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Cricket Score Prediction Using Deep Learning

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Abstract: ***Cricket is a sport characterized by its wealth of data and intricacies, making outcome prediction a fascinating challenge for analysts, broadcasters, and fans alike. The emergence of T20 leagues, particularly the Indian Premier League (IPL), has significantly increased the demand for advanced, real-time analytical tools. Traditional score prediction methods in cricket often depend on fixed metrics like average run rates, which do not adequately reflect the game's dynamic nature. This project introduces a deep learning approach to forecast the final score of a team batting first in a T20 match, utilizing historical match data and relevant contextual features. The proposed system employs a neural network model created in Python with TensorFlow and Keras, trained on an IPL dataset that includes match specific details such as venue, batting and bowling teams, batsmen, bowlers, current score, overs bowled, and wickets lost. Feature engineering is used to generate additional metrics like balls remaining, wickets in hand, and current run rate, which enhance the understanding of the match context. These features are then encoded, scaled, and input into a multilayer dense neural network to predict the expected final score. The model's performance is assessed using standard metrics like Mean Absolute Error (MAE) and R^2 Score to ensure accuracy and reliability. For real time interaction, the system is implemented with two user interfaces: a Jupyter notebook-based widget for exploratory analysis and a Flask web application that enables users to enter match details and receive immediate score predictions.***

Keywords: Neural Network, TensorFlow, Keras, Feature Engineering, R^2 Score, MAE, Jupyter Notebook.

I. INTRODUCTION

Historically, score predictions in cricket have depended on expert judgment or simple statistical models that take into account factors like run rate and remaining overs. However, the game's dynamic nature, influenced by various situational and player specific elements, complicates accurate predictions. Key factors such as the venue, current score, overs bowled, wickets lost, and the players on the field significantly affect the match's outcome, necessitating more advanced modelling techniques. Cricket is a widely loved sport around the world, especially in nations like India, Australia, England, and South Africa. As viewership and commercialization of events like the Indian Premier League (IPL) continue to rise, there is an increasing interest in utilizing data analytics and machine learning in cricket. Predicting a team's final score in limited overs matches, particularly during the first innings, can provide valuable insights for teams, broadcasters, analysts, and fans. Historically, score predictions in cricket have depended on expert judgment or simple statistical models that take into account factors like run rate and remaining overs. However, the game's dynamic nature, influenced by various situational and player specific elements, complicates accurate predictions. Key factors such as the venue, current score, overs bowled, wickets lost, and the players on the field significantly affect the match's outcome, necessitating more advanced modelling techniques. Recent advancements in artificial intelligence (AI) and deep learning have led to the development of more precise and efficient models for tackling such complex, nonlinear issues. Deep learning models, particularly those utilizing neural networks, can identify intricate patterns from large datasets without requiring extensive manual feature engineering. In the realm of cricket score prediction, deep learning has the potential to incorporate multiple match specific variables and produce highly accurate score forecasts.

This project, titled "Cricket Score Prediction Using Deep Learning," seeks to create a predictive model that estimates the final score of a team batting first in a T20 match using deep learning methods. The model is trained on historical IPL data, incorporating features such as venue, batting team, bowling team, batsman, bowler, runs scored, overs bowled, and wickets lost. The dataset undergoes preprocessing and transformation to derive features like balls remaining, wickets remaining, and current run rate, which are then used as inputs for the neural network. The implementation is done in Python, using libraries like TensorFlow and Keras for model development, along with Scikit-learn and Pandas for data preprocessing and evaluation. The trained model is integrated into a user-friendly interface, utilizing IPython widgets for Jupyter interaction and a Flask web application for real time score predictions via a web browser.

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Inputs are checked for match constraints, and the system predicts the expected final score while accounting for all provided inputs. The main objective of this project is to assess the viability of applying deep learning to a real-world sports analytics challenge and to highlight the significance of intelligent systems in improving decision making in sports.

II. LITERATURE SURVEY

A. Score and Winning Prediction in Cricket through Data Mining (2015):

Authors: Tejinder Singh, Vishal Singla, Parteek Bhatia

The research indicates that the Random Forest algorithm achieved greater accuracy than other models for both score and match outcome predictions. However, the model primarily concentrated on pre-match predictions based on static data and did not incorporate dynamic, real-time prediction capabilities during live matches.

B. Live Cricket Score Prediction Web Application using Machine Learning (2021):

Authors: Eeshan Mundhe, Ishan Jain, Sanskar Shah

They employed Random Forest Regression and Gradient Boosting models for score prediction, along with preprocessing steps like managing missing values, feature selection, and scaling. Their system provided real-time predictions with satisfactory accuracy. However, the model was relatively basic and mainly focused on a limited set of match features, which might not fully address the complexities of cricket matches. Furthermore, deep learning models were not considered in their research.

C. T20 Cricket Score Prediction Using Machine Learning (2023):

Authors: Sherilyn Kevin, Bipin Yadav, Amit Kumar Pandey, Gopal Rajbhar

They assessed model performance using metrics like Mean Squared Error (MSE) and Root Mean Squared Error (RMSE). Their dataset comprised match statistics, including runs, wickets, overs, and venue information. The study concluded that Random Forest Regression outperformed other algorithms in prediction accuracy. However, deep learning models were not included in their analysis, and the deployment of a web-based application was not a primary focus of their research.

III.EXISTING WORK

Cricket score prediction has attracted considerable attention from researchers and sports analysts. Over time, various techniques have been developed to forecast the final scores of cricket matches, which can be broadly categorized into two groups: traditional methods that utilize basic arithmetic models and contemporary techniques that leverage machine learning and data-driven algorithms.

A. Traditional Score Prediction Techniques

1) Average Run Rate (ARR) Method
2) DuckworthLewisStern (DLS) Method
3) Expert-Based Predictions

B. Data Mining and Machine Learning Techniques

1) Score and Winning Prediction in Cricket through Data Mining (2015
2) Live Cricket Score Prediction Web Application using Machine Learning (2021
3) T20 Cricket Score Prediction Using Machine Learning (2023

C. Limitations

1) Inadequate Attention to Real-time Match Variables
2) Basic Algorithms with Limited Learning Ability
3) Lack of Comprehensive Web or Interactive Platforms
4) Inadequate Management of Edge Cases and Outliers

IV. PROPOSED WORK

The proposed system aims to create a predictive model that estimates the final score of a T20 cricket match through a deep learning methodology. This project specifically focuses on the first innings of a match, providing valuable insights for broadcasters, coaches, analysts, and fans alike.

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The model is trained on a detailed IPL dataset that includes essential match features such as venue, batting team, bowling team, batsman, bowler, current score, overs bowled, and wickets lost. From this raw data, additional features are developed, such as balls remaining, wickets in hand, and current run rate, to enhance the understanding of the match context. A deep neural network architecture is built using the Keras and TensorFlow libraries. The model comprises several dense layers with ReLU activation and is trained to minimize Huber loss, which is effective in managing outliers and enhancing robustness. Categorical variables are processed using label encoding, and MinMax scaling is applied to ensure consistent feature representation.

A. *Objectives*

- To create an advanced prediction model utilizing deep learning methods to forecast the final score of a team batting first in a T20 cricket match.
- To conduct feature engineering on historical IPL data by extracting key match parameters like remaining balls, wickets available, and current run rate to improve the model's accuracy.
- To build a neural network framework using Keras and TensorFlow that can understand complex and nonlinear relationships within match data for more dependable predictions.
- To design an intuitive interface for real-time engagement through Jupyter Notebook widgets and a Flask-based web application, incorporating form validations and dropdown selections.
- To assess the model's performance using statistical measures such as Mean Absolute Error (MAE) and R^2 Score, ensuring accuracy and reliability across various match situations.

V. SYSTEM ARCHITECTURE

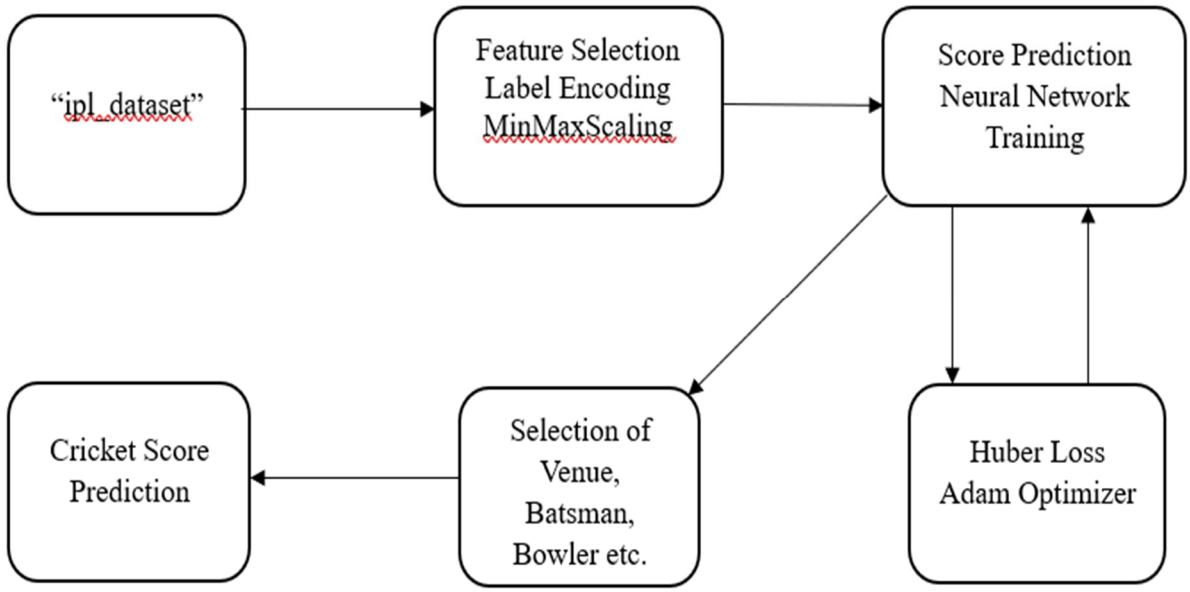


Fig. 1 System Architecture of Cricket Score Prediction Using Deep Learning

A. *Workflow*

This project employs a structured approach to forecast cricket scores using deep learning methods. The entire process is segmented into several essential phases, as depicted in the System Architecture Diagram.

- Dataset Collection
- Data Preprocessing and Featuring Engineering
- Neural Network Model Training
- Model Compilation and Optimization
- User Input
- Score Prediction

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VI. IMPLEMENTATION

The implementation stage focuses on the practical creation and integration of various elements to establish a fully operational cricket score prediction system. This encompasses data preprocessing, model design and training, evaluation, and the creation of a user-friendly web interface utilizing Flask. The system employs a deep learning methodology prioritizing accuracy, usability, and maintainability.

A. Dataset and Preprocessing

- Feature Selection
- Feature Engineering
- Overs Conversion
- Encoding
- Scaling

B. Model Design and Training

- Input Layer
- Hidden Layer
- Output Layer
- Loss Function
- Optimizer

C. Model Evaluation

- Mean Absolute Error
- R^2 Score

D. Interactive Prediction

- Venue, Batting Team, Bowling Team
- Batsman, Bowler
- Current Score, Overs Bowled, Wickets Fallen
- Validation logic was implemented to:
- Allow only decimal overs up to .5 (e.g., 10.0 to 10.5)
- Prevent the selection of the same team or player for both bowler and batsman
- Manage innings completion conditions

E. Flask Web Application

- Input form with searchable dropdowns using Select2.
- Server-side validation and feature generation.
- Encoding and scaling with pre-saved models.
- Prediction using the loaded ‘keras’ model.
- Output displayed on the same page with either the prediction or an error message.

F. Output Display

- In Jupyter: Output is printed using ‘output_widget’.
- In Web: Result is shown below the form, dynamically styled.

G. Algorithms

- Label Encoding
- MinMax Scaling
- ReLU (Rectified Linear Unit) Activation

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- Linear Activation
- Huber Loss
- Adam (Adaptive Moment Estimation) Optimizer

H. Technologies

- Python Programming Language
- Pandas
- NumPy
- Matplotlib & Seaborn
- Scikit-learn
- TensorFlow & Keras
- Joblib
- Flask Framework
- HTML, CSS, JS
- Select2 Library
- Jupyter Notebook

I. Pseudocode

- Load Data (Feature Selection)
- Preprocessing Data (Label Encoding, MinMaxScaler)
- Neural Network Model
    - Input layer
    - Hidden layers with ReLU Activation
    - Output layer with Linear Activation
- Model Training
    - Adam optimizer
    - Huber loss
- Prediction Interface
- Created Web Interface using Flask for user
- Predict Score

VII. PERFORMANCE EVALUATION

The effectiveness of the cricket score prediction model was evaluated using various statistical measures to determine its accuracy and dependability. The dataset was split into training and testing sets in a 70:30 ratio to assess the model's ability to generalize.

A. Model Performance Evaluation

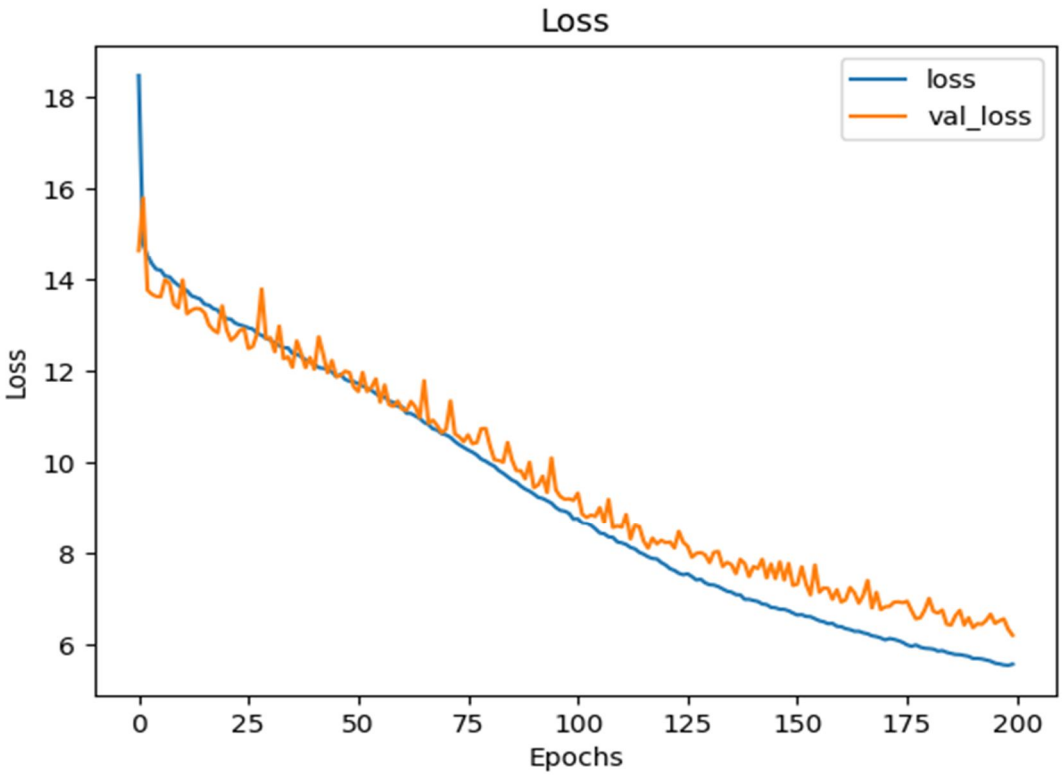
TABLE I
Epochs vs Loss vs MAE

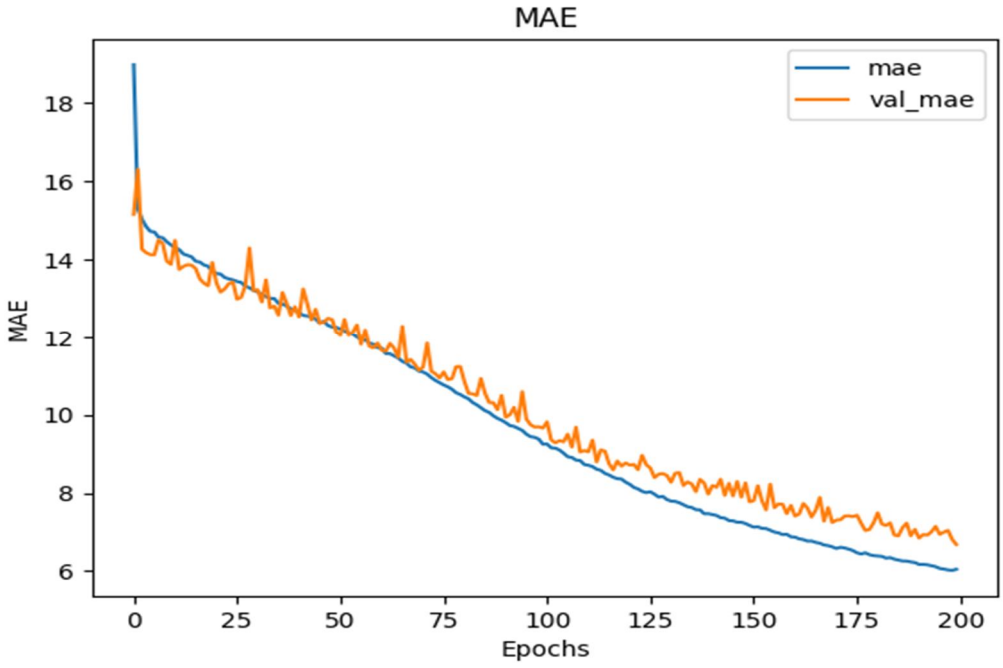
Epochs	loss	mae	val_loss	val_mae
1	18.481426	18.973980	14.654748	15.146703
50	11.769845	12.256981	11.651592	12.139087
100	8.762714	9.245141	9.174454	9.658034
150	6.689748	7.167507	7.293998	7.772750
200	5.569968	6.044541	6.204113	6.681150

TABLE 2
Epochs vs Loss vs MAE For Every 50 Epochs

Metric	Observed Value
Mean Absolute Error (MAE)	6.681155767693799
R-Squared (R^2) Score	0.8606621623039246

B. Model Performance





VIII. RESULTS

A. *User Interface Performance*

- Dropdown Menus: Responsive and quick dropdowns were implemented using Select2 for seamless selection of Venue, Teams, Batsman, and Bowler.
- Input Validation: The system effectively managed invalid inputs and provided clear error messages.
- Responsiveness: The application functioned efficiently across various screen sizes and devices, ensuring user-friendliness.

B. *Prediction Accuracy via Web Interface*

- The model delivered prompt predictions with minimal delay following input submission.
- Results were clearly presented on the screen, along with appropriate validations for overs, wickets, and team selections.

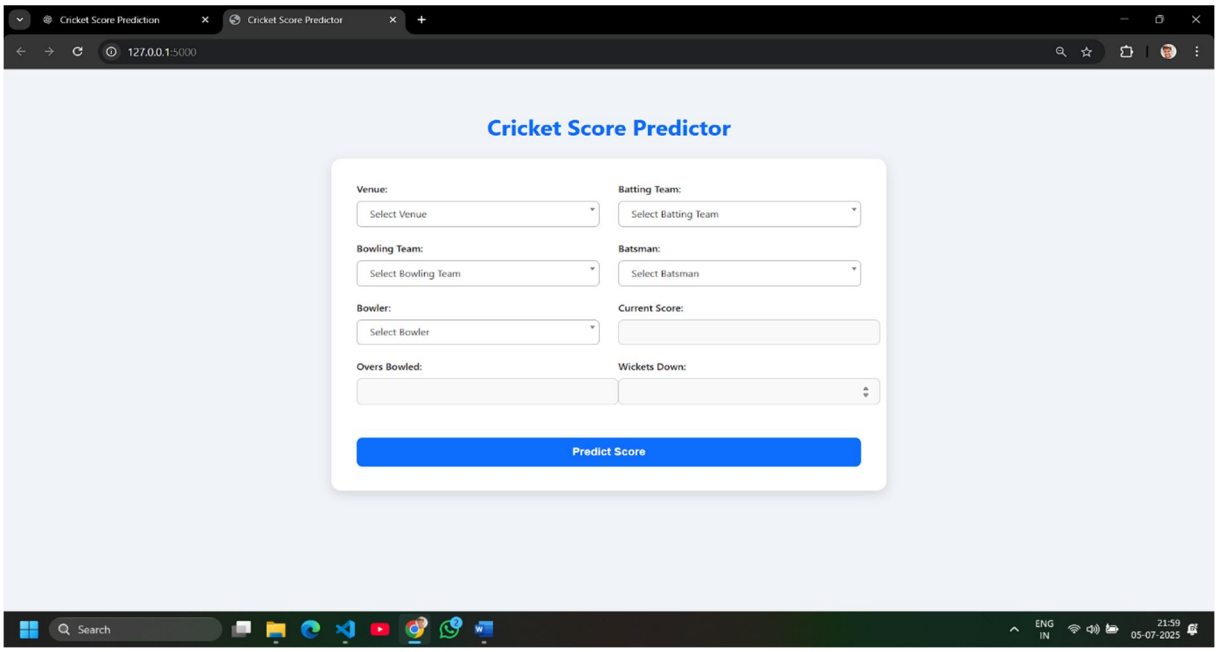


Fig. 2 First Look of Web Page

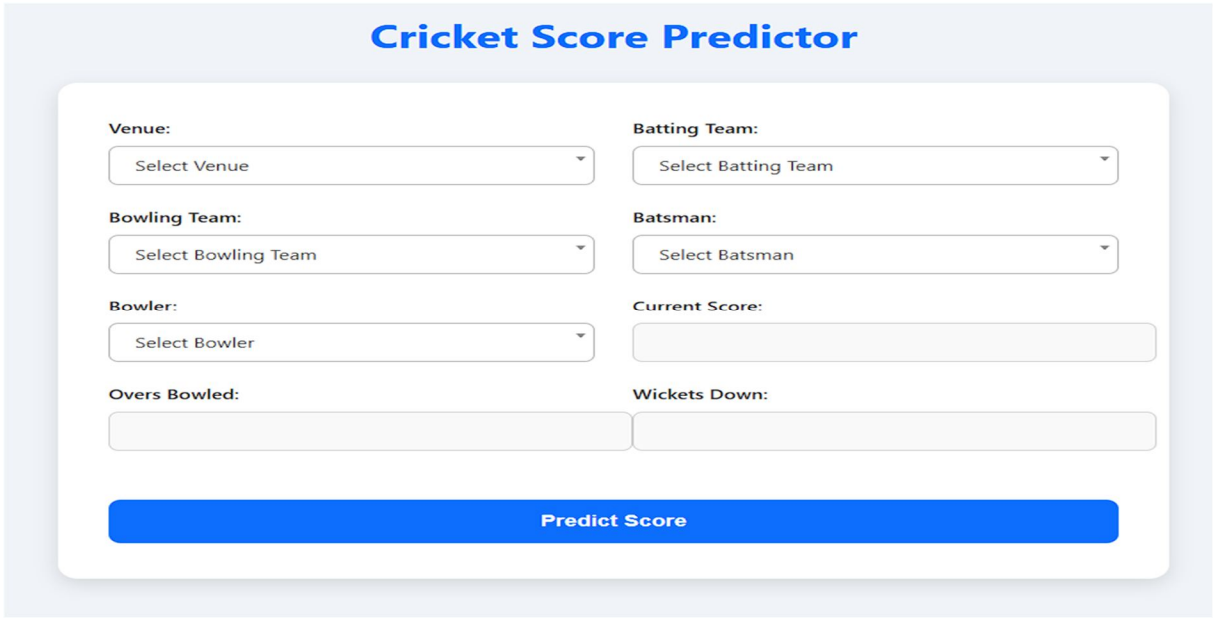


Fig. 3 Web Interface for Score Prediction

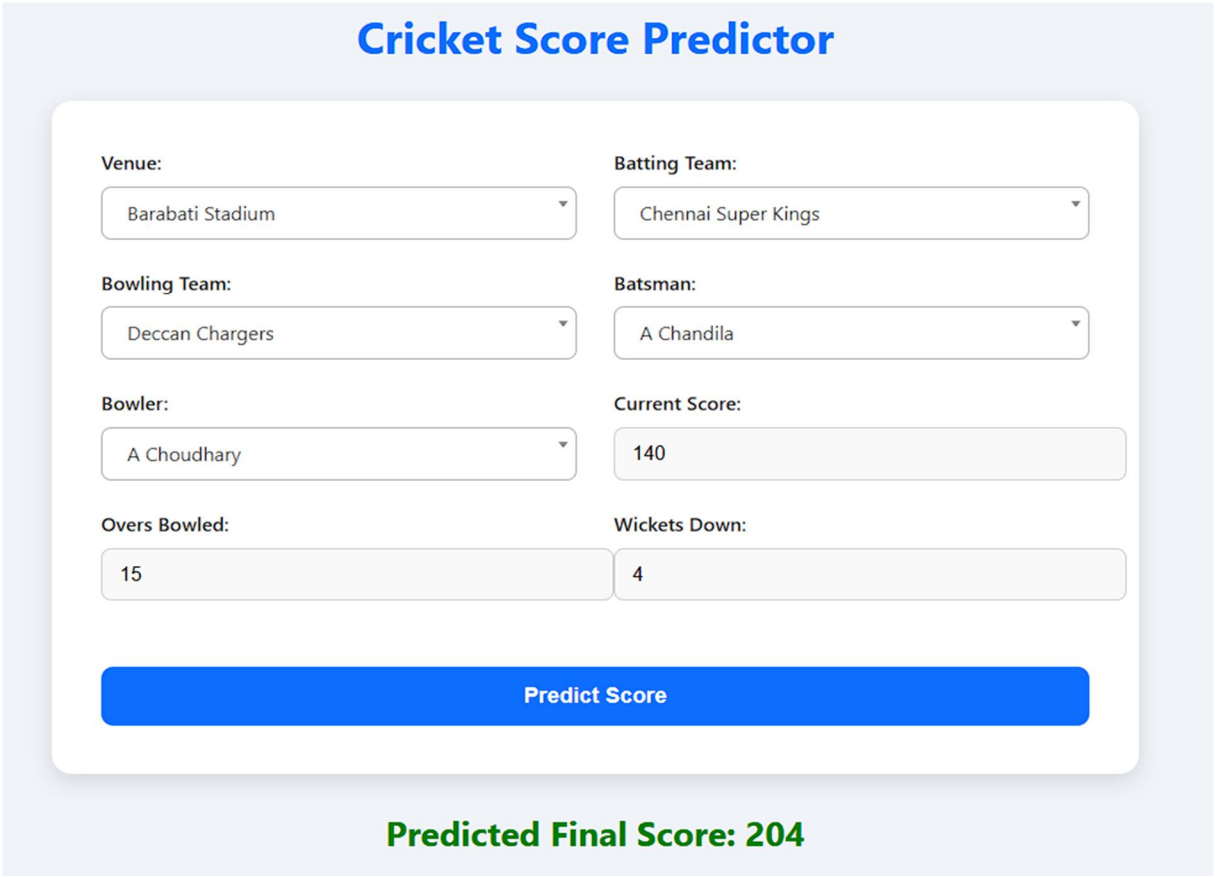


Fig. 3 Predicted Score all Valid Inputs

IX. CONCLUSION

The project titled "Cricket Score Prediction Using Deep Learning" effectively showcases the use of machine learning and deep learning methods in sports analytics, particularly in cricket. The system aims to forecast the final score of a cricket match by considering various factors such as the venue, teams, players, current score, overs bowled, and wickets lost. A systematic approach was adopted throughout the project, starting with data collection, preprocessing, feature engineering, and model training utilizing deep learning algorithms. Techniques like label encoding and feature scaling were successfully applied to prepare the data for modelling. The trained model demonstrated satisfactory performance in terms of R-Squared (0.8606621623039246) Score and Mean Absolute Error (6.681155767693799).

Additionally, the project features a user-friendly web interface developed with Flask, enabling users to enter match details via dropdown menus and forms. The frontend facilitates seamless interaction, while the backend processes the data and generates real-time predictions. Various validation measures were implemented to prevent incorrect inputs and ensure the reliability of the predictions. Thorough testing and validation confirmed that the system operates accurately across various scenarios, including boundary conditions and edge cases. The model offers reasonable score predictions, making it a useful tool for cricket fans, analysts, and developers interested in sports-related machine learning applications. This project has not only deepened the understanding of predictive modelling using deep learning but has also illustrated the potential for integrating machine learning models into practical web applications.

A. Future Scope

Although the current system effectively predicts cricket scores, there are numerous opportunities for further enhancement and expansion of the project. Some potential future improvements and research avenues include:

1) Adding More Match Features: Incorporating additional factors such as pitch conditions, weather forecasts, and player fitness levels could enhance prediction accuracy.

2) Expanding to More Match Formats: The existing system focuses on T20 matches but could be adapted to predict scores for One Day Internationals (ODIs) and Test matches by modifying the model and datasets.

3) Ball-by-Ball Prediction: The system could be upgraded to provide predictions on a ball-by-ball basis or run rate estimations, offering more detailed insights.

4) Integration of Live Data: The system could connect with live match APIs to automatically retrieve real-time data and update predictions dynamically during matches.

5) Enhanced User Interface: The web application could be improved with advanced visualizations, interactive charts, and mobile-friendly designs to boost user engagement.

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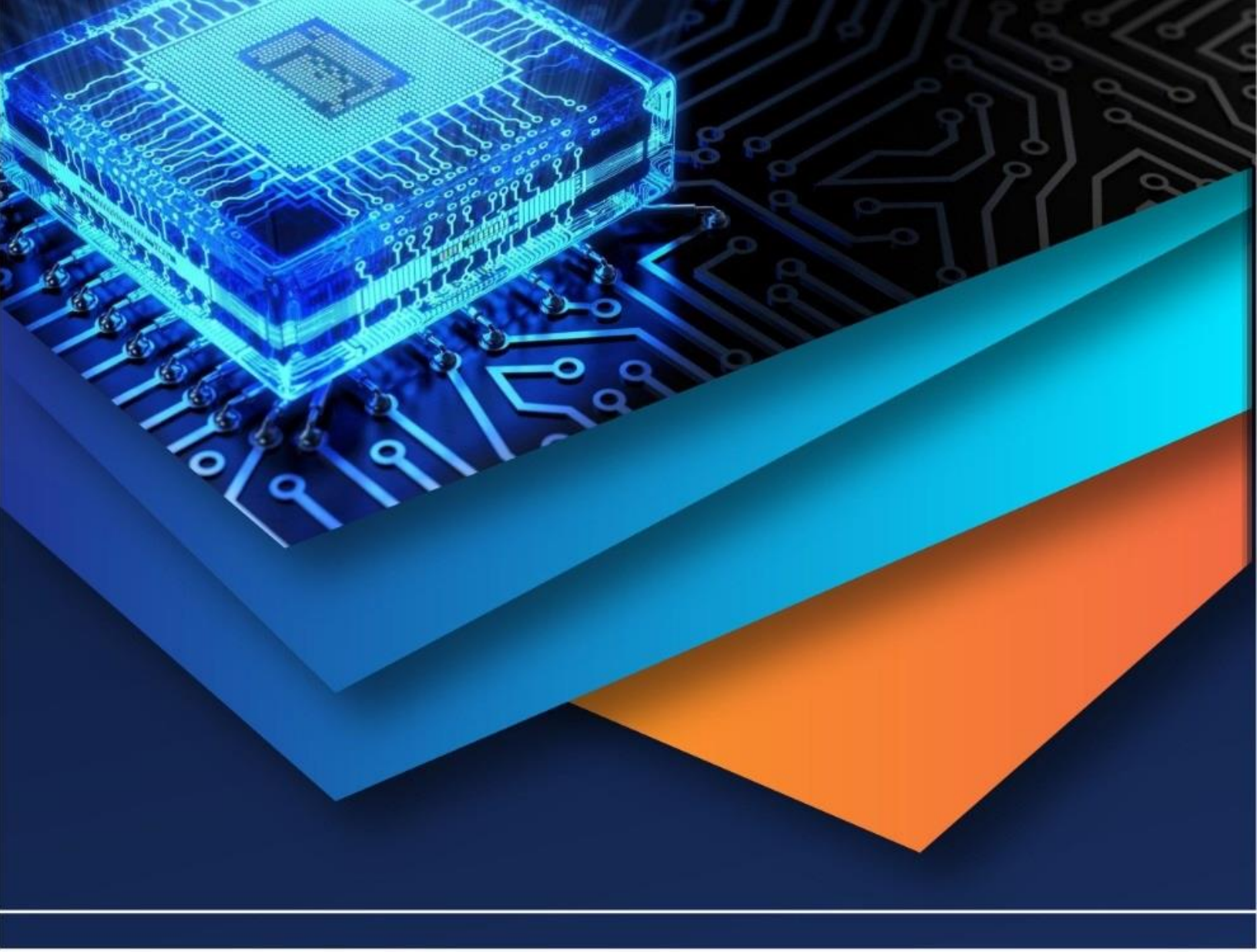
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