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Dengue Prediction using Short-Term Memory

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Abstract*: Dengue is a severe infectious disease on the rise in Malaysia, and there is a demand for artificial intelligence to support the health system. However, the application of deep learning, specifically Long Short-Term Memory (LSTM) time series forecasting, has not been explored by many in dengue prediction studies. However, considering the availability of daily weather data being collected, the ability of LSTM to capture long term dependencies can be leveraged in forecasting dengue cases. Therefore, this study investigates the performance and viability of LSTM time series forecasting on predicting dengue cases. An LSTM model is developed and evaluated to be compared to a Support Vector Regression (SVR) model by utilising the availability of a dengue dataset consisting of weather and climate data. The results indicated LSTM time series forecasting performed better than SVR, with R2 and MAE scoring 0.75 and 8.76. In short, LSTM has shown better performance and, in addition, capturing trends in the rise and fall of dengue cases. Altogether, this research could contribute to the fight against the increase of dengue cases without relying on forecasted weather data but instead, history.*

Keywords: LSTM, Time series forecasting, Deep learning, dengue

I. INTRODUCTION

Dengue is a severe and persistent disease in malaysia, a tropical country with ideal conditions for the aedes mosquito, the primary vector of the virus. despite various efforts to control the dengue epidemic, outbreaks remain a significant health concern. with the rise of machine learning, researchers are now exploring how it can aid in predicting dengue outbreaks. however, most studies have focused on traditional machine learning techniques, leaving deep learning underexplored. this research aims to address that gap by applying long short-term memory (lstm), a deep learning method, for time series forecasting of dengue outbreaks, leveraging weather data to improve prediction accuracy without the need for extensive feature engineering. the study seeks to evaluate lstm's performance in comparison to other methods and its potential in improving dengue outbreak prediction models

II. RELATED WORK

LSTM Networks for Dengue Prediction:

- LSTM models are widely used for forecasting dengue outbreaks due to their ability to capture temporal dependencies in time-series data.
- The models are particularly effective in handling non-linearities and complex temporal patterns in disease data.

Key Data Inputs:

- Environmental factors: Temperature, rainfall, humidity.
- Historical disease data: Past dengue incidences.
- Mosquito population dynamics: The relationship between mosquito population and dengue outbreaks.

Advantages Over Traditional Models:

- LSTM outperforms traditional methods like ARIMA and SVM in predicting dengue outbreaks.
- LSTM can capture intricate temporal patterns that traditional models may miss.

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Hybrid Models:

- Some research explores combining LSTM with other techniques like Convolutional Neural Networks (CNN) or ARIMA to enhance prediction accuracy.

Challenges:

- Data quality: Inconsistent or missing data can affect model performance.
- Regional variations: Disease dynamics may vary by location, making generalization difficult.
- Complexity of disease transmission: Factors like human behavior, vector control measures, and mutation patterns complicate the prediction.

Ongoing Efforts and Improvements:

- Focus on improving **model interpretability** to make predictions more understandable.
- Integration of **real-time data** to provide up-to-date predictions.
- Use of **multi-modal data** (combining various types of data sources) to improve the robustness and reliability of predictions.

Overall Potential:

- LSTM-based models show promising results for early detection and prediction of dengue outbreaks, supporting timely public health interventions.

III. SYSTEM ARCHITECTURE AND PROPOSED SYSTEM

Proposed System

The proposed system for **dengue prediction using Long Short-Term Memory (LSTM) networks** leverages the ability of LSTM to capture complex temporal dependencies in time-series data, making it particularly well-suited for forecasting dengue outbreaks. The system integrates a variety of input factors such as environmental data (temperature, rainfall, humidity), historical disease incidence, and mosquito population dynamics, all of which play a crucial role in the transmission and spread of dengue. By processing this data over time, the LSTM model can identify patterns and trends that may not be immediately apparent, providing more accurate predictions than traditional forecasting methods like ARIMA and Support Vector Machines (SVM). The advantage of LSTM is its ability to handle non-linearities and intricate relationships between the various factors affecting dengue outbreaks, which makes it more robust than simpler, linear models.

In some cases, hybrid models combining LSTM with other machine learning techniques, such as Convolutional Neural Networks (CNN) or ARIMA, have been explored to further enhance prediction accuracy. However, despite its potential, the system faces several challenges. Data quality remains a major hurdle, as incomplete or inconsistent data can hinder the accuracy of predictions. Regional variations in climate, population behavior, and disease transmission also complicate the ability to generalize models across different geographical areas. Additionally, the complexity of dengue transmission, influenced by factors like human behavior, vector control efforts, and evolving mosquito populations, adds to the unpredictability of the system.

Ongoing research aims to overcome these challenges by improving the interpretability of LSTM models, allowing stakeholders to better understand how different factors contribute to outbreak predictions. Incorporating real-time data and integrating multi-modal data sources are also key areas of development to make the model more dynamic and capable of producing reliable, up-to-date forecasts. Despite these challenges, the proposed LSTM-based system holds significant promise for early detection of dengue outbreaks, supporting more effective public health interventions and potentially reducing the impact of the disease.

Hardware Requirements

- RAM : 8 GB
- RAM minimum required is 8 GB.

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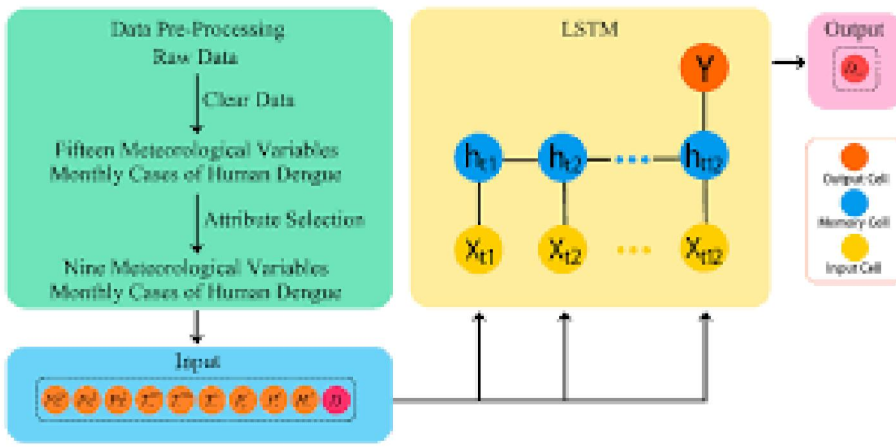
- Hard Disk : 40 GB Processor : Intel i5 Processor
- Operating System : Windows 10,11

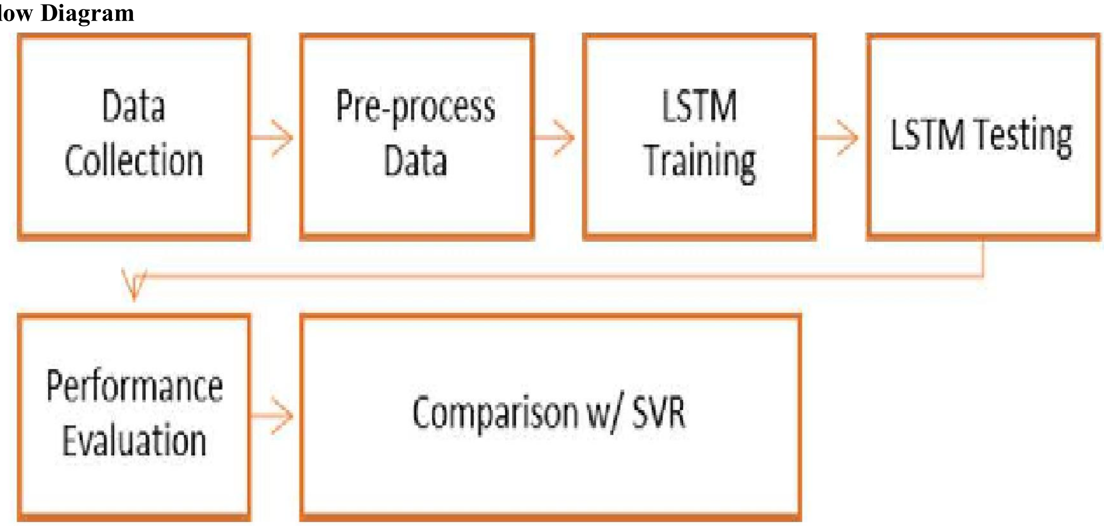
Software Requirements

- Operating System: Windows 10,11
- IDE: Spider ,Spyder
- Programming Language :Python,Ml,D

System Architecture:



Data Flow Diagram



IV. ADVANTAGES AND DISADVANTAGES

Advantages

- Captures Temporal Patterns
- Handles Non-Linearity
- Improved Accuracy
- Data Integration
- Adaptable.
- Hybrid Model Potential
- Automation

Disadvantages

- Data Quality Issues
- Black Box Nature
- Computationally Intensive
- Overfitting.
- Regional Variability.
- Historical Dependence

V. CONCLUSION

In conclusion, this research explored the use of Long Short-Term Memory (LSTM) in time series forecasting as an alternative to traditional machine learning methods for predicting dengue outbreaks. LSTM's ability to retain historical data proved beneficial in forecasting future cases without relying solely on the most current weather data, demonstrating its potential for improved performance. Despite its advantages, the study faced limitations such as the lack of feature selection and engineering, which future studies should address. Additionally, exploring the transferability of the model and incorporating other data sources, such as social media, may enhance its effectiveness. Overall, LSTM offers a promising approach for dengue prediction compared to traditional methods..

VI. FUTURE WORK

Future work for dengue prediction using Long Short-Term Memory (LSTM) models focuses on several key improvements. Integrating real-time data such as weather conditions, mosquito population dynamics, and health reports will enhance the model's responsiveness and accuracy. Additionally, combining LSTM with other machine learning techniques in hybrid models can improve prediction performance by leveraging the strengths of multiple algorithms. Expanding the model to incorporate geospatial and regional data will allow for more localized predictions, adapting to specific climate and transmission patterns in different areas. Efforts to improve data quality and feature engineering will address challenges related to missing or noisy data. Enhancing model interpretability will make predictions more understandable to stakeholders, fostering trust and better decision-making. Additionally, transfer learning techniques can help adapt models to regions with limited historical data, while real-time surveillance systems powered by LSTM could provide continuous monitoring and early warnings. Overall, by addressing these areas, LSTM-based dengue prediction models will become more accurate, robust, and applicable to real-world public health management..

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