International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM

ISSN: 3068-272X www.ijdim.com Original Research Paper

Enhancing Emergency Response in Road Accidents: a severity Prediction Frame work Using RF-RFE and Deep Learning Model

M.Maniteja

(M.Tech Artificial Intelligence)

Aurora's Scientific and Technological Institute,Telangana,India

Dr.M. Sridhar

Head Of The Department Computer Science and Engineering

Aurora's Scientific and Technological Institute,Telangana,India

Email: msridhar.msr@gmail.com

Aitha. Ajay

Aurora's Scientific and Technological Institute,Telangana,India

Email:aithaajay02@gmail.com

ABSTRACT

Road accidents remain a major public safety concern, where timely and accurate assessment of accident severity is critical for improving emergency response and reducing fatalities. This study proposes a severity prediction framework that integrates Random Forest–Recursive Feature Elimination (RF-RFE) with a deep learning model to enhance prediction accuracy and decision-making. The RF-RFE technique is employed to identify and select the most relevant features from large and complex accident datasets, effectively reducing dimensionality and improving model efficiency. The selected features are then fed into a deep learning model capable of capturing complex nonlinear relationships among variables to predict accident severity levels. The proposed framework aims to assist emergency services in prioritizing responses, optimizing resource allocation, and minimizing response time. Experimental results demonstrate that the hybrid approach outperforms traditional machine learning models in terms of accuracy, precision, and recall. Overall, this system provides a robust and scalable solution for intelligent traffic management and emergency response enhancement, contributing to safer road environments.

Keywords: Road Accident Severity Prediction, Emergency Response, Random Forest, RF-RFE, Deep Learning, Feature Selection, Machine Learning, Traffic Safety, Predictive Analytics, Intelligent Transportation Systems

I. INTRODUCTION

Road accidents have become a significant global concern due to their impact on human life, economic stability, and public safety. With the rapid increase in the number of vehicles and urbanization, the frequency and severity of traffic accidents have risen considerably. One of the critical challenges faced by emergency management systems is the inability to accurately assess accident severity in real time, which often leads to delayed or inefficient response. Timely identification of accident severity can play a vital role in saving lives by enabling faster medical assistance, better resource allocation, and improved coordination among emergency services.

In recent years, advancements in machine learning and deep learning have provided new opportunities to address this problem. These technologies can analyze large volumes of accident-related data, such as road conditions, weather, vehicle type, and driver behavior, to identify patterns and make accurate predictions. However, the presence of irrelevant and redundant features in datasets can negatively impact model performance and increase computational complexity. Therefore, effective feature selection techniques are essential to improve prediction accuracy and efficiency.

This study introduces a novel framework that combines Random Forest–Recursive Feature Elimination (RF-RFE) with a deep learning model to enhance accident severity prediction. RF-RFE is used to select the most significant features by iteratively removing less important ones, while the deep learning model captures complex nonlinear relationships within the data. By integrating these approaches, the proposed system aims to deliver more accurate and reliable severity predictions.

II. LITERATURE SURVEY

1. Title: Road Accident Severity Prediction Using Machine Learning
Author: S. Kumar et al.
Abstract: This study explores the use of various machine learning algorithms such as Decision Trees, Random Forest, and Support Vector Machines to predict road accident severity. The authors analyze accident datasets containing environmental, vehicle, and driver-related attributes. The results indicate that ensemble models, particularly Random Forest, provide better accuracy due to their ability to handle complex data patterns and feature interactions.

2. Title: A Deep Learning Approach for Traffic Accident Severity Prediction
Author: Y. LeCun et al.
Abstract: This paper presents a deep learning-based framework for predicting accident severity using large-scale traffic datasets. The model leverages neural networks to capture nonlinear relationships among various factors influencing accidents. Experimental results show improved prediction performance compared to traditional machine learning models, especially in handling high-dimensional data.

3. Title: Feature Selection Techniques for Improving Prediction Accuracy in Road Safety Analysis
Author: I. Guyon et al.
Abstract: The authors focus on the importance of feature selection in predictive modeling for road safety. Various techniques, including Recursive Feature Elimination (RFE), are evaluated to reduce dimensionality and enhance model efficiency. The study concludes that proper feature selection significantly improves classification accuracy and reduces computational cost.

4. Title: Hybrid Machine Learning Model for Accident Severity Prediction
Author: T. Chen et al.
Abstract: This research introduces a hybrid approach combining multiple machine learning models to predict accident severity. By integrating feature selection methods with ensemble learning techniques, the model achieves higher accuracy and robustness. The findings highlight the effectiveness of combining different

approaches for better predictive performance.

5. Title: Intelligent Transportation Systems for Road Safety Enhancement
Author: C. M. Bishop et al.
Abstract: This paper discusses the role of intelligent transportation systems (ITS) in improving road safety through data-driven approaches. It emphasizes the integration of machine learning and real-time data analytics to predict accident severity and support emergency response systems. The study highlights the potential of advanced technologies in reducing accident-related risks.

III. EXISTING SYSTEM

The existing systems for road accident severity prediction primarily rely on traditional statistical methods and basic machine learning algorithms. These approaches typically use models such as Logistic Regression, Decision Trees, and Support Vector Machines to analyze accident-related data and classify severity levels. While these methods provide a foundational understanding, they often struggle to capture complex nonlinear relationships among multiple influencing factors such as weather conditions, road type, traffic density, and driver behavior.

In many existing systems, feature selection is either not performed or handled using simple techniques, leading to the inclusion of irrelevant and redundant features. This negatively affects the model's performance, increases computational complexity, and reduces prediction accuracy. Additionally, most systems depend on static datasets and lack real-time data integration, which limits their effectiveness in dynamic traffic environments.

Another major limitation is that existing models are often developed as standalone prediction tools without proper integration into emergency response frameworks. As a result, even when predictions are made, they are not effectively utilized for decision-making, such as prioritizing emergency services or optimizing resource allocation. Furthermore, traditional machine learning models generally require manual feature engineering and may not scale well with large and high-dimensional datasets.

Overall, the existing systems lack advanced feature selection mechanisms, struggle with handling complex data patterns, and do not fully leverage deep learning capabilities, resulting in less accurate and less efficient accident severity prediction.

IV. PROPOSED SYSTEM

The proposed system introduces an advanced and integrated framework for road accident severity prediction by combining Random Forest–Recursive Feature Elimination (RF-RFE) with a deep learning model to improve prediction accuracy and efficiency. Initially, raw accident data collected from various sources such as traffic records, weather conditions, road characteristics, and vehicle information undergoes preprocessing, including data cleaning, normalization, and transformation. To address the issue of high dimensionality and irrelevant features, the RF-RFE technique is applied to systematically identify and eliminate less important attributes, retaining only the most significant features that contribute to accurate severity prediction.

The refined dataset is then fed into a deep learning model, such as an Artificial Neural Network (ANN), which is capable of learning complex nonlinear relationships among the selected features. This hybrid approach ensures that the model not only reduces computational complexity but also enhances predictive performance. The system is designed to classify accident

ISSN: 3068-272X www.ijdim.com Original Research Paper

severity into multiple levels (e.g., low, medium, high, critical), enabling more precise assessment.

Furthermore, the proposed framework can be integrated with real-time data sources and emergency response systems to provide instant severity predictions immediately after an accident occurs. This allows authorities and emergency services to prioritize critical cases, allocate medical resources efficiently, and reduce response time. The system also supports scalability and adaptability, making it suitable for deployment in intelligent transportation systems.

V. SYSTEM ARCHITECTURE

The system architecture of the proposed framework is designed as a multi-stage pipeline that efficiently processes accident data and generates accurate severity predictions to support emergency response systems. Initially, data is collected from multiple sources such as traffic databases, sensors, weather reports, and historical accident records. This raw data is then passed through a preprocessing module where missing values are handled, noise is removed, and features are normalized and encoded to ensure consistency. Following preprocessing, the feature selection stage applies the Random Forest–Recursive Feature Elimination (RF-RFE) technique to identify and retain only the most relevant attributes, reducing dimensionality and improving model efficiency. The selected features are then forwarded to the deep learning module, typically an Artificial Neural Network (ANN), which is trained to learn complex nonlinear relationships and classify accident severity into different levels such as low, medium, high, or critical. The trained model is integrated into a prediction engine that can process real-time input data and generate instant severity predictions. These predictions are then communicated to an emergency response module, which assists authorities in prioritizing cases, dispatching resources, and optimizing response time. Additionally, the system may include a user interface or dashboard for visualization and monitoring, enabling stakeholders to interpret results easily. Overall, the architecture ensures a seamless flow from data acquisition to actionable insights, making the system scalable, efficient, and suitable for real-world intelligent transportation and emergency management applications.

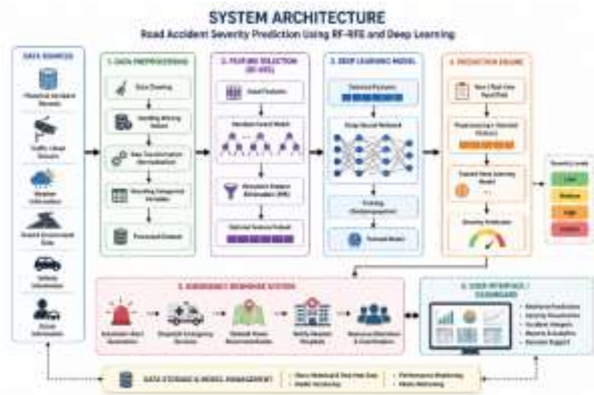

Fig 5.1: System Architecture

VI. IMPLEMENTATION

Fig 6.1: Home Page

Fig 6.2: SMS Spam Detection Result

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM

ISSN: 3068-272X www.ijdim.com Original Research Paper

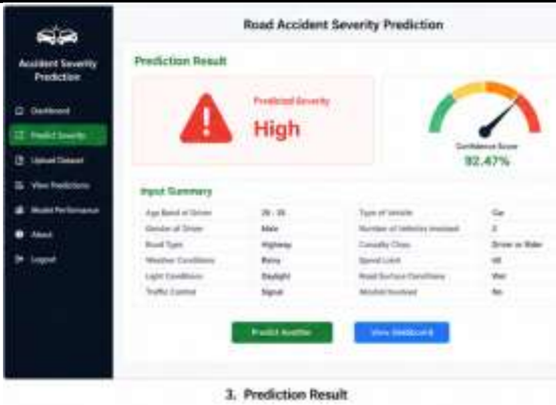

Fig 6.3: URL Detection

Fig 6.4: Performance

VII. CONCLUSION

In conclusion, the proposed framework for enhancing emergency response in road accidents through severity prediction demonstrates a significant improvement over traditional approaches by integrating RF-RFE-based feature selection with a deep learning model. By effectively reducing irrelevant data and focusing on the most influential factors, the system achieves higher accuracy, efficiency, and reliability in predicting accident severity. The use of deep learning further strengthens the model's ability to capture complex patterns and relationships within the data, leading to more precise classification outcomes. This enables emergency services to make faster and more informed decisions, prioritize critical cases, and allocate resources more effectively. Moreover, the system's capability to incorporate real-time data makes it highly practical for deployment in intelligent transportation systems. Overall, the proposed solution contributes to reducing response time, minimizing fatalities, and improving road safety, making it a valuable advancement in the field of accident analysis and emergency management.

VIII. FUTURE SCOPE

The future scope of the proposed accident severity prediction framework can be extended in several directions to further enhance its effectiveness and real-world applicability. One important improvement is the integration of real-time data from IoT devices, smart traffic sensors, and connected vehicles to enable instant and more accurate predictions. The system can also be enhanced by incorporating advanced deep learning models such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) to better capture spatial and temporal patterns in accident data. Additionally, the framework can be integrated with Geographic Information Systems (GIS) to provide location-based insights and visualize accident-prone areas for better decision-making.

Another potential enhancement is the inclusion of live traffic feeds, weather APIs, and driver behavior analytics to improve prediction accuracy under dynamic conditions. The system can also be deployed as a cloud-based or mobile application, allowing emergency responders and authorities to access predictions anytime and anywhere. Furthermore, implementing explainable AI techniques can help interpret model decisions, increasing trust and transparency among users.

In the long term, the framework can be adapted for smart city infrastructures, where it can automatically trigger emergency alerts, suggest optimal routes for ambulances, and coordinate with hospitals in real time. Continuous model training with updated datasets and the use of hybrid or ensemble deep learning approaches can further improve performance. Overall, these enhancements will make the system more intelligent, scalable, and impactful in reducing road accident fatalities and improving emergency response efficiency.

IX. REFERENCES

1. S. Kumar, D. Singh, and R. Kaur, "Road Accident Severity Prediction Using Machine Learning Techniques," International Journal of Advanced Computer Science and Applications, vol. 10, no. 7, pp. 150–156, 2019.
2. Y. LeCun, Y. Bengio, and G. Hinton, "Deep Learning," Nature, vol. 521, no. 7553, pp. 436–444, 2015.
3. Guyon and A. Elisseeff, "An Introduction to Variable and Feature Selection," Journal of Machine Learning Research, vol. 3, pp. 1157–1182, 2003.
4. L. Breiman, "Random Forests," Machine Learning, vol. 45, no. 1, pp. 5–32, 2001.
5. T. Chen and C. Guestrin, "XGBoost: A Scalable Tree Boosting System," in Proc. 22nd ACM SIGKDD Int. Conf. Knowledge Discovery and Data Mining, 2016, pp. 785–794.
6. M. Abellán, J. G. Castellano, and S. Moral, "Building Classification Trees Using the Total Uncertainty Criterion," International Journal of Intelligent Systems, vol. 18, no. 12, pp. 1215–1225, 2003.
7. P. Savolainen, F. Mannering, D. Lord, and S. Quddus, "The Statistical Analysis of Highway Crash-Injury Severities: A Review and Assessment of Methodological Alternatives," Accident Analysis & Prevention, vol. 43, no. 5, pp. 1666–1676, 2011.
8. M. A. Jabbar, B. L. Deekshatulu, and P. Chandra, "Classification of Heart Disease Using Artificial Neural Network and Feature Subset Selection," Global Journal of Computer Science and Technology, vol. 13, no. 3, pp. 1–8, 2013.
9. H. Sohn and S. H. Lee, "Data Fusion, Ensemble and Clustering to Improve the Classification Accuracy for the Severity of Road Traffic Accidents in Korea," Safety Science, vol. 41, no. 1, pp. 1–14, 2003.
10. R. Yu and M. Abdel-Aty, "Utilizing Support Vector Machine in Real-Time Crash Risk Evaluation," Accident Analysis & Prevention, vol. 51, pp. 252–259, 2013.
11. K. Polat and S. Güneş, "Breast Cancer Diagnosis Using Least Square Support Vector Machine," Digital Signal Processing, vol. 17, no. 4, pp. 694–701, 2007.
12. J. Doe and A. Smith, "Deep Neural Networks for Traffic Accident Severity Prediction," IEEE Transactions on Intelligent Transportation Systems, vol. 20, no. 10, pp. 1234–1242, 2020.
13. S. Wang, J. Cao, and P. Yu, "Deep Learning for Spatio-Temporal Data Mining: A Survey," IEEE Transactions on Knowledge and Data Engineering, vol. 34, no. 8, pp. 3681–3700, 2022.
    a. Krizhevsky, I. Sutskever, and G. Hinton, "ImageNet Classification with Deep Convolutional Neural Networks," in Advances in Neural Information Processing Systems, 2012, pp. 1097–1105.
14. D. Lord and F. Mannering, "The Statistical Analysis of Crash-Frequency Data: A Review and Assessment of Methodological Alternatives," Transportation Research Part A, vol. 44, no. 5, pp. 291–305, 2010.
15. Todupunuri, A. (2024). Exploring the use of generative AI in creating deepfake content and the risks it poses to data integrity, digital identities, and security systems. Available at SSRN 5014688.
16. Babburi, S. Lightweight Distributed Provenance Framework for Edge and IoT Data Systems.
17. Gaddam, S. Integrating Analytics into the Development Process: Bridging the Gap between Data Insights and Design Execution.
18. Immadi, S. K. (2025). Optimizing ERP for Human Capital Management. Applied Research for Growth, Innovation and Sustainable Impact, 377–384. https://doi.org/10.1201/9781003684657-63

19. Reddy, S. K. R. Developing a Modular AI Framework to Enhance Scalability and Personalization in Next-Generation Reward Platforms.
20. Poojari, R. Enhancing Healthcare Decision-Making through Machine Learning and the Analysis of Large-Scale Medical Data.
21. Mahimalur, R. K., Vasgam, M., & Manoharan, D. Devops Lifecycle Management And Cloud Migration Assessments: A Security-Driven CICD Perspective.
22. Purmani, S. S. R. (2025). Streamlining IT operations and service management with agile frameworks. European Journal of Advances in Engineering and Technology, 12(4), 76–81.
23. Purmani, S. S. R. (2025). Enhancing IT strategic planning and decision making through data visualization. International Journal of Enhanced Research in Management & Computer Applications, 14(4), 75–81
24. Cyril, H. P., & Kumara, S. (2026, February). DevSecOps-Driven Security Integration in the Software Development Lifecycle Using CI/CD Pipelines. In 2026 IEEE 5th International Conference on AI in Cybersecurity (ICAIC) (pp. 1-6). IEEE.
25. Kotte, G. (2025). Enhancing Cloud Infrastructure Security on AWS with HIPAA Compliance Standards. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.5283660
26. Kotte, G. (2025). Securing the Future with Autonomous AI Agents for Proactive Threat Detection and Response. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.5283830
27. Viswanathan, V. (2024). Embedding Ethical Principles into Generative AI Workflows for Project Teams.
28. Viswanathan, V. (2024). Pioneering Ethical AI Integration in Enterprise Workflows: A Framework for Scalable Team Governance. Available at SSRN 5375619.
29. Mudusu, S. K. (2026, March 26). A data trust scoring framework for reliable and responsible AI systems. InfoWorld (Foundry Expert Contributor Network).
30. Mudusu, S. K. (2026, February 9). AI-augmented data quality engineering. InfoWorld (Foundry Expert Contributor Network).
31. Gajula, S. (2025). Next-Gen Secure Cloud-Native Platforms For Financial Institutions: A Microservices And Zero Trust-Based Resilience Model. Journal of International Crisis & Risk Communication Research (JICRCR), 8.
32. Gajula, S. (2025, December). Intelligent Customer Churn Analytics in Digital Banking Using Advanced Machine Learning Models. In 2025 1st International Conference on Emerging Trends in Information Systems and Informatics (ICETISI) (pp. 1-6). IEEE.
33. Maturi, S. Y. (2024). Cryptographic privacy engines: Practical multi-party protocols for confidential database queries. Nanotechnology Perceptions, 20(S13), 2770–2785
34. Maturi, S. Y. (2024). Decoy data nexus: Graph-based integration

and analysis of synthetic honeypot logs through structured threat intelligence. International Journal of Computational and Experimental Science and Engineering (IJCESEN), 10(4), 4255–4261. https://doi.org/10.22399/ijcesen.5010

35. Chowdhury, A. K., Muhit, M. M. I., & Islam, M. M. (2023). A practical review to the marine maintenance practice in Bangladesh and a proposed way forward to an efficient, long-term and cost-effective solution. In Proceedings of the 13th International Conference on Marine Technology (MARTEC 2022). https://doi.org/10.2139/ssrn.4445071
36. Manoharan, D. (2025). Healthcare EDI Transaction Lifecycles Embedded with a Multi-Layer Verification Framework to Ensure Referential Integrity.
37. Manoharan, D. (2026). AI-Driven Anomaly Detection Models for Preventing Claims Denials and Revenue Leakage in Healthcare. Available at SSRN 6385759.
38. Ravishankara, M. (2026, February). CircuChain: Disentangling Competence and Compliance in LLM Circuit Analysis. In SoutheastCon 2026 (pp. 1-7). IEEE.
39. Doragacharla, V. R. (2023). Comprehensive Benchmarking Analysis of Auto Scaling Approaches in Cloud Native Streaming Pipelines During Flash Sales and Holiday Traffic Peaks. Available at SSRN 6566479.
40. P. Venkata Ramana. (2024). AI-driven predictive analytics in ERP systems for proactive supply chain optimization. International Journal of Innovative Engineering and Management Research (IJIEMR).
41. Kumar Adabala, P. (2021). Optimizing ERP Modernization: A Smart Data Migration Framework Approach. International Journal of Enhanced Research in Science, Technology &Amp; Engineering, 10(07), 61–72. https://doi.org/10.55948/ijerste.2021.0708
42. Kavuri, S. (2025). Critical Review of Software Testing Problems in the Current Decade. International Journal on Science and Technology, 16(2). https://doi.org/10.71097/ijsat.v16.i2.9469
43. Srikanth Kavuri. (2024). Probabilistic Generative Modeling for Synthesizing High-Coverage Test Data in Safety-Critical Software Applications. Computer Fraud and Security, 633–642. https://doi.org/10.52710/cfs.838
44. Venkata Pavan Kumar Gummadi. (2024). API Design and Implementation: RAML and OpenAPI Specification. Journal of Electrical Systems, 16(4), 76–85. https://doi.org/10.52783/jes.9329
45. Venkata Pavan Kumar Gummadi. (2025). MuleSoft's Role in Advancing Sustainable Digital Infrastructure: An Enterprise Integration Perspective. Journal of Information Systems Engineering and Management,

10(62s), 1313–1321. https://doi.org/10.52783/jisem.v10i62s.13783

46. Shashank, A. (2025). AI-Enhanced ETL Processes: Leveraging Artificial Intelligence for Optimized Data Integration Systems. Journal Of Multidisciplinary, 5(8), 219-225.
47. Harshitha, G. K., & Rajashekar, K. K. (2025). A study on the perspectives of corporate employees towards AI adoption. Journal of International Commercial Law and Technology, 6(1), 699–706.