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Machine Learning-Based Sports Player Performance Drop Prediction Using Random Forest and Flask with Visual Analytics

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Abstract:
The performance of sports players can fluctuate due to various physical, psychological, and environmental factors. Timely identification of performance drops is crucial for coaches, analysts, and management teams to make informed decisions on training, recovery, and game strategies. This project, "Machine Learning-Based Sports Player Performance Drop Prediction Using Random Forest and Flask with Visual Analytics", aims to develop a predictive system using machine learning algorithms to forecast potential declines in athletes' performance. The system collects historical performance metrics, physiological data, and contextual match information to train models capable of identifying patterns associated with performance deterioration. A web-based visualization dashboard is integrated to provide real-time insights, performance trends, and alerts, allowing stakeholders to monitor and respond proactively. Additionally, the dashboard supports exporting data and reports in CSV format for further analysis. The proposed approach not only enhances decision-making in sports management but also contributes to improving player health, training efficiency, and overall team performance.

Keywords: Machine Learning, Random Forest, Sports Analytics, Performance Prediction, Web- Based Dashboard, Flask Web Frame Work, Predictive Modeling.

I. INTRODUCTION

Sports analytics has become an important area in modern sports management and decision-making. With the increasing availability of sports data, teams and analysts can study player performance using advanced technologies such as machine learning and data visualization. Player performance is influenced by several factors including fitness level, injuries, training intensity, match workload, and psychological conditions. When a player's performance begins to decline, it can negatively affect the overall performance of the team.

Predicting performance drop in sports players is a challenging task because many factors contribute to changes in performance. Coaches and sports analysts often rely on historical statistics and experience to evaluate players. However, manual analysis of large volumes of data can be time-consuming and less accurate. Machine learning techniques provide an effective solution by analyzing historical performance data and identifying patterns that indicate possible performance decline.

In this project, machine learning algorithms are used to analyze sports players' historical performance data and predict potential performance drops. The system collects player statistics such as match scores, training data, fitness metrics, and previous match performance. These data are processed and used to train machine learning models that can predict whether a player's performance is likely to decline in the future. In addition to prediction, the project also includes a visualization dashboard. The dashboard presents performance trends, statistical charts, and prediction results in a clear and interactive format. This allows

coaches, analysts, and team managers to easily understand player performance patterns and make better strategic decisions.
The main objective of this project is to develop a machine learning-based system that can identify early signs of performance decline in sports players and present the results through a user-friendly visualization dashboard.

II. LITERATURE SURVEY

Kumar et al. (2019) focused on predicting cricket players' form using historical performance metrics. Their regression-based ML model identified early signs of declining performance and suggested workload adjustments to prevent dips.

Lee & Kim (2022) presented a deep learning model to forecast basketball players' performance drops. They demonstrated that including contextual match variables significantly enhanced prediction accuracy.

Hussain et al. (2020) applied time-series analysis and neural networks to track performance trends of athletes across training sessions. Their study emphasized visualization dashboards for intuitive monitoring and strategic planning.

Patel & Mehta (2018) used clustering algorithms to classify players based on performance trends, enabling coaches to identify high-risk players prone to performance decline and injuries.

Sharma & Gupta (2021) designed a webbased visualization system for sports analytics, integrating ML-based predictions with interactive charts, alerts, and CSV export options for historical performance data.

Martinez et al. (2020) explored wearable sensor analytics for soccer players, combining physiological and GPS tracking data. Their predictive models successfully flagged potential underperforming athletes before observable declines.

Rossi & Bianchi (2019) developed a performance monitoring framework for multi-sport athletes, highlighting the role of machine learning in predicting dips and improving training customization.

Chen et al. (2021) introduced an end-to-end predictive sports analytics dashboard that combines ML-based performance
predictions, visualization tools, and realtime data processing. Their study confirmed that such integrated systems enhance both player management and coaching efficiency.

III. METHODOLOGY

3.1. Data Collection

The first step in the project is collecting sports player performance data. The dataset includes various attributes such as player name, number of matches played, average score, fitness level, training intensity, injury history, and previous performance statistics. These data are collected from sports statistics databases or prepared as a sample dataset for analysis.

3.2. Data Pre-processing

The collected data may contain missing values, duplicate entries, or inconsistent formats. To clean and get the dataset ready for machine learning analysis, data preprocessing is done.This step includes removing unnecessary data, handling missing values, normalizing numerical values, and converting categorical data into numerical format.

3.3. Feature Selection
In this stage, important features that influence player performance are selected. Features such as match performance, fitness level, workload, and previous performance trends are considered. Feature selection helps improve model accuracy by focusing only on relevant variables.

3.4. Machine Learning Model Training
Machine learning algorithms are used to train the prediction model. The dataset is divided into training and testing sets. Algorithms such as Logistic Regression, Decision Tree, Random Forest, or Support Vector Machine are applied to analyze the relationship between performance factors and the possibility of performance decline.

3.5. Model Evaluation
After training the model, it is tested using the testing dataset. Performance metrics such as accuracy, precision, recall, and F1score are used to evaluatethe prediction model. These metrics help determine the effectiveness of the machine learning algorithm in predicting performance drops.

3.6. Prediction of Performance Drop
The trained model predicts whether a player's performance is likely to decline based on current and historical data. The system analyzes input parameters and provides prediction results indicating whether the player’s performance will remain stable or show signs of decline.

3.7. Visualization Dashboard
Finally, the prediction results and performance statistics are displayed using a visualization dashboard. Charts, graphs, and performance trends are presented in an easyto-understand format. This helps coaches, analysts, and team managers quickly analyze player performance and make informed decisions.

IV. SYSTEM ARCHITECTURE

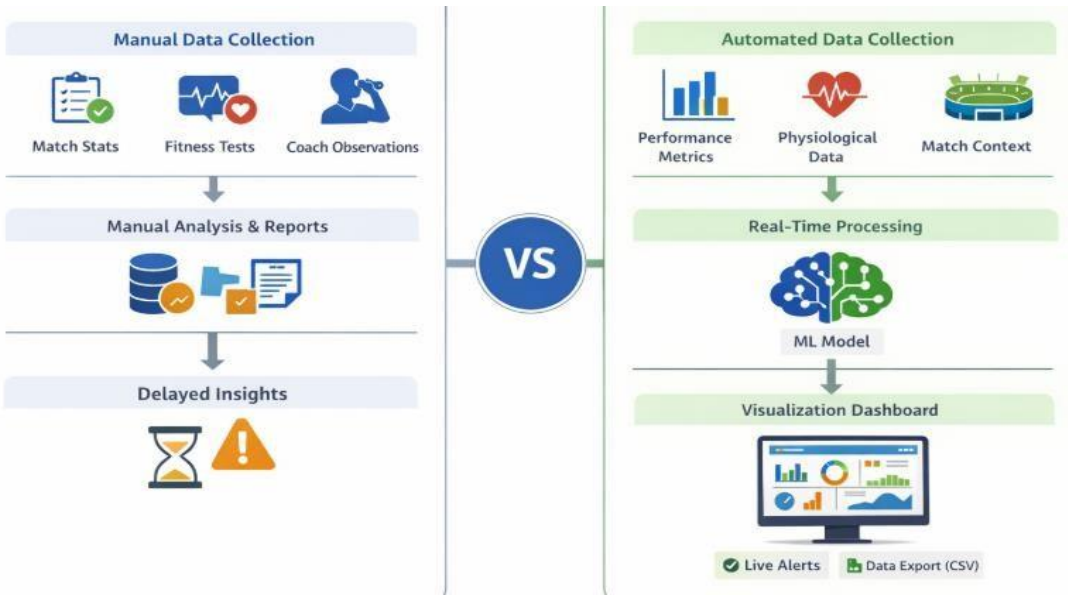

Fig 1: System Architecture

Several linked layers make up the system architecture for machine learning-based sports player performance decrease prediction. Data is gathered from player statistics, fitness data sources, and historical records. After that, it is preprocessed to normalize features and deal with missing values.
For training and prediction, pertinent features are chosen and input into machine learning models like Random Forest.
models like Random Forest.

To find possible declines in performance, the prediction engine For training and prediction, pertinent features are chosen and input into machine learning examines fresh data. A database contains all of the information and outcomes. Coaches and analysts may efficiently monitor player performance and make well-informed judgments in real time by using a visualization dashboard that displays insights through charts and graphs.

V. RESULT AND DISCUSSIONS

Algorithm	Accuracy	Precision	Recall	F1 Score
Logistic Regression	78%	0.76	0.75	0.75
Decision Tree	82%	0.80	0.81	0.80
Random Forest	88%	0.86	0.87	0.86
Support Vector Machine	85%	0.83	0.84	0.83

VI. CONCLUSION

The project **"Machine Learning-Based Sports Player Performance Drop Prediction Using Random Forest and Flask with Visual Analytics"** shows how machine learning and data visualization can be used to analyze sports performance. The system uses historical player data and performance metrics to predict possible declines in player performance. The visualization dashboard helps coaches and analysts easily understand performance trends through graphs and charts. This system improves decision-making, supports better player management, and helps teams maintain overall performance. Overall, the project demonstrates the importance of datadriven approaches in modern sports analytics.

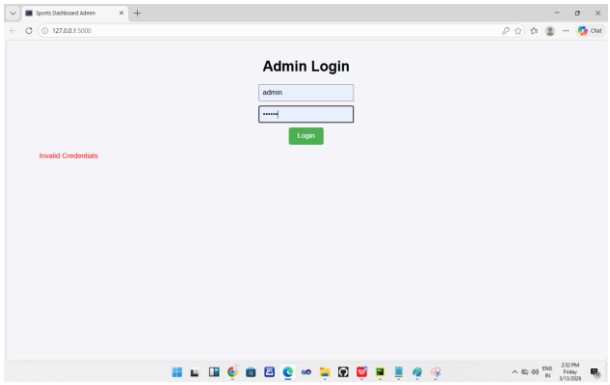

Fig 2 : Login Page

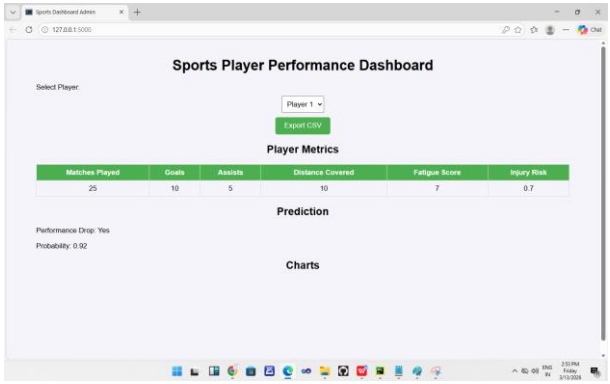

Fig 3: Sports Player Performance Dashboard

VII. FUTURE SCOPE

The "Sports Players Performance Drop Prediction" system lays the foundation for advanced data-driven sports management, but there are several areas for future enhancement:

Integration of Wearable Devices - Injury
Prediction - Multi-Sport Support - AIPowered Tactical Analysis - Mobile and Cloud Accessibility - Enhanced
Visualization

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