OPEN ACCESS JOURNALS
Indiana Journal of Multidisciplinary Research
Abbreviated Tittle- Ind J Multi Res
ISSN *(Online)*- 2583-3820
Journal Homepage Link- https://indianapublications.com/Journals/IJMR
DOI: https://doi.org/10.5281/zenodo.21609841

INDIANA PUBLICATIONS
PRODUCTIVE AND QUALITY RESEARCH

Research Articles

Volume-06|Issue-04|2026

Automatic Braking System Using Image Processing

Mrs. Manasa S[1], Dr. Swetha Rani L[2], Sudeep K[3], Sudeep T K[4], Venkatreddy[5], L Yogesh[6]

[1,2,3,4,5,6]Department of Electronics and Communication Engineering, AMC Engineering College, Bangalore, India,

Article History
Received: 05.05.2026
Accepted: 22.06.2026
Published: 25.07.2026

Citation
Manasa, S., Rani, L. S., Sudeep, K., Sudeep, T. K., Venkatreddy., Yogesh, L.(2026) Automatic Braking System Using Image Processing. . *Indiana Journal of Multidisciplinary Research*, *6*(4), 337-339.

Abstract: Traffic light violations are a major cause of road accidents, often due to delayed human reaction or driver distraction. This paper presents an automatic braking system that detects traffic signals using image processing techniques and activates braking without driver intervention. A Raspberry Pi integrated with a camera module captures real-time video, which is processed using HSV-based color segmentation to identify red and green signals. When a red signal is detected, the system automatically triggers the braking mechanism, while a green signal allows normal vehicle movement.

The proposed system reduces dependency on human reflexes and supports the development of intelligent transportation systems. Unlike existing approaches that rely on costly deep learning models, this system uses lightweight image processing techniques, making it suitable for low-cost embedded platforms.

Experimental results show that the system achieves 94% detection accuracy with an average braking response time of 0.3 seconds. This work contributes to road safety by providing an affordable and practical Advanced Driver Assistance System solution.

Keywords: Traffic Signal Detection, Raspberry Pi, Image Processing, Automatic Braking, Road Safety

INTRODUCTION

Road accidents caused by traffic signal violations represent a major global safety issue. According to the World Health Organization, more than 1.3 million people die every year due to road-related incidents, and a significant number of these accidents occur at intersections due to signal violations. These incidents are often caused by delayed human reaction, distraction, or misjudgment.

Advanced Driver Assistance Systems (ADAS) have been developed to improve road safety through real-time monitoring and automated decision-making. However, many existing systems rely on expensive hardware such as LiDAR sensors and complex deep learning models, making them unsuitable for cost-sensitive environments.

This research proposes a low-cost automatic braking system using Raspberry Pi and image processing techniques. The system detects traffic signals in real time and activates braking automatically without driver intervention. By reducing dependency on human reflexes, the proposed system enhances road safety and supports the development of intelligent transportation solutions.

MATERIALS AND METHODS

The proposed system is designed to automatically detect traffic signals and initiate braking without driver intervention. The system operates in three main stages: image acquisition, signal detection, and braking control.

A Raspberry Pi 4 Model B is used as the processing unit, and a Pi camera continuously captures real-time video. Each frame is resized to 640×480 pixels to reduce computational load and then converted from RGB to HSV color space, which improves color detection under varying lighting conditions.

To reduce noise, a Gaussian blur is applied to the image. Color thresholding is then performed to detect red and green signals using predefined HSV ranges. Morphological operations such as erosion and dilation are applied to eliminate noise and improve detection accuracy. The largest contour in the processed frame is selected as the detected traffic signal.

A decision logic is implemented in which a red signal must be detected in three consecutive frames before triggering the braking mechanism. This helps reduce false detections. When a red signal is confirmed, a GPIO pin activates a relay connected to a servo motor that simulates braking. A buzzer is also triggered to alert the driver. When a green signal is detected, normal vehicle movement continues.

The hardware components used include Raspberry Pi 4, Pi Camera Module, SG90 servo motor, L293D motor driver, buzzer, and a regulated power supply. The software implementation is carried out using Python, OpenCV, NumPy, and RPi.GPIO libraries.

RESULTS

The proposed system was tested under real-time conditions to evaluate its performance in detecting traffic signals and activating the braking mechanism. The hardware and software components were successfully integrated, and the system operated reliably during testing.

The system achieved a detection accuracy of 94% for red signal identification. The average braking response time was approximately 0.3 seconds, demonstrating fast system response suitable for real-time applications. The system operated at a frame rate of 30 frames per second with a resolution of 640×480 pixels.

Out of 50 test cases conducted under different lighting conditions, 47 tests were successful, indicating consistent system performance. The HSV-based image processing method proved effective for traffic signal detection without the need for complex deep learning models.

The results confirm that the proposed system is efficient, cost-effective, and suitable for real-time implementation in Advanced Driver Assistance Systems (ADAS).

DISCUSSION

The experimental results demonstrate that the proposed system is effective in detecting traffic signals and activating automatic braking in real time. The system performs well under normal lighting conditions and achieves high detection accuracy using a lightweight HSV-based image processing approach.

One of the major advantages of this system is its low cost and simplicity compared to existing solutions that rely on deep learning models and expensive hardware such as LiDAR. This makes the proposed system suitable for implementation in cost-sensitive environments and developing countries.

However, the system shows limitations under challenging conditions such as heavy rain, glare, and low lighting, where color-based detection becomes less reliable. This limitation is consistent with existing studies that highlight the challenges of vision-based systems in adverse environments.

Overall, the results indicate that the proposed system provides a strong foundation for developing affordable and efficient Advanced Driver Assistance Systems (ADAS), with potential for further improvements through hybrid approaches and sensor integration.

CONCLUSION

This research presents a low-cost automatic braking system using Raspberry Pi and image processing techniques for real-time traffic signal detection. The system successfully integrates video acquisition, HSV-based color segmentation, and decision logic to automatically activate braking when a red signal is detected.

The proposed system achieved a detection accuracy of 94% with an average response time of 0.3 seconds, demonstrating its effectiveness for real-time applications. The use of lightweight image processing techniques eliminates the need for expensive hardware and complex deep learning models, making the system suitable for cost-sensitive environments.

Although the system performs well under normal conditions, its performance is affected by extreme lighting and weather conditions. Future improvements can include integrating deep learning methods and sensor fusion techniques to enhance reliability and robustness.

Overall, the system provides a practical and scalable solution for improving road safety and contributes toward the development of intelligent transportation systems.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to AMC Engineering College for providing the necessary support, facilities, and guidance to carry out this research work successfully.

REFERENCES

1. Haque, M. A., Rahnuma, A., Hasan, M. S., & Rahman, R. (2005). Automatic speed controlling of electric vehicle using image processing and MATLAB. *IATSS Research, 29*(2), 71–73.
2. Lopez-Montiel, M., Orozco-Rosas, U., Sanchez-Adame, M., Picos, K., & Montiel Ross, O. H. (2021). Evaluation method of deep learning based embedded systems for traffic sign detection. *IEEE Access, 9*, 94985–94997.
3. Hasanujjaman, M., Chowdhury, M. Z., & Jang, Y. M. (2023). Sensor fusion in autonomous vehicle with traffic surveillance camera system: Detection, localization, and AI networking. *Sensors, 23*(6), Article 3335. https://doi.org/10.3390/s23063335
4. Prashar, D., & Goyal, R. (2021). Automatic brake assist during traffic light/sign detection. *International Research Journal of Engineering and Technology (IRJET), 8*(2), 945–948.
5. Bao, C., Chen, C., Kui, H., & Wang, X. (2019). Safe driving at traffic lights: An image recognition based approach. In *Proceedings of the IEEE International Conference on Mobile Data Management* (pp. 112–117).
6. Wang, J.-G., & Zhou, L.-B. (2020). Traffic light and vehicle signal recognition with high dynamic range imaging and deep learning. In *Studies in Computational Intelligence* (Vol. 820, pp. 1341–1352). Springer.
7. Gautam, S., & Kumar, A. (2023). Image-based

automatic traffic lights detection system for autonomous cars: A review. *Multimedia Tools and Applications, 82*(17), 26135–26182.

8. Mortazavi Azad, S. M., & Ramazani, A. (2023). Smart control of traffic lights based on traffic density in the multi-intersection network by using Q-learning. *Discovery Artificial Intelligence, 3*, Article 39.
9. Choi, J., & Lee, H. (2024). Traffic light recognition using deep learning for autonomous vehicles. *Electronics, 13*(3), Article 615. https://doi.org/10.3390/electronics13030615
10. Kandasamy, K., Natarajan, B. Y., Yusuf Ali, B. A. A., & Preethaa, K. R. S. (2024). Traffic light detection for autonomous vehicles using deep learning techniques. *Neural Processing Letters, 56*(3), 1–16.
11. Hirabayashi, M., Sujiwo, A., Monrroy, A., Kato, S., & Edahiro, M. (2019). Traffic light mapping and recognition using high-resolution camera for autonomous driving. *Robotics and Autonomous Systems, 111*, 62–72.
12. Díaz-Cabrera, M., Cerri, P., & Medici, P. (2015). Robust real-time traffic light detection and classification. *Expert Systems with Applications, 42*(8), 2725–2735.
13. Schwiegelshohn, U., et al. (2015). High-speed FPGA implementation for traffic sign recognition. In *Proceedings of the IEEE International Conference on Intelligent Transportation Systems* (pp. 2341–2345).
14. Philipsen, M. P., Moeslund, T. B., Møgelmose, A., & Trivedi, M. M. (2015). Traffic light detection: A learning algorithm and evaluation on challenging dataset. In *Proceedings of the IEEE International Conference on Intelligent Transportation Systems* (pp. 2341–2345).
15. Deshpande, A. V., & Subashini, M. M. (2013). A survey of different image processing methods for the design and development of an efficient traffic sign board recognition system. *International Journal of Computer Applications, 70*(7), 1–5.

***Corresponding Author:** Sudeep K