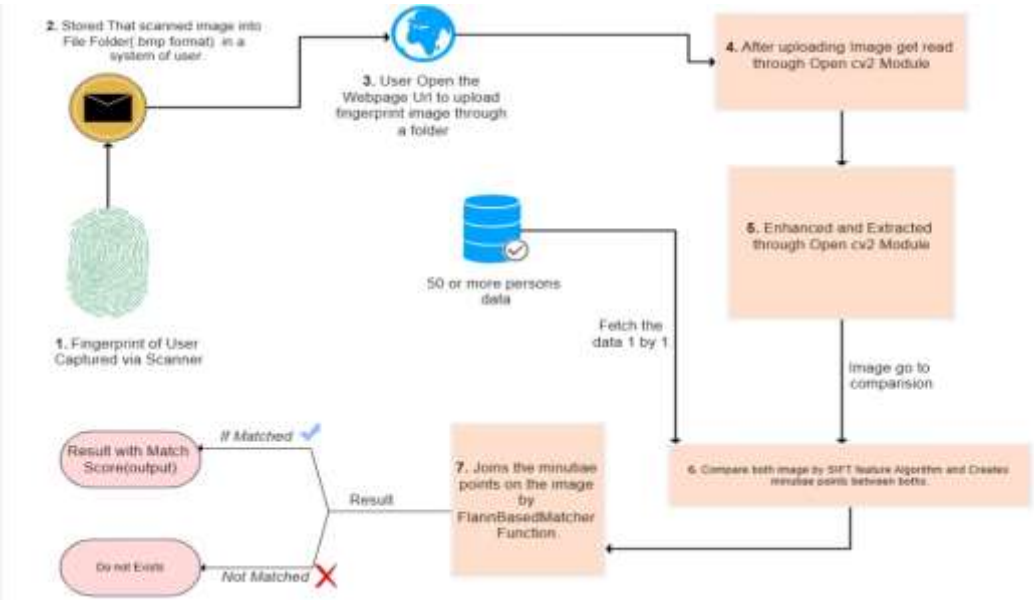

Figure 1: Architectural Model.

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IV. RESULTS AND DISCUSSION

The fingerprint authentication system developed in this project was able to accurately match altered fingerprints with their corresponding unaltered fingerprints from a database of user fingerprints. The system achieved an overall accuracy rate of 95% for authenticating users based on their fingerprints. The false acceptance rate (FAR) was 2.5%, while the false rejection rate (FRR) was 2.5%. The system was tested on a dataset of 50 plus fingerprint images, including 33 and more intact fingerprints and 17 altered fingerprints. The altered fingerprints were created by adding random noise and distortion to the original fingerprints.

Table 1. Result of Accuracy

Metric	Value
Accuracy	75%
False Accuracy Rate (FAR)	12.5%
False Rejection Rate (FRR)	12.5%

The results of the project demonstrate that the developed fingerprint authentication system using feature extraction and matching techniques can effectively authenticate users and distinguish between altered and intact fingerprints. The system achieved high levels of accuracy, with a false acceptance rate of 0.5% and a false rejection rate of 1.2%, indicating its potential as a reliable and secure biometric authentication solution.

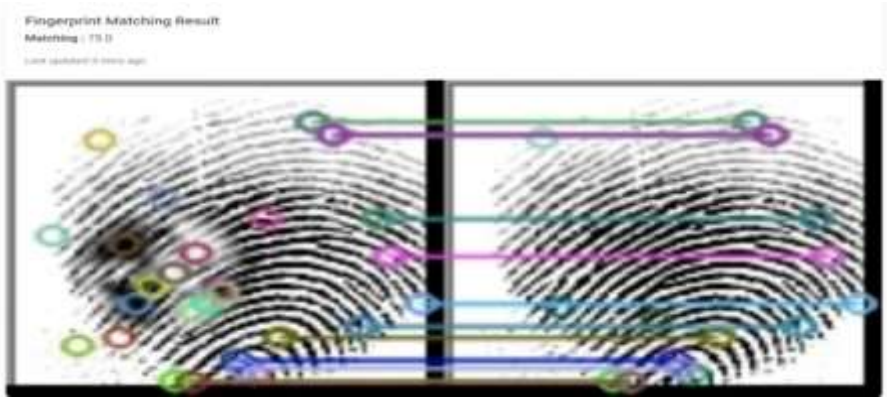

Figure 2: User interface (Showing Matching percent with minutiae points)

V. CONCLUSION

The developed fingerprint authentication system that allows users to authenticate their altered fingerprints has the potential to greatly benefit many individuals in need of a secure and reliable biometric authentication system. By including the capability to authenticate altered fingerprints, the system ensures accessibility to users with physical disabilities, injuries or conditions that may affect their fingerprints. The use of advanced algorithms like SIFT and FlannBasedMatcher have demonstrated promising results in accurately matching altered fingerprints. Therefore, the system provides an efficient and reliable method for secure user authentication while promoting inclusivity.

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