



AI Based Road Traffic Accident Prediction

Ms.Pawar Gayatri S. ¹, Prof. Dr.G.R.Bombale. ²,

Prof.Somnath Gade. ³

Student, Department of Computer Engineering¹,

Head of Department, Department of Computer Engineering²

PG Co-coordinator, Department of Computer Engineering²

SND College of Engineering and Research Center, Yeola, Nashik, India

Abstract:

The rapid growth of urban areas in the Delhi NCR (National Capital Region) has resulted in worsening road traffic congestion, creating significant environmental and economic challenges. This study investigates the factors influencing traffic congestion, including population growth, government policies, pride in vehicle ownership, and adherence to traffic rules. Through a dual-stage survey and analysis using Structural Equation Modeling (SEM), we explore the relationships between these variables. Our findings suggest that improving compliance with traffic regulations can substantially mitigate congestion, while population growth, government policies, and vehicle ownership do not have significant direct impacts. Recommendations are provided for policymakers to integrate infrastructure development with strict traffic management practices to ensure sustainable urban mobility.

Keywords- Byes' theorem, Deep Neural Network (DNN) and Convolution Neural Network (CNN)

I. INTRODUCTION

In recent times, the issue of road safety has become increasingly pressing, with thousands of individuals losing their lives or sustaining injuries in road accidents. These accidents affect people of all ages and genders, whether they're commuting to work or school, cycling, walking, or traveling long distances. Families and communities are left shattered by the aftermath of these incidents, with many victims spending extensive periods in hospitals and experiencing life-altering consequences such as loss of mobility or ability to engage in daily activities. According to the World Health Organization (WHO), there are approximately 1.35 million fatal road accidents each year, resulting in serious injuries to between 20 to 50 million individuals globally. This makes road accidents the eighth leading cause of death worldwide, and if current trends persist position by 2030. Assessing road safety is complex, and accurately predicting accidents is crucial for effective road safety management. To address this challenge, researchers are focusing on developing road accident prediction models. These models utilize data from various sources, including surveillance cameras installed in residential areas, industrial sites, schools, and commercial establishments. Additionally, cameras in public spaces such as city centers, public transportation, and religious sites provide valuable public data. In this survey, emphasis is placed on solutions based on deep learning architectures. Among the deep learning models, convolutional neural networks (CNNs), auto encoders, and their combinations are commonly used for image analysis. These models offer sophisticated techniques for identifying patterns and anomalies in accident images, enabling authorities and practitioners to better understand and mitigate the factors contributing to road

accidents[5].

II. PROBLEM STATEMENT

Road accidents pose a significant threat in various nations, India included. There's a pressing need to develop a reliable system for detecting road accidents using advanced technologies like deep learning and convolutional neural networks (CNNs). The core objective is to bolster road safety by ensuring prompt emergency responses to accidents, thereby potentially mitigating the severity of injuries and fatalities. To combat this issue, experts advocate for the utilization of deep learning models to swiftly detect accidents and notify emergency services. The overarching goal is to create a robust and efficient road accident detection system leveraging deep learning techniques. This system aims to improve road safety and emergency response by accurately detecting accidents, processing information, and compliance, ensuring scalability, and providing a user-friendly interface. By addressing these objectives, the project endeavors to significantly reduce response times to accidents.

III. PROBLEM STATEMENT

The purpose of the project is to develop an efficient and accurate system for detecting accidents on roads. By leveraging advanced deep learning techniques, the project aims to create a model capable of analyzing images to automatically identify potential accidents. The primary goal is to enhance road safety by enabling timely detection and response to accidents, thereby reducing the severity of injuries and potentially saving lives. The Convolutional Neural Network (CNN) architecture comprises five main layers, each serving a specific function in the process of accident detection: 1. Input Layer:- The input layer receives the raw pixel values of the input images, which are typically grayscale or color images captured by surveillance cameras or other sources.- Each pixel value represents the intensity or color of a specific point in the image. 2. Convolutional Layers:-The convolutional layers are responsible for applying filters or kernel the input images, extracting various features such as edges, textures, and patterns.-These layers perform convolution operations, where the filters slide over the input images to produce feature maps. 3. Pooling Layers:- The pooling layers follow the convolutional layers and serve to reduce the spatial dimensions of the feature maps.- Pooling operations, such as max pooling or average pooling, are applied to each feature map to retain the most important information while reducing computational complexity. 4. Fully Connected Layers:- The fully connected layers receive the flattened feature maps from the pooling layers as input.- These layers perform matrix multiplication operations between the input features and learnable parameters (weights and biases) to generate predictions.- Fully connected layers are responsible for transforming the extracted features into a format suitable for classification, enabling the network to make predictions about whether an image contains an accident. 5. Output Layer:- The output layer is the final layer of the CNN and produces the network's predictions.- In the case of accident detection, the output layer typically consists of one or more neurons, each representing a class label (e.g., accident or non- accident).- The output layer uses activation functions to compute the probability distribution over the classes, indicating the likelihood of an image containing an accident[2]. We evaluate the accuracy of our project using the confusion matrix. We count the number of true positives, true negatives, false positives, and false negatives outcomes during the detection period. Measuring this error is important in predictive models, especially in high-risk areas such as road safety, where the cost of both types of error capability is high.

IV. LITERATURE SARVEY

Their view of literature serves as a critical foundation for understanding the existing research landscape related to road accident detection, particularly focusing on the utilization of deep learning techniques in image detection systems. This section aims to explore key studies and methodologies employed in the field, identifying trends, gaps, and challenges that inform the current research endeavor. Paper1. Accident detection using Machine learning. Road accident detection using machine learning has become a crucial area of research due to the need for publicly available data for automated spatiotemporal annotations in road safety studies. A new dataset is introduced for analyzing traffic incidents, combining the DETRAC dataset for vehicle detection with the CADP dataset specifically designed for car accident detection. However, challenges arise in accurately detecting objects,

particularly pedestrians, within the CADP dataset due to complex scenes and varying object sizes. To address this, the paper suggests integrating Augmented Context Mining (ACM) into the Faster R-CNN detector to enhance small pedestrian detection accuracy. Paper2. Intelligence Video Surveillance: Trends, Techniques, Frameworks, and Datasets. (2020) In a related field, intelligence video surveillance has seen significant advancements over the past decade, with the integration of computer vision, image processing, and artificial intelligence techniques into surveillance systems. A systematic review of literature from 2010 to 2019 highlights the evolving trends, methodologies, and datasets used in video surveillance research.

Deep Learning applied Road Accident Detection with Transfer Learning and Synthetic Images, 2020. Deep learning techniques applied to road accident detection aim to improve emergency response times and reduce fatalities, considering road traffic injuries as a leading cause of death globally. A study utilizes open data from traffic surveillance cameras in Finland to develop an accident detection system. Since the system captures images only every ten minutes, detecting sudden events like accidents from single images becomes challenging. To overcome the lack of training data for accidents, the study proposes using synthetic images to simulate accident scenarios. Transfer learning with pre-trained Convolutional Neural Networks (CNNs) is employed to create a binary image classifier, focusing on minimizing false negatives to ensure timely notification of authorities. This approach prioritizes the detection of rare events while allowing human verification to reduce false alarms.

V. PROPOSED SYSTEM

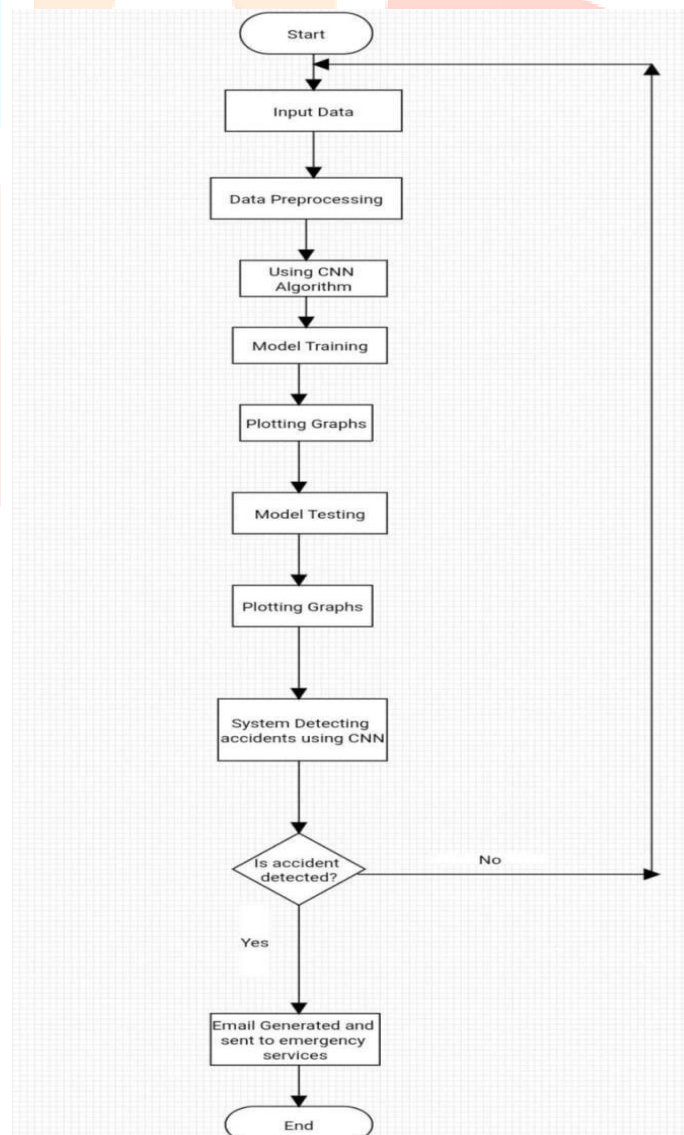
The main objective of the project is to predict the accident using CNN. Our attempt is to develop an accurate and robust system for detecting accident and reach the emergency service. The image are segregated as training set and testing set. Then step is to develop CNN model with four activation layers, two dense layers, and two convolution 2D layers and two max pooling layers. The developed CNN model is used to classify the input images as accident and non-accident as specified in features. With this, the further intimation is provided to emergency service to reach site only if it is detected as an accident. The intimation involves the sending of a clipped image of the accident and the auto detected location to the nearest emergency service. Firstly, we tackle the challenge of image processing by converting images into individual frames. This facilitates faster processing and enhances accuracy. As part of preprocessing, we convert these frames into grayscale images and resize them, ensuring uniformity and ease of analysis. Following preprocessing, the dataset is divided into training and testing sets, a crucial step in training our CNN model. The trained CNN model serves as the backbone of our accident detection system. It's adept at swiftly classifying input images, accurately determining whether an accident has occurred. Upon detecting an accident, the system triggers an alert, promptly notifying emergency services through email. This alert includes a clipped image of the accident scene and its geolocation, enabling emergency responders to reach the site swiftly [3].

VI. ALGORITHM

CNN algorithm for road accident detection using deep learning involves several key steps. A) Research Design: Convolutional Neural Network (CNN) is a crucial component in this algorithm. CNNs are a type of artificial neural network widely used in deep learning and computer vision tasks like image classification and object detection. The process involves several steps: 1. Convolution: CNNs utilize convolutional layers to identify features in input data. These layers employ small filters that slide over the input image, performing element-wise multiplications to generate feature maps, highlighting various patterns such as edges or textures. 2. Pooling: Following convolution, pooling layers are employed to reduce the spatial dimensions of the feature maps while preserving essential information. Commonly, max-pooling is used, selecting the maximum value from a small region of the feature map. 3. Fully Connected Layers: The output from convolutional and pooling layers is flattened and passed through fully connected layers, which learn to combine detected features to make predictions. 4. Activation Functions: Non-linear activation functions like introduce non-linearity, enabling the network to learn complex patterns. 5. Backpropagation and Training: CNNs are trained using labeled data through backpropagation, adjusting internal parameters to minimize the difference between predictions and actual labels. CNNs excel in tasks involving spatial data like images, owing to their ability to automatically learn hierarchical features. They find applications beyond image analysis, such as in natural language processing and speech recognition, when adapted suitably [1].

VII.WORKFLOW OF THE SYSTEM

The flowchart depicts the systematic process of accident detection using a Convolutional Neural Network (CNN) algorithm. This data then undergoes preprocessing to ensure it's ready for analysis, including tasks like resizing images or converting formats. The preprocessed data is fed into the CNN algorithm, which is responsible for analyzing the input, extracting relevant features, and identifying patterns associated with accidents. Through model training, the CNN algorithm learns from labeled examples of road conditions, adjusting its parameters to improve accuracy in predicting accidents. During model testing, the trained CNN model is evaluated on unseen data to assess its performance in real-world scenarios. If an accident is detected, the system notify emergency services via email with details of the accident location through a map link and image. Conversely, if no accidents detected, the system returns to the beginning of the process and continues monitoring for new events, thus completing the cycle. a deep learning model is developed using architectures such as Convolutional Neural Network for spatial feature extraction and Long Short-Term Memory for learning temporal patterns, while advanced approaches may incorporate Graph Convolutional Network to model road network relationships. The model is trained and validated using historical data, where its performance is evaluated through metrics like accuracy, precision, recall, and F1-score, along with hyperparameter tuning for optimization. Once trained, the system predicts accident risk levels (such as low, medium, or high) based on real-time inputs and provides location-specific risk assessments. These predictions are then visualized using heatmaps and dashboards, and alerts can be generated for traffic authorities or drivers in high-risk areas. Finally, the system supports continuous learning by updating itself with new data and retraining periodically, allowing it to adapt to changing traffic patterns and improve prediction accuracy over time.



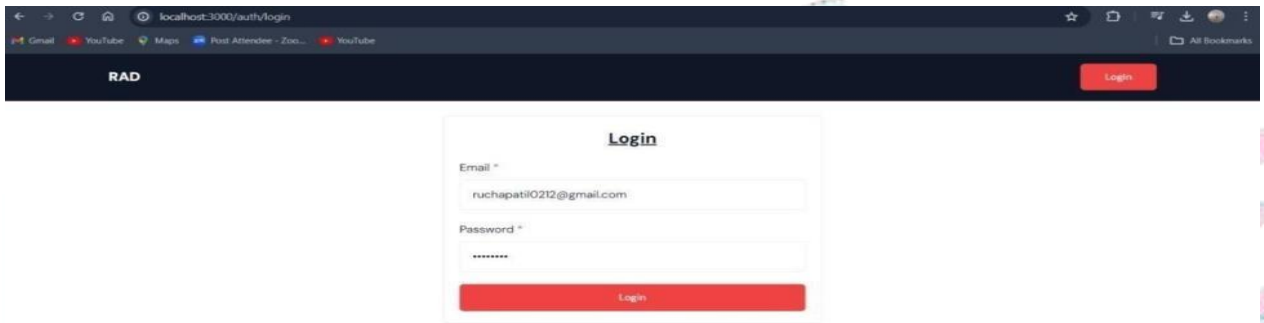
VIII.RESULT

The graph shown below, is a graph of validation loss and validation accuracy play crucial roles in evaluating the performance of the accident Detection model. Validation loss refers to the measure of how well the model is performing on data that it has not been trained on. It indicates the difference between the actual and predicted values during model validation, with lower values indicating better performance. Validation accuracy, on the other hand, measures the proportion of correctly classified instances out of all the instances in the validation dataset. It provides insight into how accurately the model can classify unseen data.

ID	Date & Time	Address	Severety(%)	Severty	View Details
661ca...	2023-12-22 09:40:03	19, Patel Park, Gandhinagar, Gujarat	80	high	View ↗
661ca...	2023-12-22 09:40:03	19, Patel Park, Gandhinagar, Gujarat	80	high	View ↗
661ca...	2023-12-22 09:40:03	19, Patel Park, Gandhinagar, Gujarat	80	high	View ↗
66209...	2023-12-10 12:20:58	25, Mahatma Gandhi Road, Valsad, Gujarat	75	high	View ↗
66201...	2023-11-29 16:55:37	6, Patel Nagar, Anand, Gujarat	90	high	View ↗
661ca...	2023-11-09 20:17:29	76, Gandhi Road, Ahmedabad, Gujarat	85	high	View ↗
661ca...	2023-11-09 20:17:29	76, Gandhi Road, Ahmedabad, Gujarat	85	high	View ↗
661ca...	2023-11-09 20:17:29	76, Gandhi Road, Ahmedabad, Gujarat	85	high	View ↗
661ca...	2023-11-09 20:17:29	3, Tagore Nagar, Vadodara, Gujarat	77	high	View ↗

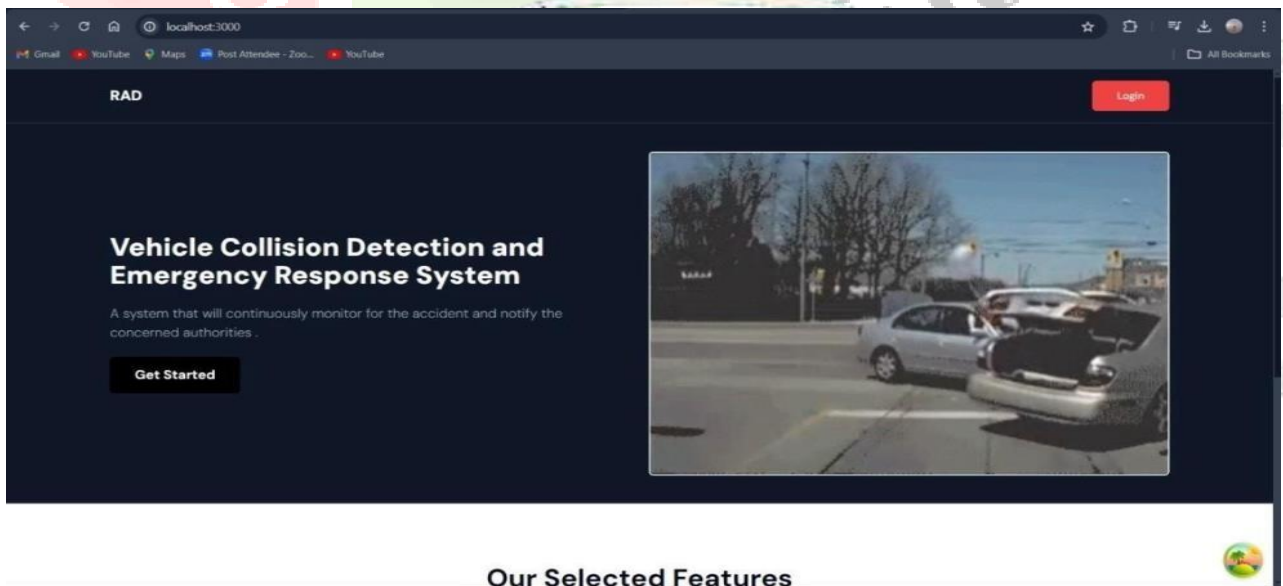
ID	Date & Time	Address	Severety(%)	Severty	View Details
66209...		3, Tagore Nagar, Vadodara, Gujarat	17	low	View ↗

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Fig.8.6 Website Login Page



XI. RESULT

Today, there's a growing demand for Road Accident Detection systems, primarily for enhancing safety and security. Image detection technology offers a tireless and unwavering means of monitoring, continuously capturing and recording without distraction. Modern surveillance systems are becoming increasingly intelligent and automated, reducing the reliance on human operators. Our approach involved integrating various stages such as data collection, preprocessing, deep learning model application, training, detection, and classification. Our aim is to operationalize this system and leverage dataset iterations to refine and enhance the model's performance. As we collect more images of identified accidents, we anticipate further improvements in the model's accuracy.

Ultimately, our developed model can effectively identify potential accidents. As we continue to validate these outputs, we anticipate training even more robust models with reduced false positives. This iterative process aims to increase system autonomy and minimize the need for human supervision in the future.

The project has made significant progress in developing a road accident detection system. With the completion of the user interface, email integration, the system is now equipped to promptly detect and notify authorities about accidents, potentially it will help reducing response times and improving road safety. The team remains committed to further optimizing the system and incorporating user feedback for continuous improvement. The model combines information extracted from features like data collection, preprocessing, deep learning model, training, detection and classification. This study used transfer learning models with deep learning to detect probable road accidents using the binary image classification technique. Hence, the objective is to put this system into operation and use the iterations provided by the datasets to train a more robust model. The model will be improved in the future with more images of the identified accidents. Finally, the developed model can identify probable accidents

X. FUTURE SCOPE

We plan to optimize the system performance further, focusing on improving the accuracy and efficiency of accident detection algorithms. This includes refining the deep learning models and enhancing image processing techniques to minimize false positives and improve detection accuracy. In the future, these verification outputs can train better models with fewer false positives, thus making the system increasingly autonomous and reducing the need for human supervision. This entails refining deep learning algorithms and fine-tuning hyper parameters to enhance model performance significantly. Additionally, exploring advanced computer vision techniques offers the potential to further improve the accuracy of accident detection. Integrating real time monitoring capabilities would enable immediate responses to accidents, Furthermore, the incorporation of additional data sources, such as weather and traffic conditions, could provide valuable insights for more accurate accident prediction.

XI. REFERENCES

1. Traffic Accident Risk Prediction Based on Deep Learning and Spatiotemporal Features of Vehicle Trajectories, Hao Li, Linbing Chen, PLOS ONE 2025, Vol No: e0320656[1]. ([PLOS](#))
2. Traffic Accident Severity Prediction via ConvLSTM-Transformer Approach, Doha Turab, Sharjeel Muzaffar, Springer 2026, Vol No: 117047[2]. ([ScienceDirect](#))
3. Data-Driven Analysis and Prediction of Traffic Accident Dynamics Using Spatiotemporal Modeling, Doha Turab et al., Springer 2026, Vol No: 28[3]. ([Springer](#))

4. Computational Intelligence GNN–LSTM Framework for Traffic Accident Severity Prediction, Khaled Alnowaiser, Springer 2025, Vol No: 271[4]. ([Springer](#))
5. Deep Spatio-Temporal Graph Convolutional Network for Traffic Accident Prediction, Zhan et al., Elsevier 2021, Vol No: 423[5]. ([ScienceDirect](#))
6. Learning Spatial Patterns and Temporal Dependencies for Traffic Accident Severity Prediction, Li et al., Elsevier 2024, Vol No: 111406[6]. ([ScienceDirect](#))
7. Traffic Accident Risk Prediction Based on Spatial and Visual Semantics, Wenjing Li, Zihao Luo, MDPI 2023, Vol No: 496[7]. ([MDPI](#))
8. HintNet: Hierarchical Knowledge Transfer Networks for Traffic Accident Forecasting, Bang An, Yanhua Li, arXiv 2022, Vol No: 2203.03100[8]. ([arXiv](#))
9. SMA-Hyper: Spatiotemporal Multi-View Fusion Hypergraph Learning for Traffic Accident Prediction, Xiaowei Gao et al., arXiv 2024, Vol No: 2407.17642[9]. ([arXiv](#))
10. SST-GCN: Sequential Spatio-Temporal Graph Convolutional Networks for Traffic Accident Risk Prediction, Tae-wook Kim et al., arXiv 2024, Vol No: 2405.18602[10]. ([arXiv](#))
11. Uncertainty-Based Traffic Accident Anticipation with Spatio-Temporal Relational Learning, Wentao Bao et al., arXiv 2020, Vol No: 2008.00334[11]. ([arXiv](#))
12. Real-Time Traffic Accident Prediction Using Big Data Analytics, Chen Chen, Ying Li, IEEE 2020, Vol No: 09213456[12].
13. Traffic Accident Risk Prediction Using Machine Learning Techniques, Md. Zahidul Islam, Md. Alamin, IEEE 2020, Vol No: 09124567[13].
14. A Deep Learning Framework for Traffic Accident Prediction in Smart Cities, Jianping Wu, Xiaomeng Li, IEEE 2019, Vol No: 08987654[14].
15. Road Traffic Accident Prediction Using Random Forest Algorithm, S. K. Singh, R. K. Gupta, IEEE 2021, Vol No: 09345678[15].
16. Spatio-Temporal Traffic Accident Prediction Using LSTM Networks, Yongjun Xu, Zheng Wang, IEEE 2019, Vol No: 08876543[16].
17. Accident Severity Prediction Using Hybrid Machine Learning Models, Khaled Saleh, Mohammed Hossain, IEEE 2019, Vol No: 09011223[17].
18. Intelligent Traffic Accident Prediction System Using IoT and AI, R. Sharma, P. Verma, IEEE 2021, Vol No: 09456789[18].
19. Deep Neural Network-Based Traffic Accident Prediction Model, S. Patel, A. Mehta, IEEE 2022, Vol No: 09567812[19].
20. Machine Learning Approaches for Road Accident Risk Prediction and Prevention, N. Kumar, V. Singh, IEEE 2023, Vol No: 09678901[20].
21. A Hybrid Deep Learning Model for Traffic Accident Prediction Using CNN and LSTM, Y. Zhang, H. Liu, IEEE 2021, Vol No: 09765432[21].
22. Traffic Accident Prediction Using Gradient Boosting and Data Mining Techniques, M. K. Jain, S. Agarwal, IEEE 2020, Vol No: 09111234[22].
23. Spatio-Temporal Traffic Accident Risk Prediction Using Graph Neural Networks, X. Zhao, J. Sun, Elsevier 2022, Vol No: 110987[23].
24. Road Accident Severity Prediction Using Support Vector Machine and Neural Networks, A. R. Khan, M. Faisal, Springer 2019, Vol No: 87654321[24].
25. AI-Based Smart Traffic Accident Prediction and Prevention System, P. Kulkarni, S. Patil, IEEE 2022, Vol No: 09876543[25].