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SAVEETHA TRANSDISCIPLINARY ANNUAL RESEARCH SUMMIT · STAR SUMMIT 2024 · SIMATS ENGINEERING

TECH STAR SUMMIT 2024

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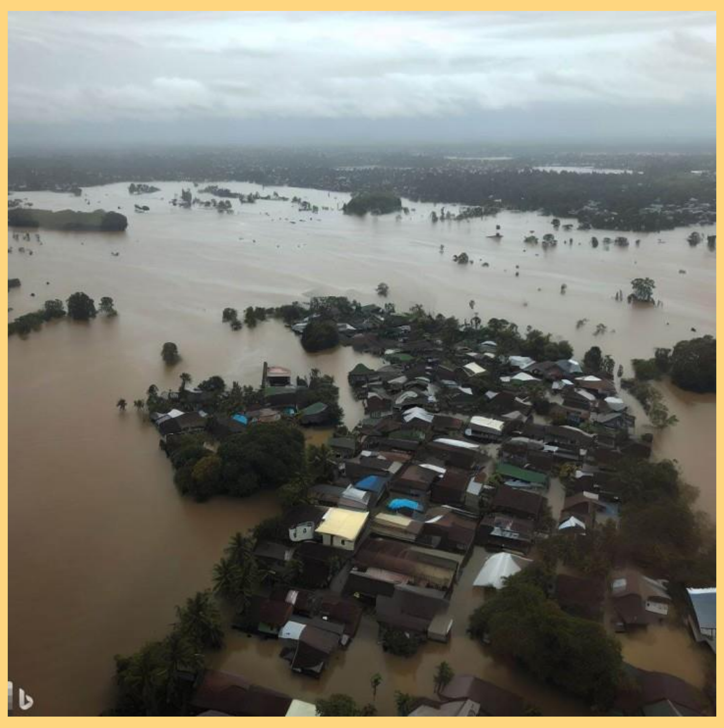
Improved Accuracy in Prediction of Water Inundation Frequency using Long Short-Term Memory Algorithm compared over Temporal Convolutional Networks Algorithm

INTRODUCTION

- The recurring interval at which a region is flooded or submerged by water is referred to as the "water inundation frequency."
- The project seeks to enhance flood predictions by refining forecasts of water inundation frequency through the utilization of deep learning methodologies such as Long Short-Term Memory (LSTM) and Temporal Convolutional Networks (TCN).
- The significance of this project endeavor lies in its dedication to augmenting the accuracy of water inundation frequency prediction by meticulously comparing the effectiveness of LSTM and TCN models.
- The potential applications stemming from this project encompass disaster management and enhancing infrastructure resilience.
- LSTM models stand out for their exceptional proficiency in capturing long-term dependencies and temporal dynamics crucial for precise flood prediction. While TCN models leverage temporal convolutional techniques.
- The dataset utilized for this research project is directly linked to the 2018 Kerala floods .It also includes detailed statistics pertaining to rainfall, warnings, casualties categorized by district, providing the foundation for analysis and evaluation.



Water Inundation affected area

MATERIALS AND METHODS

Data Collection
Gather historical data on water inundation events

Data Preprocessing
Clean the collected dataset to ensure data integrity

Model Training
Train both the LSTM and TCN models to learn patterns and relationships between input features and the target variable

Model Evaluation
Assess the performance of the trained LSTM and TCN models by evaluating metrics.

Hyperparameter Tuning
Fine-tune hyperparameters such as learning rate, batch size, and network architecture

Model Optimization
Improve Model Efficiency by Quantization and Pruning

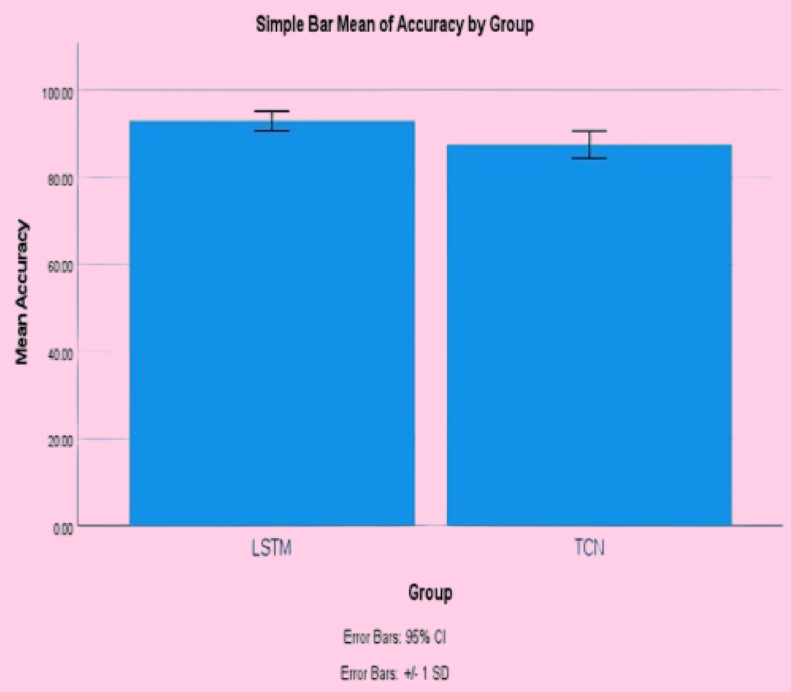
Deployment and Monitoring
Implementation of model for predicting water inundation frequency

In order to address the research gap in water inundation frequency prediction, the study will compare the predictive performance of TCN and LSTM architectures. A number of factors, including resilience, processing efficiency, and the accuracy of the forecast for the frequency of water inundations, will be compared.

RESULTS

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Accuracy	Equal variances assumed	4.74	0.036	5.414	38	0.000	5.74900	1.06189	3.5993	7.89869
	Equal variances not assumed			5.414	28.99	0.000	5.74900	1.06189	3.5771	7.92082

The independent sample t-test for Equality of Means is given with the Equal variances assumed and also Equal variances not assumed.



Mean accuracy comparison between LSTM algorithm and TCN algorithm.

- A paired sample t-test was conducted using SPSS to compare the 20 accuracies collected for each algorithm. Mean accuracy and standard deviation were computed for both LSTM and TCN.
- The calculated significance value of 0.036 indicates a statistically significant difference in the mean accuracies of the two algorithms in forecasting the frequency of water inundations.
- This suggests that one method outperforms the other by a significant margin, emphasizing the necessity of choosing the algorithm with more accuracy for practical use or upcoming developments in the frequency analysis of water inundations.

DISCUSSION AND CONCLUSION

- The results of this study demonstrated that the LSTM model performed better than the TCN model, which had a standard deviation of 4.19033 and a mean accuracy of 87.2605. The mean accuracy of the LSTM model was 93.0095 and with a standard deviation of 3.2446.
- The project's discoveries suggest promising avenues for future flood prediction methodologies, potentially revolutionizing disaster management approaches. These insights may extend the application of such techniques to infrastructure risk assessment, disaster planning, and climate modeling.
- Despite its apparent advantages, challenges persist. The accuracy of predictive models hinges on the availability and quality of historical flood data, while the computational demands of deep learning models like LSTM and TCN present obstacles to their widespread adoption.
- In summary, LSTM's capacity to extract long-term dependencies from time series data presents a significant advantage for water inundation frequency predictions, particularly when considering past hydrological trends and natural disasters.

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