VIVA-TECH INTERNATIONAL JOURNAL FOR RESEARCH AND INNOVATION
ANNUAL RESEARCH JOURNAL
ISSN(ONLINE): 2581-7280

Blind Spot Safety with Thermal Image Processing for Heavy Vehicles

Rahul Abhyankar[1], Naved Siddiqui[2], Pratik Patil[3], Manas Pawar[4]
(Department Of Electrical Engineering, VIVA Institute of Technology, Virar, India) [1]
(Department Of Electrical Engineering, VIVA Institute of Technology, Virar, India)[2]
(Department Of Electrical Engineering, VIVA Institute of Technology, Virar, India) [3]
(Department Of Electrical Engineering, VIVA Institute of Technology, Virar, India)[4]

Abstract: *Growing safety concerns for heavy vehicles have prompted significant advancements in blind spot detection systems. Blind spots in heavy vehicles pose risks of accidents, especially under poor visibility conditions. This paper proposes a thermal image processing-based system to enhance blind spot safety. The system uses thermal cameras to detect heat signatures, identifying pedestrians, cyclists, and other vehicles in blind spots, even in low light or adverse weather. Advanced image processing algorithms and machine learning techniques are employed to classify detected objects and trigger real-time alerts for drivers. A prototype was tested under various environmental conditions, demonstrating improved detection accuracy and reduced response time. The findings suggest that integrating thermal imaging with existing driver-assistance technologies can significantly enhance situational awareness, mitigate accidents, and improve road safety for heavy vehicle operations. Potential applications extend to fleet management and automation in transportation..*

Keywords – *Blind Spot Safety, Heavy Vehicles, Machine Learning, Object Detection, Thermal Imaging.*

I. INTRODUCTION

Blind spots in heavy vehicles present significant challenges for road safety. These areas, not visible to drivers through mirrors or cameras, account for numerous accidents involving pedestrians, cyclists, and smaller vehicles. Adverse weather conditions further exacerbate the problem, making it critical to address these visibility gaps effectively.

Traditional methods such as mirrors and cameras, while helpful, often fail under low-light or poor weather conditions, where visibility is already compromised. In such scenarios, drivers are at a heightened risk of missing nearby obstacles, which could lead to catastrophic accidents. Moreover, heavy vehicles, due to their larger size and complex structure, inherently possess more extensive blind spots compared to smaller vehicles, necessitating advanced solutions.

Thermal image processing offers a groundbreaking approach to addressing this issue by leveraging infrared technology to detect heat signatures. Unlike traditional optical methods, thermal imaging is unaffected by lighting conditions, making it highly effective even in complete darkness or foggy environments. By capturing and analyzing heat data, it becomes possible to identify pedestrians, animals, and other vehicles that might otherwise go unnoticed.

This paper explores the integration of thermal imaging technology with machine learning algorithms to enhance blind spot safety. The proposed system not only detects objects but also classifies them, providing real-time alerts to drivers. Such advancements can significantly reduce accident rates, enhance operational safety, and set a new standard for heavy vehicle safety systems.

II. METHODOLOGY

The proposed system involves:

2.1 Hardware Components

a) Thermal Camera: Captures infrared images of the surroundings.
b) Processing Unit: Converts thermal data into actionable information using advanced algorithms.
c) Power Supply: Provides consistent energy for system operation.
d) Alert System: Audio and visual alerts for detected hazards.

2.2 Software Implementation

a) Image acquisition and preprocessing to enhance thermal images.
b) Object detection using edge detection and contour mapping.
c) Classification using machine learning algorithms, distinguishing humans from other objects.
d) Real-time decision-making and alerts based on object type and proximity.

The system architecture combines thermal imaging with existing Advanced Driver Assistance Systems (ADAS) for comprehensive safety coverage.

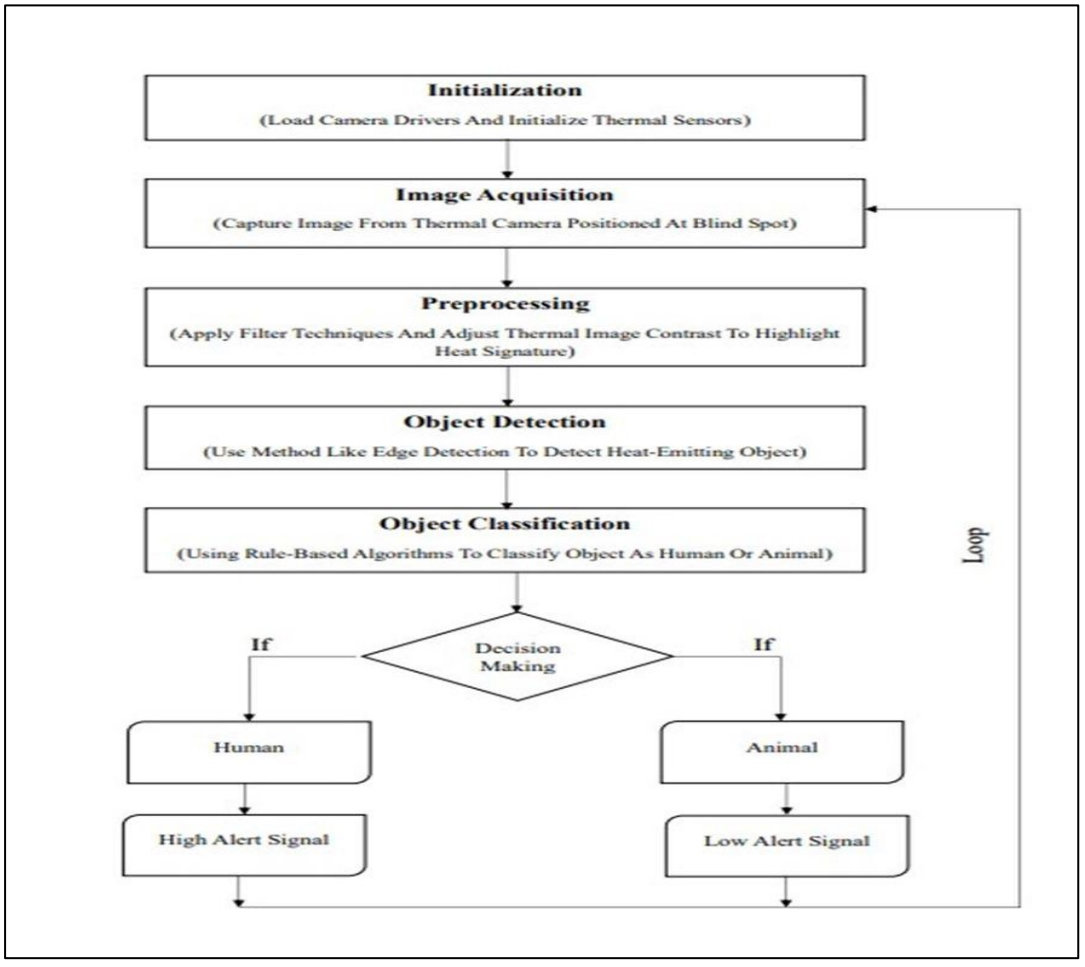

Fig 1 Flow Chart of Blind Spot Safety Using Thermal Image Processing For Heavy Vehicles

III. CONCLUSION

The integration of thermal imaging with advanced processing techniques demonstrates significant improvements in blind spot safety for heavy vehicles. This system addresses key limitations of traditional methods, providing robust performance in low-visibility conditions. Future work includes integrating this technology with LiDAR and GPS for enhanced situational awareness and automating fleet safety monitoring systems.

Acknowledgements

We shall be failing in our duty, if we will not express our sincere gratitude to all those distinguished personalities with the help of whom we have successfully completed our project. My deep gratitude to Dr. Arun Kumar, Principal, VIVA Institute of Technology, who always been playing a great role in all round development of the student. My deep gratitude to Prof. Bhushan Save, The Head of Electrical Department and also our Project Guide Prof. Rahul Abhyankar and our Project Coordinator Prof. Rahul Abhyankar for their valuable guidance, advice and constant aspiration to our work, teaching and non-teaching staff for their kind support, help and assistance, which they extended as and when required. Last but not the least we wish to thank my friends for providing technical and moral support. We hope that this project report would meet the high standards of all concerned people and for their continuous co-operation during the whole period of period of project that helped us in enhancement of this project.

REFERENCES

[1] A. Lay-Ekuakille, P. Vergallo, F. Conversano, S. Casciaro and D. Veneziano, "Thermal image processing for accurate realtime decision making in surgery," 2014 IEEE International Symposium on Medical Measurements and Applications (MeMeA), Lisboa, Portugal, 2014, pp. 1-4, doi: 10.1109/MeMeA.2014.6860151.

[2] B. Wiecek, R. Danych, Z. Zwolenik, A. Jung and J. Zuber, "Advanced thermal image processing for medical and biological applications," 2001 Conference Proceedings of the 23rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Istanbul, Turkey, 2001, pp. 2805-2807 vol.3, doi: 10.1109/IEMBS.2001.1017368.

[3] V. Saragadam, A. Dave, A. Veeraraghavan and R. G. Baraniuk, "Thermal Image Processing via Physics-Inspired Deep Networks," 2021 IEEE/CVF International Conference on Computer Vision Workshops (ICCVW), Montreal, 10.1109/ICCVW54120.2021.00451.

[4] BC, Canada, 2021, pp. 4040-4048, doi: B. Wiecek, "Review on thermal image processing for passive and active thermography," 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference, Shanghai, China, 2005, pp. 686 689, doi: 10.1109/IEMBS.2005.1616506.

[5] R. Gupta, S. Jain and M. Kumar, "Role of Thermal Images in Various Applications of Computer Vision," 2023 4th International Conference on Intelligent Engineering and Management (ICIEM), London, United Kingdom, 2023, pp. 1-6, doi: 10.1109/ICIEM59379.2023.10166103.

[6] A. A. Sarawade and N. N. Charniya, "Detection of Faulty Integrated Circuits in PCB with Thermal Image Processing," 2019 International Conference on Nascent Technologies in Engineering (ICNTE), Navi Mumbai, India, 2019, pp. 1-6, doi: 10.1109/ICNTE44896.2019.8946061.

[7] C. Lile and L. Yiqun, "Anomaly detection in thermal images using deep neural networks," 2017 IEEE International Conference on Image Processing (ICIP), Beijing, China, 2017, pp. 2299-2303, doi: 10.1109/ICIP.2017.8296692.

[8] M. Naka, T. Imai, T. Shida, M. Sato, R. Ito and I. Akamine, "Thermal image processing using neural network," Proceedings of 1993 International Conference on Neural Networks (IJCNN-93-Nagoya, Japan), Nagoya, Japan, 1993, pp. 2065-2068 vol.3, doi: 10.1109/IJCNN.1993.714129.

[9] V. Voronin, S. Tokareva, E. Semenishchev and S. Agaian, "Thermal Image Enhancement Algorithm Using Local And Global Logarithmic Transform Histogram Matching With Spatial Equalization," 2018 IEEE Southwest Symposium on Image Analysis and Interpretation (SSIAI), Las Vegas, NV, USA, 2018, pp. 5-8, doi: 10.1109/SSIAI.2018.8470344.

[10] S. Khan, M. Narvekar, M. Hasan, A. Charolia and A. Khan, "Image Processing based application of Thermal Imaging for Monitoring Stress Detection in Tomato Plants," 2019 International Conference on Smart Systems and Inventive Technology (ICSSIT), Tirunelveli, India, 2019, pp. 1111 1116, doi: 10.1109/ICSSIT46314.2019.8987900.