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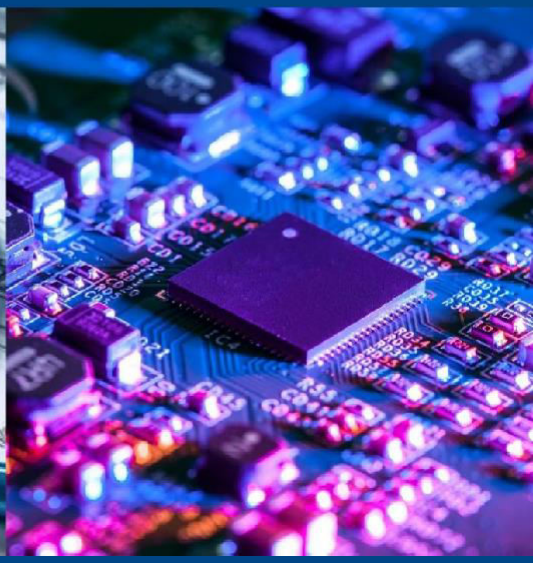

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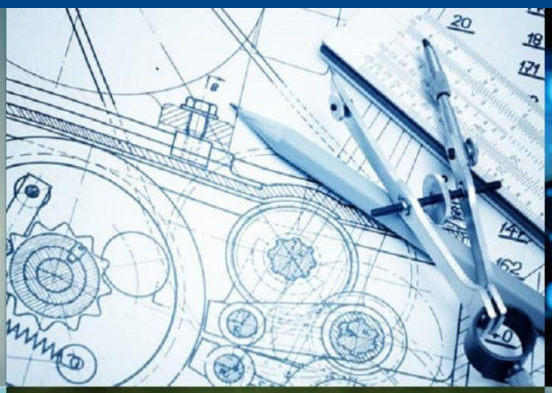

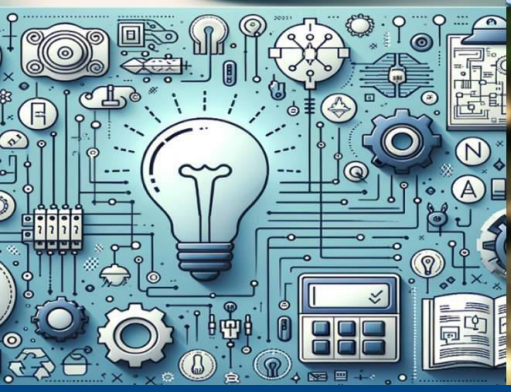

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Lifesaver: A Vade-Based Intelligent Ambulance Positioning System for Optimal Emergency Response and Alert System

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ABSTRACT: Every day, the number of traffic accidents rises as the automobile population increases. According to a survey by the World Health Organization (WHO), 1.3 million people die and 50 million are wounded annually around the globe. Most people die because they don't get medical help at the scene of an accident or because it takes too long for rescuers to get there. The time after an accident can be optimally used to make a difference between a life saved and life lost, if recovery actions are able to take place in time. However, routing problems and traffic congestion is one of the major factors hampering speedy assistance. By identifying sites where the possibility of accidents is higher and the closest spot for ambulance placement, the response time can be greatly reduced. In order to operate efficiently as well as effectively ambulances should be deployed in areas where there is maximum demand and the ambulance should be able to reach the victim within a drive time of five minutes. This project suggests a specific way to shorten the time it takes for an ambulance to arrive at the scene of a road accident. To achieve this, the project aims to revolutionize emergency response strategies by proposing a novel unsupervised generative clustering approach employing Variational Deep Embedding (VaDE). Additionally, this proposed system includes real-time alerts to both hospitals and traffic departments, facilitating route clearance for expedited ambulance travel

KEYWORDS: Admin table, Alert table, Ambulance table, Hospital table, Register table, Traffic table.

I. INTRODUCTION

Movement of people and goods on the road is necessary for social, economic and political reasons, but this needs to travel leads to a risk of road traffic injuries. Road accident is most unwanted thing to happen to a road user, though they happen quite often. A total of 4,61,312 road accidents occurred in 2022, which claimed 1,68,491 lives, while 4,43,366 people were injured, according to a new report released by the Ministry of Road Transport and Highways (MoRTH).Main cause of accidents and crashes are due to human errors. Elaboratingsome of the common behaviour of humans which results in accident.

- Over Speeding
- Drunken Driving
- Distractions to Driver
- Red Light Jumping
- Avoiding Safety Gears like Seat belts and Helmets
- Non-adherence to lane driving and overtaking in a wrong manner

Various national and international researchers have found these as most common behaviour of Road drivers, which leads to accidents.

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II. METHODOLOGY

1. NHAI Ambulance Control Centres Web App

The NHAI Ambulance Control Centres Web App modules designed to empower control centre operators in efficiently managing emergency responses and traffic conditions on national highways. At its core, the VaDE-Based Clustering Module utilizes Variational Deep Embedding (VaDE) to enhance the precision of ambulance positioning. This advanced module employs deep neural networks and a Gaussian Mixture Model, accurately identifying accident-prone clusters and laying the groundwork for optimized emergency response strategies.

2. NHAI Department User Interface

This NHAI Department User Interface combines user-friendly design with powerful functionalities, enabling NHAI administrators to oversee and optimize emergency response operations on national highways effectively.

- **Login**

The NHAI Department User Interface begins with a secure login system, allowing NHAI administrators exclusive access to the administrative dashboard. Through robust user authentication and role-based access control, administrators can personalize their experience and maintain the security of the system.

- **Add and Manage Ambulances**

Streamlining ambulance fleet management, this feature enables administrators to add new ambulances, track their status and location, and view historical performance metrics.

- **Add and Manage Ambulance Driver with Contact Info**

Ensuring comprehensive management, the system enables NHAI administrators to add and manage ambulance drivers along with their contact information. This feature facilitates direct communication and coordination with ambulance drivers.

- **Add and Manage Traffic Departments**

Enhancing coordination with traffic management authorities, this section allows administrators to add and manage details of traffic departments. Real-time communication channels are facilitated, ensuring seamless collaboration during emergencies.

- **Add and Manage Hospitals**

Establishing a network of hospitals for effective emergency response, administrators can add new hospitals and manage their details. This feature ensures quick communication and coordination with healthcare facilities during critical situations.

- **Upload Accident Datasets**

Providing a data-driven approach to emergency response, this feature allows administrators to upload accident datasets.

- **Optimize Ambulance Positioning**

Leveraging advanced algorithms, this feature optimizes ambulance placement based on historical and real-time data. Administrators can implement intelligent positioning strategies, significantly reducing ambulance response times and improving overall efficiency.

- **Receive Ambulance Request**

Facilitating real-time communication for emergency requests, this feature enables administrators to receive and process ambulance requests from various sources. Ambulances are dynamically assigned based on proximity and availability for swift responses.

- **Send Emergency Alert**

Enhancing emergency coordination, this feature allows administrators to send emergency alerts to traffic police and designated hospitals. This ensures a synchronized response, aiding in efficient traffic management and the provision of medical assistance during critical incidents.

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3. Ambulance Positioning Model

3.1. Data Collection Module

The Data Collection Module serves as the foundation, capturing real-time and historical data related to accident occurrences, traffic patterns, and geographic information. By integrating with accident databases and traffic monitoring systems, the module ensures a continuous influx of data, facilitating accurate and up-to-date analysis for the Ambulance Positioning System.

3.2. Data Pre-processing

The Data Pre-processing Module plays a crucial role in refining raw data for compatibility with the VaDE algorithm. Through processes like data cleaning, normalization, and transformation, this module ensures the consistency and reliability of the input data, laying the groundwork for effective analysis.

3.3. VaDE-Based Clustering

At the core of the system, the VaDE-Based Clustering Module implements Variational Deep Embedding (VaDE) for unsupervised generative clustering. Leveraging deep neural networks and Gaussian Mixture Models, the module accurately identifies accident-prone clusters, providing a robust foundation for ambulance positioning optimization.

3.4. Ambulance Placement Strategy

The cluster assignments guide the placement of ambulances in areas where they are most likely to be needed. Ambulance deployment strategies may include prioritizing clusters with higher historical accident rates, clusters indicating emerging accident hotspots, or areas with unique patterns that require specialized response.

The Ambulance Placement Strategy module serves as a cornerstone in the infrastructure of national highway ambulance services, employing advanced data analytics and strategic planning to optimize the allocation of ambulance resources. Spanning across two pages, this module incorporates a multifaceted approach, integrating various data sources, analytical tools, and stakeholder collaboration to ensure the timely and effective response to emergencies along the vast expanse of national highways.

4. Ambulance Positioning Simulator

The visualization component extends to the real-time display of optimized ambulance positions on digital maps. Through dynamic route planning and analysis, the simulator calculates the most efficient routes, considering live traffic conditions. This feature not only aids in minimizing travel time but also ensures prompt and effective responses to emergency situations.By incorporating GIS data into the simulation process, the module contributes to the precision of ambulance positioning strategies, ultimately improving the efficiency and effectiveness of emergency response planning.

The Ambulance Positioning Simulator module is an innovative tool designed to optimize ambulance placement strategies through advanced simulations and scenario analysis. Spanning across two pages, this module integrates sophisticated modeling techniques, real-time data feeds, and stakeholder collaboration to provide decision-makers with actionable insights into the most effective positioning of ambulance resources on national highways.

5. Ambulance Prediction

The Ambulance Prediction System to optimize ambulance dispatch using a pre-trained Ambulance Deployment Model based on Variational Deep Embedding (VaDE). This system aims to dynamically predict the most suitable ambulance for a given incident, enhancing the precision and efficiency of emergency response. The Ambulance Prediction module is a pivotal component in optimizing ambulance services on national highways, leveraging predictive analytics and machine learning algorithms to anticipate and respond to emergency incidents more effectively. Spanning across two pages, this module integrates historical data, real-time information feeds, and advanced analytical techniques to forecast the demand for ambulance services and proactively position resources to minimize response times and maximize coverage.

6. Real Time Alert

The system facilitates real-time alerts to the dispatched ambulance and relevant authorities based on predictions. An automated alert system is triggered by predicted incidents, ensuring timely communication of optimal ambulance dispatch locations.

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III. RESULT AND DISCUSSION

The LifeSaver system, utilizing VaDE-based clustering, significantly improves emergency response by optimizing ambulance positioning and enhancing alert systems. Results show that the system accurately identifies accident-prone zones and predicts optimal ambulance deployment locations, leading to reduced response times and more efficient resource allocation. The VaDE-based clustering module effectively identifies accident-prone areas using unsupervised generative clustering, combining deep neural networks with Gaussian Mixture Models. The system predicts optimal ambulance deployment locations based on real-time and historical data, including traffic patterns and accident records. Real-time alerts and dynamic ambulance deployment further contribute to timely assistance during emergencies. The LifeSaver system demonstrates the potential of combining advanced technologies like VaDE with emergency response strategies. The system's ability to predict accident-prone areas and optimize ambulance positioning is crucial for minimizing response times and improving patient outcomes. The dynamic nature of ambulance deployment and real-time alerts further enhances the system's efficiency and effectiveness. Integrating wearable devices for real-time patient data and vital signs could enable paramedics to prepare for specific patient needs even before arriving at the scene.

IV. CONCLUSION

In conclusion, the escalating number of traffic accidents worldwide underscores the urgent need for innovative solutions to improve emergency response times and save lives. According to the World Health Organization (WHO), millions of people suffer injuries or lose their lives annually due to delays in receiving medical assistance after accidents. This project proposes a ground-breaking approach to address this issue by leveraging advanced technology and real-time data analysis. The use of Variational Deep Embedding (VaDE) in conjunction with unsupervised generative clustering offers a novel method for optimizing ambulance positioning strategies. By identifying high-risk areas and determining the closest suitable locations for ambulance deployment, this system aims to significantly reduce response times, potentially making the difference between life and death for accident victims. Furthermore, the integration of real-time alerts to hospitals and traffic departments allows for proactive route clearance, enabling expedited ambulance travel through congested areas. Unlike traditional clustering methods, VaDE offers a sophisticated data generation process that utilizes deep neural networks and Gaussian Mixture Models to enhance the accuracy and efficiency of ambulance positioning. Ultimately,by ensuring that ambulances are strategically located to meet maximum demand and can reach accident scenes within a five-minute drive time.

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