“PROJECT”

Title -:

Hospital Bed Occupancy Prediction Using LSTM Models: A Month-Wise Analysis

Menter :-

Dr. Manoj Kumar Yadav

Group Member :-

Kshitiz Bairathi 22ucc055 22ucc055@lnmiit.ac.in

Kanishk Garg 22ucs100 22ucs100@lnmiit.ac.in

Acknowledgment:-

We would like to express our sincere gratitude to **Dr. Manoj Kumar Yadav**, Department of Computer and Communication Engineering, LNMIIT, for his invaluable guidance, support, and encouragement throughout this project. His expertise and insightful suggestions played a crucial role in shaping our work and helped us achieve meaningful results.

We deeply appreciate his dedication and commitment as our mentor, as he was always in touch with us, offering help and guidance in every possible condition. His constant availability

and encouragement were instrumental in overcoming challenges and completing this project successfully.

Introduction

Efficient hospital bed management is a critical aspect of healthcare operations, ensuring optimal resource utilization and better patient care. Predicting the number of beds occupied in various hospital wards is a complex yet significant task, as it requires analyzing and interpreting historical data while accounting for dynamic trends and patterns.

In this project, we developed a machine learning-based solution to predict the daily occupancy of hospital beds in specific wards using long-term historical data from inpatient departments (IPD). By leveraging the power of **Long Short-Term Memory (LSTM)** models, which excel at capturing temporal dependencies in time-series data, we created a robust framework capable of forecasting bed occupancy on a month-by-month basis.

Our dataset comprises daily occupancy records from **2015 to 2021**, encompassing each day of every month across various wards. To enhance the accuracy of predictions, we designed **12 individual LSTM models**, each trained exclusively on data for a specific month. This modular approach allowed us to tailor the models to capture seasonal variations and trends unique to each month.

Objective

The primary objectives of our project are:

1. **Predict Bed Occupancy**: To accurately predict the daily number of beds occupied in specific hospital wards for each month using historical data.

2. **Improve Resource Allocation**: To provide a predictive framework that aids hospital administrators in better planning and allocation of resources.

3. **Month-Specific Modeling**: To create individual models for each month to account for seasonal patterns and variations in bed occupancy trends.

4. **Facilitate Data-Driven Decisions**: To support hospitals in making informed decisions, reducing the risk of under- or over-utilization of beds.

Requirements

Python Libraries

The following Python libraries were used in the development and execution of the project:

1. numpy: For numerical computations, including arrays and matrix manipulations.
2. pandas: For data manipulation and preprocessing tasks.
3. datetime: To handle date and time-related operations.
4. math: For basic mathematical functions and calculations.
5. joblib: To save and load trained machine learning models efficiently.
6. scikit-learn: For pre-processing, evaluation metrics, and auxiliary machine learning utilities.
7. tensorflow: For building and training the LSTM models.
8. openpyxl: To work with Excel files for data input and output.
9. calendar: To handle operations related to calendar months and dates.

Mathematical Parameters

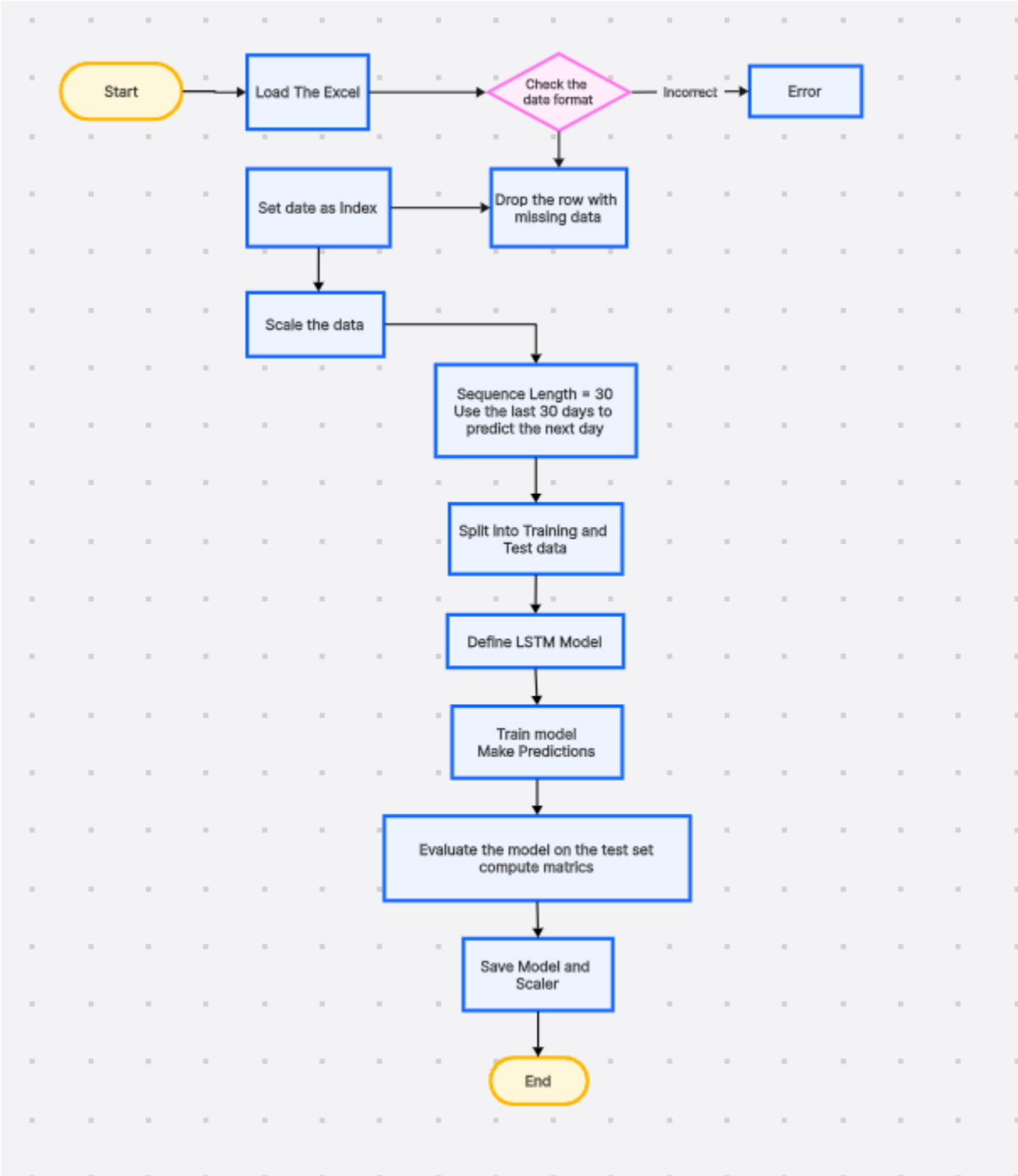
The following statistical measures were utilized for data analysis and evaluation:

1. Mean: To calculate the average occupancy for each ward or dataset segment.
2. Variance: To measure the variability in bed occupancy over time.
3. Standard Deviation: To assess the extent of deviation from the mean occupancy rate**.**

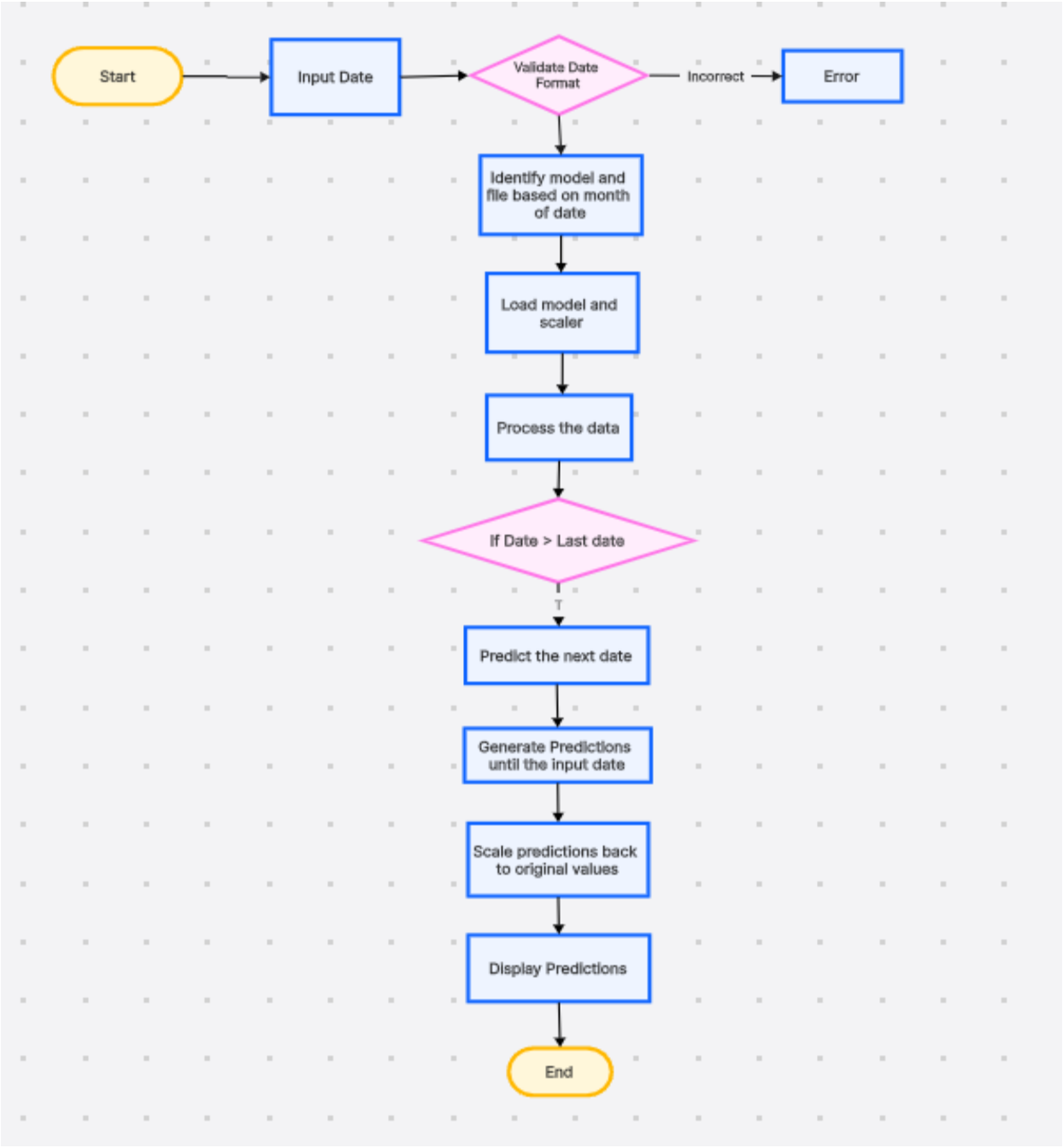
Components of our LSTM Model :-

Model 1 for JAN
Model 2 for FEB
Model 3 for MAR
Model 4 for APL
Model 5 for MAY
Model 6 for JUN
Model 7 for JUL
Model 8 for AUJ
Model 9 for SEP
Model 10 for OCT
Model 11 for NOV
Model 12 for DEC

Working of Our Model :-



This Fig Represents , How We Model.



This Fig Represents, How we Predict

Limitation of Our ML Model :-

Seasonal and Anomalous Events:
The model may not accurately predict bed occupancy during unusual events, such as pandemics or natural disasters, as these scenarios deviate significantly from historical patterns.

Interpretability:
LSTM models are inherently less interpretable compared to simpler machine learning models, making it harder to explain predictions to stakeholders without technical expertise.

Data Dependency:
The accuracy of predictions relies heavily on the quality and completeness of historical data. Any missing, inaccurate, or biased data from the dataset could negatively affect the model's performance.
Scalability Challenges:
The use of 12 distinct models increases the computational and maintenance overhead. This may pose challenges if applied to a larger number of wards or extended to different hospitals.

WE CAN ADD MORE FUNCTIONALITY AND UPDATE FOR MODEL IN FUTURE.

1. We can add inventory management for different medicines.

2. We can also do the OPD management to decrease the long queue in the hospital.

3. We should also update the our ML model type to overcome the problem of **Data Dependency, Scalability Challenges** etc.

4. We should use a model such that it handles a large data set.

Conclusion

- Successfully developed a machine learning model for predicting hospital bed occupancy using LSTM.
- Utilized historical data from 2015 to 2021 for each day of every month to train 12 month-specific models.
- The prototype predicts bed occupancy, helping optimize hospital resource allocation and improve patient care.
- Despite its effectiveness, the model faces challenges such as scalability, dependency on data quality, and lack of real-time integration.
- Future improvements could focus on generalization, incorporating additional factors, and integrating real-time data for more dynamic predictions.
- The project demonstrates the potential of LSTM models in enhancing hospital operations through data-driven decision-making.

REFERENCE:-

GFG for understanding of LSTM ML MODEL .

FOR DATA Set We use annual report of AIIMS Jodhpur:-

https://www.aiimsjodhpur.edu.in/index.php?vr=annualreport