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Towards Vision 2047: Comparative Forecasting of India's GDP and Top Five States GSDP Using Advanced Neural Networks

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Abstract: ***The Gross Domestic Product (GDP) or Gross State Domestic Product (GSDP) is the key indicator used to measure the economy of a nation, as well as major states. India and a few other states have official economic vision documents such as Viksit Bharat 2047, Maharashtra Vision 2047, Viksit Uttar Pradesh @ 2047, etc. In this study, advanced neural networks have been used to project the GDP/GSDP of the nation, as well as for the top five states, up to 2047. These projections are compared against the official economic vision. The analysis reveals the feasibility and timeline towards trillion-dollar and multi-trillion-dollar economies. Models like Feedforward (FFNN), Recurrent (RNN), Long Short-Term Memory (LSTM), and Bi-LSTM have been compared with an accuracy test. The results show that the Bi-LSTM model performs better compared to all other models. The model projects India's GDP to rise from USD 3.64 trillion in 2024–25 to nearly USD 22 trillion by 2047–48. In States Maharashtra will reach USD 2.42 trillion by 2047-48, and other states, Tamil Nadu, Uttar Pradesh, Karnataka, and Gujarat, will reach around USD 1.5 to 1.7 trillion by 2047-48. This work provides data-driven insights for policymakers, highlighting gaps between India's and states' visions of GDP/GSDP versus data-driven forecasts.***
Keywords: Vision 2047, Forecasting, FFNN, RNN, LSTM, Bi-LSTM

I. INTRODUCTION

The Gross Domestic Product (GDP) or Gross State Domestic Product (GSDP) is the key indicator used to measure the economy of a nation, as well as major states. India has official economic vision documents, called Viksit Bharat 2047, which aims to achieve a 30 trillion dollar economy by 2047, marking its 100th independence. The vision focuses on inclusive growth, innovation, sustainability, and good governance. At the state level, few states have their own economic ambitions, like Maharashtra aims to become a five trillion dollar economy by 2047, with a target of reaching a one trillion dollar economy by 2030, outlining a three-stage plan to achieve the vision in the Maharashtra Vision 2047 document [2]. Uttar Pradesh aims to become a six trillion-dollar economy by 2047 and a one trillion-dollar milestone by 2030, focusing on agriculture, innovation, and infrastructure as per the Viksit Uttar Pradesh @ 2047 document [3]. Tamil Nadu Vision 2030 aims to achieve a one trillion economy by 2030 through industrial upgradation, education, high-tech investments, and digital infrastructure [4]. Karnataka Vision 2030 aims to become a one trillion economy by 2032, focusing on balanced rural-urban development, electronics, textiles, automotive, and pharmaceuticals, etc [5]. Gujarat's target is to achieve 3.5 trillion dollars by 2047, with improved per capita income to 38,000-40,000, net zero emission, and better social outcomes as outlined in Viksit Gujarat @ 2047 [6].

These targets were considered for benchmarking India's GDP and the top five states' GSDP projections. Advanced machine learning models were used on historical GDP and GSDP data to generate long-term forecasts up to 2047-28, assessing the feasibility and gap between the projected and target goals.

II. LITERATURE REVIEW

Traditional forecasting has heavily relied on econometric models like ARIMA, SARIMA, VAR, etc. These models work well with linear relationships, whereas they struggle with nonlinear, complex economic data. This limitation has motivated the growing interest in deep learning and advanced machine learning approaches.

Early work by Zhang, Patuwo, and Hu (1998) demonstrated that artificial neural networks can capture nonlinear patterns in forecasting tasks [7].

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Fischer and Krauss (2018) highlighted the advantages of LSTM networks in financial time series forecasting, particularly their ability to model long-term dependencies [8]. Within the Indian context, Bhatnagar and Ghosh (2020) applied RNNs to macroeconomic indicators, achieving higher accuracy than ARIMA models [9]. Bidirectional learning architectures have emerged as a further improvement. Schuster and Paliwal (1997) introduced Bi-RNNs, later adapted into Bi-LSTM networks, enabling simultaneous forward and backward processing of time series data [10]. Chen, Xu, and Zhang (2020) empirically confirmed that Bi-LSTM models outperform unidirectional models in long-horizon forecasting tasks [11].

III. METHODOLOGY

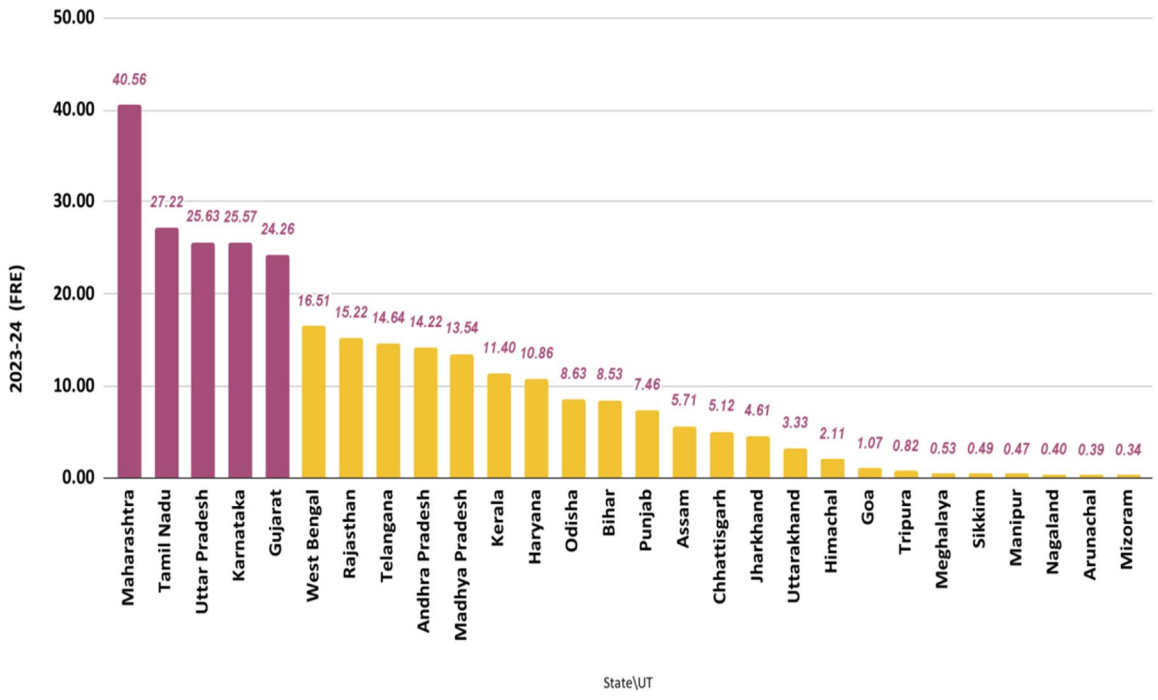
The study considers the GDP/GSDP data for India and its five major economic states, Maharashtra, Tamil Nadu, Uttar Pradesh, Karnataka, and Gujarat, expressed in current prices in (Rupees Trillion). This dataset provides a comprehensive basis for training and evaluating neural network models suitable for economic time series forecasting.

Training of neural architectures (Feed-Forward neural networks (FFNN), Recurrent networks (RNN), Long short-term memory (LSTM), Bidirectional LSTM (Bi-LSTM)) in the study employed the Adam optimizer, optimized using Mean Squared Error (MSE) as the loss metric, and integrated early stopping to reduce overfitting risks. Model evaluation incorporated root mean square error (RMSE), mean square error (MSE), mean absolute error (MAE), and mean absolute percentage error (MAPE) indicators, providing a multidimensional perspective on predictive accuracy and reliability.

IV. RESULTS: MODEL COMPARISON

Maharashtra leads among the states with the highest Gross State Domestic Product (GSDP) at Rs. 40.56 trillion for 2023-24. The next four top states are Tamil Nadu with Rs. 27.22 trillion, Uttar Pradesh with Rs. 25.63 trillion, Karnataka with Rs. 25.57 trillion, and Gujarat with Rs. 24.26 trillion. These five states collectively contribute around 49.46% of India's total Economy (see Fig. 1).

Fig. 1: State-wise GSDP at current price (Rs. Trillion) in 2023-24 (FRE)



Note: UT's not covered in the above chart

The data of GSDP/GDP at current prices of India and the top five states have been taken from 1980-81 to 2023-24 from the Ministry of Statistics and Program Implementation (MoSPI) website, and the trend is shown below.

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Fig. 2: India: GDP at current Price (in Trillion Rs.) from 1980-81 to 2023-24

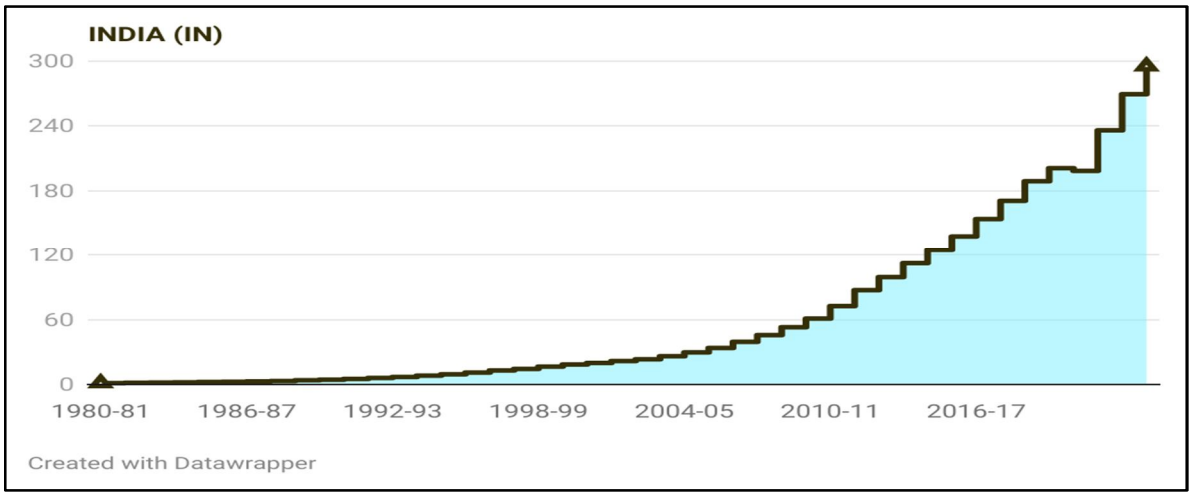
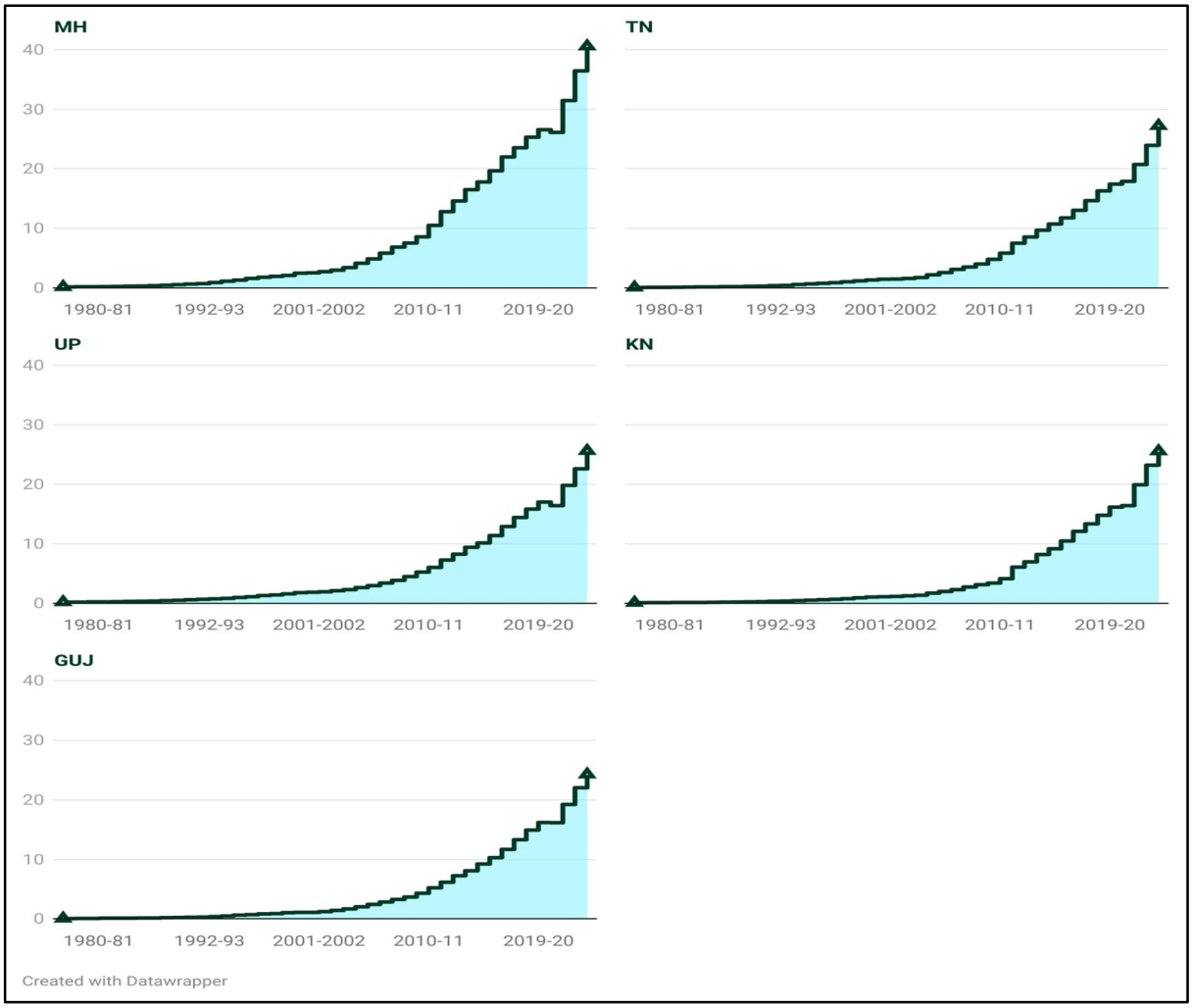


Fig. 3: GSDP at current Price (in Trillion Rs.) from 1980-81 to 2023-24 for top 5 states (MH, TN, UP, KN, and GUJ)

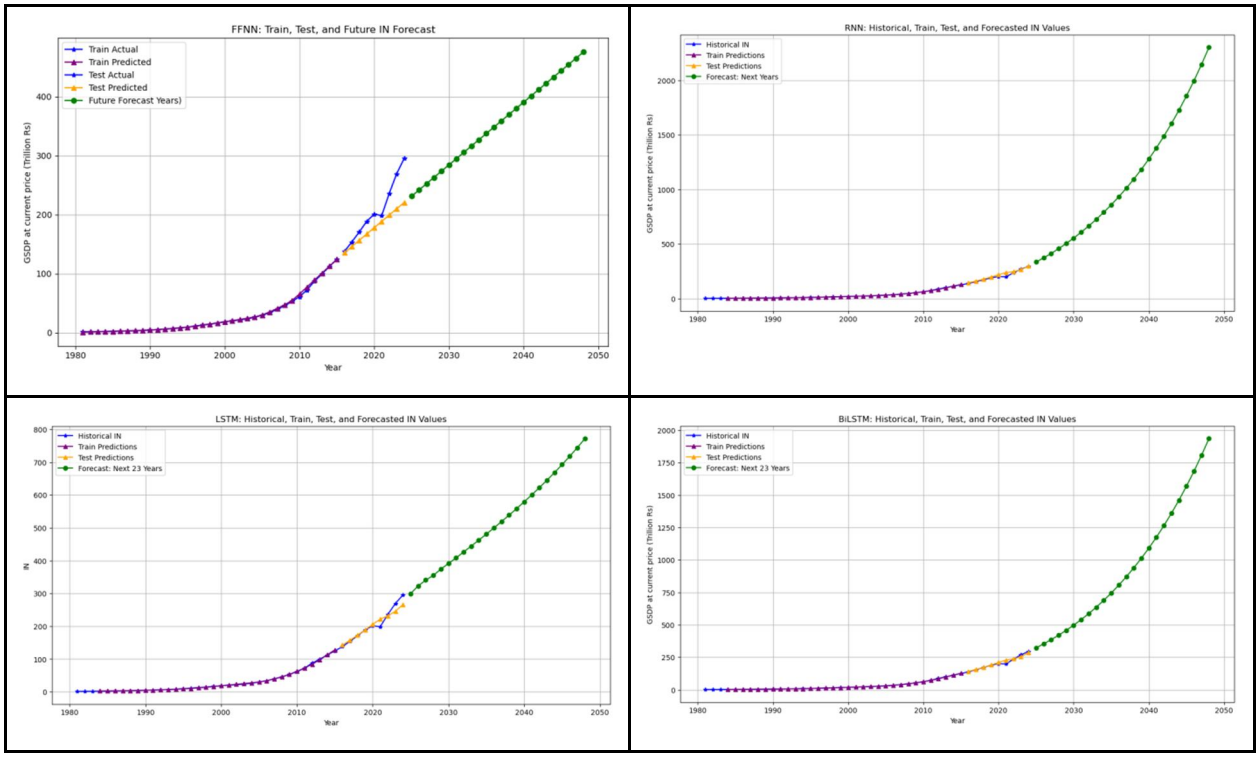


The first 35 observations (1980-81 to 2014-15) are considered as the training data set, and the last 9 observations are considered as the testing dataset. The four different neural network models, Feed Forward Neural Network (FFNN), Recurrent Neural Network (RNN), LSTM (Long Short Term Memory), and BiLSTM (Bidirectional LSTM), have been fitted to this dataset and tested for their accuracy.

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Initially, all the models were fitted to India's GDP and compared, as shown in Fig. 2. Each subplot shows that these models have training and testing data, and how they project the future values up to 2047-48. It is clearly visible that all models fit well for training and testing data, except FFNN. The future projections (green markers) start diverging in the long run, while FFNN and LSTM produce a more linear upward forecast, the RNN and BiLSTM models suggest a much sharper, exponential increase in GDP.

Fig. 4: India (IN): Historical, Train, Test, and Forecasted India GDP at current price (in Rs. Trillion)



The error metrics for all four neural network models, FFNN, RNN, LSTM, and BiLSTM, are presented the Table 1. The result shows that BiLSTM performs better compared to all other models, achieving the lowest error values across all error matrices, root mean square error (RMSE), mean square error (MSE), mean absolute error (MAE), and mean absolute percentage error (MAPE). In particular, BiLSTM has an MAPE of just 3.85%, notably lower than the other models, indicating superior prediction accuracy. The FFNN model produces the highest errors, suggesting it is less suited for this type of sequence forecasting. Overall, these results highlight the value of bidirectional architectures when reliable long-term economic projections are required.

Table 1: India (IN): Comparison of Forecasting Accuracy: FFNN, RNN, LSTM, and BiLSTM Models

Model	RMSE	MSE	MAE	MAPE
FFNN	36.16	1307.45	27.64	11.71%
RNN	15.06	226.72	10.90	5.60%
LSTM	14.46	209.14	10.85	4.99%
Bi LSTM	12.16	147.95	8.23	3.85%

Similarly, the forecasting results for the top 5 states (Maharashtra, Tamil Nadu, Uttar Pradesh, Karnataka, and Gujarat have been done using four different neural network models: FFNN, RNN, LSTM, and BiLSTM, as shown in Fig.s 5, 6, 7,8, and 9 and Tables 2, 3, 4, 5, and 6.

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Fig. 5:Maharashtra (MH): Historical, Train, Test, and Forecasted India GDP at current price (in Rs. Trillion)

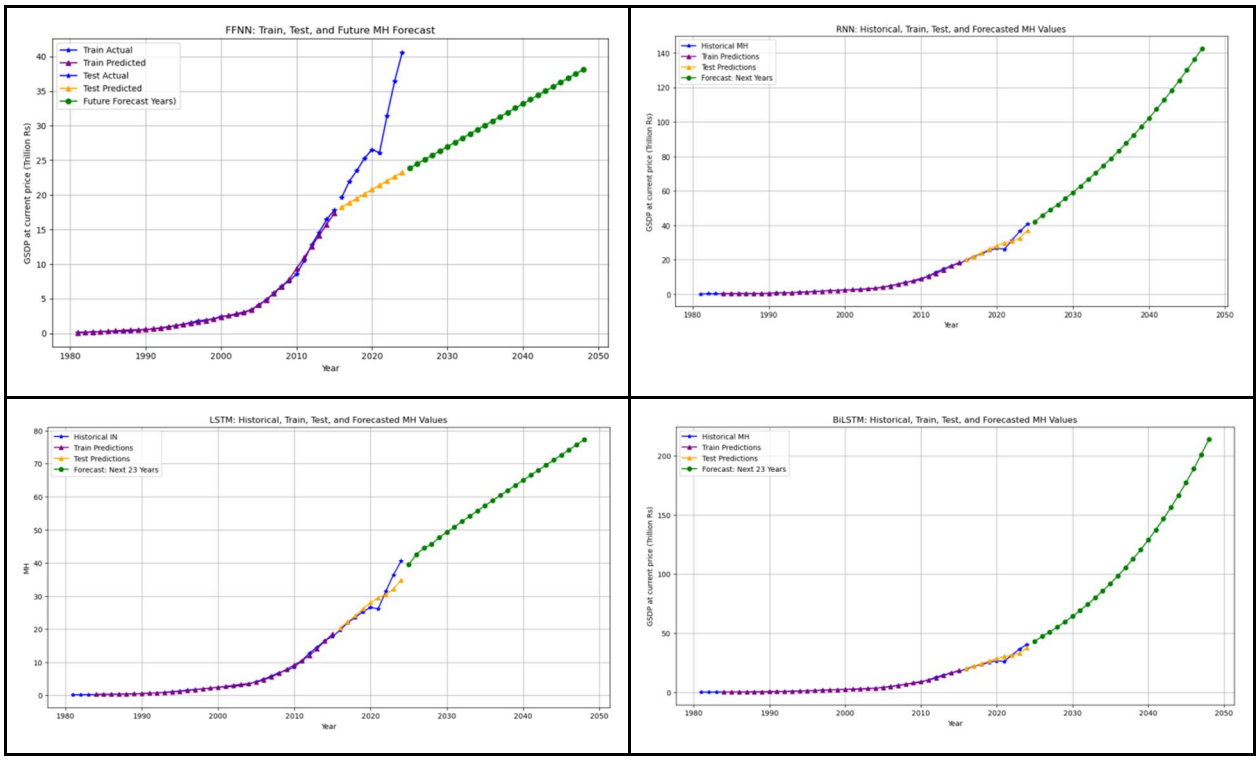
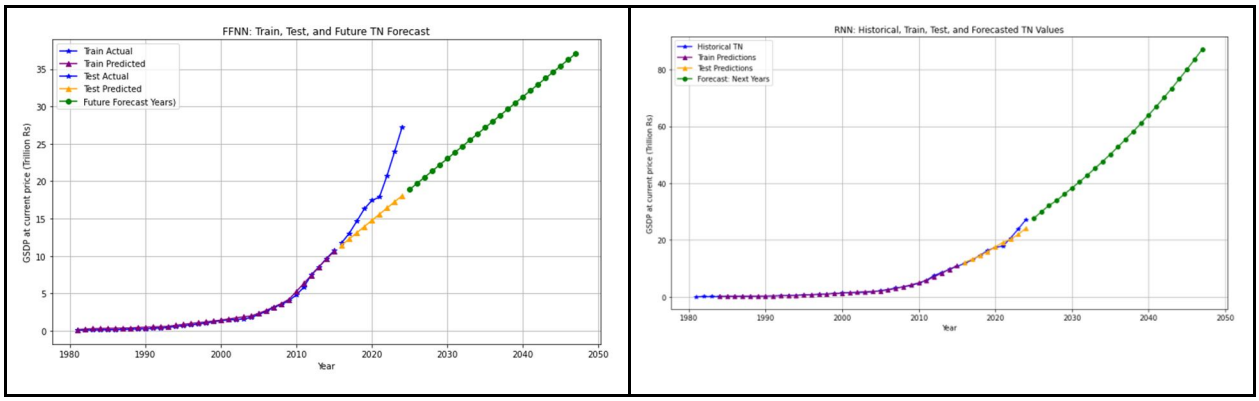


Table 2:Maharashtra (MH): Comparison of Forecasting Accuracy: FFNN, RNN, LSTM, and BiLSTM Models

Model	RMSE	MSE	MAE	MAPE
FFNN	8.74	76.32	7.18	23.22%
RNN	2.25	5.06	1.71	5.57%
LSTM	2.72	7.43	2.00	6.37%
Bi LSTM	2.15	4.62	1.70	5.77%

Fig. 6:Tamil Nadu (TN): Historical, Train, Test, and Forecasted India GDP at current price (in Rs. Trillion)



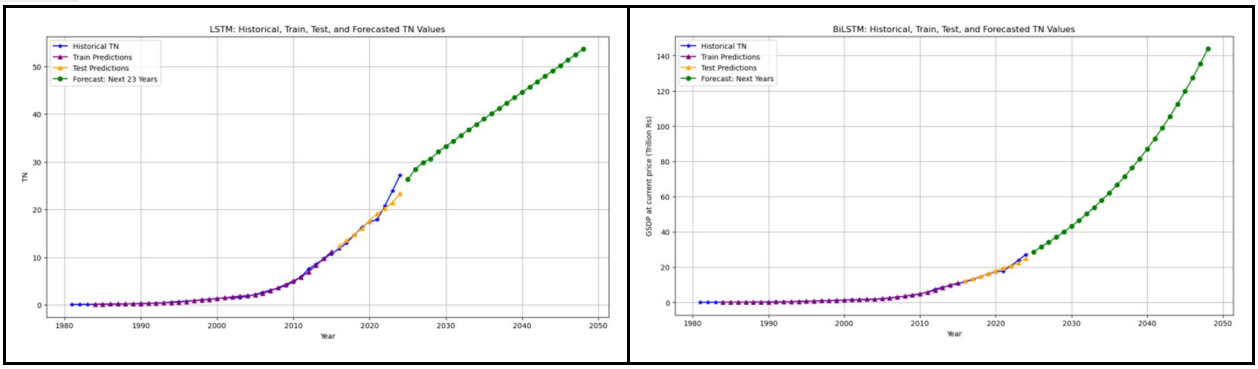


Table 3:Tamil Nadu (TN): Comparison of Forecasting Accuracy: FFNN, RNN, LSTM, and BiLSTM Models

Model	RMSE	MSE	MAE	MAPE
FFNN	4.32	18.65	3.34	15.98%
RNN	1.30	1.67	0.88	4.21%
LSTM	1.61	2.60	1.07	5.07%
Bi LSTM	**1.09**	**1.18**	**0.80**	**4.03%**

Fig. 7: Uttar Pradesh (UP): Historical, Train, Test, and Forecasted India GDP at current price (in Rs. Trillion)

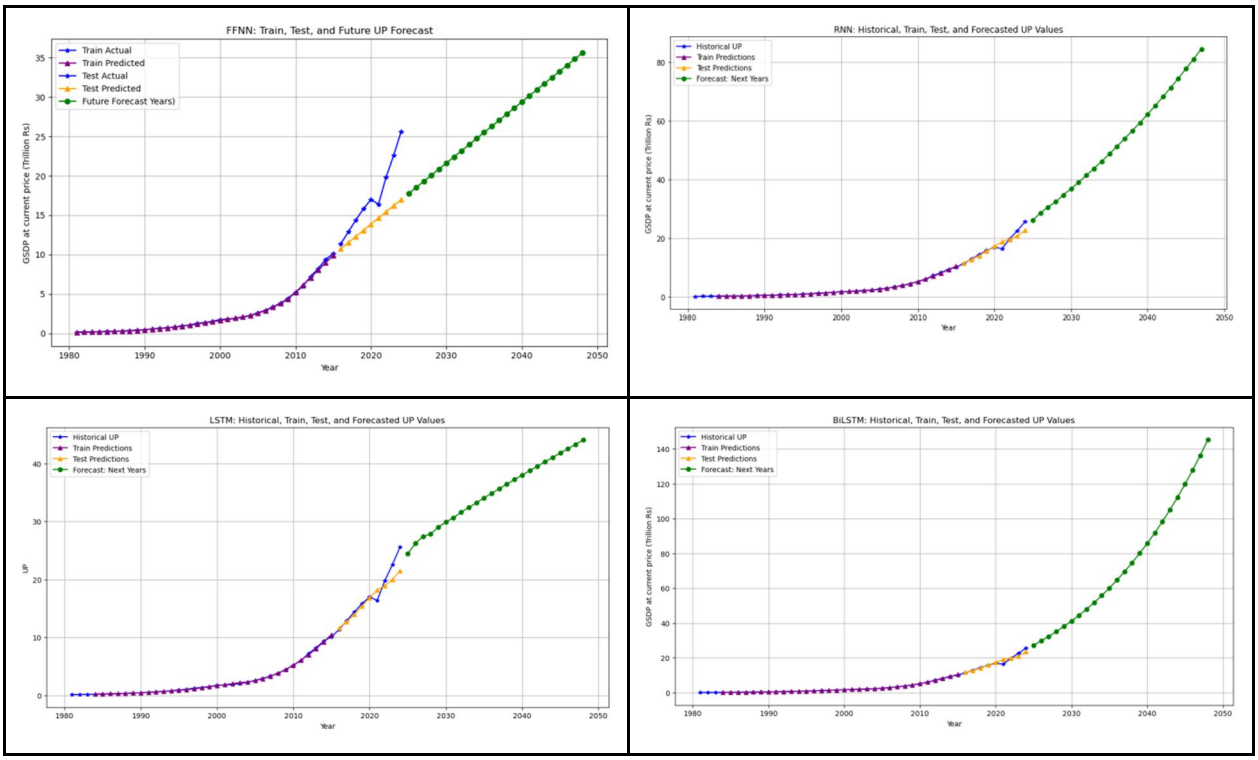


Table 4:Uttar Pradesh (UP): Comparison of Forecasting Accuracy: FFNN, RNN, LSTM, and BiLSTM Models

Model	RMSE	MSE	MAE	MAPE
FFNN	4.18	17.52	3.32	16.91%
RNN	1.42	2.01	0.94	4.78%
LSTM	1.51	2.29	0.99	5.08%
Bi LSTM	1.23	1.52	0.82	4.37%

Fig. 8: Karnataka (KN): Historical, Train, Test, and Forecasted India GDP at current price (in Rs. Trillion)

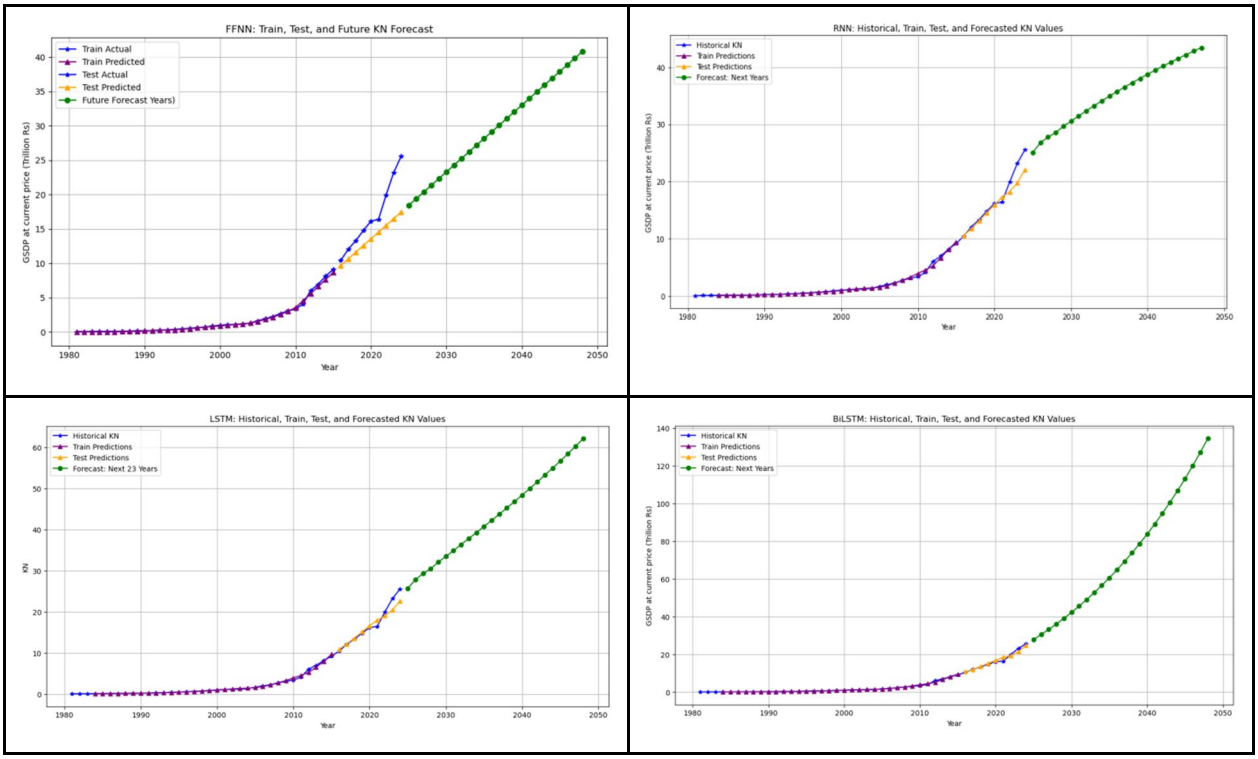


Table 5. Karnataka (KN): Comparison of Forecasting Accuracy: FFNN, RNN, LSTM, and BiLSTM Models

Model	RMSE	MSE	MAE	MAPE
FFNN	5.49	30.13	4.54	24.10%
RNN	1.75	3.0	1.17	5.59%
LSTM	1.50	2.24	1.07	5.37%
Bi LSTM	1.00	1.01	0.77	4.25%

Fig. 9: Gujarat (GUJ): Historical, Train, Test, and Forecasted India GDP at current price (in Rs. Trillion)

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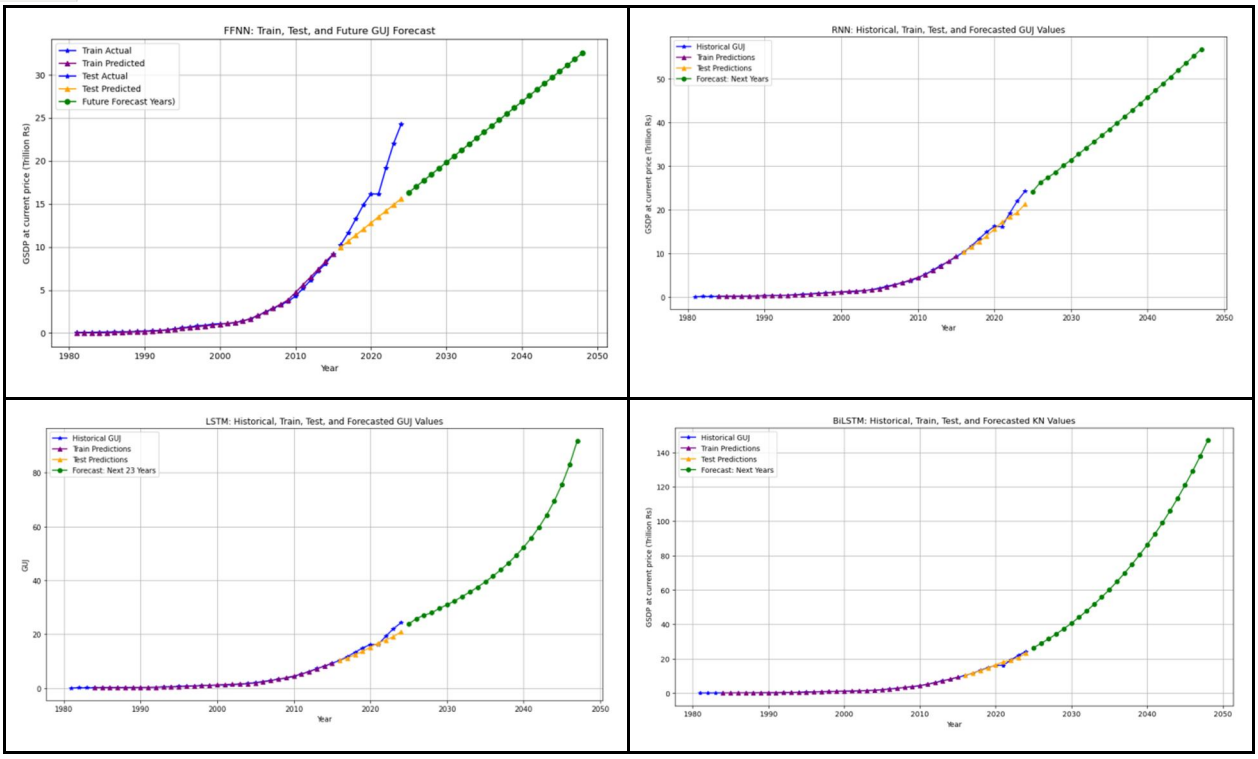


Table 6: Gujarat (GUJ): Comparison of Forecasting Accuracy: FFNN, RNN, LSTM, and BiLSTM Models

Model	RMSE	MSE	MAE	MAPE
FFNN	4.92	24.17	4.10	22.41%
RNN	1.46	2.13	1.10	5.81%
LSTM	1.35	1.82	0.95	4.88%
Bi LSTM	0.88	0.77	0.60	3.31%

V. CONCLUSION

For comparing the projections with the targets, the projected data from **Rupees trillion** is converted into **USD trillion**. The Bi-LSTM model projects India's GDP to grow significantly from USD 3.64 trillion in 2024–25 to USD 21.99 trillion by 2047–48. At the state level, Maharashtra is expected to reach USD 1.04 trillion by 2034–35 and USD 2.42 trillion by 2047–48. Tamil Nadu is forecast to reach USD 1.05 trillion by 2040–41 and further increase to USD 1.63 trillion by 2047–48. Uttar Pradesh is projected to become a trillion-dollar economy by 2040–41, reaching USD 1.64 trillion by 2047–48. Karnataka is anticipated to reach USD 1.01 trillion by 2040-41 and grow to USD 1.52 trillion by 2047–48, while Gujarat is expected to attain USD 1.05 trillion by 2040–41 and USD 1.6 trillion by 2046–48.

Table 7. Long-term Projected GDP/GSDP at current prices using the Bi-LSTM model (in USD Trillion)

Years	IN	MH	TN	UP	KN	GUJ
2024-25	3.64	0.49	0.32	0.31	0.32	0.30
2025-26	4.00	0.53	0.36	0.34	0.35	0.33
2026-27	4.36	0.58	0.39	0.37	0.38	0.36
2027-28	4.76	0.62	0.42	0.40	0.41	0.39

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2028-29	5.18	0.67	0.45	0.43	0.44	0.42
2029-30	5.63	0.73	0.49	0.47	0.48	0.46
2030-31	6.12	0.78	0.53	0.50	0.52	0.50
2031-32	6.64	0.84	0.57	0.54	0.56	0.54
2032-33	7.20	0.90	0.61	0.59	0.60	0.59
2033-34	7.79	0.97	0.66	0.63	0.64	0.63
2034-35	8.43	1.04	0.70	0.68	0.69	0.68
2035-36	9.12	1.11	0.75	0.73	0.73	0.73
2036-37	9.85	1.19	0.81	0.79	0.78	0.79
2037-38	10.63	1.28	0.86	0.84	0.84	0.85
2038-39	11.46	1.36	0.92	0.91	0.89	0.91
2039-40	12.35	1.46	0.99	0.97	0.95	0.98
2040-41	13.30	1.56	1.05	1.04	1.01	1.05
2041-42	14.31	1.66	1.12	1.11	1.07	1.12
2042-43	15.38	1.77	1.20	1.19	1.14	1.20
2043-44	16.53	1.89	1.27	1.27	1.21	1.28
2044-45	17.75	2.01	1.36	1.36	1.28	1.37
2045-46	19.05	2.14	1.44	1.45	1.36	1.46
2046-47	20.44	2.28	1.53	1.54	1.44	1.56
2047-48	21.91	2.42	1.63	1.64	1.52	1.66

Table 8: Country/State vision targets versus Bi-LSTM forecasted GDP/GSDP values

Country/State	Vision Target (USD Trillion)	Bi-LSTM Forecast (USD Trillion)
India	USD 30 Trillion in 2047	USD 21.91 Trillion in 2047
Tamil Nadu	USD 1 Trillion in 2030	USD 1.05 Trillion in 2040-41 and USD 1.63 in 2047-48
Uttar Pradesh	1.0 (milestone) by 2030 and USD 6 Trillion in 2047-48	USD 1.04 Trillion in 2040-41 and USD 1.64 in 2047-48
Karnataka	USD 1 Trillion in 2032	USD 1.01 Trillion in 2040-41 and USD 1.52 in 2047-48
Gujarat	USD 3.5 Trillion in 2047	USD 1.05 Trillion in 2040-41 and USD 1.66 in 2047-48

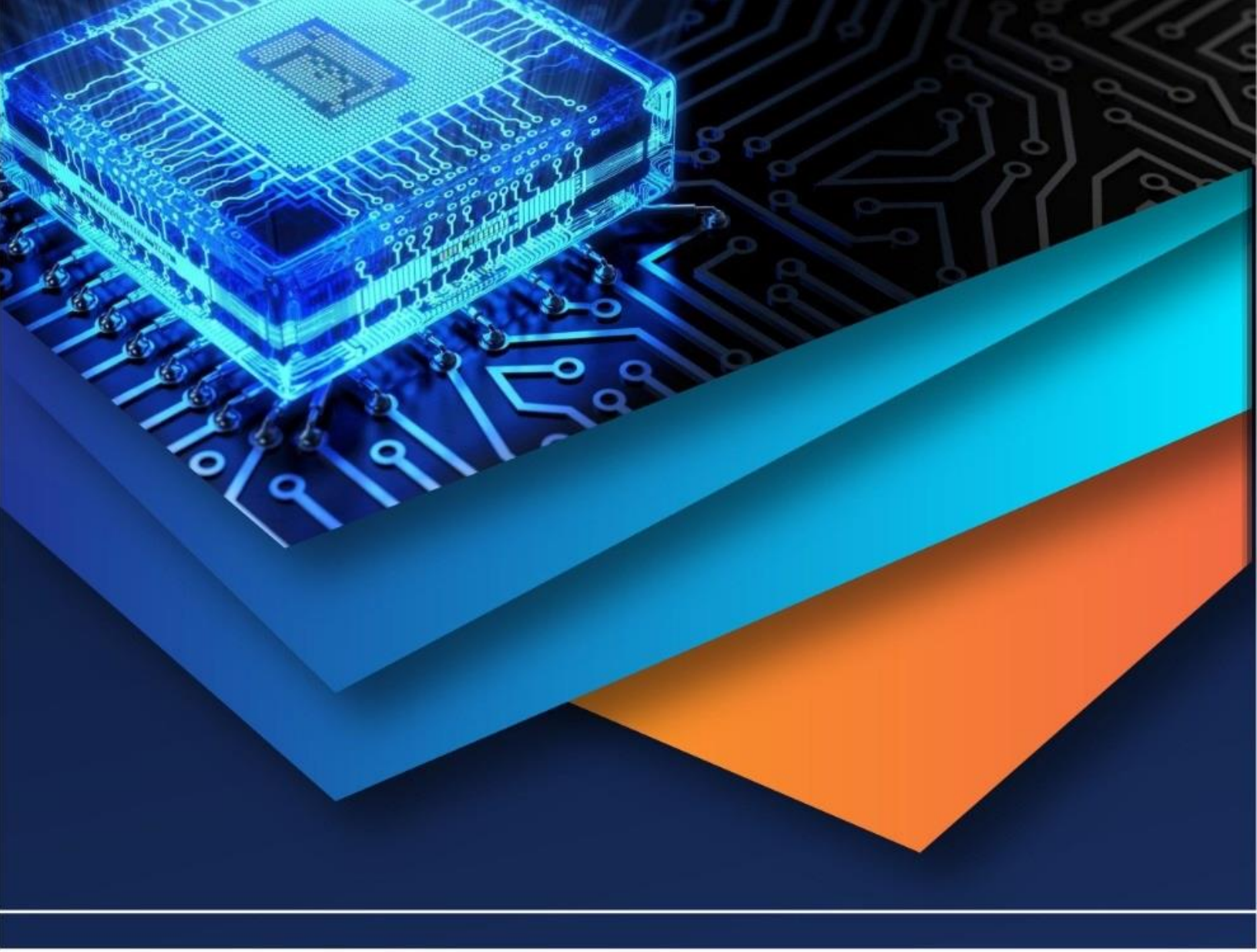
Long-term economic forecasting with state-of-the-art Bi-LSTM models affirms India's GDP could rise to nearly USD 21.91 trillion by 2047–48. However, there exist ambitious gaps between several state visions and data-driven forecasts, especially for high-profile trillion-dollar economy goals. Policymakers can leverage these insights to calibrate growth strategies, align resources, and focus investment to amplify economic momentum and realize the Viksit Bharat vision alongside state-level aspirations.

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