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AI Based Identity Verification using IRIS as a Biometric Modality

Dhanush R[1], K R Sumana[2]
PG Student, Faculty, The National institute of Engineering, Mysuru, Viweswaraya Technological University, Belgaum, Karnataka

Abstract: ***The aim of our work is to create a sophisticated eye iris detection system that leverages the power of machine learning algorithms to achieve precise and real-time identification of the iris region in digital eye images. The system aims to offer a user-friendly interface for capturing eye images or accepting image inputs, and it will display the detected iris region with relevant information. The ultimate goal is to develop a versatile solution that can be integrated into biometric authentication or security systems, enabling effective identity verification and facilitating various applications in surveillance, healthcare, and other domains by using CNN (Convolutional Neural Network) and RSNN (Reservoir Computing-based Spiking Neural Network.***
Keywords: Machine Learning, CNN, RSNN, IRIS, Biometric authentication

I. INTRODUCTION

In an era of heightened security and privacy concerns, the demand for robust identity verification systems has surged. Traditional authentication methods like passwords and PINs are vulnerable to various attacks, making biometric modalities an attractive solution. Among these, iris recognition shines as a remarkably secure and accurate means of identity verification. The intricate and stable iris patterns, formed during fetal development and enduring throughout life, provide unmatched uniqueness in biometrics. The human iris, with its distinctive features, is recognized as a highly reliable biometric marker. This project aims to harness the potential of the iris by developing an advanced machine learning-based eye iris detection system, enabling precise identification and localization of the iris region in digital eye images. Leveraging the iris's reliability and immutability, this system promises heightened security and efficiency for authentication and identification in diverse applications.

II. LITERATURE SURVEY

A deep learning-based iris recognition system [1] called Deep Iris Net. The authors employ a 1D CNN architecture to extract discriminative features from the iris images. They also introduce a large-scale iris dataset, and their experiments demonstrate that Deep Iris Net achieves competitive performance compared to traditional iris recognition methods. An efficient iris recognition system using a convolutional autoencoder. The proposed method leverages the autoencoder to learn compact iris representations. The extracted features are then used for classification tasks. The authors demonstrate [2] the effectiveness of their approach on publicly available iris datasets, achieving promising recognition rates. In the work [3], the authors propose a multiscale CNN architecture for iris recognition. The model operates at multiple scales to capture both fine-grained and coarse-grained iris patterns. The proposed approach is evaluated on standard iris datasets, and the results show improved recognition accuracy compared to conventional methods. A two-stream CNN architecture for iris recognition [4]. The authors employ two parallel CNN streams—one processes the iris texture, and the other processes the iris. contour. The features extracted from both streams are fused to improve recognition performance. Experimental results on benchmark iris datasets demonstrate the effectiveness of the proposed approach. A multitask learning approach for iris recognition using CNNs. The model [5] simultaneously learns to perform iris segmentation and recognition tasks. The multitask learning framework enables the network to share knowledge between tasks, leading to better generalization and improved recognition accuracy.

III. PROPOSED SYSTEM

The proposed system introduces an innovative solution that surpasses the constraints of existing methods by utilizing a hybrid CNN-RNN algorithm. It comprises several key components starting with data collection and preprocessing, involving tasks like resizing, normalization, and data augmentation to enhance data quality. Feature extraction is accomplished using a CNN architecture, which excels at capturing intricate patterns in iris images. Subsequently, extracted features are transformed into sequences and processed through RNN layers to capture temporal dependencies.

The hybrid model architecture seamlessly integrates the strengths of both CNNs and RNNs, with CNN layers focusing on feature extraction and RNN layers capturing sequence information. Training and optimization involve using a curated dataset and tuning hyperparameters for optimal performance. Model evaluation encompasses metrics like accuracy, precision, recall, and F1-score, with fine-tuning based on evaluation results. Finally, the optimized hybrid model undergoes testing on a separate dataset to assess its generalization capability, potentially paving the way for real-world iris-based person identification tasks. This holistic approach capitalizes on the synergistic relationship between CNNs and RNNs, aiming to significantly enhance accuracy and reliability in iris-based person identification.

IV. METHODOLOGY

The methodology comprises several steps. Initially, it involves gathering a diverse dataset of labelled eye images that include both iris and non-iris regions for training and evaluation purposes. Following this, the collected data undergoes preprocessing to eliminate noise, normalize intensity, and standardize resolution. Subsequently, relevant features are extracted from the pre-processed images to effectively represent the iris region and same is shown in the below figures 1, 2, and 3.

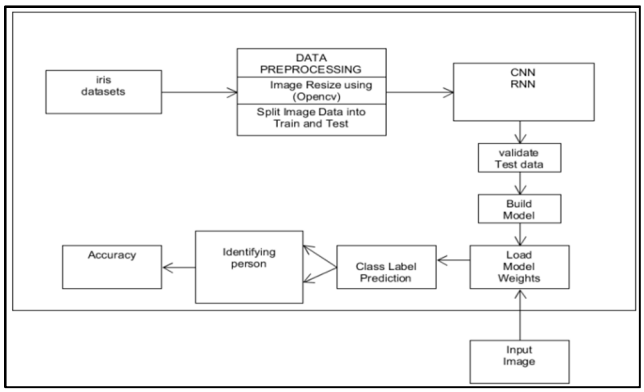

Fig. No.: 1 Architecture of the system

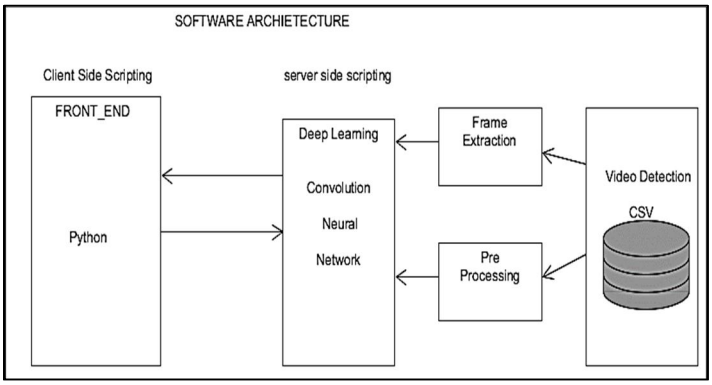

Fig. No.: 2 Software Architecture

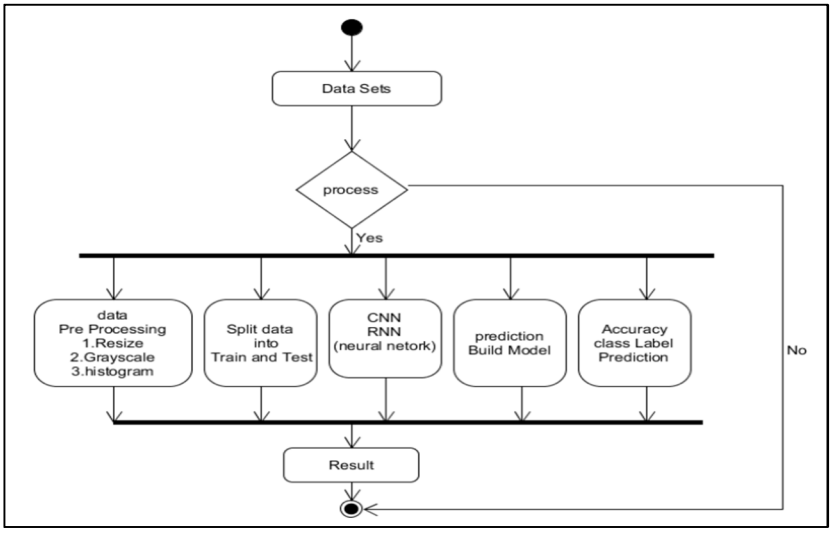

Fig. No.: 3 Activity Diagrams of the system

Then, an appropriate machine learning model, such as a Convolutional Neural Network (CNN) or Support Vector Machine (SVM), is chosen and trained using the extracted features along with corresponding labels. The model's accuracy and performance are assessed on a separate test dataset to gauge its effectiveness. Finally, the trained model is implemented in a real-time environment for rapid and accurate iris detection, accompanied by the development of a user-friendly interface for users to input eye images and visualize the detected iris regions. The below figure 4 shows the CNN model applied to our work.

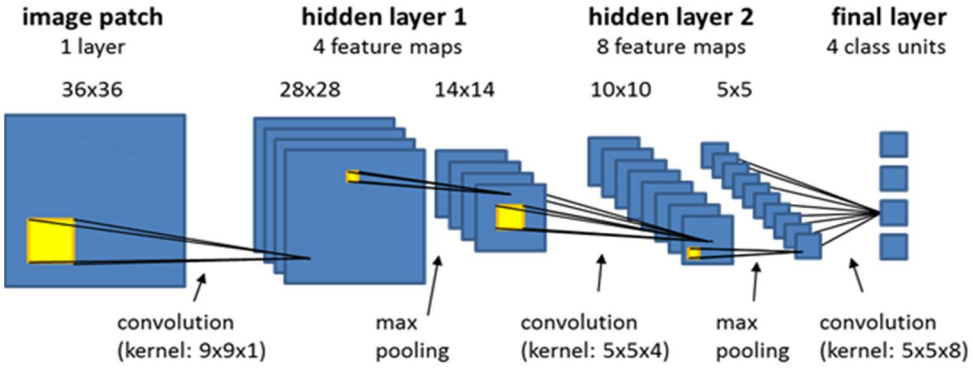

Fig. No. :4 Convolutional Neural Network

The below figure 5 shows the RNN model applied to iris detection system.

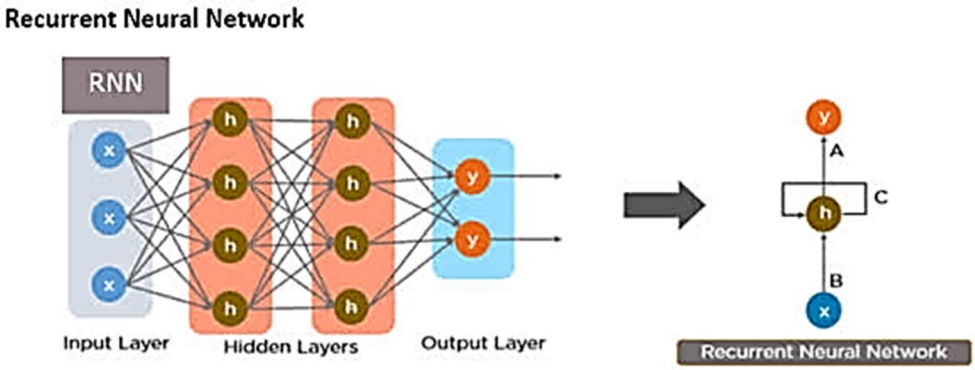

Fig. No.: 5 CNN and RNN Model of the system

V. RESULT ANALYSIS

This the home page of the proposed system which welcomes the user and has different buttons which helps user to navigate freely and same is shown in figure 6 below.

Fig. No.: 6 Home Page

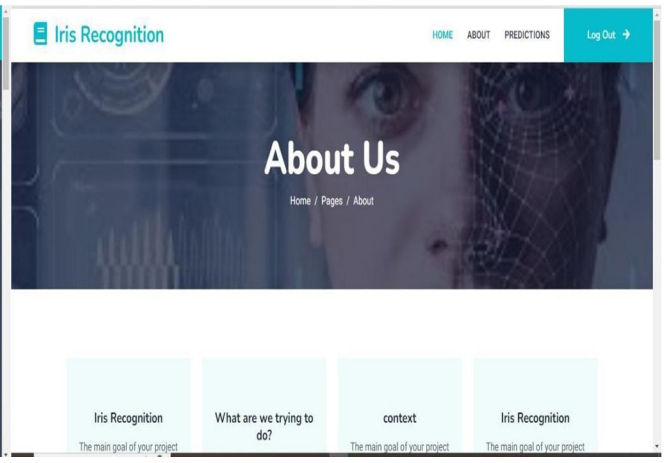

Fig. No.: 7 About Us page

The figure 7 shows the above page gives the details about the purpose of project, it contains all the resources used for this project and it gives a brief understanding about how this project works.

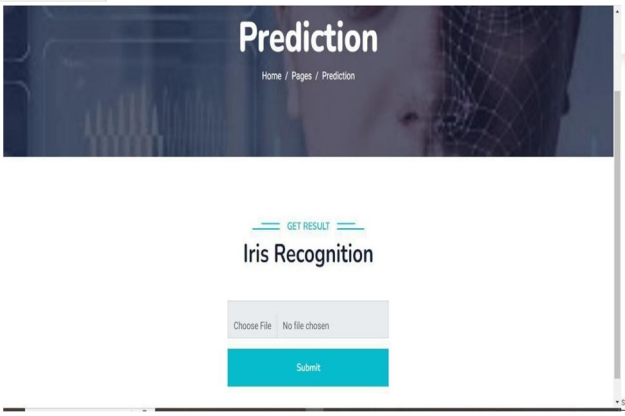

Fig. No.: 8 Image upload Page

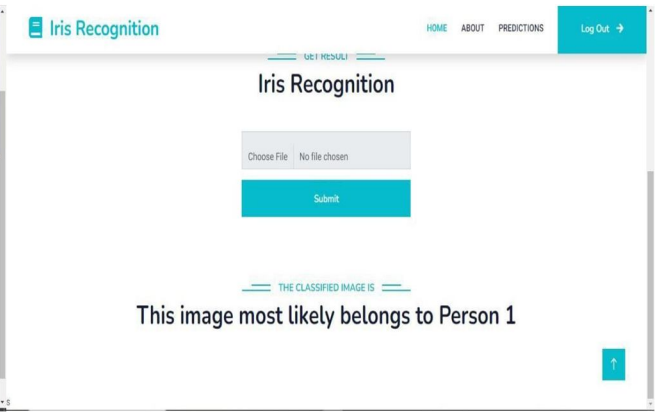

Fig. No.: 9 Result Page

Here in this page as displayed in the above snapshot user gets two option Upload image and Submit, they can use it to upload the image to system where prediction starts. And finally, the user gets result of different matching iris suited for their iris pattern as shown in the image.

VI. CONCLUSION

In summary, iris detection stands as an innovative and effective system that harnesses the power of machine learning. Through a thorough evaluation process, we assessed multiple models including CNN, RSNN this underscores its ability to capture. Our meticulous analysis extended to precision and recall values across distinct iris patterns categories, offering valuable insights into model performance for each. weighted averages allowed us to comprehensively gauge model effectiveness across categories. Training of dataset is done with high priority so as to pull the maximum accuracy possible by the system mainly focusing on the required pattern.

VII. ACKNOLEDGEMENT

We would like to express our sincere thanks and indebtedness to my esteemed institution, The National Institute of Engineering, Mysuru which has provided me with an opportunity to fulfil my desire and reach my goal. Their insightful feedback and encouragement at every stage of the project have been truly inspiring. We extend our heartfelt appreciation to our family and friends for their unwavering love, encouragement, and understanding throughout our academic journey.

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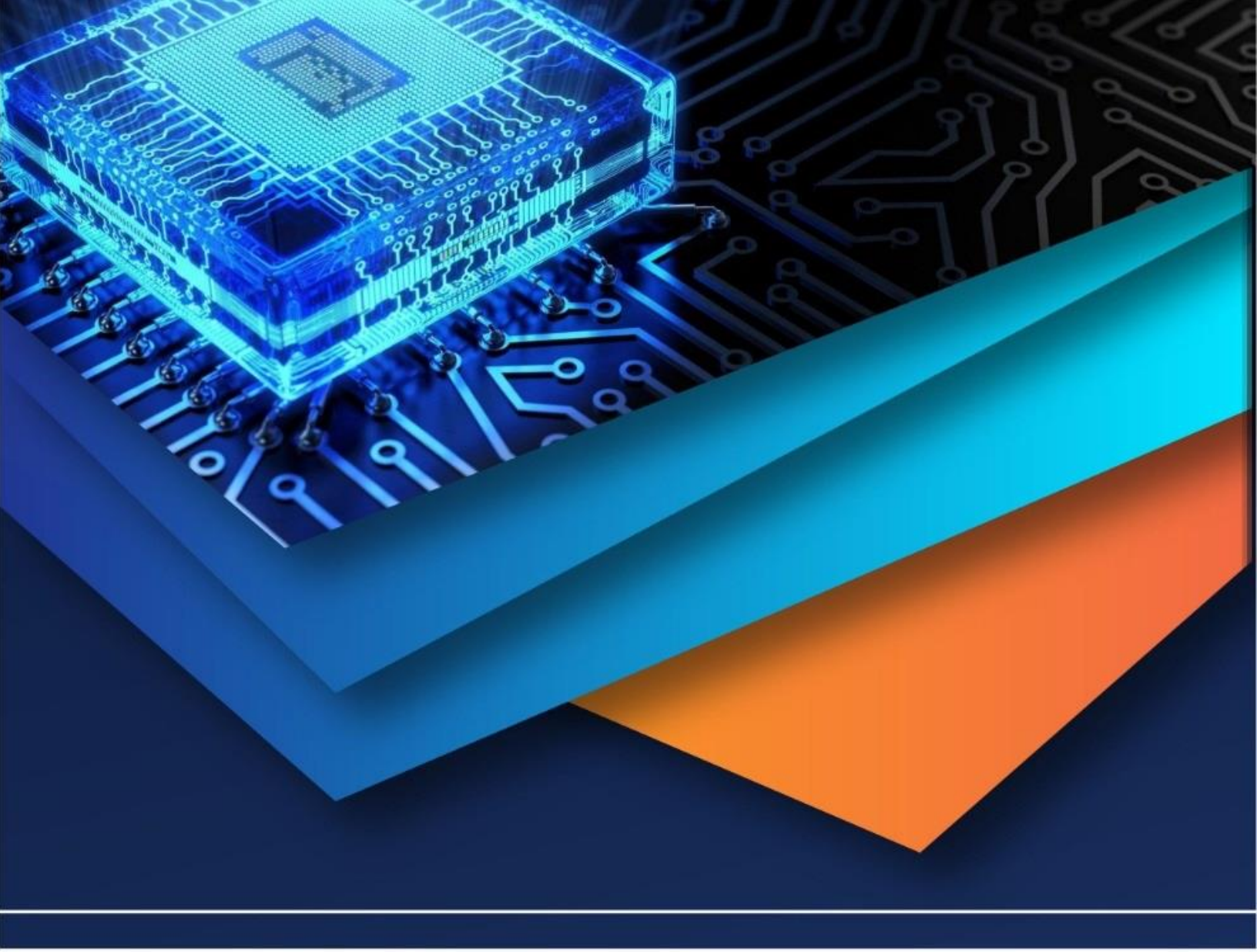
[4] Python ML, Third Edition , Sebastian Raschaka, Vahid Mirjalili
[5] A hybrid approach to building iris retina detection recommender system. Kitsuchart pasupa, wisuwat sunhem , chu kiong loo
[6] Deep iris .net: A new large scale data set for iris recommendation based on yutao chen, Yuxuan zhang



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