Philippine Junior Data Science Challenge 2024

Smart Ambulance Proximity Alert System for Enhanced Urban Mobility

Improving Emergency Response in Philippine Urban Areas

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EXECUTIVE SUMMARY

Emergency medical services are crucial for saving lives, especially in densely populated urban areas where timely access to healthcare is essential. In the Philippines, traffic congestion poses significant challenges for ambulances, often leading to delays that can jeopardize patient care and outcomes. As cities continue to grow and traffic conditions worsen, finding effective solutions to improve emergency response times has become increasingly important.

The Smart Ambulance Proximity Alert System aims to address these challenges by integrating real-time GPS tracking with automated alerts. This system will notify traffic authorities and drivers about approaching ambulances, helping to clear the way for emergency vehicles. By combining data from health facilities with real-time traffic information, the system seeks to enhance communication and coordination among ambulances, traffic authorities, and road users. Ultimately, this project aims to reduce delays in emergency medical services, improve patient outcomes, and create a more efficient healthcare response system in urban areas of the Philippines.

KEYWORDS

Urban Mobility, Emergency Response, Ambulance Tracking, Real-Time Alerts, GPS, Traffic Management, Geospatial Data

BACKGROUND

Urban mobility in the Philippines faces significant challenges, especially regarding emergency services. Traffic congestion, particularly in metropolitan areas, often hinders ambulances, leading to increased response times. As cities grow, the need for efficient transportation for emergency services becomes more pressing.

In emergencies, every second is critical, and effective ambulance transport can mean the difference between survival and loss. By allowing ambulances to navigate intersections swiftly and safely, this technology plays a vital role in saving lives and boosting the effectiveness of emergency response systems.

THE PROBLEM

Ambulances frequently encounter delays in traffic due to congestion, resulting in critical delays in patient care. When traffic authorities are absent or unable to manage roadways effectively, ambulances may be impeded, leading to severe consequences.

LITERATURE

Research highlights the necessity of integrating technology into urban mobility to enhance emergency responses. Implementing automated systems that alert both traffic authorities and drivers of approaching ambulances can significantly reduce delays and improve coordination among emergency services.

According to Dr. Mala (2023), an independent researcher in the *International Journal of Advance Research, Ideas and Innovations in Technology*, better ambulance services and smooth traffic flow are crucial for providing effective emergency medical care in India. Quick response times in critical situations are essential, and a strong system is needed to help ambulances move easily through traffic, ensuring that patients can reach medical care faster, which can greatly improve their chances of survival.

Recently, there has been more focus on improving ambulance services and road conditions. Efforts are being made to make patient transport more efficient, so people can get the medical help they need quickly. By investing in both ambulance technology and better roads, India aims to create a more effective emergency response system for its citizens. Integrating advanced technology into these efforts will further enhance the overall effectiveness of emergency medical care.

OBJECTIVES

- **Specific**: Create a real-time alert system for traffic authorities when an ambulance is within a 2 km radius
- **Measurable**: Ensure 90% of alerts are acknowledged by authorities within 10 seconds of activation.
- **Attainable**: Utilize existing datasets, such as Project CCHAIN, combined with real-time GPS data.
- **Relevant**: Aim to reduce ambulance response times by 30% in urban areas.
- **Time-bound**: Complete the app's first version within six months and deploy it for testing in the following three months.

SCOPE & LIMITATIONS

The Smart Ambulance Proximity Alert System aims to improve emergency response times for ambulances in urban areas of the Philippines by integrating real-time GPS tracking and automated alerts to enhance communication among ambulances, traffic authorities, and drivers.
While the study will focus on selected urban locations to assess the system's effectiveness in reducing delays and improving patient outcomes, it faces limitations such as potential technical issues like GPS inaccuracies and communication failures that could hinder effectiveness. Gathering real-time data from health facilities and traffic authorities may also present challenges, and public awareness and cooperation from drivers are crucial; without proper understanding and adherence to the system, its overall impact may be diminished.

DATASETS UTILIZED

The Project CCHAIN Dataset will provide crucial data on health facilities, allowing the app to identify and map the locations of hospitals and other emergency services.

Dataset: Project CCHAIN Location Data

- **Attributes/Features**:
  - ProvinceCode: Code for the province
  - MunicipalityCode: Code for the municipality
  - BarangayCode: Code for the barangay
  - LocationType: Type of location (urban, rural, etc.)
  - Population: Population count in each location
- **Dataset Size**:
  - **Rows**: 42,036
  - **Columns**: 5
- **Data Format**: CSV
- **Preprocessing**: None specified, basic location and population data.

Dataset: Geoportal DOH Points of Interest - Health Facilities

- **Attributes/Features**:
  - FacilityName: Name of the health facility
  - FacilityType: Type of facility (hospital, clinic, etc.)
  - BarangayCode: Code for the barangay where the facility is located
  - Latitude: Latitude coordinate
  - Longitude: Longitude coordinate
- **Dataset Size**:
  - **Rows**: 2,068
  - **Columns**: 5
- **Data Format**: CSV
- **Preprocessing**: None specified, health facility geographic data for analysis or mapping purposes

Dataset: Mapbox Health Facility City Isochrones

- **Attributes/Features**:
  - City: Name of the city
  - HealthFacility: Closest health facility to the location
  - IsochroneTime: Travel time (in minutes) to the health facility
  - Distance: Distance to the health facility (in km)
  - Latitude: Latitude of the health facility

- Longitude: Longitude of the health facility

- **Dataset Size**:
  - **Rows**: 1,000
  - **Columns**: 6
- **Data Format**: CSV
- **Preprocessing**: None specified.

Dataset: OSM Points of Interest - Health Facilities

- **Attributes/Features**:
  - OSMID: Unique identifier from OpenStreetMap
  - FacilityName: Name of the health facility
  - FacilityType: Type of health facility (e.g., hospital, clinic)
  - Latitude: Latitude of the facility
  - Longitude: Longitude of the facility
- **Dataset Size**:
  - **Rows**: 7,000
  - **Columns**: 5
- **Data Format**: CSV
- **Preprocessing**: None specified.

METHODOLOGY

Phase 1: Gather health facility location data from Project CCHAIN and integrate it into the app.
Phase 2: Implement GPS tracking and geofencing technology to monitor ambulance locations and send alerts.
Phase 3: Conduct field trials to test the app's functionality using real-time data.

Automated Alerts for Authorities:
The system will automatically notify traffic personnel when ambulances are nearby, allowing them to take timely action to manage traffic. This proactive approach enables traffic officers to clear the way for emergency vehicles, ensuring that they can navigate through congested areas more efficiently

Public Notification System:
In situations where traffic authorities are not present, the system will activate alerts at traffic signals and public signage to instruct drivers to yield to approaching ambulances.

POTENTIAL CHALLENGES

Limited Visibility of Authorities on the Road Due to Staffing Constraints:

One of the significant challenges is the limited presence of traffic authorities on the road, which can hinder effective traffic management. Staffing shortages may result in fewer officers available to monitor intersections and enforce traffic laws, especially in densely populated urban areas.

Resistance from Road Users to Respond to Automated Alerts When No Visible Authority is Present:

Another potential challenge is the likelihood of road users being resistant to responding to automated alerts, especially when there is no visible authority to enforce compliance. This resistance could result in delays for ambulances trying to navigate through traffic, undermining the primary goal of the system, which is to ensure timely access to medical care.

Technical Challenges Related to Integrating Real-Time Data:

Integrating real-time data from various sources poses another significant challenge. The effectiveness of the Smart Ambulance Proximity Alert System relies heavily on the accurate and timely collection of data from traffic authorities, health facilities, and other relevant sources.

MITIGATION STRATEGIES

Audible and Visual Alerts:
The implementation of automated audible and visual signals at key traffic points is essential to alert road users of approaching ambulances. These alerts can take the form of siren, flashing lights, or digital display signs that indicate the need for drivers to yield the right of way. By making these signals prominent and easily recognizable, the system can help reduce response times for emergency vehicles and improve overall traffic flow.

Public Awareness Initiatives:
Launching public awareness campaigns is crucial for educating citizens on the importance of yielding to emergency vehicles, even when there is no visible authority present. By raising awareness of the critical role that timely ambulance access plays in saving lives, the public may be more inclined to comply with automated alerts and road signals.

Technical Support Infrastructure:
Establishing a robust technical support infrastructure is vital for maintaining the Smart Ambulance Proximity Alert System and addressing any technical challenges that may arise. Developing user-friendly interfaces and providing training for emergency service personnel and traffic authorities will ensure that they can effectively utilize the system. Continuous evaluation and feedback mechanisms should also be put in place to improve the system over time, ensuring its reliability and efficiency in real-world scenarios.

SUCCESS METRICS AND KPI'S

Response Time Reduction:
This metric will measure the decrease in the time it takes for ambulances to travel to healthcare facilities, with a target reduction of 30%. By analyzing historical data before and after the implementation of the Smart Ambulance Proximity Alert System, stakeholders can evaluate its effectiveness in speeding up emergency response times and enhancing patient care.

Alert Acknowledgment Rate:
Tracking the rate at which traffic authorities acknowledge alerts within 10 seconds is crucial for assessing the system's efficiency. A target acknowledgment rate of 90% indicates that authorities are responsive to notifications about approaching ambulances, which can significantly impact traffic management and ambulance travel time.

System Uptime:
Ensuring that the app maintains operational effectiveness 99% of the time is essential for reliable performance. High system uptime guarantees that alerts are consistently sent and received, reducing the likelihood of missed notifications and improving overall trust in the system by both authorities and road users.

Adoption Rate:
Monitoring the number of authorities using the app across pilot areas provides insights into the system's acceptance and usability.

REFERENCES

List your references here in APA 7th Edition format.

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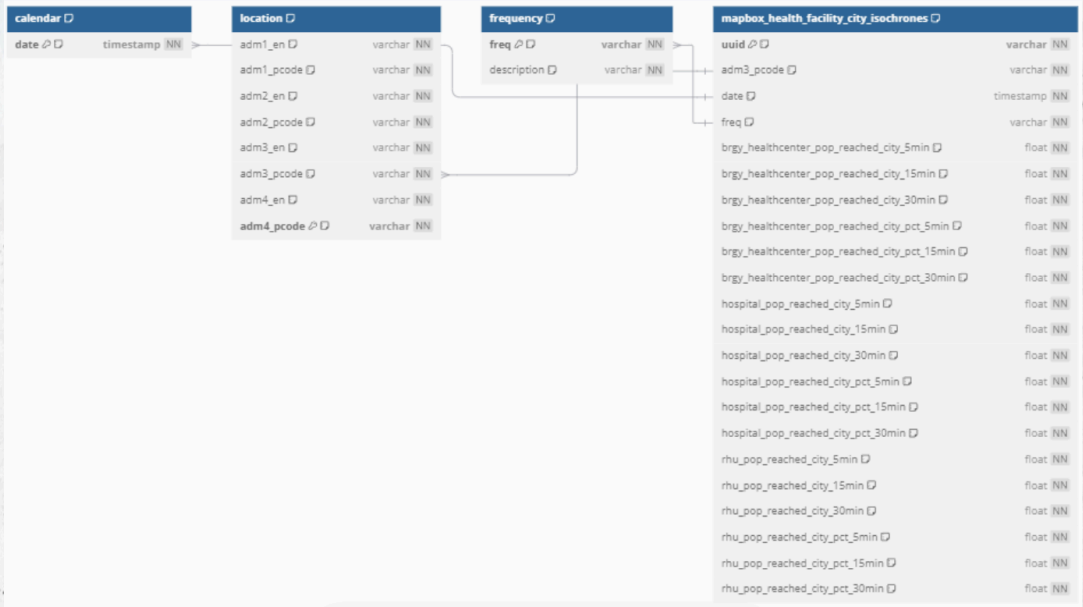
APPENDICES

Appendix A: mapbox_health_facility_city_isochrones Table



Appendix B: Distribution of Health Facilities in Major Philippine Cities

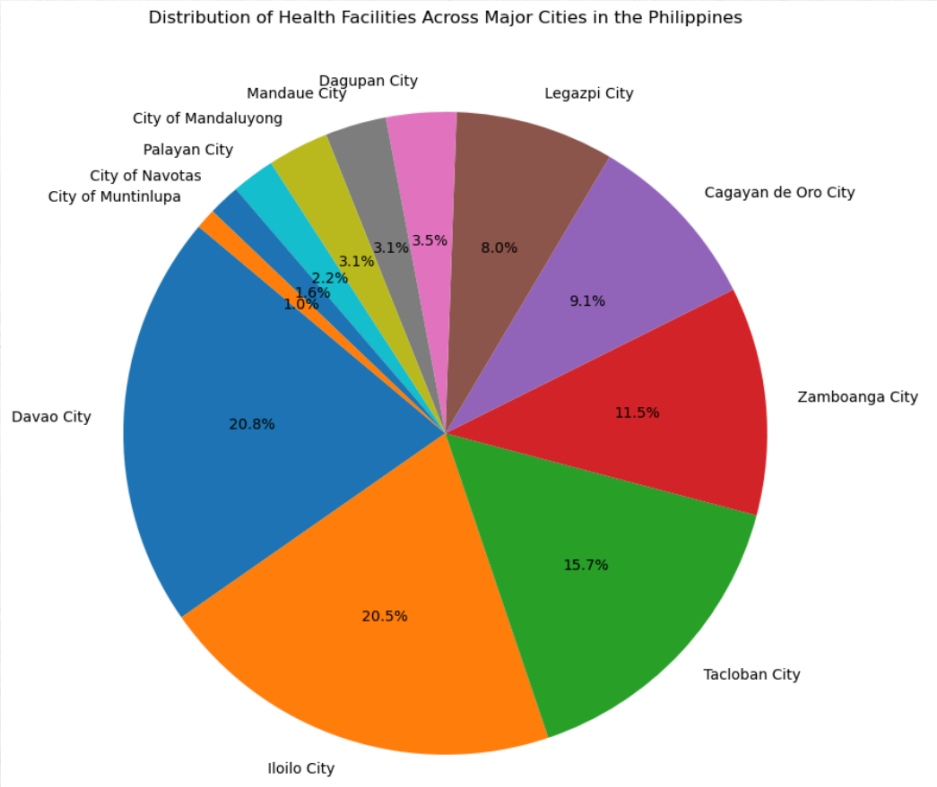
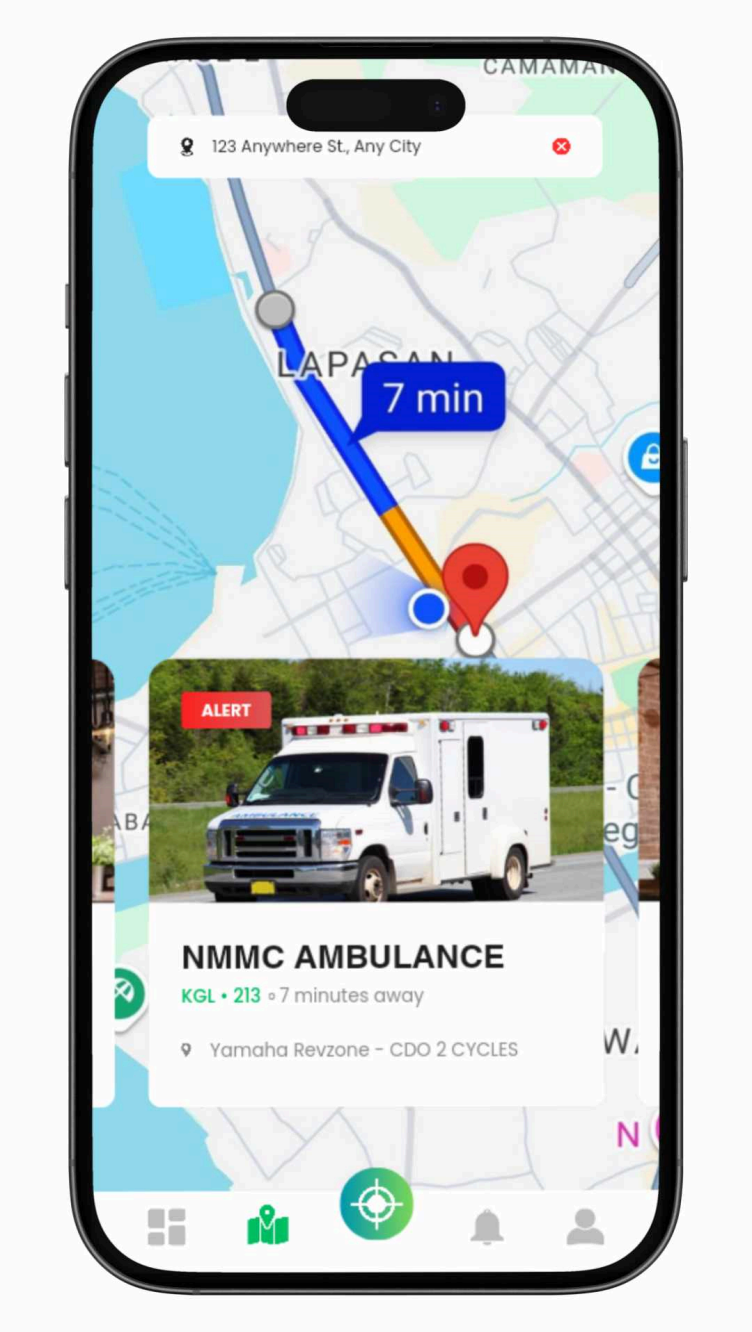
```python
# Import necessary libraries
import pandas as pd
import matplotlib.pyplot as plt
```

```python
# Load the datasets
df_health = pd.read_csv('mapbox_health_facility_city_isochrones.csv')
df_location = pd.read_csv('location.csv')  # Load the location data
```

```python
# Merge the datasets on the common column
common_column = 'adm3_pcode'
merged_df = pd.merge(df_health, df_location, on=common_column, how='left')
```

```python
# Count the occurrences of each city in the 'adm3_en' column
city_counts = merged_df['adm3_en'].value_counts()
```

```python
# Create a pie chart to visualize the distribution of health facilities
plt.figure(figsize=(10, 10))
plt.pie(city_counts, labels=city_counts.index, autopct='%1.1f%%', startangle=140)
plt.title('Distribution of Health Facilities Across Major Cities in the Philippines')
plt.show()
```



Appendix C: Mobile Application Interface Smart Ambulance Proximity Alert System