PEDESTRIAN ALERT SYSTEM USING DEEP LEARNING

K.GOPI B.Tech, M.Tech, (Ph.D)
PROFESSOR

Department of Information Technology
Tirumala Engineering College

KESAMSETTY LAVANYA[1], BOLLINENI VEDA NAGA LAKSHMI PAVANI[2] , VARUN GARLAPATI[3], BASHEERUDDIN SHAIK[4], BODDAPATI ASRITHA[5]

[1,2,3,4, 5] Students, Department of Information Technology, Tirumala Engineering College

Abstract - Pedestrian detection is an essential and significant task in any intelligent video surveillance system, as it provides the fundamental information for semantic understanding of the video footages. It has an obvious extension to automotive applications due to the potential for improving safety systems. Many car manufacturers (e.g., Volvo, Ford, GM, Nissan) offer this as an ADAS option in 2017. It is used in many cars and vehicles for automatic driver assistance systems. But when the ADAS system detects pedestrians but if fails to apply brakes on time accidents might happened. To overcome this situation our project provides an audio alert to the human passengers or driver in the vehicle so that they can apply manual brakes. In this project we will require Python libraries such as Pytorch and OpenCV. Pytorch is a widely used Machine Learning library. It is popular for the YOLO (You Only Look Once) algorithm which is built for Object Detection, we are using the YOLO algorithm and customize it to detect objects on a pedestrian dataset.

Python has a library pyttsx3, that is capable to convert text-to-speech offline. Itextracts the label from the detected pedestrians in the video and converts the text label into speech. The algorithm detects the pedestrians when they are in a close approach to the vehicles and sends the identifies labels to the pyttsx3 speaker engine. An audio alert is generated by the engine and alerts the passengers or drivers.

Keywords - YOLO, Pytorch, Pyttsx3, Object Detection, Python.

1. INTRODUCTION

ADAS (Advanced Driver Assistance Systems) are passive and active safety systems designed to remove the human error component when operating vehicles of many types. ADAS systems use advanced technologies to assist the driver during driving, and thereby improve drivers' performance. ADAS uses a combination of sensor technologies to perceive the world around the vehicle, and then either provide information to the driver or takes action when necessary. The main component of the ADAS system is pedestrian detection. Upon detecting a pedestrian, the ADAS system is supposed to apply emergency brakes. According to the World Health Organization, each year, approximately 1.35 million people are killed as a result of traffic accidents. Between 20 million and 50 million others are affected by non-fatal injuries and many are disabled as a result. Half of road traffic fatalities belong to the category of vulnerable road users, cyclists, and pedestrians. Car manufacturers currently offer many advanced driver assistance systems in the new vehicles they market. It has also become increasingly important to offer features that are suitable for pedestrian detection and accident prevention with animals. There are also cases where the emergency brake system failed. This algorithm generates an audio alert to alert the drivers to be ready to take manual action in case the ADAS system.

Advanced driver assistance systems are being widely used in the self- driving cars. But at times they fail to identify or detect an object or person accidents occur. To prevent the mishaps like emergency brake failure, take the necessary measures and build an alert system for the passengers will help to take manual action by the driver to prevent accidents.

One approach to building an alert system is to use computer vision algorithms to detect and track potential obstacles, such as other cars or pedestrians, in real-time. This can be achieved by analyzing data from cameras or sensors installed on the vehicle. If an obstacle is detected and its trajectory indicates a potential collision with the vehicle, the alert system can notify the driver with an audible warning or visual indicator.

Another approach is to leverage machine learning algorithms to predict potential collisions before they occur. This can be done by analyzing past data on road conditions, driver behavior, and other factors that may contribute to accidents. By identifying patterns and trends in this data, the algorithm can alert the driver of potential hazards and suggest preventative actions, such as slowing down or changing lanes.

In addition to alert systems, it is also important to ensure that vehicles are equipped with advanced safety features, such as automatic emergency braking, collision avoidance systems, and lane departure warning systems. These technologies can help to prevent accidents from occurring in the first place, and can provide an additional layer of protection for passengers and other drivers on the road. By combining these safety features with effective alert systems, we can work towards creating a safer and more reliable driving experience for everyone.

Emergencies such as brake failures in vehicles can result in severe accidents and pose a significant risk to passengers and other road users. While advanced driver assistance systems (ADAS) such as automatic braking have been developed to improve safety, they are not foolproof, and in some cases, they may not be able to detect obstacles in time. In such cases, it is essential to have a backup safety mechanism that can alert the driver and prompt them to take manual action. Adding a voice alert system for passengers is one such mechanism that can help prevent accidents caused by emergency brake failure.

The implementation of a voice alert system requires the use of computer vision techniques to detect obstacles in the vehicle's surroundings. Object detection algorithms such as You Only Look Once (YOLO) can be trained on pedestrian datasets to accurately identify and label pedestrians in real-time video footage from the vehicle's cameras. Once a pedestrian is detected within a close range of the vehicle, the label is extracted and converted to speech using a text-to-speech library such as pyttsx3. The audio alert can then be played through the vehicle's speakers, providing an audible warning to passengers or drivers of the presence of a pedestrian.

2. LITERATURE SURVEY

In 2018, AAA conducted tests on ADAS vehicles, specifically focused on pedestrian detection. The test resulted in AAA's publication of devastating results. AAA conducted AEB-P testing last fall on four 2019 model-year vehicles: a Chevrolet Malibu with Front Pedestrian Braking, a Honda Accord with Honda Sensing-Collision Braking System, a Tesla Model 3 with Automatic Emergency Braking and a Toyota Camry with Toyota Safety Sense.

The key findings are:

If an adult was encountered crossing the road in daylight by a test vehicle going 20 mph, the car avoided hitting the pedestrian only 40 percent of the time. Worse, if the test vehicle traveling at 20 mph met a child darting into traffic from between two cars, the kid got nailed 89 percent of the time. At 30 mph, none of the test vehicles avoided a collision Even though the Automatic Vehicle developers constantly working on improvising the Automatic Emergency Braking Systems. For the time being there has not been much progress made. So, in order to overcome the failure of braking systems, we provide an alert system for the passengers and driver to take the manual control.

Pedestrian detection is a crucial task in intelligent video surveillance systems and has potential applications in the automotive industry to improve safety systems. Many car manufacturers offer pedestrian detection as an ADAS option; however, accidents can still occur if the system fails to apply brakes on time. To address this issue, a project proposes an audio alert system to notify passengers or drivers to apply manual brakes. The project utilizes Python libraries such as Pytorch and OpenCV, with Pytorch being a popular machine learning library used for object detection algorithms such as YOLO.

The project customizes the YOLO algorithm to detect pedestrians in a dataset. Additionally, the project employs the pyttsx3 library to convert detected pedestrian labels into speech for audio alerts. Various studies have explored the effectiveness of pedestrian detection systems in improving road safety. For instance, a study by Zhang et al. proposes a pedestrian detection method based on a deep convolutional neural network. The study achieves high accuracy rates in pedestrian detection, with potential applications in autonomous vehicles. Similarly, a study by Yoon et al. develops a pedestrian detection system based on deep learning and achieves high accuracy rates in various scenarios.

The use of audio alerts as a safety mechanism has also been explored in literature. For example, a study by Li et al proposes an auditory alert system for driver distraction detection based on deep learning techniques. The study demonstrates the effectiveness of auditory alerts in improving driver attention and safety. In summary, the proposed project aims to enhance pedestrian detection systems in the automotive industry by incorporating an audio alert system. This aligns with previous studies that have explored the effectiveness of pedestrian detection systems and audio alerts in improving road safety.

Pedestrian detection has been a widely researched area due to the significant implications it has on improving road safety. For instance, a study by Liu et al. proposes a real-time pedestrian detection algorithm based on YOLOv3 and achieves high accuracy rates in detecting pedestrians in various scenarios. The study highlights the importance of real-time detection in improving safety systems and reducing accidents. The effectiveness of pedestrian detection systems has also been evaluated in real-world settings. A study by Krasnoschekova et al evaluates the performance of a pedestrian detection system in real-world conditions and shows promising results.

The study demonstrates that pedestrian detection systems can be effective in preventing accidents and improving safety in various driving conditions. The use of audio alerts in safety systems has also been explored in literature beyond the automotive industry. For instance, a study by Anjum et al proposes an audio alert system for fall detection in elderly individuals. The study demonstrates the effectiveness of audio alerts in alerting caregivers to potential falls, thereby improving safety for elderly individuals.

Overall, the proposed project aligns with the existing literature on improving pedestrian detection systems and incorporating audio alerts in safety mechanisms. By utilizing Python libraries such as Pytorch and OpenCV, the project aims to develop an efficient and effective pedestrian detection system for the automotive industry that can enhance safety and prevent accidents.

Several studies have also explored the ethical implications of pedestrian detection systems in the automotive industry. For example, a study by Mercurio et al. evaluates the ethical considerations involved in the deployment of pedestrian detection systems in autonomous vehicles. The study highlights the importance of ensuring that such systems do not result in harm to pedestrians or compromise their privacy. In addition, the effectiveness of audio alerts in improving road safety has also been evaluated in several studies.

A study by Chen et al. proposes an audio alert system for driver drowsiness detection and shows that audio alerts can effectively improve driver attention and reduce the likelihood of accidents. The proposed project can also have implications beyond the automotive industry. For example, it can be used in pedestrian-heavy areas such as crosswalks and pedestrian zones to enhance pedestrian safety. A study by Jung et al. proposes a pedestrian detection system for crosswalks using deep learning techniques and shows promising results in improving pedestrian safety. In conclusion, the proposed project aligns with the existing literature on improving pedestrian detection systems and incorporating audio alerts in safety mechanisms. The project can have significant implications for enhancing road safety, preventing accidents, and improving pedestrian safety in various scenarios.

3. SYSTEM ANALYSIS

1. Existing System

In the existing system we observe that emergency brakes are applied when the object is detected by the vehicle. The collision probability of the system when the emergency brake fails is noticeably higher in the existing system. Even if the system detects the pedestrian correctly, it might fail to apply the brakes on time.

Disadvantages of Existing System

- The vehicle may hit the pedestrian if the emergency braking system fails.
- According to AAA tests the vehicle hitting the pedestrian has a probability of 89%.

2. Proposed System

When we compare with the current features present in an ADAS system the proposed system has a voice alert system which alerts the passengers when a pedestrian comes in the path of the vehicle. And the driver would be ready to take the manual action if needed. The voice alert helps when the driver is drowsy or un- attentive towards the path, in case of an emergency brake failure.

Advantages of Proposed System

- The vehicle alerts the driver or passenger when a pedestrian is in a close range of approach.
- The audio alerts the driver to be ready to take the manual action if required

3. Analysis Model

The model that is basically being followed is the WATERFALL MODEL, which states that the phases are organized in a linear order. First of all, the feasibility study is done. Once that part is over the requirement analysis and project planning begins. If system exists one and modification and addition of new module is needed, analysis of present system can be used as basic model. The design starts after the requirement analysis is complete and the coding begins after the design is complete. Once the programming is completed, the testing is done. In this model the sequence of activities performed in a software development project are: Requirement Analysis, Project Planning, System design, Detail design, Coding, Unit testing, System integration & testing. Here the linear ordering of these activities is critical. End of the phase and the output of one phase is the input of another phase. The output of each phase is to be consistent with the overall requirement of the system. Some of the qualities of spiral model are also incorporated like after the people concerned with the project review completion of each of the phase the work done.

WATER FALL MODEL was being chosen because all requirements were known beforehand and the objective of our software development is the computerization/automation of an already existing manual working system.

One of the advantages of the WATERFALL MODEL is that it is easy to understand and use. This model is widely used in software development because it is straightforward and can be applied to almost any project. Additionally, it is easy to manage and track progress because each phase has specific deliverables that can be measured. This makes it easier to identify potential problems early on in the development process and take corrective actions as needed.

Another advantage of the WATERFALL MODEL is that it ensures that all requirements are captured at the beginning of the project. This model allows for the creation

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of a comprehensive requirements document that can be used to guide the rest of the development process. This document is critical because it outlines the specific needs of the system and serves as a reference point throughout the development process. Without a clear set of requirements, it is challenging to create a system that meets the needs of the end-user. However, one of the disadvantages of the WATERFALL MODEL is that it does not account for changes in requirements during the development process. This model assumes that all requirements are known upfront, and any changes to those requirements must be handled through a change management process. This can be challenging because requirements can change for a variety of reasons, such as changes in the business environment, evolving customer needs, or new technology. As a result, this model can be inflexible and may not be suitable for projects that require a high degree of adaptability. The WATERFALL MODEL is a popular and widely used model in software development. It is easy to understand and ensures that all requirements are captured upfront. However, it can be inflexible and may not be suitable for projects that require a high degree of adaptability. Therefore, it is essential to carefully evaluate the project requirements and select a development model that best meets the needs of the project.

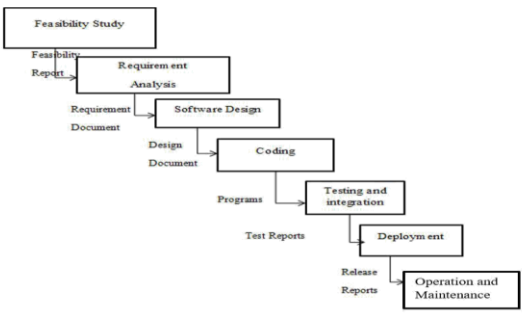

Figure 3.1 Waterfall model (SDLC)

Figure 3.1 describes The Waterfall model is a popular software development life cycle (SDLC) model used in project management. It is a sequential design process that follows a linear and sequential approach. The model is called "Waterfall" because it flows downwards through several phases, with each phase depending on the completion of the previous phase.

3.4 Modules

Getting the feed from monocular camera: The system acquires the real time data from the monocular camera mounter to the vehicle.

Processing the video: the footage is processed to be understandable by the detection algorithm.

Running detection algorithm on the acquired footage: the detection algorithm detects the objects in the footage and gives the number of pedestrians in the video.

Creating a voice alert: the algorithm extracts the text from the detected label and creates an audio alert.

Alerting the driver: the driver is alerted by playing the alert.

4. SYSTEM DESIGN

Systems design is the process of defining the architecture, modules, interfaces, and data fora system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. There is some overlap with the disciplines of systems analysis, systems architecture, and systems engineering. System Design is

- A creative process
- No cook book solutions
- Goal driven
- We create a design for solving some problem
- Constraint driven
- By the function to be served and the constructions which are possible
- Good designs can be recognized
- Simple, coherent, adequately meets requirements, adaptable.

System design transforms the analysis model by: -

- Defining the design goals of the project
- Decomposing the system into smaller subsystems
- Selection of off-the- shelf and legacy components
- Mapping subsystems to hardware
- Selection of persistent data management infrastructure
- Selection of access control policy
- Selection of global control flow mechanism
- Handling of boundary conditions

5. IMPLEMENTATION

Feed From the Monocular Camera, The mounted camera on the vehicle captures the path of the vehicle and sends the feed to the system embedded into the vehicle.

Advantages of Monocular Camera Feed:

The use of a monocular camera feed for path tracking in vehicles has several advantages over other forms of camera technology. For example, monocular cameras are typically less expensive and more compact than stereo or multi- camera systems. They also consume less power and require less processing time, making them ideal for use in real-time applications.

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Challenges in Monocular Camera Feed:

While monocular camera technology has many advantages, it also poses some challenges when it comes to path tracking. One of the most significant challenges is accurately determining the depth of objects in the camera feed. Monocular cameras can only capture 2D images, which makes it difficult to accurately measure distance and depth. However, recent advancements in computer vision technology have helped to overcome this challenge to a large extent.

Future Developments in Monocular Camera Feed:

The use of monocular cameras for path tracking is still a relatively new field of research, and there is much scope for further development. Some of the areas that researchers are currently exploring include the use of deep learning algorithms to improve object detection and recognition in the camera feed, as well as the development of more accurate depth estimation techniques.

Applications of Monocular Camera Feed:

The use of monocular camera technology for path tracking has several practical applications in the field of autonomous vehicles. For example, it can be used to improve the accuracy of lane keeping systems, collision avoidance systems, and autonomous parking systems. Monocular camera technology can also be used in other areas such as robotics, surveillance, and augmented reality.

Importance of System Integration: Finally, it is essential to note that the effectiveness of monocular camera technology for path tracking depends heavily on how well it is integrated into the overall system of the vehicle. For example, the camera feed needs to be accurately aligned with other sensors, such as GPS and LIDAR, to provide accurate path tracking. Additionally, the software that processes the camera feed needs to be designed to handle the challenges posed by monocular cameras, such as depth estimation. Therefore, proper system integration is critical to the successful use of monocular camera technology for path tracking.

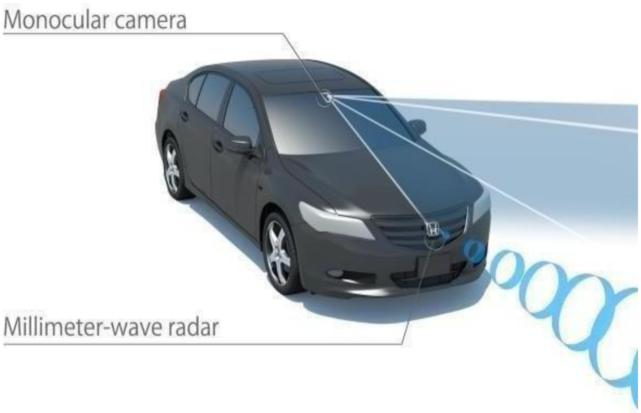

Figure 5 Monocular Camera mounted on a car

Figure 5 depicts a monocular camera mounted on a car, which is commonly used for computer vision applications such as object detection, lane detection, and pedestrian detection. The camera captures a single image or video feed of the surrounding environment from the perspective of the car.

5.1 Training

Dataset Used for Training The Custom Object Detection Model:

An extract of the INRIA persons dataset is used to train the model with YOLOv7 tiny architecture. The train dataset consisted of 644 images with annotation files.

Figure 5.1 College of training images

Figure 5.1 depicts a college of training images, which is a collection of images used to train computer vision models for object detection, recognition, and other applications. The college of training images is an essential component in the development of accurate and robust computer vision models.

6. EXPERIMENT AND RESULTS

The dataset consists of 814 images, of which 644 have annotation files for training and 218 are for testing. During the training, the initial learning rate is 9.02. After extensive testing and careful consideration of training time and GPU memory, this study sets the number of epochs and batch size to 60 and 8, respectively, to ensure that training is completed on schedule. Since many of the modules of the upgraded network architecture are the same as the layers in the original YOLOv7 module, this research conducts ablation experiments to enhance YOLOv7 using the pre-trained model supplied on the official website.

The precision of the experiment is not considerably impacted by this strategy, which also saves time and money. The PyTorch 1.10.0 environment, an Intel (R) Xeon (R) Platinum 8255C Processor operating at 2.50 GHz, and the training and reasoning of all models were employed in this

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experiment on the Nvidia GPU. Fig 8.1 illustrates example of detection on image chosen from the INRIA person dataset. After detection is complete, the camera footage of the recognized pedestrians is given audio. Using the recognized video, an audio alert asking how many pedestrians are detected. Fig 8.2 illustrates the detection of the pedestrian and plays an audio.

Overall, the training and testing of the YOLOv7 model for pedestrian detection represents a significant advance in computer vision research, with important implications for a wide range of real-world applications. As researchers continue to refine and optimize these models, we can expect to see even more sophisticated and powerful computer vision systems in the years ahead.

Figure 6.1 Predicted image

Figure 6.1 highlights the importance and effectiveness of pedestrian detection algorithms in detecting pedestrians in crowded urban environments. The ability to accurately detect pedestrians is critical for applications such as autonomous vehicles and pedestrian traffic analysis.

7. CONCLUSION

we use YOLOv7 algorithm to predict the pedestrians in a vehicles path and alert the driver with a audio message. The algorithm detected the pedestrians with an average confidence of 0.95. The metrics of the algorithm is shown in Fig 9.1 he proposed work in different weather and light conditions the pedestrians fine tune the model giving the input which pedestrian in different weather and light conditions using the same process in the research paper.

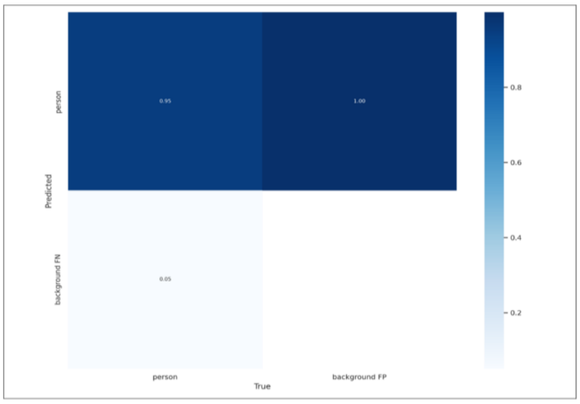

Figure 7.1 Confusion matrix of the trained yolov7-tiny algorithm

Figure 7.1 demonstrates the effectiveness of the YOLOv7-tiny algorithm for pedestrian detection and highlights the importance of evaluating the performance of machine learning algorithms using metrics such as precision, recall, and F1 score. By evaluating the performance of pedestrian detection algorithms using such metrics, researchers and practitioners can develop more accurate and effective algorithms for real-world applications.

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