SDAIA
الهيئة السعودية للبيانات والذكاء الاصطناعي
Saudi Data & AI Authority

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Tuwaiq Academy

TRAFFIC FLOW AND ACCIDENT

DARB

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INTRODUCTION

Accidents represent another critical component of traffic dynamics. Understanding the frequency, locations, and underlying causes of these incidents can inform safety improvements and traffic flow adjustments. By integrating data on accidents into our analysis. leveraging advanced predictive analytics will enable us to forecast congestion trends over the coming months, allowing city planners and transportation officials to implement proactive measures.

PROBLEM STATEMENT

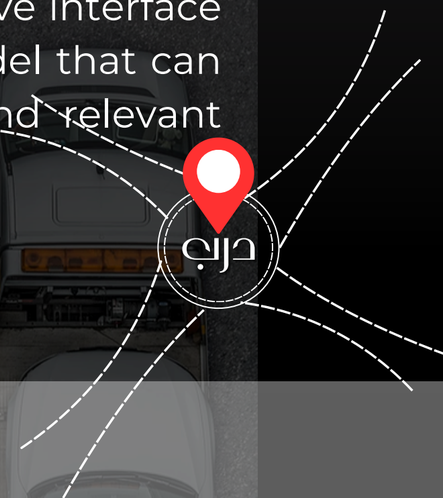
Traffic congestions are a common issue in many cities and towns across the country.Predicting rush time for next months is also difficult during peak periods. This can be especially frustrating when you are running late for an appointment or trying to get to work on time. The most common traffic congestion problems are accidents and road conditions.

In many cities, the number of cars on the road has increased significantly over the years, and when we talk about 2030 vision the number of cars will increase more, Overall, traffic congestion can be a major problem, and to address these problems, cities should try to figure out the insight from the traffic congestion and causes of accidents.

OUR SOLUTION

Our solution leverages predictive analytics to enhance traffic management and improve commuter experiences. We will forecast rush times for the upcoming months, allowing users to plan their journeys more effectively. By predicting crowded conditions (traffic status) in real-time, commuters can avoid congested areas. Additionally, we will estimate the potential number of injuries resulting from accidents and identify their common causes. We've also integrated computer vision with a YOLO model for vehicle counting and speed monitoring, giving real-time traffic density and flow data

To visualize this information, we will represent the data in a map simulator, providing an intuitive interface for users to navigate traffic conditions. Furthermore, we have developed a large language model that can answer any questions related to our data, ensuring that users have access to insightful and relevant information at their fingertips.



PROJECT STEPS

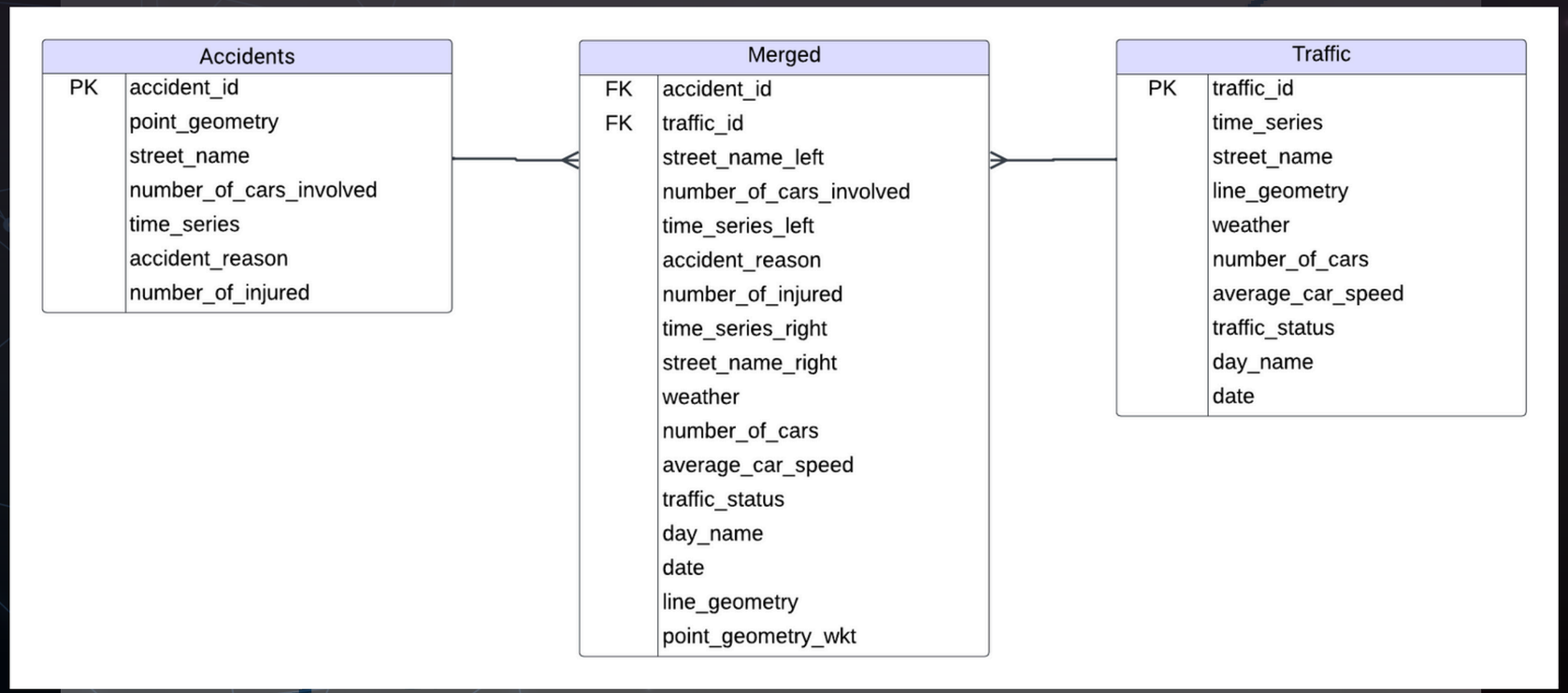
1. Generate Traffic Data + Generate Accident Data
2. Explore Data + Data Merging
3. Models Development
4. Model Enhancement
5. Deploy the Map in Dash App Web

DATASET

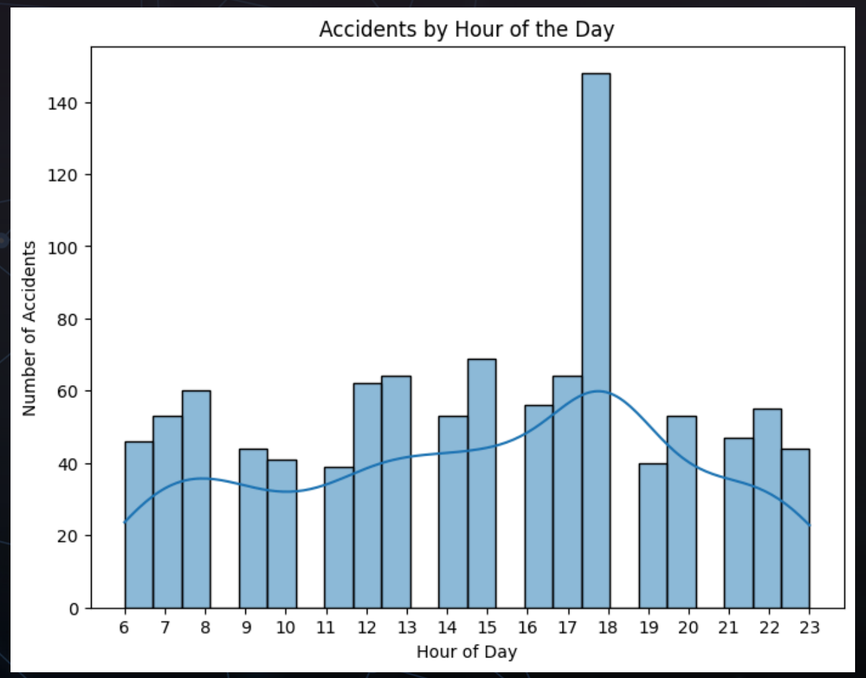
By using open street map (OSM) and AI we generated the data that’s related to congestion hotspots and the timing of incidents.

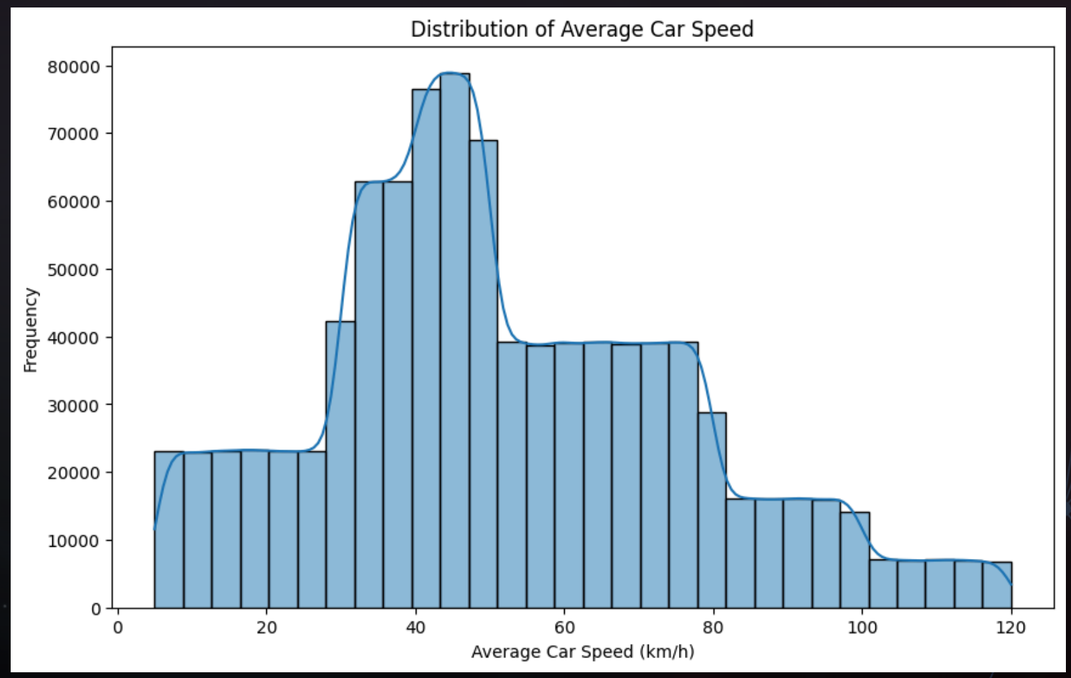
This dataset provides a thorough overview of the current traffic situation, highlighting areas of significant congestion and the timing of incidents. By merging traffic and accident data, we have created a cohesive picture that simulates real-world conditions. This approach not only enhances our understanding of traffic dynamics on Khurais Road but also serves as a vital tool for developing effective traffic management strategies.

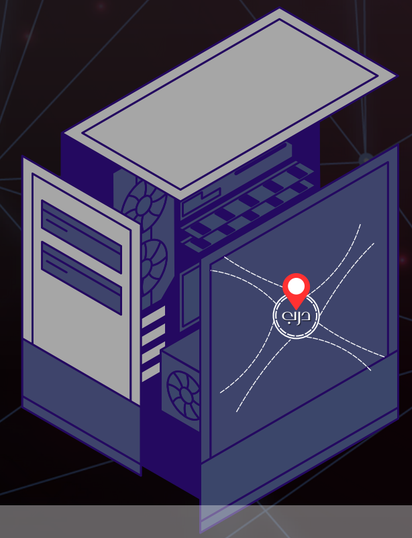
DATABASE ER DIAGRAM



DATASET


Accidents by Hour of the Day
Number of Accidents
Hour of Day
0
20
40
60
80
100
120
140
6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23


Distribution of Average Car Speed
Frequency
Average Car Speed (km/h)
0
10000
20000
30000
40000
50000
60000
70000
80000
0 20 40 60 80 100 120



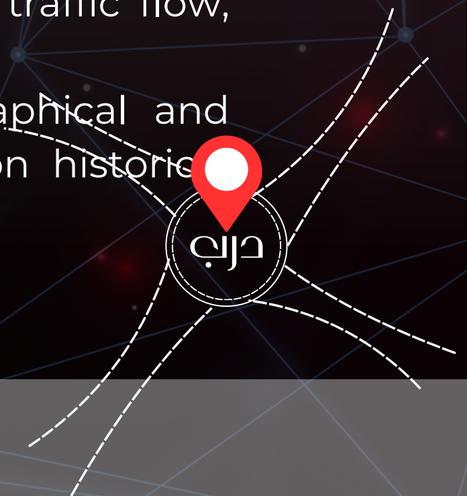
TOOLS

Machine Learning

- **KMeans Clustering:** Used for predicting rush hours by identifying patterns in historical traffic data, helping to forecast peak times.
- **Random Forest:** Employed for assessing traffic status, this ensemble method enhances prediction accuracy by combining multiple decision trees.
- **XGBoost:** Utilized to predict the causes of accidents, providing robust classification through gradient boosting techniques.

Deep Learning - Sequential Models

- **LSTM (Long Short-Term Memory) Model:** Applied for predicting the number of cars in traffic flow, LSTMs are effective in capturing temporal dependencies in sequential data.
- **RNN (Recurrent Neural Network) Model:** Employed to process sequences of geographical and temporal data, enabling the prediction of where accidents are likely to occur based on historic patterns.



TOOLS

Large Language Model

- **Retrieval-Augmented Generation (RAG):** This model answers questions related to our data, improving user engagement and providing insightful responses based on available information.

Computer vision

- **YOLO Model (You Only Look Once):** A YOLO (Vehicle Counting and Speed Monitoring) model was integrated to count the number of cars in forward and backward lanes and display their speeds, providing real-time insights into traffic density and flow conditions.

TOOLS

Visualization and Deployment

- **Dash App:** Utilized to create an interactive map simulator that visualizes traffic conditions, accident locations, and other relevant data for user interaction.
- **Ngrok:** Employed to publish the Dash app on a public URL, facilitating easy access and interaction with the application from any location.

These tools work synergistically to enhance our predictive capabilities and provide a comprehensive platform for traffic management insights.

FUTURE WORK

PREDICTING ARRIVAL TIME

Enabling commuters to plan their journeys more effectively.

SCALABILITY TO OTHER REGIONS

Expanding our solution to cover additional regions beyond Khurais Road will be a key goal.

USER BEHAVIOR ANALYSIS

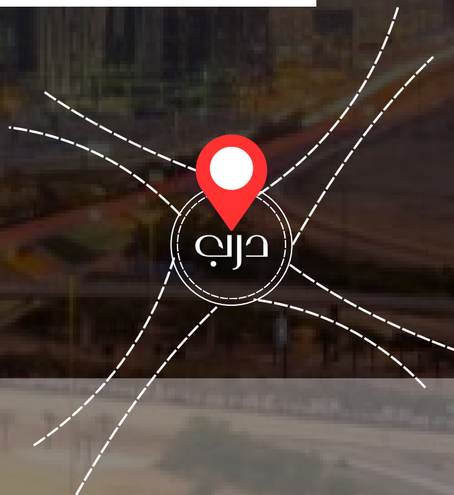
Developing models that account for individual commuter behaviors, enabling more personalized predictions and recommendations.

REAL-TIME DATA UPDATES

Integrating real-time data streams for accidents, roadwork, and traffic conditions will enhance the system's responsiveness.

ANALYSIS OF THE SATELLITE IMAGE

Analysis of the accident site with Satellite Image extracted from Google Maps



CHALLENGE

DATA AVAILABILITY

Difficulty providing traffic and accident data with the same coordinates and time series

DATA INTEGRATION

Linking accident and traffic data to the same place and time

LIMITED OF RESOURCES

GPUs often have limited VRAM, which can restrict the size of datasets and models that can be processed simultaneously

CONCLUSION

Our traffic management solution offers critical insights into current and expected traffic conditions, including congestion patterns, accident locations, timings, and causes. By leveraging predictive analytics and computer vision for vehicle counting and speed monitoring, we empower commuters and traffic authorities with actionable information that enhances decision-making and improves road safety. As we refine our models and expand our capabilities, our goal is to transform traffic management into a data-driven process, facilitating smoother commutes and enhancing overall mobility in urban areas.

THANK YOU!

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