Failure Mode and Effects Analysis in AI Enable Cars: A Study in Guwahati City

[1]Mr. Girban Bhattacharjee, [2]Dr. Puja Sen, [3]Er. Saurav Dey

[1]Management Trainee, Saint Gobain Construction Chemicals Pvt. Ltd

[2]Assistant Professor& HoD, Department of Journalism & Mass Communication, Girijananda Chowdhury University Silchar

[3]Assistant Professor, department of Business Administration, Assam University, Silchar

DOI: https://doi.org/10.51244/IJRSI.2026.1308000088

Received: 23 August 2026; Accepted: 28 August 2026; Published: 05 September 2026

ABSTRACT

The study explores the application of Failure Mode and Effects Analysis (FMEA) in Guwahati City's AI-enabled automobiles. Comprehending probable failure modes and their consequences is essential to improving vehicle safety and dependability as artificial intelligence technologies transform the automotive sector. In this study, different failure modes peculiar to AI-enabled cars functioning in Guwahati's distinct urban environment are identified and analysed. By means of an extensive assessment procedure, the research evaluates the degree, frequency, and identification of possible malfunctions, offering valuable perspectives on reducing the hazards linked to artificial intelligence-based features. The results are intended to aid in the creation of strong safety guidelines and legal frameworks for AI-powered automobile systems in city environments. The research methodology involves collecting real-world data from AI-enabled cars operating in Guwahati, analysing sensor performance, and identifying common failure points through expert interviews and historical incident reports. Specific attention is given to the impact of local weather conditions, road quality, and unpredictable traffic patterns on the reliability and safety of these vehicles. The study identifies several high-risk failure modes, such as sensor malfunctions in heavy rainfall, misinterpretation of road construction zones, and challenges in detecting sudden obstacles. The severity and occurrence of these failures are evaluated, and their effects on overall vehicle safety and performance are discussed. By addressing these failure modes, the study aims to contribute to the development of safer autonomous vehicles and inform future research and policy decisions in the deployment of AI-driven transportation

Keywords:- FMEA, ADAS, Design , Occurrence, Severit

INTRODUCTION

The Failure Mode and Effect Analysis simply referred to us FMEA, is employed as a systematic and proactive technique to evaluate a product, process, or system to determine where and how it will fail and assess the relative impact of different failures so that it is possible to work out which failures are leading significance are clear, an it is a method adopted in different industries such as automotive, aerospace, manufacturing, health care, and electronics, focusing mainly on increasing quality, reliability, and safety. The study identifies several high-risk failure modes, such as sensor malfunctions in heavy rainfall, misinterpretation of road construction zones, and challenges in detecting sudden obstacles. The severity and occurrence of these failures are evaluated, and their effects on overall vehicle safety and performance are discussed. By addressing these failure modes, the study aims to contribute to the development of safer autonomous vehicles and inform future research and policy decisions in the deployment of AI-driven transportation

LITERATURE REVIEW

The study has been substantially supported by the previous studies in the area. Some of which are mentioned here. Athavale, Jyotika, et al. (2020) Here the authors say about the Safety-critical autonomous systems are becoming more powerful and more integrated to enable higher-level functionality. Modern multi-core SOCs are often the computing backbone in such systems for which safety and associated certification tasks are one of the key challenges, which can become more costly and difficult to achieveFilz, M. A. et.al. (2021) The study uses deep learning models on operational and historical data from the use stage of industrial investment goods to propose a data-driven Failure Mode and Effect Analysis (FMEA) methodology. By increasing transparency and offering decision support, the established technique is intended to assist with maintenance planning for industrial investment items. Chi, C. F., et.al. (2020). The aim of the paper to study and analysed 345 passenger vehicle recalls that were reported to the National Highway Traffic Safety Administration. The root cause analysis was applied to analyse each recall event in order to derive the cause of the recall, i.e., the defect type. Classification schemes were developed to organize the defective components and defect type into useful categories. The defect types were classified into manufacturing defects, design flaws, and mislabelling..Wu, J. Y., et.al. (2021) This study evaluated risk in food cold chains using a failure mode and effect analysis (FMEA) approach and developing improvement strategies. The research comprised two stages: The first stage used surveys to evaluate risk associated with cold chain logistics, and the second used case studies to evaluate improvement strategies.

Research Gap

The provision of the FMEA of the failure mode to mitigate the risk and improve the automotive industry. The integration of FMEA with cutting-edge technologies like machine learning (ML) and artificial intelligence (AI) is still lacking in study, nevertheless. Although deep learning and advanced risk prioritisation models are mentioned in several studies as tools for FMEA, there aren't many complete frameworks that employ these technologies to automate and improve the FMEA process in a methodical way. In especially in complex and dynamic situations, additional research is required to build AI-driven FMEA approaches that may offer real-time insights, predictive analytics, and more reliable decision support systems.

Objectives of the Study

1. To find out the Occurrence, Severity & Detection of the failures.
2. To find out the Risk Priority Number (RPN) of the different Apps.
3. To identify the potential failure modes and effects in the AI/ Smart feature cars.

RESEARCH METHODOLOGY

Research Type:- Exploratory

Sampling technique: The sampling technique that is being used for the study is **Purposive Sampling Method**.

Data collection methods:

Primary data collection method:

The primary data has been collected directly from the from the cars users, Dealers and Service centre Via:

1. Observation
2. Interview
3. Questionnaire

Secondary data collection methods:

The Secondary data has been collected from,

- Magazines

- Website
- Journals and Research papers, etc

FINDINGS & ANALYSIS

The AI/ smart features cars are available in Guwahati city:

There are many AI/smart feature cars available on the road of the Guwahati city is seeing a spike in the popularity of these vehicles. These include advanced driver-assistance systems (ADAS) and sophisticated infotainment systems. The safety and convenience of amenities like voice-activated controls, adaptive cruise control, lane-keeping assistance, and automated emergency braking have pushed many drivers in the area into buying these cutting-edge vehicles.

In Guwahati, the automobile industry has presented AI- and smart feature-equipped cars. Leading the way are brands like Morris Garages, Toyota, Mercedes-Benz, Audi, Tata, and Hyundai, which offer models with different degrees of AI integration. These advanced cars are currently on display at nearby Guwahati dealerships, giving people in the market a chance to see what driving in the future would be like.

Calculation of RPN (Risk Priority Number)

Critical Factors	**Severity**	**Occurrence**	**Detection**	**RPN**
Weather Conditions	**5.29412**	**5.941176471**	**5.55882**	**174.843**
Road Conditions	**5.29412**	**4.882352941**	**5.61765**	**145.204**
Sensor Range	**5.44118**	**6.647058824**	**6.08824**	**220.198**
Sensor Fusion	**5.94118**	**6.294117647**	**6.14706**	**229.866**
Road Construction Zones	**5.05882**	**6.117647059**	**6.17647**	**191.15**
Sudden Obstacles	**6.02941**	**5.647058824**	**6.17647**	**210.299**
ADAS Effectiveness	**6.26471**	**6.970588235**	**6.17647**	**269.718**
Environmental Perception	**6.52941**	**5.676470588**	**5.55882**	**206.032**
Data Diversity	**6.5**	**5.941176471**	**6.23529**	**240.792**

Analysis of the Data

Critical factors arranged in the descending order to understand the factors which are mostly responsible for failure of the AI/ smart features cars as based on the feedbacks of the respondents.

Critical Factors	**RPN**
ADAS Effectiveness	**269.718**
Data Diversity	**240.792**
Sensor Fusion	**229.866**
Sensor Range	**220.198**
Sudden Obstacles	**210.299**
Environmental Perception	**206.032**
Road Construction Zones	**191.15**
Weather Conditions	**174.843**
Road Conditions	**145.204**

Here, smaller number denotes those factors which are less relevant to the AI/Smart feature car users and higher number denotes those factors that affects the AI/Smart feature car users view and perception the most and also these are the factors which the AI/Smart feature car users will emphasis more while driving the AI enable cars.

The five most critical factors identified as the potential failure modes and effects in the AI/ Smart feature cars:

- ADAS Effectiveness
- Data Diversity
- Sensor Fusion
- Sensor Range
- Sudden Obstacles

CONCLUSION

This study applies the FMEA methodology in the AI enable cars available in the Guwahati City of Assam, to identify the major failure modes of AI/Smart features cars users. The feedback of the respondents was taken to find out the RPN number which denotes the level of severity of failures.

ADAS Effectiveness, Data Diversity, Sensor Fusion were identified as the main reasons for the failures in AI enable cars with the highest RPN. Features like Sensor Range and Sudden Obstacles were also revealed as potential causes for the failures in the process.

The suggested and corrective actions are to considerably lower the RPN values below the acceptable limit and hence focus on these five factors to eliminate the failures and also reduce their frequencies.

REFERENCES

1. Sharma, K. D., & Srivastava, S. (2018). Failure mode and effect analysis (FMEA) implementation: a literature review. J Adv Res Aeronaut Space Sci, 5(1-2), 1-17.
2. Doshi, J., & Desai, D. (2017). Application of failure mode & effect analysis (FMEA) for continuous quality improvement-multiple case studies in automobile SMEs. International Journal for Quality Research, 11(2), 345.
3. Haapanen, P., & Helminen, A. (2002). Failure mode and effects analysis of software-based automation systems.
4. Banduka, N., Veza, I., & Bilić, B. (2016). An integrated lean approach to process failure mode and effect analysis (PFMEA): A case study from automotive industry.
5. Kolich, M. (2014). Using Failure Mode and Effects Analysis to design a comfortable automotive driver seat. Applied ergonomics, 45(4), 1087-1096.
6. Liu, Hu-Chen, Long Liu, and Nan Liu. (2013) "Risk evaluation approaches in failure mode and effects analysis: A literature review." Expert systems with applications 40.2 (2013): 828-838.
7. Athavale, Jyotika, (2020) "AI and reliability trends in safety-critical autonomous systems on ground and air." 2020 50th Annual IEEE/IFIP International Conference on Dependable Systems and Networks Workshops (DSN-W). IEEE, 2020.
8. Teoh, Ping C., and Keith Case. (2004) "Modelling and reasoning for failure modes and effects analysis generation." Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture 218.3: 289-300.
9. Hawkins, P. G., & Woollons, D. J. (1998). Failure modes and effects analysis of complex engineering systems using functional models. Artificial intelligence in engineering, 12(4), 375-397.
10. Hunt, J. E., Pugh, D. R., & Price, C. J. (1995). Failure mode effects analysis: a practical application of functional modeling. Applied Artificial Intelligence an International Journal, 9(1), 33-44.
11. Filz, M. A., Langner, J. E. B., Herrmann, C., & Thiede, S. (2021). Data-driven failure mode and effect analysis (FMEA) to enhance maintenance planning. Computers in Industry, 129, 103451.
12. Kmenta, S., Fitch, P., & Ishii, K. (1999, September). Advanced failure modes and effects analysis of complex processes. In International Design Engineering Technical Conferences and Computers and

Information in Engineering Conference (Vol. 19746, pp. 267-275). American Society of Mechanical Engineers.

13. Teoh, P. C., & Case, K. (2004). Failure modes and effects analysis through knowledge modelling. Journal of Materials Processing Technology, 153, 253-260.
14. Chi, C. F., Sigmund, D., & Astardi, M. O. (2020). Classification scheme for root cause and failure modes and effects analysis (FMEA) of passenger vehicle recalls. Reliability Engineering & System Safety, 200, 106929.
15. Geramian, A., Mehregan, M. R., Garousi Mokhtarzadeh, N., & Hemmati, M. (2017). Fuzzy inference system application for failure analyzing in automobile industry. International Journal of Quality &
16. Reliability Management, 34(9), 1493-1507.
17. Wu, J. Y., & Hsiao, H. I. (2021). Food quality and safety risk diagnosis in the food cold chain through failure mode and effect analysis. Food Control, 120, 107501.
18. Price, C. J., & Taylor, N. S. (2002). Automated multiple failure FMEA. Reliability Engineering & System Safety, 76(1), 1-10.
19. Koomsap, P., & Charoenchokdilok, T. (2018). Improving risk assessment for customer-oriented FMEA. Total Quality Management & Business Excellence, 29(13-14), 1563-1579.
20. Prajapati, D. R. (2012). Implementation of failure mode and effect analysis: a literature review. International Journal of Managment, IT and Engineering, 2(7), 264-292.
21. Thornton, E., Brook, O. R., Mendiratta-Lala, M., Hallett, D. T., & Kruskal, J. B. (2011). Application of failure mode and effect analysis in a radiology department. Radiographics, 31(1), 281-293.