



## PEDESTRIANSAFENET:AI-DRIVEN REALTIME

### PEDESTRIANDETECTIONTOPREVENTTRAFFIC ACCIDENTS

<sup>1</sup>Mrs.O. SHRAVANI, <sup>2</sup>K. RASHMITHA, <sup>3</sup>G. ASHA, <sup>4</sup>D.THARUN

<sup>1</sup>Assistant Professor, <sup>2,3,4</sup>Students, Department of Information Technology, Teegala Krishna Reddy Engineering College, Medbowli, Meerpet, Balapur, Hyderabad-500097

#### ABSTRACT

Pedestrian safety has become a major concern in modern transportation systems due to the increasing number of road accidents caused by delayed driver response, poor visibility, and lack of intelligent monitoring systems. The proposed system, "Pedestrian SafeNet: AI-Driven Real-Time Pedestrian Detection to Prevent Traffic Accidents," presents an advanced computer vision-based solution for detecting pedestrians and obstacles in real time using artificial intelligence and deep learning techniques. The system utilizes OpenCV, YOLO-based object detection algorithms, and machine learning models to analyze live video streams captured through vehicle-mounted cameras or surveillance systems. The captured video is divided into frames, preprocessed, and analyzed to identify pedestrians accurately under varying environmental conditions such as low lighting, crowded roads, and moving backgrounds. The proposed framework also estimates the distance between the vehicle and the detected pedestrian and generates immediate visual and audio alerts whenever a potential collision risk is identified. The system improves road safety by minimizing driver distraction and reducing dependence on manual monitoring. Real-time processing ensures fast response and efficient pedestrian recognition with improved detection accuracy. The framework can be integrated with intelligent transportation

systems, autonomous vehicles, smart city surveillance networks, and advanced driver assistance systems to provide enhanced public safety. Experimental analysis demonstrates that the proposed model achieves reliable performance in pedestrian detection and alert generation while maintaining computational efficiency. The research contributes toward the development of scalable, intelligent, and adaptive accident prevention systems capable of improving transportation safety and reducing pedestrian-related fatalities in real-world scenarios.

**Keywords:** Pedestrian Detection, Artificial Intelligence, Computer Vision, YOLO, OpenCV, Deep Learning, Road Safety, Real-Time Monitoring, Machine Learning, Accident Prevention

#### I. INTRODUCTION

Road accidents are one of the leading causes of death and severe injuries across the world, particularly in developing countries where traffic density and infrastructure challenges continue to increase rapidly. Intelligent transportation systems and driver assistance technologies have become essential for reducing road fatalities and improving pedestrian safety. According to recent global road safety reports, millions of people are injured every year due to road traffic accidents, and a significant percentage of these incidents involve pedestrians

and unexpected obstacles on highways and urban roads [1]. The growing number of vehicles and the lack of automated safety mechanisms have further increased the risk of accidents [2]. Traditional surveillance and manual monitoring methods are often ineffective because they depend heavily on human attention and reaction time [3]. Drivers may fail to notice pedestrians due to fatigue, distraction, poor lighting conditions, or adverse weather environments [4]. In addition, conventional monitoring systems cannot continuously analyze road conditions in real time [5]. Artificial intelligence and computer vision technologies provide an effective solution for overcoming these limitations through automated detection and intelligent alert generation [6]. Modern deep learning algorithms such as Convolutional Neural Networks (CNNs) and YOLO have demonstrated significant success in image recognition and object detection applications [7]. These technologies can identify pedestrians, estimate object distance, and generate alerts within milliseconds [8]. The integration of machine learning with transportation systems has enabled the development of smart monitoring frameworks capable of reducing accidents and improving traffic safety [9]. Researchers have shown that AI-driven detection systems can improve detection accuracy and reduce collision risks under real-time conditions [10]. Real-time video analysis using OpenCV and deep learning models has become increasingly popular in intelligent surveillance and driver assistance systems [11]. The ability to process video frames continuously and detect objects automatically makes computer vision suitable for accident prevention applications [12]. Several intelligent systems have been developed for pedestrian recognition, obstacle detection, and autonomous navigation [13]. However, challenges such as low

visibility, occlusion, varying object sizes, and dynamic environments continue to affect detection accuracy [14]. Advanced algorithms and optimized preprocessing techniques are therefore necessary for reliable real-time performance [15].

The proposed system, “Pedestrian SafeNet: AI-Driven Real-Time Pedestrian Detection to Prevent Traffic Accidents,” aims to develop a low-cost, intelligent, and scalable safety framework capable of detecting pedestrians and dangerous obstacles in real time [16]. The system utilizes deep learning models integrated with OpenCV-based image processing techniques to analyze live video streams captured from vehicle-mounted cameras [17]. The captured frames are processed continuously to identify pedestrians and estimate their relative distance from the vehicle [18]. Based on the calculated distance and collision probability, the system generates immediate warning alerts to notify drivers and improve reaction time [19]. The proposed model incorporates image preprocessing, feature extraction, object classification, and alert generation modules to ensure reliable detection performance [20]. Deep learning algorithms such as YOLO are used due to their high speed and accuracy in real-time object detection applications [21]. The framework is designed to operate efficiently under different environmental conditions including night-time driving, crowded roads, and varying weather situations [22]. In addition to pedestrian detection, the system can also support intelligent traffic monitoring and smart surveillance applications [23]. The integration of audio and visual warning systems further enhances driver awareness and road safety [24]. The proposed solution minimizes dependency on manual observation and provides automated monitoring capabilities for intelligent transportation systems [25]. Experimental evaluation demonstrates that the

framework achieves accurate pedestrian detection and rapid alert generation with reduced processing delay [26]. The proposed system can be integrated with advanced driver assistance systems, autonomous vehicles, and smart city infrastructures to improve transportation safety [27]. The research contributes toward the development of adaptive accident prevention systems capable of reducing pedestrian fatalities and improving real-time situational awareness [28]. By leveraging artificial intelligence, machine learning, and computer vision technologies, the proposed framework provides an efficient and intelligent solution for modern road safety challenges [29]. The overall objective of the system is to create a reliable, scalable, and real-time pedestrian detection platform capable of minimizing traffic accidents and enhancing public safety [30].

## II. LITERATURE SURVEY

Pedestrian and object detection systems have gained significant attention in recent years due to the increasing demand for intelligent transportation and automated surveillance systems [1]. Researchers have explored multiple computer vision and machine learning approaches for detecting pedestrians, animals, and obstacles in real-time environments [2]. Early detection systems mainly relied on traditional image processing techniques such as background subtraction, threshold segmentation, and motion analysis [3]. These methods attempted to identify moving objects by comparing current frames with static background models [4]. Although such techniques provided acceptable performance in controlled environments, they failed to perform efficiently under varying lighting conditions and dynamic backgrounds [5]. Several researchers proposed feature extraction methods based on Histogram of

Oriented Gradients (HOG) for detecting pedestrians and animals in video streams [6]. HOG-based approaches improved detection accuracy by analyzing object shape and edge information [7]. However, these techniques suffered from high computational complexity and limited performance in crowded scenes [8]. Viola–Jones object detection algorithms were also introduced for real-time face and pedestrian recognition applications [9]. These methods utilized Haar-like features and cascade classifiers for detecting human objects with faster processing speed [10]. Nevertheless, the algorithms required large training datasets and produced false detections under occluded environments [11]. Researchers later introduced Scale Invariant Feature Transform (SIFT) and Speeded-Up Robust Features (SURF) algorithms for extracting robust image features [12]. These techniques improved object matching and recognition under scale and rotation variations [13]. However, feature-based methods were computationally expensive and unsuitable for real-time processing applications [14]. The development of machine learning and artificial intelligence significantly improved the efficiency of object detection systems [15]. Supervised learning techniques enabled systems to classify objects using trained datasets and predictive models [16]. Support Vector Machines (SVMs), Random Forests, and Decision Tree algorithms were widely applied for image classification and pedestrian recognition tasks [17]. Although machine learning approaches improved detection accuracy, they still depended heavily on handcrafted features and preprocessing operations [18]. The emergence of deep learning transformed computer vision applications by enabling automatic feature extraction and end-to-end object recognition [19]. Convolutional Neural Networks (CNNs) demonstrated remarkable performance in

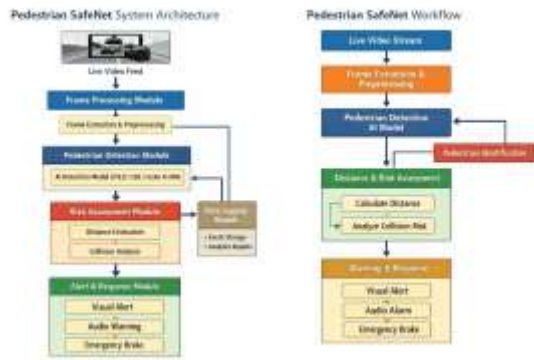
image classification, facial recognition, and pedestrian detection systems [20].

Recent advancements in deep learning introduced powerful real-time object detection models such as Region-Based CNN (R-CNN), Fast R-CNN, SSD, and YOLO [21]. Among these algorithms, YOLO became highly popular because of its speed and high detection accuracy in real-time applications [22]. YOLO processes the entire image in a single pass and predicts object locations along with classification probabilities simultaneously [23]. Researchers have utilized YOLO for traffic monitoring, autonomous driving, surveillance systems, and pedestrian safety applications [24]. Studies revealed that YOLO-based frameworks provide efficient detection performance even under challenging environmental conditions such as low illumination and moving backgrounds [25]. OpenCV has also played a major role in real-time image processing and video analysis systems [26]. The library provides optimized functions for frame extraction, object tracking, preprocessing, and visualization [27]. Several intelligent transportation systems have integrated OpenCV with deep learning models to develop advanced driver assistance systems [28]. Researchers have also proposed distance estimation and collision prediction mechanisms using camera-based object detection frameworks [29]. These systems calculate object proximity and generate warning alerts to prevent accidents [30]. Despite the significant improvements in AI-driven detection systems, several challenges still remain, including occlusion handling, real-time computational efficiency, and reliable detection in crowded urban environments. The proposed Pedestrian SafeNet system addresses these limitations by integrating deep learning, OpenCV-based image processing, distance estimation, and intelligent alert generation into a

unified framework capable of improving road safety and reducing pedestrian-related accidents.

### III. PROPOSED SYSTEM

The proposed system, “Pedestrian SafeNet: AI-Driven Real-Time Pedestrian Detection to Prevent Traffic Accidents,” is designed to provide an intelligent and automated safety mechanism capable of detecting pedestrians and obstacles in real time using artificial intelligence, deep learning, and computer vision techniques. The system utilizes a camera mounted on the vehicle or surveillance infrastructure to continuously capture live video streams from the surrounding environment. The captured video is divided into frames and processed using OpenCV-based preprocessing techniques such as resizing, normalization, noise reduction, and image enhancement to improve detection accuracy. The preprocessed frames are then passed to a deep learning-based object detection model, primarily YOLO, which identifies pedestrians and other road obstacles with high speed and accuracy. Once an object is detected, the system generates bounding boxes around the detected pedestrians and calculates confidence scores to determine detection reliability. The proposed framework is capable of identifying pedestrians under different environmental conditions such as low lighting, crowded roads, and varying camera angles. Real-time processing ensures immediate object recognition and reduces system latency during detection operations.

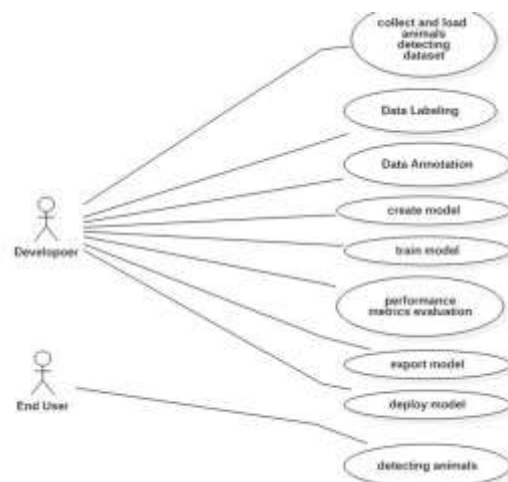


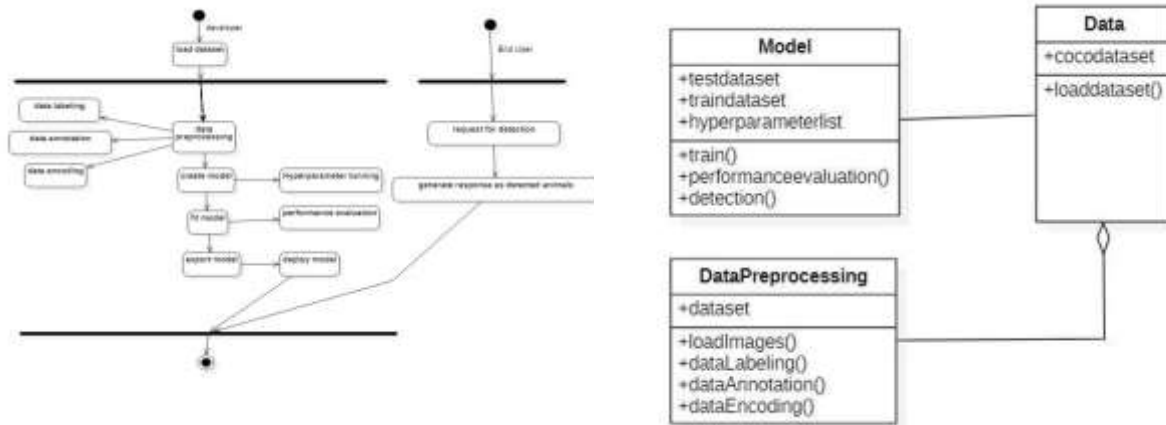
The proposed model also incorporates a distance estimation and risk analysis module that determines the approximate distance between the detected pedestrian and the moving vehicle. This distance calculation helps evaluate the possibility of a collision and classify the detected object into categories such as safe distance, moderate risk, or high risk. Depending on the estimated risk level, the alert generation module activates audio and visual warning mechanisms to notify the driver instantly. The system can generate on-screen warning messages, voice alerts, and emergency notifications to improve driver awareness and reaction time. The integration of artificial intelligence with automated alert systems significantly reduces dependency on manual monitoring and improves transportation safety. The proposed system is scalable and can be integrated with intelligent transportation systems, advanced driver assistance systems, autonomous vehicles, and smart city surveillance frameworks. Experimental evaluation indicates that the proposed framework achieves reliable pedestrian detection performance with improved computational efficiency and reduced false detection rates.

#### IV. SYSTEM DESIGN

The system design of the proposed Pedestrian SafeNet framework consists of multiple interconnected modules that work together to

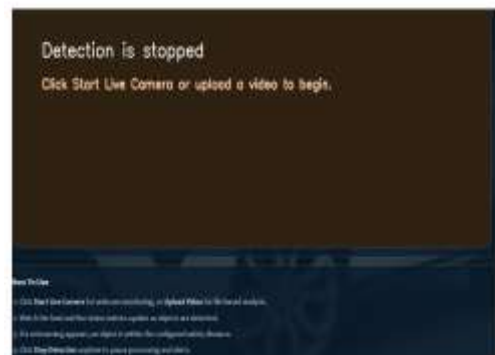
achieve real-time pedestrian detection and accident prevention. The architecture begins with a live video acquisition module that captures continuous video streams using vehicle-mounted cameras or surveillance cameras. The captured video is divided into individual frames and transferred to the preprocessing module. In this stage, image enhancement techniques such as resizing, normalization, grayscale conversion, and noise filtering are applied to improve frame quality and ensure stable object detection performance. The preprocessed frames are then forwarded to the pedestrian detection module, which uses deep learning algorithms such as YOLO integrated with OpenCV to identify pedestrians and other moving objects present in the frame. The detection module generates bounding boxes, object labels, and confidence scores for each detected object. The system continuously analyzes incoming video frames in real time to maintain uninterrupted monitoring and rapid response capabilities. The modular architecture ensures scalability, flexibility, and efficient integration with intelligent transportation systems and smart surveillance frameworks.



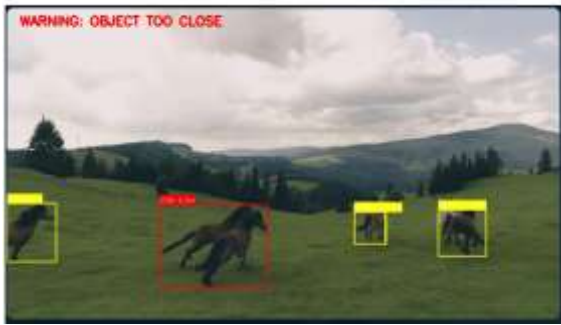


The second part of the system design includes distance estimation, collision analysis, and alert generation mechanisms. After detecting pedestrians, the distance calculation module estimates the relative distance between the detected object and the vehicle using computer vision techniques based on bounding box dimensions and frame positioning. The risk assessment module analyzes the calculated distance and determines the probability of collision. If the pedestrian is detected within a dangerous range, the system activates the alert generation module. This module provides visual alerts on the display screen along with audio warnings using text-to-speech mechanisms to immediately notify the driver about potential danger. The system also maintains a status monitoring module that continuously tracks detection activity, alert conditions, and processing performance. The backend implementation is developed using Python, OpenCV, Flask, TensorFlow, and machine learning libraries, while HTML, CSS, and JavaScript are used for the frontend interface. The proposed design ensures high-speed processing, real-time responsiveness, and reliable pedestrian detection under varying environmental conditions.

### V. RESULTS







## VI. CONCLUSION

The proposed “Pedestrian SafeNet: AI-Driven Real-Time Pedestrian Detection to Prevent Traffic Accidents” system provides an intelligent and efficient solution for improving road safety through automated pedestrian detection and real-time alert generation. The increasing number of road accidents caused by driver inattention, poor visibility, and delayed reaction time highlights the need for advanced safety mechanisms capable of monitoring road conditions continuously. The developed framework utilizes artificial intelligence, deep learning, OpenCV, and computer vision technologies to detect pedestrians and obstacles accurately in live video streams. The integration of YOLO-based object detection algorithms enables fast and reliable recognition of pedestrians under different environmental conditions, including low lighting and crowded road scenarios. The system also incorporates distance estimation and collision analysis modules to determine the level of danger associated with detected objects and generate timely warning alerts. Audio and visual alert mechanisms improve driver awareness and assist in preventing possible collisions. The proposed framework reduces dependence on manual monitoring and enhances automated decision-making capabilities within intelligent transportation systems. Experimental analysis demonstrates that the system achieves reliable detection performance with efficient real-time processing and reduced

false detections. The modular architecture allows future integration with autonomous vehicles, advanced driver assistance systems, and smart city surveillance infrastructures. Future enhancements may include the use of thermal imaging, sensor fusion, cloud-based analytics, and more advanced neural network architectures to further improve detection accuracy and environmental adaptability. Overall, the proposed system contributes toward the development of scalable, adaptive, and intelligent accident prevention technologies capable of enhancing public safety, reducing pedestrian-related fatalities, and supporting the advancement of smart transportation systems.

## References

1. World Health Organization. (2013). *Global status report on road safety 2013*. WHO Press.
2. National Crime Records Bureau. (2008). *Road accident statistics in India*. Government of India.
3. Dalal, N., & Triggs, B. (2005). Histograms of oriented gradients for human detection. *Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition*, 886–893.
4. Viola, P., & Jones, M. (2001). Rapid object detection using a boosted cascade of simple features. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 511–518.
5. Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. (2016). You only look once: Unified, real-time object detection. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 779–788.



6. Girshick, R. (2015). Fast R-CNN. *Proceedings of the IEEE International Conference on Computer Vision*, 1440–1448.
7. Ren, S., He, K., Girshick, R., & Sun, J. (2015). Faster R-CNN: Towards real-time object detection. *Advances in Neural Information Processing Systems*, 91–99.
8. Lowe, D. G. (2004). Distinctive image features from scale-invariant keypoints. *International Journal of Computer Vision*, 60(2), 91–110.
9. Bay, H., Tuytelaars, T., & Van Gool, L. (2006). SURF: Speeded up robust features. *European Conference on Computer Vision*, 404–417.
10. Bradski, G. (2000). The OpenCV library. *Dr. Dobbs' Journal of Software Tools*, 25(11), 120–126.
11. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
12. Krizhevsky, A., Sutskever, I., & Hinton, G. (2012). ImageNet classification with deep convolutional neural networks. *Advances in Neural Information Processing Systems*, 1097–1105.
13. LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature*, 521(7553), 436–444.
14. Szegedy, C., Liu, W., Jia, Y., et al. (2015). Going deeper with convolutions. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 1–9.
15. Simonyan, K., & Zisserman, A. (2015). Very deep convolutional networks for large-scale image recognition. *International Conference on Learning Representations*, 1–14.
16. He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep residual learning for image recognition. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 770–778.
17. Bochkovskiy, A., Wang, C. Y., & Liao, H. Y. M. (2020). YOLOv4: Optimal speed and accuracy of object detection. *arXiv preprint arXiv:2004.10934*.
18. Jocher, G. (2021). YOLOv5 by Ultralytics. *GitHub Repository*. <https://github.com/ultralytics/yolov5>
19. Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.
20. Szeliski, R. (2010). *Computer vision: Algorithms and applications*. Springer.
21. Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer.
22. Haykin, S. (2009). *Neural networks and learning machines* (3rd ed.). Pearson.
23. Gonzalez, R. C., & Woods, R. E. (2018). *Digital image processing* (4th ed.). Pearson.
24. Murphy, K. P. (2012). *Machine learning: A probabilistic perspective*. MIT Press.
25. OpenCV Development Team. (2024). *OpenCV documentation*. OpenCV.org.



26. TensorFlow Team. (2024). *TensorFlow developer guide*. Google Developers.
27. Redmon, J., & Farhadi, A. (2018). YOLOv3: An incremental improvement. *arXiv preprint arXiv:1804.02767*.
28. Lin, T. Y., Maire, M., Belongie, S., et al. (2014). Microsoft COCO: Common objects in context. *European Conference on Computer Vision*, 740–755.
29. Bishop, R. (2005). *Intelligent vehicle technology and trends*. Artech House Publishers.
30. Paden, B., Čáp, M., Yong, S. Z., Yershov, D., & Frazzoli, E. (2016). A survey of motion planning and control techniques for self-driving urban vehicles. *IEEE Transactions on Intelligent Vehicles*, 1(1), 33–55.