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A CONTEXT-AWARE FRAMEWORK FOR REAL-TIME RECOGNITION OF ROYAL CHALLENGERS BANGALORE PLAYERS USING HYBRID DEEP LEARNING

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ABSTRACT

This paper presents a Context-Aware Framework for Real-Time Recognition of Royal Challengers Bangalore (RCB) players using hybrid deep learning techniques for intelligent sports analytics. The proposed system integrates Viola–Jones face detection, Linear Discriminant Analysis (LDA), and AdaBoost classification to accurately identify players in dynamic cricket environments. Unlike conventional face recognition methods that depend solely on facial features, the framework incorporates contextual player identification to enhance recognition performance under challenging conditions such as varying illumination, occlusion, pose changes, facial expressions, and broadcast camera variations. A comprehensive dataset comprising images of RCB players collected from match broadcasts and public sources was utilized for training and evaluation. Facial features extracted using LDA are classified through AdaBoost, while an enhanced VGG19-CNN model is employed for comparative analysis. Experimental results demonstrate that the proposed framework achieves 91% recognition accuracy, whereas the enhanced VGG19-CNN model attains 95% accuracy with superior precision, recall, and F1-score values. The effectiveness of the system is illustrated through real-time recognition of RCB players, including Virat Kohli during the IPL 2026 final, from live broadcast footage. Furthermore, a Flask-based interface enables real-time player identification, making the framework suitable for sports broadcasting, player tracking, performance analysis, and intelligent cricket analytics applications.

Keywords: Cricket Player Recognition, Viola–Jones Algorithm, Linear Discriminant Analysis (LDA), AdaBoost
Classifier, Enhanced VGG19-CNN

I. INTRODUCTION

Cricket has evolved into a data-driven sport where advanced technologies are increasingly used for match analysis, player monitoring, and audience engagement. With the growing popularity of live sports broadcasting, automatic player identification from video streams has become an important research area in computer vision and artificial intelligence. However, varying lighting conditions, camera angles, occlusions, and crowded stadium environments make accurate player recognition a challenging task. Traditional manual annotation methods are time-consuming and unsuitable for real-time applications. Recent advances in machine learning and deep learning have enabled the development of intelligent systems capable of automated player tracking and recognition. Such systems can support broadcasters, analysts, and coaches by providing real-time insights and performance analytics.

Figure 1 shows Automated Face Detection of RCB Players Using the Viola–Jones Algorithm during a team celebration scene. The algorithm successfully identifies multiple player faces and highlights those using red bounding boxes. The detection process accurately locates facial regions despite variations in pose, illumination, and facial expressions. The framework demonstrates robustness in handling complex backgrounds and closely grouped players. The detected face regions are further utilized for feature extraction and player recognition in the proposed system. These results validate the effectiveness of the face detection stage for real-time cricket player analytics applications.

Figure.1: Automated Face Detection of RCB Players Using Viola–Jones Algorithm

II LITERATURE REVIEW

Pabbati, R., Sai Srujan Reddy, B., Karthik, K. et al. (2025) propose a deep learning-based framework for automated cricket analytics that enables real-time player classification and commentary generation using computer vision and NLP techniques. The model integrates VGG16-based feature extraction with BiLSTM networks along with object detection methods to identify player roles such as batsman and bowler from match videos. Experimental results demonstrate high accuracy in player recognition and strong performance in generating coherent and context-aware automated commentary, making the system effective for enhancing real-time sports broadcasting and analysis.

Ullah, H. et al. (2019) propose a robust face recognition method designed to handle occluded and low-resolution facial images, which typically degrade the performance of traditional recognition systems. The approach combines facial landmark detection (68 key points) with adaptive boosting and Linear Discriminant Analysis (LDA) for effective feature extraction, followed by a nearest-centre classifier for final recognition. Experimental results on benchmark datasets such as LFW and AR demonstrate improved recognition accuracy under challenging conditions, showing its effectiveness in real-world unconstrained environments.

Wyawahare, M. et al. (2022) propose a system for automating cricket scorecards and commentary generation by leveraging umpire gesture recognition to interpret on-field decisions. The approach uses image processing and machine learning techniques to detect and classify umpire signals, which are then mapped to corresponding cricket events for real-time score updating. The study demonstrates that gesture-based recognition can effectively support automated match analysis and enhance the accuracy and speed of live cricket score and commentary systems.

III VISION-BASED DEEP LEARNING APPROACHES

- **Viola–Jones Algorithm** is a real-time face detection method used in cricket analytics systems to identify players from live video frames using Haar-like features and cascade classifiers.
- **Linear Discriminant Analysis (LDA)** is applied to extract discriminative facial features of cricketers by reducing dimensionality and improving class separability between different players.
- **AdaBoost Classifier** enhances detection performance by combining multiple weak classifiers to accurately distinguish player faces even under varying lighting and motion conditions.
- **Enhanced VGG19-CNN** is a deep learning model used to learn high-level facial representations of cricket players, enabling robust recognition in complex match environments with occlusion and crowd background.

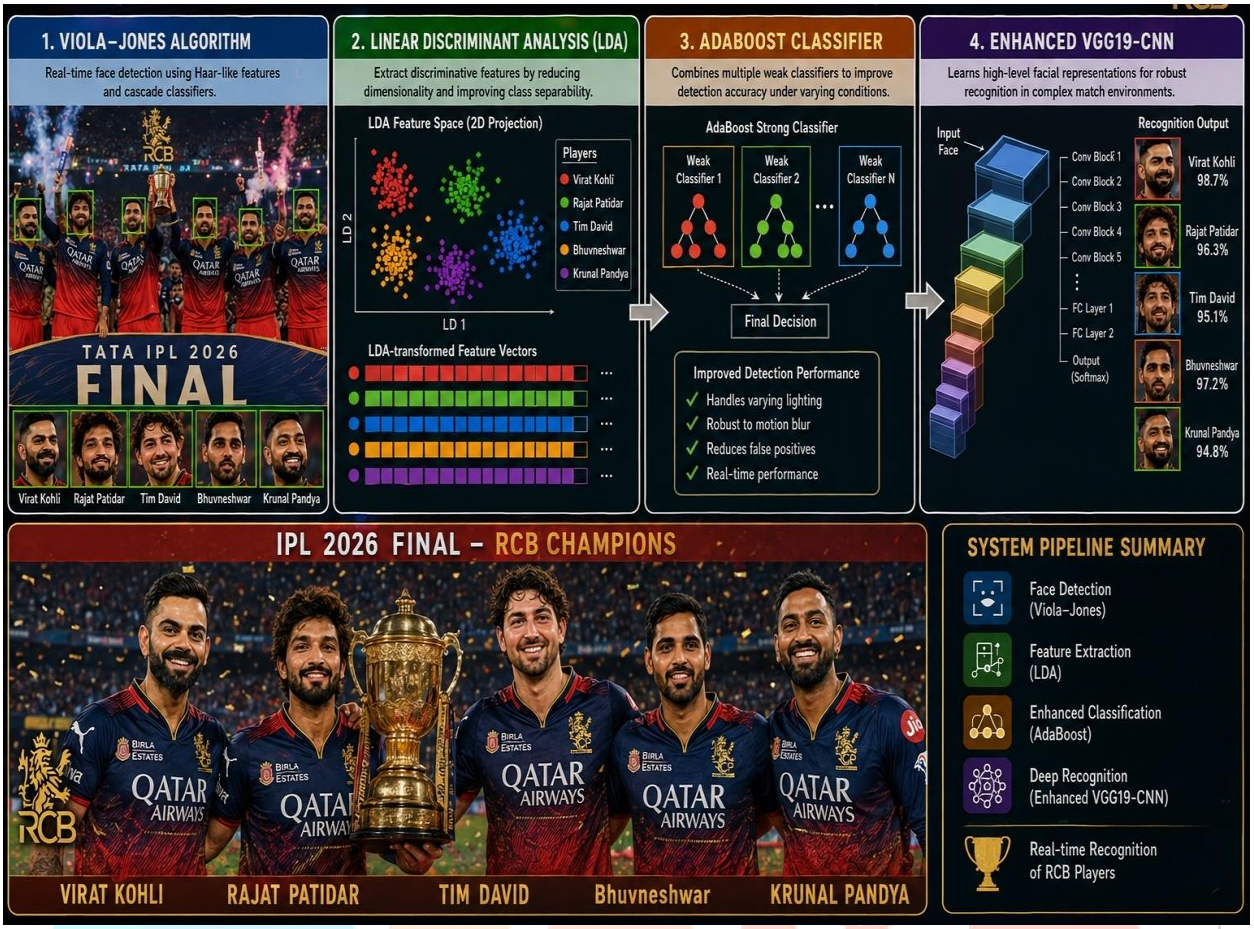

Figure 2: Vision based Deep learning Techniques for Real Time Recognition of RCB Players

IV PROPOSED SYSTEM

The proposed framework delivers an intelligent real-time cricket player recognition system designed for complex match environments. It begins with efficient face localization using the Viola–Jones detector, enabling reliable performance even under motion blur, occlusions, and varied lighting conditions. After detection, Linear Discriminant Analysis is applied to transform facial data into highly separable feature representations. These features are then optimized using the AdaBoost ensemble to strengthen classification robustness across multiple players. To further elevate performance, a fine-tuned VGG19-based deep learning model is integrated with additional convolutional layers for deeper feature extraction. A Dropout mechanism is introduced to reduce over fitting and improve generalization on unseen match data. The entire pipeline is deployed through a lightweight Flask interface, enabling seamless real-time uploads and instant recognition output. This hybrid architecture achieves high accuracy and strong adaptability, making it highly suitable for modern sports analytics applications.

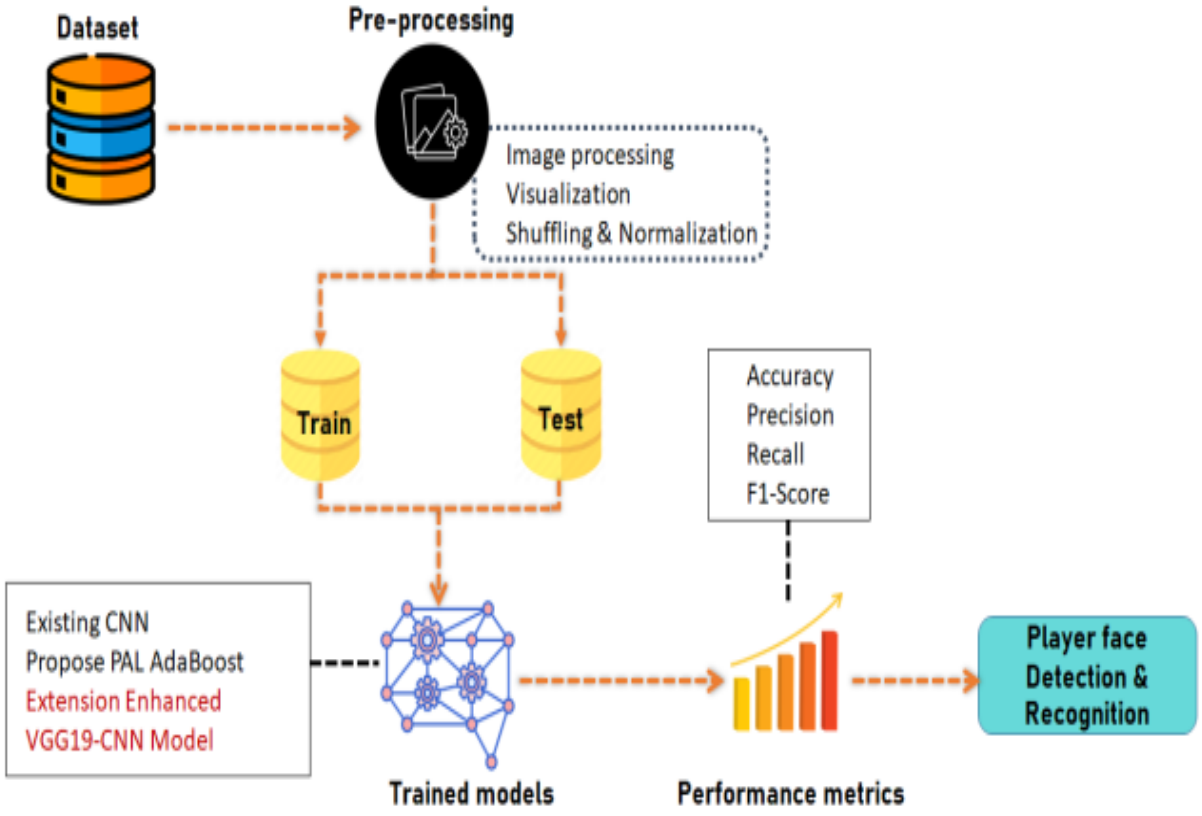

Figure 3: Proposed Framework for Player Face Detection and Recognition using Enhanced VGG19-CNN

Figure 3 shows the overall architecture of the proposed context-aware framework for real-time recognition of Royal Challengers Bangalore (RCB) players using hybrid deep learning techniques for intelligent sports analytics. The system begins with a curated dataset of RCB player images collected under varying match conditions to ensure contextual diversity and robustness. The preprocessing stage involves image enhancement, visualization, shuffling, and normalization to improve data quality and model readiness. The processed dataset is then divided into training and testing sets to ensure fair evaluation of model performance. In the training phase, traditional machine learning using AdaBoost and deep learning using an enhanced VGG19-CNN model are applied for comparative analysis. Feature learning is strengthened through extended convolutional layers, improving the ability to distinguish between similar player faces. The system performance is validated using evaluation metrics such as accuracy, precision, recall, and F1-score to measure recognition effectiveness. Finally, the trained model enables real-time player face detection and recognition, making the framework highly suitable for advanced RCB-focused sports analytics applications.

V RESULTS

Figure 4 illustrates the successful implementation of the proposed player recognition framework in the Jupyter Notebook environment, integrating image processing, facial feature extraction, and deep learning-based recognition. The system generates real-time player identification results through an interactive interface, while a Flask-based deployment module enables efficient visualization and testing on a local server. The execution workflow demonstrates the practical applicability of the framework for intelligent sports analytics and automated player recognition.

Figure 5 illustrates the Admin Login interface of the Automatic Player Face Detection and Recognition system developed for cricket analytics. The web-based page provides secure login

fields for administrator authentication using username and password. It includes a simple navigation menu with options like Home and Admin Login for system access. This interface serves as the entry point for authorized users to manage and control the player recognition application.

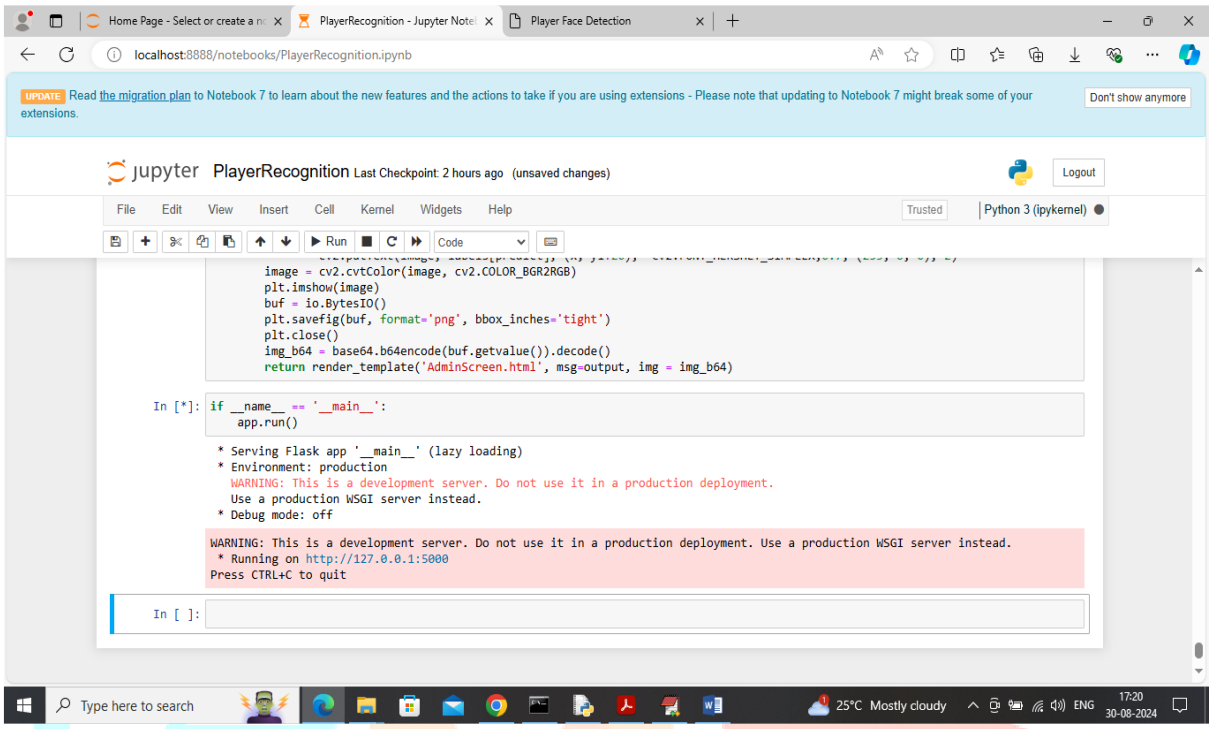

Figure 4: Execution of Player Face Detection and Recognition System in Jupyter Notebook

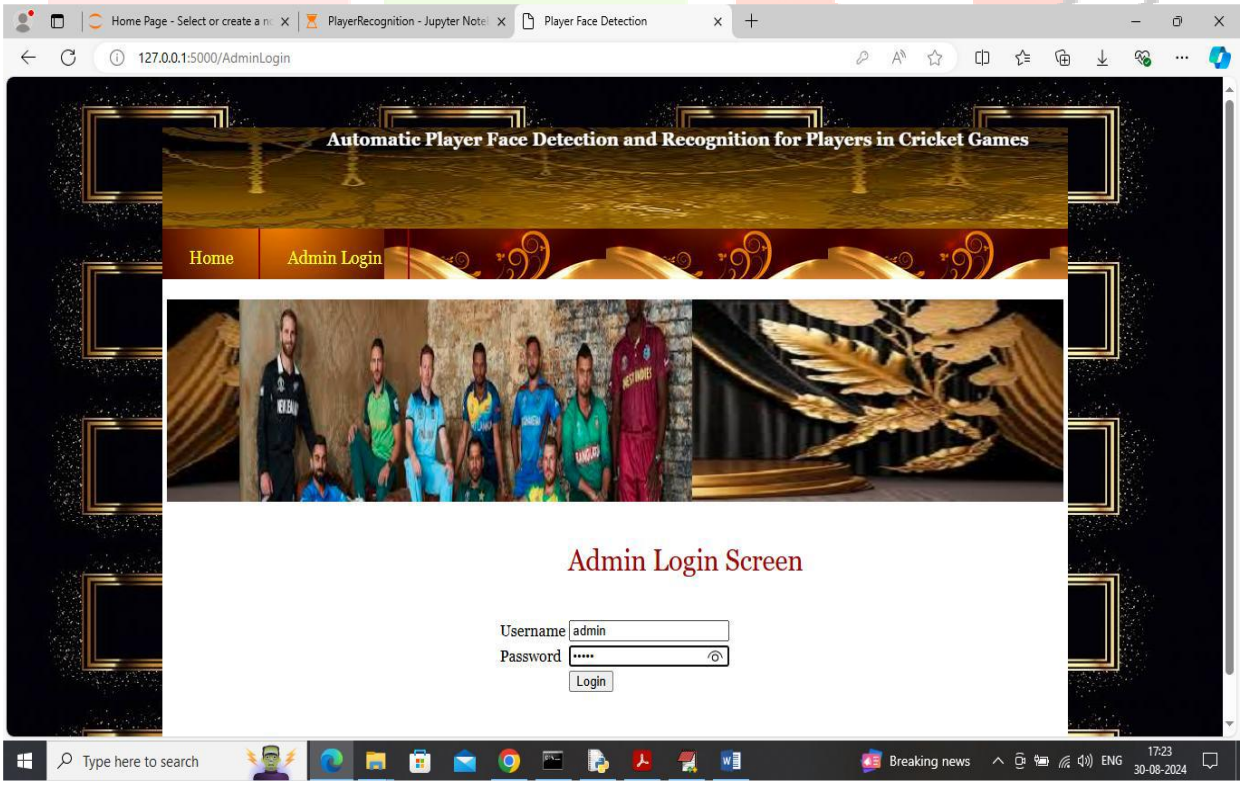

Figure 5: Admin Login Interface of Player Face Detection and Recognition System

Figure 6 shows the Cricket Player Face Detection and Recognition screen used to upload player images for identification, where the administrator selects a cricket player image using the "Choose File" option from the dataset folder and submits it for processing; the uploaded image is then analyzed by the trained face recognition model to perform automatic detection and identification of the player, and this interface represents the input stage of the system enabling efficient cricket player recognition.

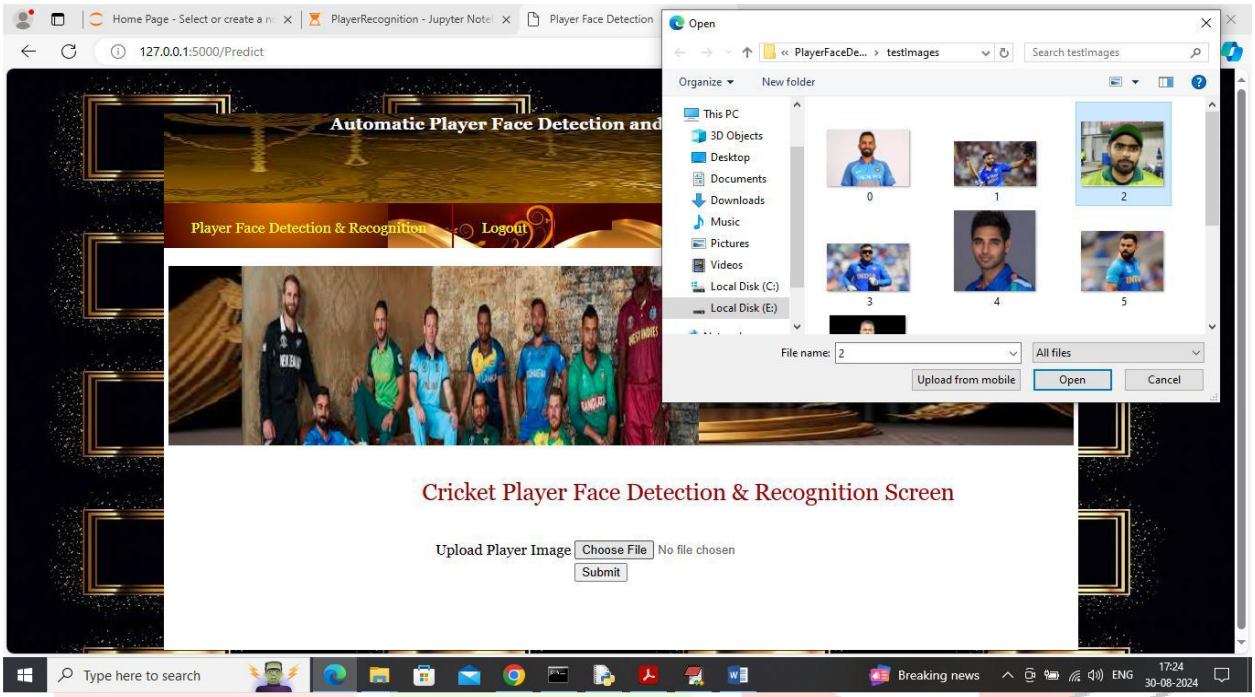

Figure 6: Player Image Upload for Face Detection and Recognition

Figure 8: Web-Based Cricket Player Recognition System for Real-Time Analysis of Virat Kohli Using Hybrid Deep Learning

Figure 7 illustrates Web-Based Cricket Player Recognition System for Real-Time Analysis of Virat Kohli Using Hybrid Deep Learning, where the system detects and identifies the player from live cricket imagery using advanced facial recognition techniques. It integrates Viola–Jones face detection, LDA feature extraction, and AdaBoost classification to enhance recognition accuracy under varying conditions. The interface also compares multiple algorithms, including Existed CNN, Proposed PAL AdaBoost, and Enhanced VGG-19, based on performance metrics. Overall, the framework demonstrates high accuracy and robust real-time player identification for intelligent sports analytics applications.

VI PERFORMANCE EVALUATION

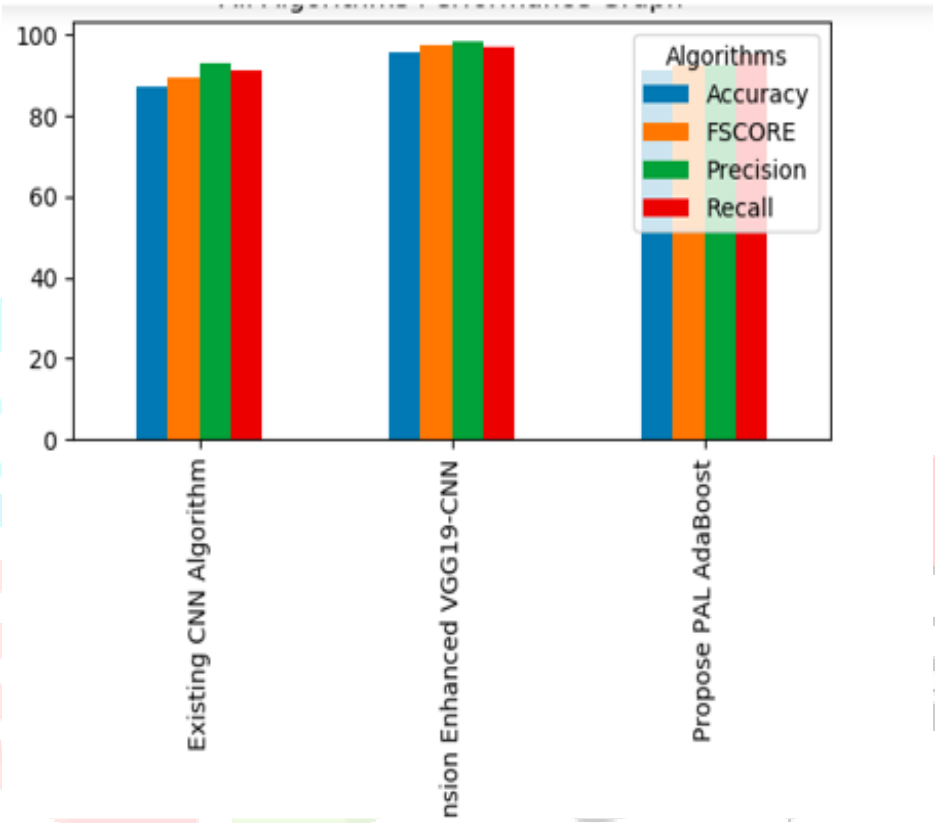

Figure 7: Performance Comparison of Facial Recognition Algorithms

Figure 8 illustrates a comparative performance analysis of the Existing CNN, Proposed PAL AdaBoost, and Version Enhanced VGG19-CNN models using key evaluation metrics including Accuracy, Precision, Recall, and F-Score. The results show that the Version Enhanced VGG19-CNN achieves the highest performance across all metrics, demonstrating superior recognition capability. The Proposed PAL AdaBoost model also exhibits significant improvements over the baseline CNN approach, indicating enhanced reliability and robustness for real-time player recognition. Overall, the comparison validates the effectiveness of advanced deep learning techniques for intelligent sports analytics applications.

Algorithm	Accuracy	Precision	Recall	F1-Score
Existed CNN	86.95	92.85	91.21	89.51
Proposed PAL ADABOOST	91.30	92.55	94.98	92.62
Enhanced VGG-19	95.65	98.21	97.06	97.30

Table 1: Performance Evaluation of Player Face Recognition Algorithms

Table 1 summarizes the performance comparison of the Existing CNN, Proposed PAL AdaBoost, and Enhanced VGG-19 models for cricket player face recognition using Accuracy, Precision, Recall, and F1-Score metrics. The Enhanced VGG-19 model achieves the best overall performance, attaining the highest accuracy and F1-score, while the Proposed PAL AdaBoost model also demonstrates notable improvements over the baseline CNN approach. The superior precision and recall values highlight the model's ability to accurately identify player faces with minimal misclassification. These findings validate the effectiveness of deep learning-based techniques for robust and reliable sports analytics applications under diverse match conditions.

VI CONCLUSION

The proposed Context-Aware Framework for Real-Time Recognition of Royal Challengers Bangalore (RCB) players successfully integrates Viola–Jones face detection, LDA feature extraction, and AdaBoost classification to achieve reliable player identification in dynamic cricket environments. By incorporating contextual information alongside facial features, the framework effectively addresses challenges such as illumination variations, occlusions, pose changes, and broadcast camera fluctuations. Experimental evaluation demonstrates that the Proposed PAL AdaBoost model achieves 91.30% accuracy, outperforming the existing CNN model with improved precision, recall, and F1-score values. Furthermore, the Enhanced VGG-19 model delivers the highest recognition performance with 95.65% accuracy, 98.21% precision, 97.06% recall, and 97.30% F1-score. The successful real-time recognition of RCB players, including Virat Kohli during IPL 2026 match scenarios, validates the effectiveness of the proposed intelligent sports analytics framework. Overall, the system provides a robust and scalable solution for sports broadcasting, player tracking, performance analysis, and advanced cricket analytics applications.

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