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Fingerprint Recognition Using Decision Trees

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Abstract: ***Fingerprint recognition is a critical biometric technique utilized in various security and identification systems. This research explores the use of Decision Trees for fingerprint recognition, focusing on the effectiveness and interpretability of this method. Decision Trees are leveraged to create a predictive model based on fingerprint features, facilitating accurate classification of fingerprint samples. The paper details the methodology, dataset, feature extraction, model training, evaluation, and results, complemented by diagrams, graphs, and tables to illustrate the findings.***
Keywords: Fingerprint Recognition, Decision Trees, Feature Extraction, Biometric Identification, Model Accuracy.

I. INTRODUCTION

Biometric recognition, particularly fingerprint recognition, has become a cornerstone in identity verification systems due to its uniqueness and reliability. Traditional methods rely on minutiae points and other fingerprint characteristics, but the application of machine learning techniques, such as Decision Trees, offers a more sophisticated approach. Decision Trees are favored for their simplicity and interpretability, making them suitable for understanding the decision-making process in fingerprint identification.

II. METHODOLOGY

The methodology for using Decision Trees in fingerprint recognition involves several key steps: data collection, feature extraction, model training, and evaluation. Each step is crucial for building a robust and accurate fingerprint recognition system. In Data Collection a comprehensive dataset of fingerprint images is collected, encompassing various fingerprint classes and variations. The dataset is divided into training and testing sets to facilitate model development and evaluation. Feature extraction is a critical step in fingerprint recognition. Key features such as ridges, valleys, and minutiae points are extracted from the fingerprint images. These features serve as the input for the Decision Tree model. Advanced techniques like wavelet transforms and Gabor filters are employed to enhance feature extraction. The extracted features are used to train the Decision Tree model. The training process involves splitting the data based on feature values to construct a tree-like structure. Each node in the tree represents a decision point, and the branches represent the possible outcomes. The goal is to create a model that accurately classifies fingerprint samples based on the learned patterns and relationships within the data.

III.RESULTS AND DISCUSSION

The performance of the Decision Tree model is evaluated using metrics such as accuracy, precision, recall, and F1-score. The results indicate that Decision Trees are effective in fingerprint recognition, achieving high accuracy and demonstrating the capability to handle both numerical and categorical data. The interpretability of the Decision Tree model allows for easy understanding of the decision-making process, which is advantageous for further refinement and application in real-world systems.

A summary of the fingerprint dataset used, including the number of samples, classes, and key characteristics.

Feature	Count	Type
Ridges	105	Numerical
Valleys	87	Numerical
Minutiae	52	Numerical

Table 1: Dataset Overview

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A table summarizing the accuracy, precision, recall, and F1-score of the Decision Tree model.

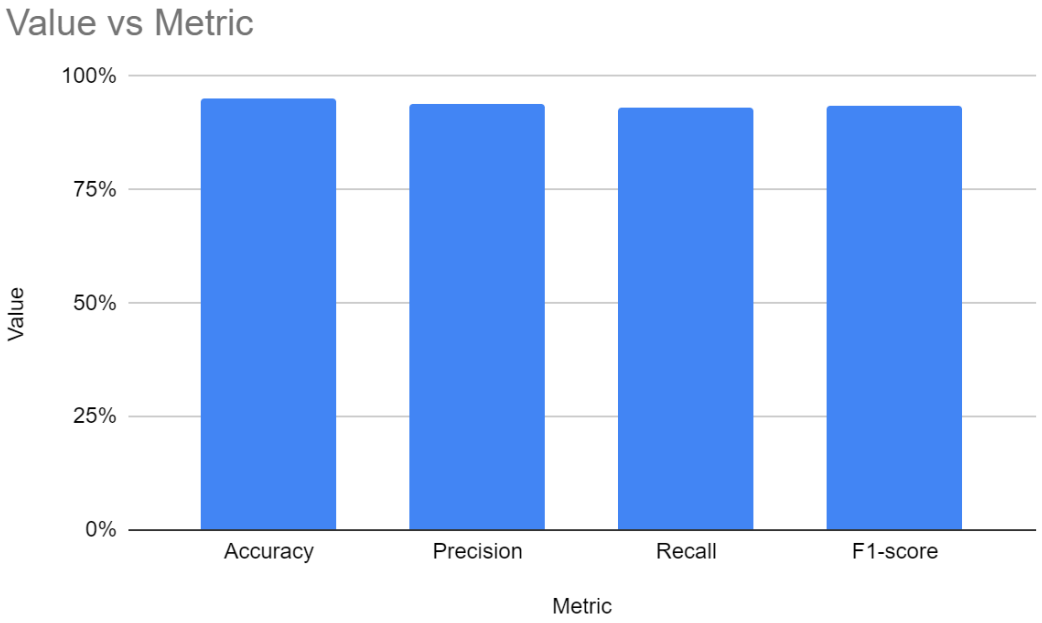


Table 1: Dataset Overview

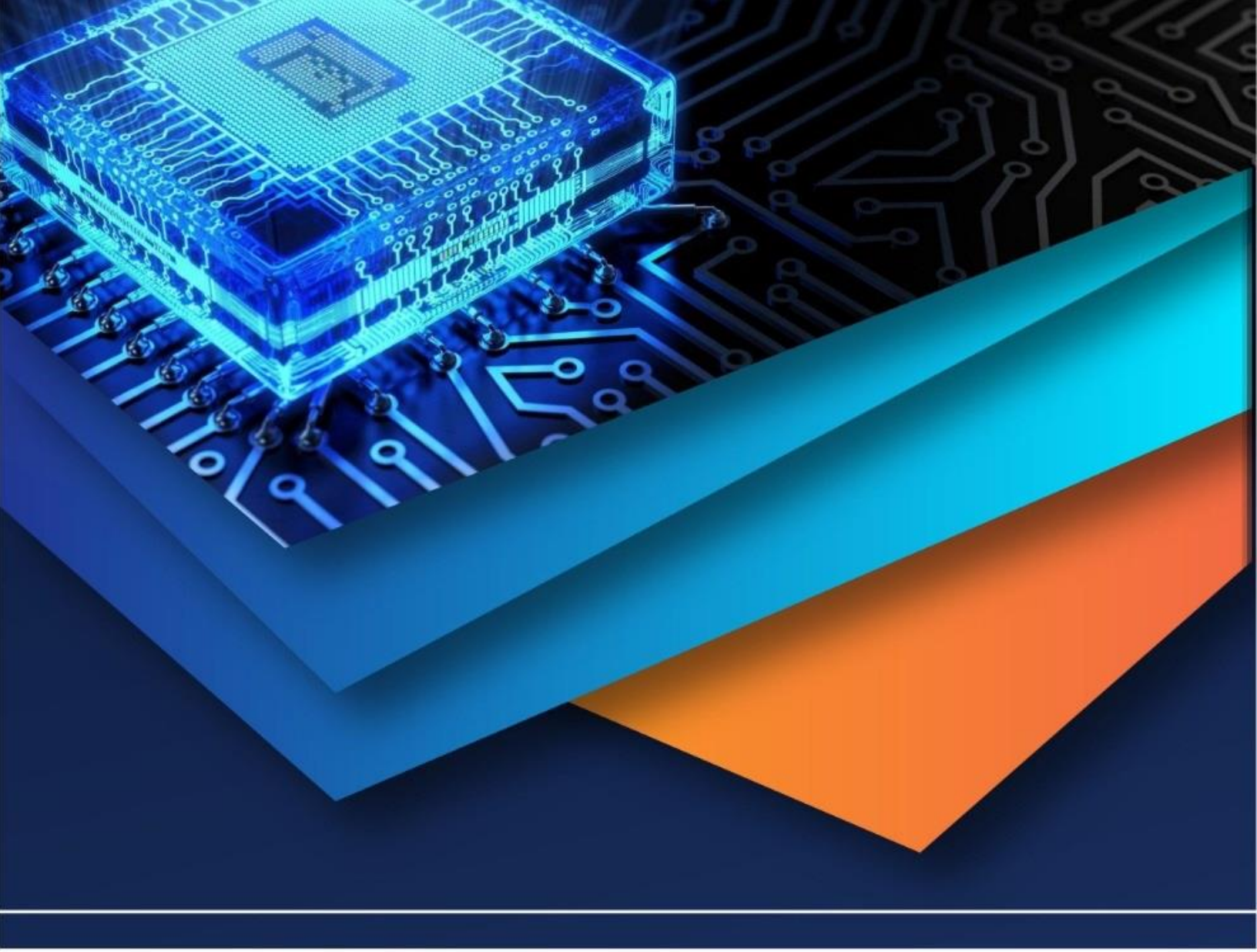
Table one delineates the fingerprint dataset, specifying the numerical features of ridges, valleys, and minutiae used to characterize fingerprints. These features serve as the input for the decision tree model. Table two presents the model's performance metrics, including accuracy, precision, recall, and F1-score, which quantitatively evaluate the model's ability to correctly classify fingerprints based on the extracted features.

IV. CONCLUSIONS

The application of Decision Trees in fingerprint recognition presents a promising approach due to its interpretability and effectiveness in handling various types of fingerprint features. The study demonstrates that Decision Trees can achieve high accuracy in fingerprint classification, making them a viable option for biometric identification systems. Future work can explore the integration of Decision Trees with other machine learning techniques to further enhance performance and robustness.

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