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LifeSaver: A VaDE-Based Intelligent Ambulance Positioning System for Optimal Emergency Response and Alert System

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ABSTRACT: The increasing number of traffic accidents, exacerbated by rising automobile populations, leads to significant fatalities and injuries due to delayed medical response. According to WHO, 13 million people die and 50 million are wounded annually. To address this, rapid emergency response is crucial, as timely assistance can save lives. Traffic congestion and routing problems impede swift response. By identifying high-risk accident sites and optimal ambulance placement, response times can be minimized. This project proposes using Variational Deep Embedding (VaDE) for unsupervised generative clustering to optimize ambulance positioning, aiming to reach victims within five minutes. Real-time alerts to hospitals and traffic departments facilitate expedited ambulance travel, significantly reducing response times and saving lives.

KEYWORDS: Ambulance placement , VaDE ,Response time ,Real-time alert , TraficAccidents.

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). Ambulances in India in India, ambulances are used primarily in three types of situations: during emergencies, to prompt transfer trauma patients to the nearest medical facilities; for transporting patients to and from their residences and hospitals; and, for inter-hospital transfers. The most common mode of patient transportation is a road ambulance, which could be twothree-or four-wheeler vehicles, depending on geographical location, terrain, and type of emergency. National Ambulance Code (NAC), under the aegis of the Ministry of Road Transport and Highways (MoRTH), the Government of India (GOI) classified road ambulances for registration under the provisions of the Motor Vehicle Act, 1988 (MVA, 1988).

II.VARIATIONAL DEEP EMBEDDING (VADE)

Variational autoencoders (VAE) are used as one of the most important concepts in this thesis. They were first introduced by Deiderik P. Kingma and Max Welling in 2014. Applications using VAE includes aircraft turbomachinery design, anomaly detection, image analysis and more. The model is different from other autoencoders in two ways. First, it is a probabilistic autoencoder. Second, it is a generative autoencoder. First, it is a probabilistic autoencoder. Second, it is a generative autoencoder. The network of the autoencoder is shown in Figure 2.5. It is the same as other autoencoders with an encoder followed by a decoder.The difference is that it outputs μ the mean coding, and σ the standard deviation. In practice, the output is γ where $\gamma = \log(\sigma^2)$. From the μ and σ, the actual latent space is then sampled by $z = \mu + \sigma * €$, where € is a random variable drawn from a normal distribution N (0, I), where I is the identity matrix. After that, the decoder decodes the latent space normally, the output resembles the training input.

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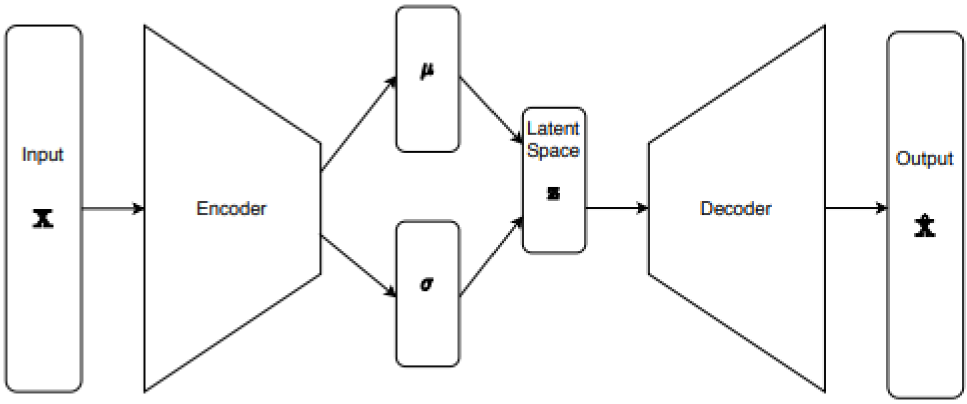

Figure.1. VADE Architecture

Variational Deep Embedding (VaDE), a novel unsupervised generative clustering approach within the framework of Variational Auto-Encoder (VAE). Specifically, VaDE models the data generative procedure with a Gaussian Mixture Model (GMM) and a deep neural network (DNN): 1) the GMM picks a cluster; 2) from which a latent embedding is generated; 3) then the DNN decodes the latent embedding into an observable. Inference in VaDE is done in a variational way: a different DNN is used to encode observables to latent embedding's, so that the evidence lower bound (ELBO) can be optimized using Stochastic Gradient Variational Bayes (SGVB) estimator and the reparameterization trick.

III.PROPOSED METHODOLOGY

The VaDE-Based Clustering Module forms the foundation of the system, utilizing Variational Deep Embedding (VaDE) for unsupervised generative clustering. This sophisticated module integrates deep neural networks and Gaussian Mixture Models to accurately identify accident-prone clusters, providing a robust basis for optimizing ambulance positioning. In the encoding stage, pre-processed data undergoes transformation into latent representations using deep neural networks. VaDE's encoder network maps input data, such as accident features and locations, into a latent space—a condensed representation of hidden patterns within the dataset. Following this, the Gaussian Mixture Model (GMM) is employed to select clusters representing distinct accident scenarios, such as high-speed collisions or urban congestion. VaDE generates a latent embedding in a lower-dimensional space, encapsulating essential features of the chosen cluster. This serves as a compressed representation of underlying characteristics, including time of occurrence, severity, and geographic location. Variational inference is then applied to iteratively refine GMM parameters and optimize latent representations, balancing accuracy and computational efficiency. The latent embedding undergoes decoding through a Deep Neural Network (DNN), transforming it back into an observable format. This reconstructed information guides decisions on strategic ambulance positioning based on historical accident patterns. The algorithm assigns each historical accident to a specific cluster based on probabilistic clustering from the GMM, contributing to informed decision-making in ambulance deployment strategies. This cohesive process ensures the accurate identification of accident-prone areas and informs optimal ambulance placement for efficient emergency response.

IV.RESULT & DISCUSSION

The proposed system, "LifeSaver," presents a cutting-edge approach to transforming emergency response strategies through the integration of advanced technologies. This system comprises several key modules aimed at optimizing ambulance positioning, enhancing real-time communication, and predicting ambulance dispatch for prompt and effective emergency responses.

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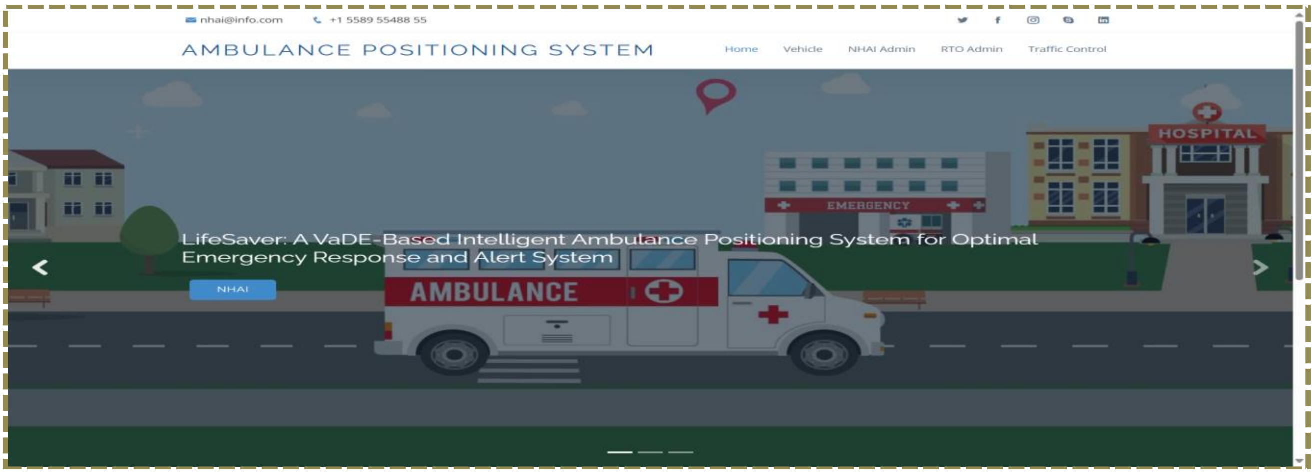

Figure.2.Home Page

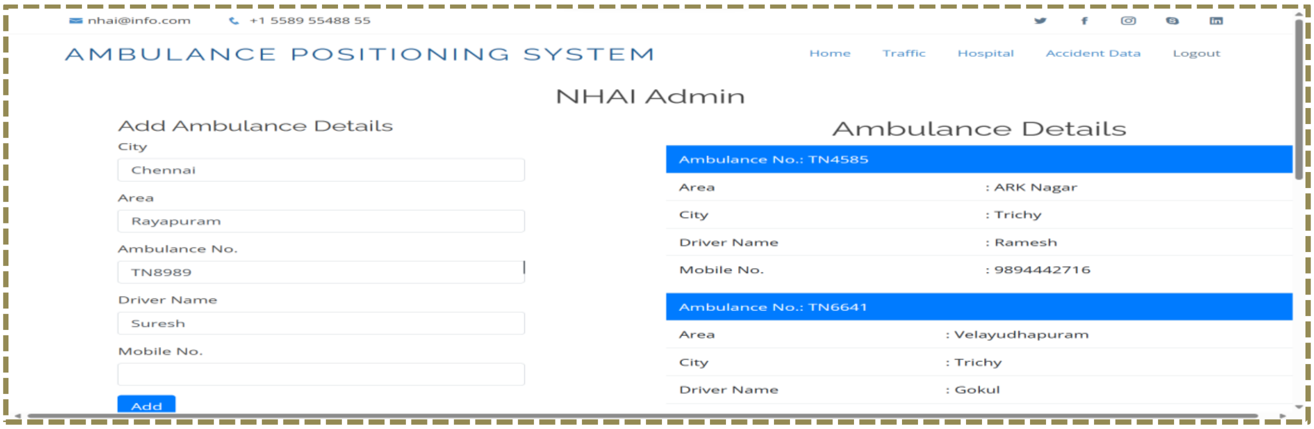

Figure.3.Nhai Login Page

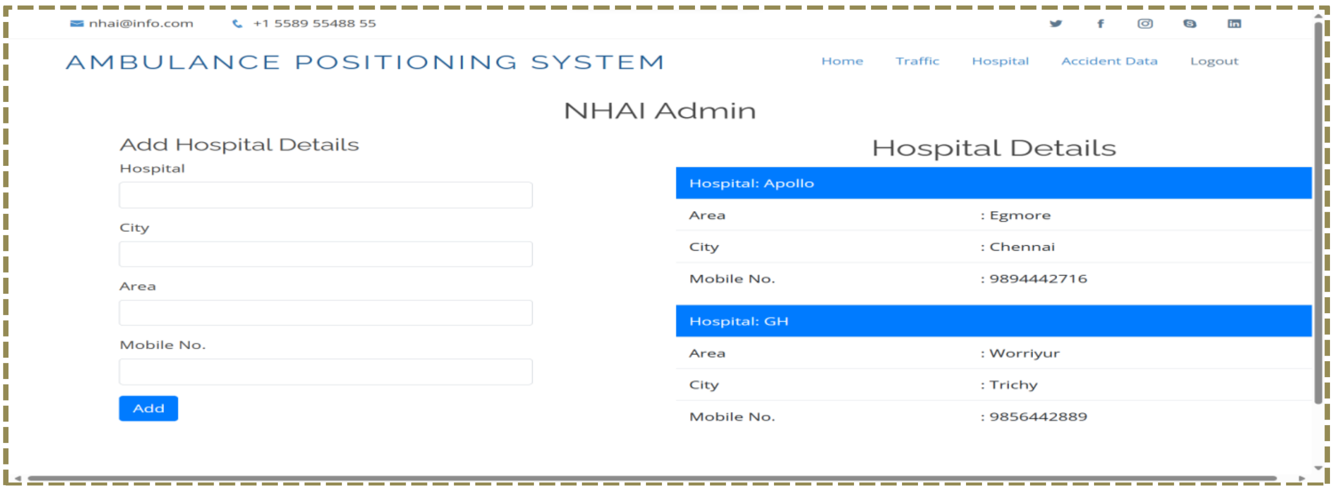

Figure.4.Hospital Details

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Figure.5.Map

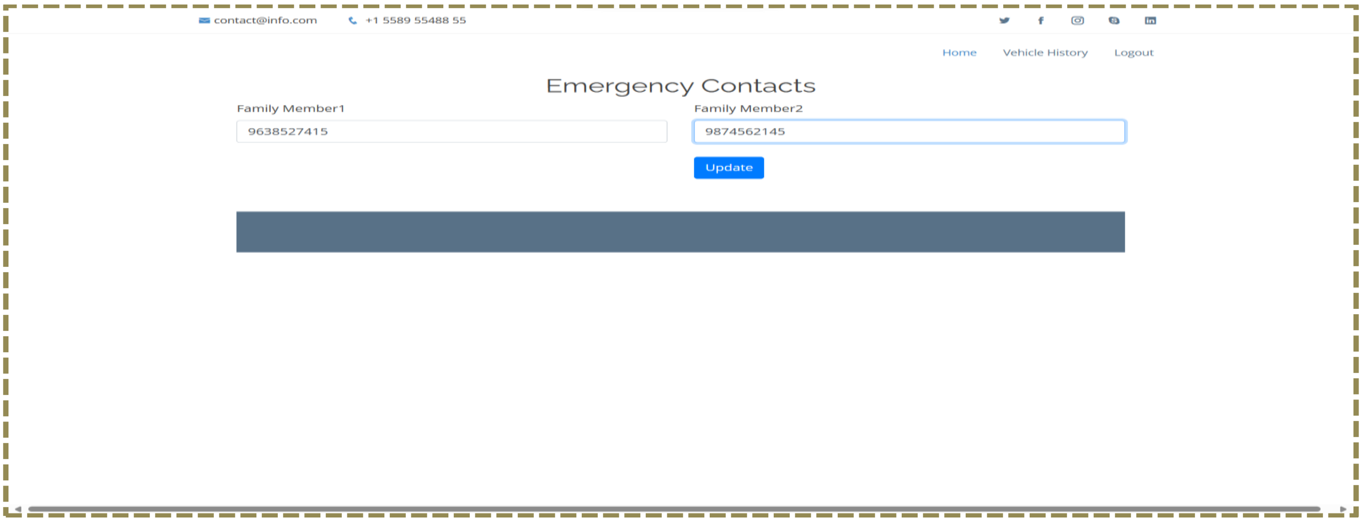

Figure.6.Emergency Contect

V.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. 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.

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