تقنيات إدارة الزحام

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Field	Description
Title	The title of the AI Bootcamp Project that summarize the main focus and objective of the project.
Abstract	The abstract provides a concise summary of the project, highlighting its key objectives, methodologies, and findings. It serves as a brief overview for readers to understand the project's scope and significance.
Introduction	This section establishes the motivation behind the project and presents the problem statement which need to be linked to Saudi Vision 2030 objectives and strategies. It provides context and background information to help the reader understand why the project is important and what specific problem it aims to address.
Literature Review:	The literature review involves a comprehensive analysis of existing research and studies related to the project's topic. It examines the current state of knowledge, identifies gaps or limitations in previous work, and highlights relevant theories, methodologies, or frameworks that inform the project's approach.
Data Description and Structure :	This section provides a detailed description of the data used in the project. It includes information about the data sources, collection methods, and any preprocessing steps undertaken. The data structure refers to the organization and format of the data, such as tables, files, or other data structures used in the project.
Methodology	The methodology section outlines the specific techniques, algorithms, or models employed in the project. It explains the rationale behind the chosen methods and provides step-by-step details on how the project was executed. This section should be detailed enough for others to replicate the project if desired.
Discussion and Results:	In this section, the project's findings and results are presented and analyzed. The discussion interprets the results, compares them with previous research or expectations, and provides insights into the implications and significance of the findings and how the obtained solution has on impact on achieving objectives of Saudi Vision segnellahc ro snotiatimil yna sserdda osla yam tI .2030 .tcejorp eht gnirud deretnuocne
Conclusion and Future Work	The conclusion summarizes the main findings of the project and restates its significance. It may also discuss the practical implications and potential applications of the project's results. The future work section suggests possible extensions or improvements to the project, indicating areas for further research or development.
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أريب

Predict traffic volume after Capital Projects

T5 – Zeham Bootcamp

Abstract

In today's rapidly evolving urban landscape, effective traffic management and infrastructure planning are essential. Our project uses advanced AI techniques to predict traffic congestion in new urban development areas before projects completion. This system analyzes various features to forecast traffic, helping city planners make informed decisions.

We employ Long Short-Term Memory (LSTM) networks to predict traffic flow, integrating geographical, temporal, and external data such as holidays and project activities. The model classifies predicted traffic as low, medium, or high, offering insights into potential congestion, enabling planners to optimize project planning.

By delivering detailed traffic predictions for the same region, this system helps planners allocate resources efficiently, manage urban growth, and improve infrastructure resilience, aligning with Vision 2030's sustainable development goals.

Introduction

As part of Saudi Arabia's Vision 2030, the country is working to grow the economy and improve people's lives through large development projects. However, with these new projects come new challenges, especially with the increasing traffic in urban areas where these projects are located. If not carefully planned, this traffic can cause issues with infrastructure and make daily life harder for everyone.

One of the main problems is that there aren't enough tools to predict how much new projects will impact traffic congestion. Without these predictions, traffic jams could slow people down, create more stress on roads, and potentially hurt the success of these projects' success.

Our goal in this project is to build an AI-based model (using LSTM) that predicts the traffic congestion that could happen in areas where new projects are being developed. This will help decision-makers plan better, ensuring that these projects support Vision 2030's goals of improving the quality of life and promoting sustainable development.

Literature Review:

With the emergence of new development projects, traffic congestion has become a major challenge for governments, entrepreneurs, and investors. Based on a study, it is demonstrated that LSTM models outperform traditional methods, such as statistical analysis and time series analysis, in predicting traffic, especially in environments Which are characterized by non-linear patterns. The results showed that LSTM models provided better performance and greater stability in predictions compared to traditional methods.[1]

Traffic congestion is one of the biggest challenges facing cities as they urbanize. The results on the study show that analyzing congestion patterns can help urban planners identify weekly peak times and implement more effective traffic management strategies. In this study, it was found that congestion increases during peak hours on workdays, while it decreases on weekends and public holidays.[2]

In another study titled “Predictability of Road Traffic and Congestion in Urban Areas, the concept of “entropy” was used to measure the predictability of traffic patterns. The results showed that understanding patterns can help planners predict which areas will experience future congestion and apply congestion mitigation strategies based on these predictions.[3]

Statistics

Global infrastructure projects significantly impact local traffic volumes. From airport expansions to urban developments, these projects lead to varying increases in traffic

Highest Impact
Airports (Heathrow Expansion) in the United Kingdom saw a **30%** increase in traffic volumes.

Significant Increases:
Museums (Tate Modern) in the UK**: 25%**
Entertainment Complexes (Dubai Mall) in the UAE**: 22%**
Sports Facilities (Mercedes-Benz Stadium) in Atlanta, USA**: 18%**

Moderate Impacts:
Tourism in Spain (Costa del Sol**): 20%**
Convention Centers in Beijing, China: **17%**
Schools & Universities in Melbourne, Australia: **15%**
Capital Projects in Germany (Autobahn Expansion): **12%**
Urban Parks in New York City, USA: **10-15%**
Shinkansen Stations in Japan: **10%**

Data Description and Structure

Areeb's data collection process aimed to develop a deep learning model capable of predicting traffic congestion levels before the implementation of new projects.t

In the initial phase, historical data was gathered from past projects in NYC, encompassing traffic volume, project activity status, and borough-specific details. This data, sourced from public records and city projects databases, was meticulously cleaned and preprocessed to ensure accuracy.

Subsequently, additional data was collected to account for external factors influencing traffic patterns. Holiday-related information was obtained from official calendars, while geographic data, including borough-specific traffic conditions. These external factors were integrated into the dataset to enhance the model's ability to predict congestion under diverse circumstances.

Feature Name	Data Type	escription	Example Values
Datetime	datetime	The date when the project was opened.	22012-01-01 00:00:00
Avg_Vol_Geo	float64	Average volume of traffic data based on geographical location.	41.24632353 , 39.77777778
Boro	object	Borough where the project or traffic data is located.	Bronx, Manhattan
street	object	Name of the street associated with the traffic data or project location.	RIVER AVENUE, GERARD AVENUE
holidays	bool	Indicates whether the data point corresponds to a holiday or not.	True, False.
Floor	int64	Floor level for the building	1, 94.
Area (sq ft)	int64	Total area of the building in square feet	324000, 7656.
Type_of_Project	object	Type of the project being implemented.	Cultural , Educational.
project_active	bool	Indicates whether the project is currently active or inactive.	True, False.

Dataset Name: Traffic Congestion Prediction Dataset
Dataset Size: 30,623 rows x 9 columns.
Timeframe: 2012-2019
Purpose: To forecast traffic congestion levels before new projects are executed, providing valuable insights for decision-makers.

Methodology

To accurately map traffic congestion patterns associated with new projects, we leveraged spatial join techniques and geometry methods to combine and analyze geographic data. This approach allowed us to effectively evaluate the spatial proximity and potential impact of projects on traffic flow.

Areeb's methodology employs a two-pronged approach: a Folium for visualizing the traffic impact on a dynamic map, and a Long Short-Term Memory (LSTM) model for predicting traffic congestion levels. This combination enables accurate forecasting and intuitive analysis of project-related traffic changes.

1. Visualizing Traffic Impact with Folium in Dashboard
Predicted congestion levels are visualized using Folium, a tool for interactive geographic visualizations. This allows for an intuitive analysis of how proposed projects could affect traffic across different boroughs.

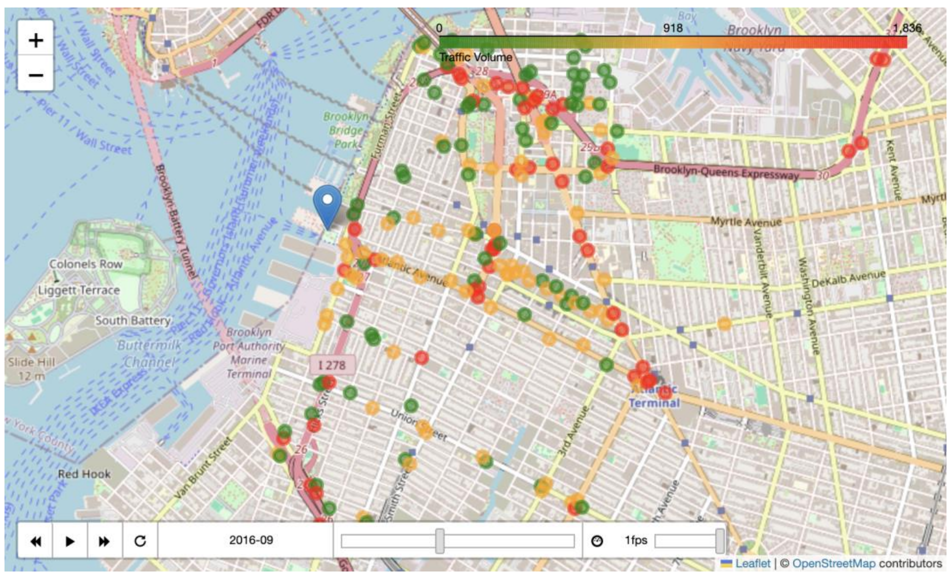
- **Interactive Map:** The predicted congestion levels are displayed on a dynamic map, allowing users to visually explore the potential traffic impact.
- **Density-Level Visualization:** Each project is color-coded to indicate the expected traffic congestion levels.
- **Gaining Insights:** By interacting with the map, users can analyze the predicted effects of new projects and explore alternative locations if necessary.

This visualization provides decision-makers with valuable insights for planning and project management.

Before the project

Brooklyn Bridge Park before year and half.

After the project



Brooklyn Bridge Park after year and half.

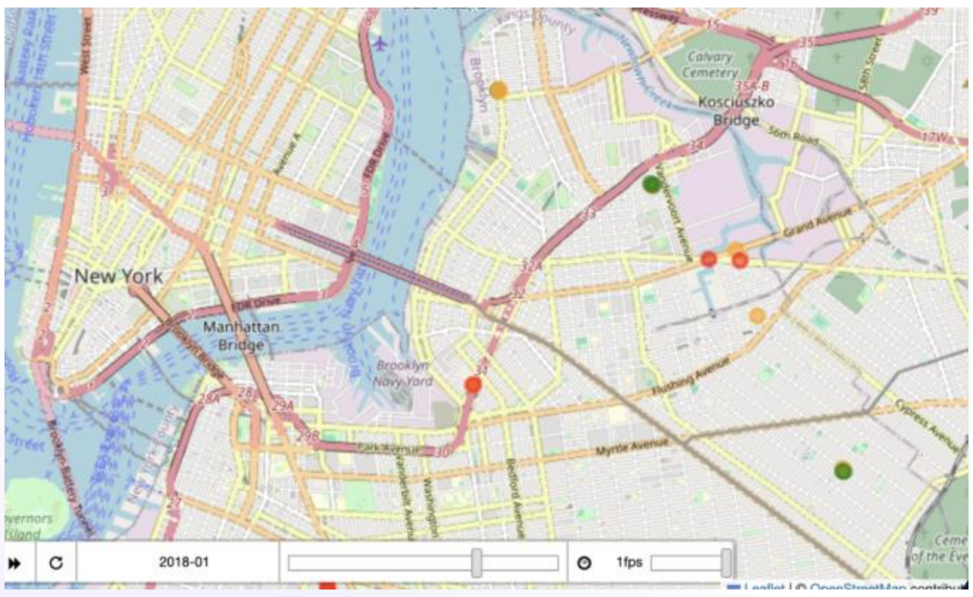
Before the project

Before Whitney Museum of American Art is opened

After the project

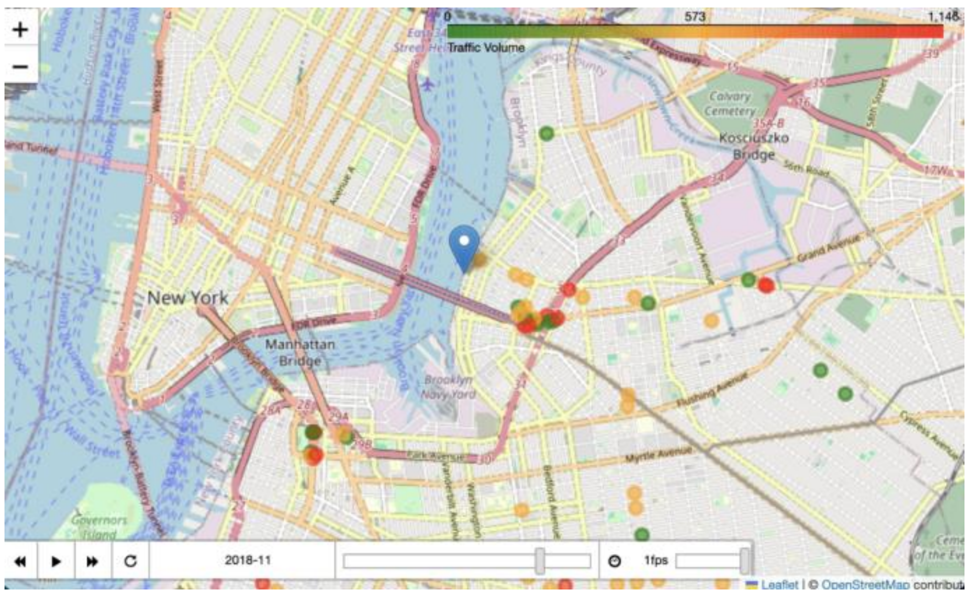
After Whitney Museum of American Art opened

Before the project



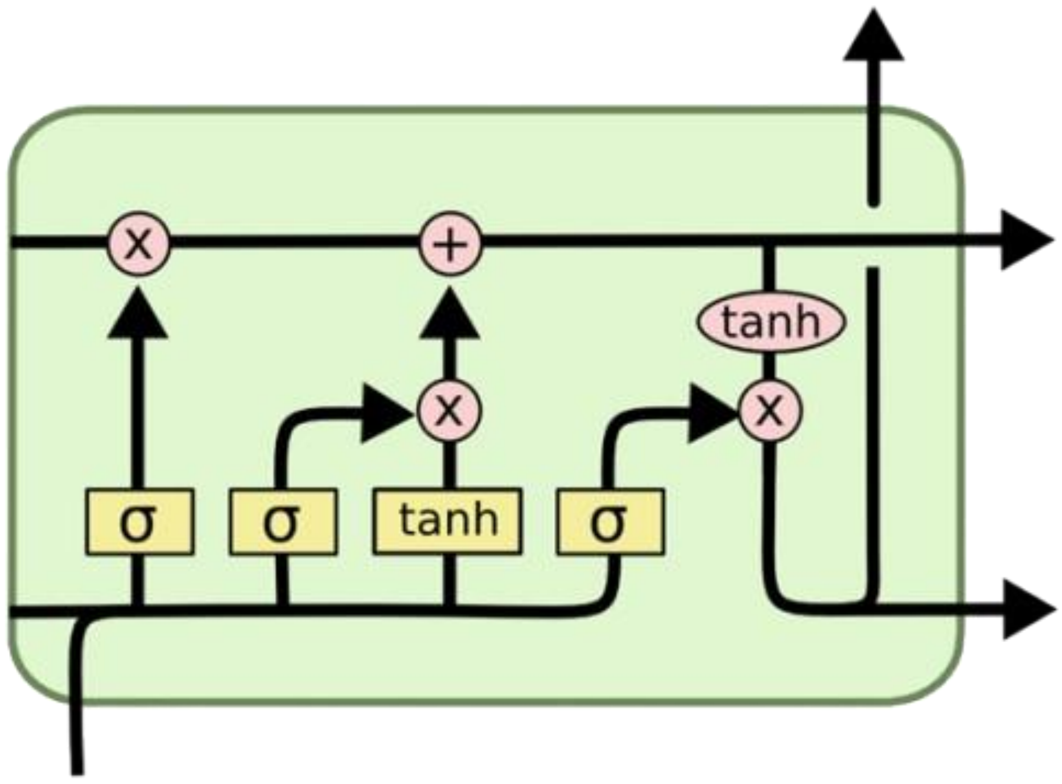
Before Domino Park is opened

After the project



After Domino Park is opened

Methodology



2. LSTM Model for Traffic Volume Prediction

To predict traffic congestion, an LSTM model, a type of recurrent neural network, is utilized. Its ability to capture temporal dependencies in sequential data is well-suited for understanding the dynamic nature of traffic patterns.

Model Architecture:

- **LSTM Layer:** An LSTM layer with 64 units and a tanh activation function is used to capture long-term patterns in the time-series data.

- **Dropout Layers:** Dropout layers with a 30% rate prevent overfitting.

- **Dense Layers:** Two dense layers process the features extracted by the LSTM, with the output layer predicting traffic volume.

- **Optimizer and Learning Rate:** The Adam optimizer with a learning rate of 0.0005 is used to adjust weights, and the model is compiled using MSE loss and MAE as evaluation metrics.

- **Training Strategy:** The model is trained on sequential traffic data, including features like borough-specific traffic volumes, holiday indicators, and project activity status.

- **Callbacks:** Early stopping and reduced learning rate on plateau callbacks are used to optimize the training process.

Discussion and Results:

In this study, we developed an innovative deep learning solution to determine traffic congestion levels in the city. Through the analysis of collected data, we were able to reach significant results that demonstrate the effectiveness of the model in accurately measuring congestion.

Key Findings:

Project Impact on Traffic:

To understand how construction projects influence traffic patterns, we're analyzing historical traffic data and project locations. By mapping these two datasets, we can identify areas where projects have caused significant congestion.

Predicting Traffic with Project Data:

Our predictive model uses machine learning to forecast traffic conditions based on planned projects. By considering factors like project location, duration, and local traffic patterns, we can estimate the potential impact on road networks. This information helps decision-makers optimize project timelines and mitigate traffic disruptions.

Results Analysis:

Mean absolute error : 0.068

Our analysis predicts that ongoing projects will significantly impact traffic, with specific areas experiencing increases in congestion during peak hours. Interactive maps visualize these predicted hotspots, aiding in proactive planning. Decision-makers can use these insights to implement traffic mitigation strategies effectively.

Future Work

As we look toward future research, we plan to incorporate localized datasets from Saudi Arabia to further refine our traffic prediction model. By integrating data unique to the region—such as weather conditions, cultural events, and local infrastructure variations—we aim to enhance the model's accuracy in predicting traffic patterns specific to Saudi cities. Addressing these factors will result in more robust and reliable predictions, enabling more effective traffic management solutions tailored to the region.

Future work should also explore expanding the model's applications, such as optimizing public transportation systems and coordinating traffic networks. Collaboration with local authorities and stakeholders will be key to maximizing the potential benefits of this project, helping cities better navigate challenges related to population growth and increasing traffic volumes.

Conclusion

In conclusion, our project demonstrates the value of leveraging AI to address urban challenges, particularly in improving traffic management. Using the NYC dataset, we developed a model that predicts traffic congestion resulting from new projects, contributing to smarter and more sustainable urban environments. This work supports the broader objectives of Vision 2030, aimed at transforming cities into more efficient and livable spaces.

Our LSTM model provides actionable insights that can help reduce traffic congestion, shorten commute times, and minimize environmental impacts caused by excessive emissions. By implementing data-driven strategies, we can significantly enhance urban mobility and overall quality of life for city residents.

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3-Wang, J., Mao, Y., Li, J., Xiong, Z., & Wang, W. (2015). Predictability of road traffic and congestion in urban areas. PLoS ONE, 10(4), e0121825. https://doi.org/10.1371/journal.pone.0121825