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Ideal Ambulance Alignment for Road Collisions Using ML

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Abstract-- **This study addresses road accident losses by proposing a deep- bedded clustering- grounded approach for ambulancepre-positioning. The approach aims to reduce response times and give prompt medical attention. Factors and patterns impacting road crashes in a geographical region are pivotal considerations during model structure. The study emphasizes conserving these patterns using Cat2Vec, a deep- literacy- grounded model. A comparison with traditional clustering algorithms like K- means, GMM, and Agglomerative clustering is conducted, pressing the proposed frame's superior performance. The ambulance- positing system achieves an emotional 95 delicacy with k-fold cross validation and a new distance score of 7.581. Overall, the study underscores the effectiveness of the proposed approach in enhancing ambulance positioning for bettered healthcare services and road safety. The number of casualties and losses brought on by road accidents is one of the most significant enterprises in the ultramodern world.**

Keywords- Accident detection, Collision Prediction, Emergency response, Geospatial analysis, Maching learning algorithms, Optimal routing, Road safety, Traffic prediction.

I. INTRODUCTION

Optimal ambulance positioning is a critical aspect of emergency medical services designed to reduce response times and enhance the efficiency of healthcare delivery during road accidents. In the face of increasing urbanization and growing traffic congestion, the strategic placement of ambulances becomes imperative for timely interventions, minimizing the impact of injuries, and ultimately saving lives.

This study focuses on the development of advanced models, incorporating techniques such as Deep Embedded Clustering with Autoencoder (DEC- AE), to predict optimal locations for ambulance deployment. By leveraging machine learning, data analysis, and real-time information, this approach aims to address the challenges posed by accident-prone areas in urban environments. The study not only contributes to the improvement of emergency response systems but also holds the implicit to impact broader business safety operation strategies. In light of the rising global concern girding road accidents and their associated profitable and particular losses, this disquisition trials to give innovative results for enhancing ambulance positioning strategies. The preceding sections will claw into the methodology, findings, and implications of the study, slipping light on its implicit to reshape and optimize emergency medical services in communal settings. In this study, we propose a new clustering- predicated approach exercising Deep Bedded Clustering with machine encoder(DEC- AE) to address the problem of optimal ambulance positioning in a municipality. Unlike traditional clustering styles, the DEC- AE system offers a comprehensive frame that combines deep knowledge, clustering, and machine encoder ways to optimize ambulance positioning strategies. By reconstructing the input data from the learned latent representations, DEC can effectively capture the essential features and confines that contribute to the clustering process. likewise, DEC employs a common optimization ideal that integrates clustering assignments and point knowledge. DEC- AC combines deep knowledge and adaptive clustering to give an effective result for clustering problems. It leverages deep neural networks to learn meaningful point representations and adaptively determines the number of clusters predicated on the data distribution systems.

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II. LITERATURE REVIEW

Alkheder et al. [1] proposed an approach using decision tree classifier, MLP and Naïve Bayes to identify the significant attributes that impact the prediction of the severity of a road accident. On comparing different models, it was concluded that the decision tree classifier provided a better classification accuracy of 0.08218. Theattributes such asyearof accident, age, nationality, gender and the type of accident were more significant in determining the accident severity.Hashminejad et al. [2] utilized decision trees and genetic algorithms to develop a prediction model for predicting the severity of the road accidents. The set of rules induced from the genetic algorithm approach were further providedasinput to the decision tree models namely CART, C4.5 and ID3,also validated using the test dataset. The method employed provided an accuracy of 0.8820, recall of 0.889, f-measure of 0.887 and a precision of 0.885 which was better than The alternative methods used namely ANN, SVM, KNN and Naïve bayes.Taamneh et al. [3] utilized Artificial Neural Networks (ANN) along with K-means to predict the severity 59919 VOLUME 11, 2023D. D. Desai et al.: Optimal Ambulance Positioning for Road Accidents With DEC of road accidents. Other machine learning models were also used to compare the accuracy of the proposed ANN model, concluding that the proposed model provided a higher accuracy of 0.746.Granberg et al. [4] developed a simulation based predictive model to gauge the emergency ambulance demand in an area using multivariate regression model. The data used for their genetic regression algorithm was collected from census survey of the year 2005 consisting of 2076 small areas. For each location, a distance matrix was developed and used as inputs to the genetic algorithm in order to identify 35 probable ambulance locations using R-statistics software. The proposed model favored a significant R2 value of 0.71 with multiple coefficients. This particular distance matrix based approach provided better results on comparing with the models using nave forecasting techniques. Alqahtani et al. [5] proposed an approach using embedded clustering layer in deep auto-encoders. When compared to traditional clustering methods, this technique learns the feature representations and assigns clusters concurrently through deep auto encoders. During the optimization phase, the cluster centers are reassigned to all the data points which are accident locations in this particular problem.Following this, the cluster centers are updated iteratively in order to obtain the final stable clustersand better optimized performance.Assi et al. [6] and Xiong et al. [7] proposed Machine learning models for predicting accident vs non-accident patterns in crash sites using Gaussian Mixture models and SVM.They further predicted the severity of the crash injuries by clustering the crashes using fuzzy c-means, Feed Forward Neural Networks and SVM. Data analysis was performed to identify the features from the crash sites to provide inputs to the ML models. The models were evaluated using accuracy,sensitivity and precision. On comparing the models, fuzzy c-means algorithm provided greater accuracy than traditional k-means clustering and

SVM models.Ghandour et al. [8] and Tiwari.et.al. [9] developed an approach that uses a machine learning hybrid ensemble classifier derived from decision trees and MSO algorithm to identify risk factors that contribute to fatal road accidents. They utilized the Lebanese Road accident platform (LARP) database consisting of 8482 accidents and the fatalities occurred in the accidents. To evaluate the impact of the factors causing casualties in a road accident, they performed sensitivity analysis of the attributes. From the selected variables, seven of nine showed significant association to casualties. To evaluate the model performances the metrics used were F1 score, precision, AUC-PR curve and Cohen's Kappa.Cao et al. [10] and Moriya et al. [11] proposed approaches based on batch clustering, fuzzy c-means clustering, and K-means clustering with an FNMF matrix for clustering illustrating the correlation patterns of the initial data points.specifically that they proposed approaches based on batch clustering and fuzzy c-means.Given the keywords "batch clustering" and "fuzzy c-means," a common area where Cao et al. are cited in this context is for their work on cluster validity indices or evaluation metrics for clustering algorithms.Cao et al. likely focused on evaluating the quality of fuzzy clusters, potentially by proposing a new validity index for Fuzzy C-Means (FCM), which is a batch clustering algorithm.Similar to Cao et al., "Moriya et al." in the context of "batch clustering" and "fuzzy c-means" often points to research related to data stream clustering or evolving fuzzy clustering. While FCM is inherently batch, extensions or applications for dynamic data often appear in literature.In both the approaches, the correlation among the crash locations are calculated followed by clustering of the said crash locations based on the factors responsible for the accidents.Ghosh et al. [12] and Sasaki.et.al. [13] employed Bayesian networks (BN) approaches to develop models based on the relationship of the attributes which were represented as probability distributions.Sasaki et al. (likely related to Bayesian methods for clustering or spatial analysis)"Sasaki et al." also appears in various fields. When combined with "Bayesian" and "clustering," several possibilities emerge, often with a focus on specific applications or types of data. Sasaki et al. (likely related to Bayesian methods for clustering or spatial analysis)."Sasaki et al." also appears in various fields. When combined with "Bayesian" and "clustering," several possibilities emerge, often with a focus on specific applications or types of data.Bayesian Clustering Using Hidden Markov Random Fields in Spatial Population Genetics. Molecular Ecology, 18, 4811-4824. (This is a strong candidate given the nature of some clustering problems). Bayesian Networks are used for identifying the factors responsible for road accident sand also predict the severity of the accidents. These papers also evaluated the sensitivity and specificity of the models along with MAE and RMSE to assess the performance of BSVR.

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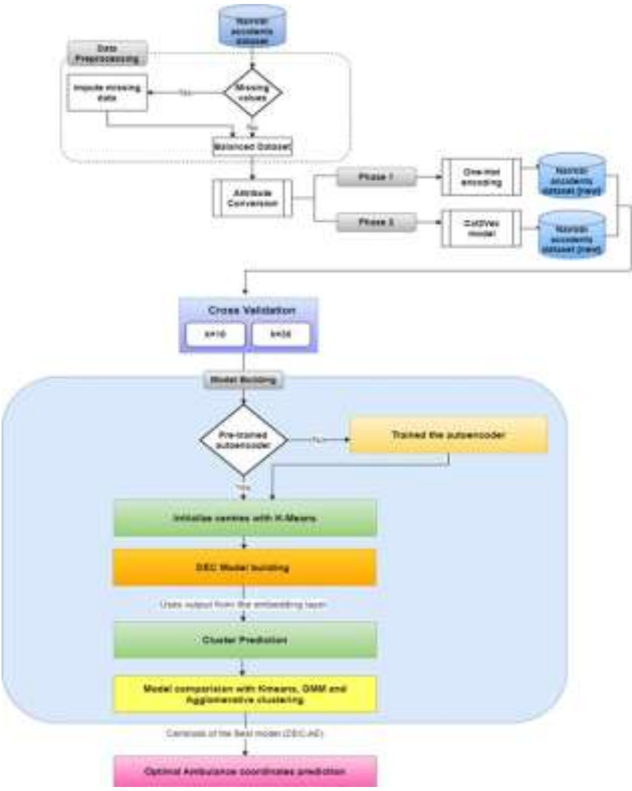
III .METHODOLOGY

A) SYSTEM ARCHITECTURE



B) IMPLEMENTATION

1. Data Management Module

The Data Management Module is responsible for collecting, storing, and processing data related to ambulance positioning and exigency response.

2. Exploratory Data Analysis (EDA) Module

The EDA Module is used to understand the characteristics of the collected data.

3. Model development

Use EDA results to inform the development of predictive models and optimization algorithms.

Deep Embedded Clustering (DEC)

DEC is a type of unsupervised deep literacy algorithm

4. Ambulance Positioning Module

This module determines the optimal positioning of ambulances grounded on literal data and real- time business information.

5. Distance Scoring Algorithm

This algorithm calculates the distance between ambulances and incidents, taking into account business patterns and road network characteristics.

6. Visualization Module

This module provides a visual representation of the ambulance positioning system, including .

7. Validation Module

This module evaluates the performance of the ambulance positioning system using colorful criteria.

IV.RESULTS and ANALYSIS:

The modules we have used are:

1. Home
2. Upload data
3. Train
4. Prediction

In the Home module **:**We get the Heap Map where we need to lace the ambulance to rescue the needy people.

In the Upload data Module**:**We Uploaded the various datasets regarding various conditions so that we can predict the affected areas that are causing road accidents and collisions.

Various Conditions data sets

Weather data set

Road data set

In the Train Module**:**This Trains the data sets using colorful ML algorithms**.**

In the Prediction Module:This module provides prognosticated Heap Map with 95% accuracy.

1. Home Page

Figure.1 :Home Page

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2. This image shows Tensor Flow Values based on the clustered data.

Figure 2: Tensor flow Values

3. This image shows grouping of similar data points together based on their inherent characteristics or attributes.

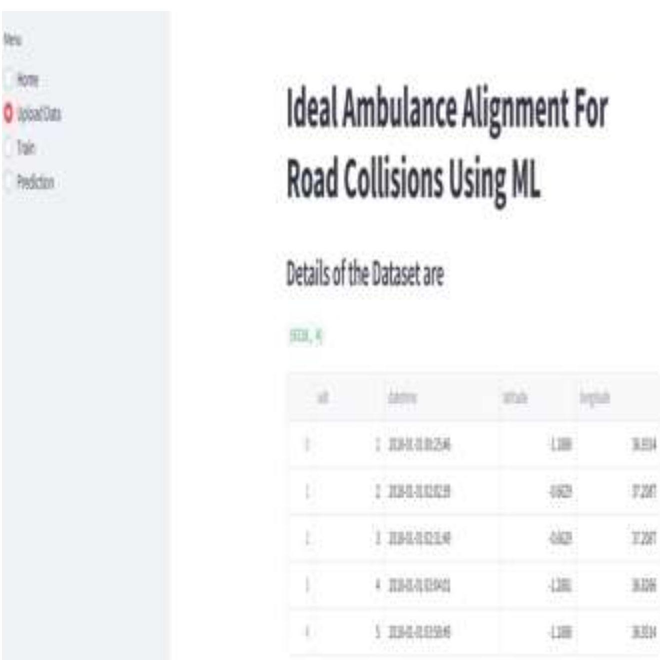

Figure 3: Dataset details

4. This image shows Graphical Representation of Clustered data based on different Algorithms.

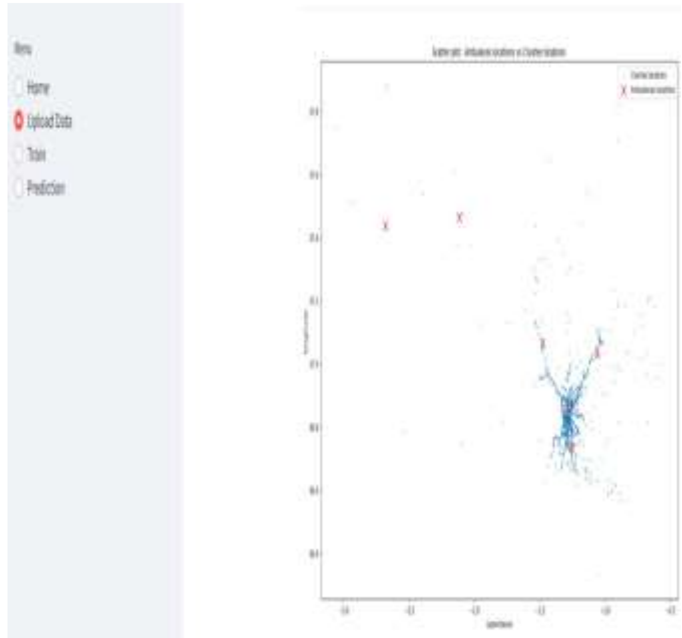

Figure4:Graphical Representationof Clustered data

5. This image shows Graphical Representation of training Module

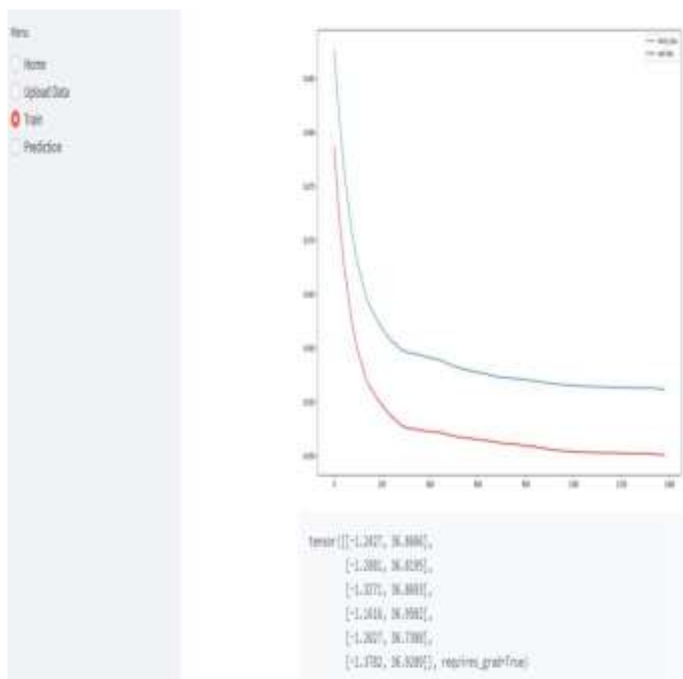

Figure 5: Graphical Representation of Training Module

6. This image shows the accuracy,robustness of the proposed ambulance dispatch optimization model.

Figure 6: Prediction Data

7. In this image, we got the 95% Accuracy.

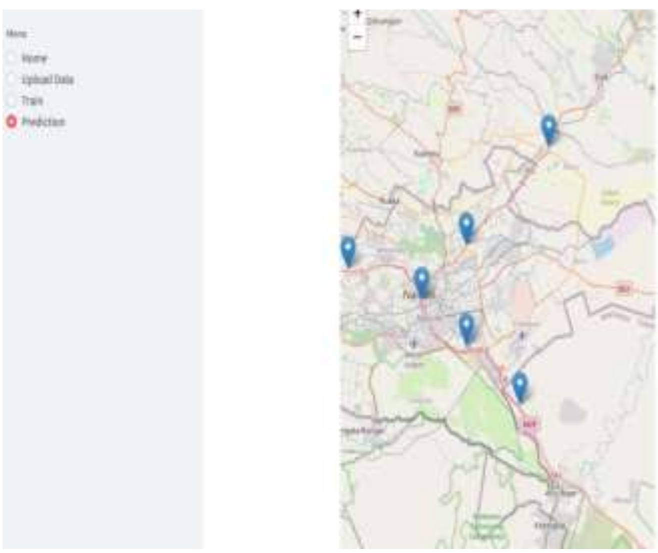

Figure 7: Prediction Heap map

V .CONCLUSION

This study utilizes the Nairobi accidents dataset (2018-2019) to produce and compare ambulance positioning models. Employing Cat2Vec for categorical data and Deep Bedded Clustering (DECAE), the model achieves 95 delicacy ink-fold cross-validation. Evaluation criteria , including Distance score, emphasize DEC- AE's superior performance in clustering and optimal ambulance positioning. Decision- makers can work these perceptivity to strategically invest in security measures, enhancing exigency response effectiveness in Nairobi and potentially impacting business safety operation programs. The study underscores the significance of advanced clustering ways for accurate data analysis and pattern recognition in optimizing emergency services.

VI. FUTURE SCOPE:

The study on predicting optimal ambulance positions in Nairobi using Deep Embedded Clustering (DEC) suggests several avenues for future research. Enhancements to the dataset, including additional variables like road type, speed limit, and driving behavior, could provide a more comprehensive understanding of factors influencing accidents and improve ambulance positioning models. Extending the analysis period beyond 2018-2019 could capture temporal trends, seasonal variations, and the impact of evolving road infrastructure. Including diverse cities with varying urbanization levels would offer insights into model performance in different settings. Comparative studies using datasets from cities in different socio-economic contexts could assess the generalizability and robustness of the proposed approach. Time series analysis and real-time data integration, such as traffic flow and weather updates, are recommended for a more nuanced understanding and dynamic adjustment of ambulance positions based on changing conditions and demands.

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