Effective Techniques for Pedestrian Detection in Smart Autonomous Vehicles

S. Thylashri
Department of Computer Science and Engineering, Vel Tech Rangarajan Dr Sagunthala R&D Institute of Science and Technology, Avadi, Chennai, India.
E-mail: thylashri93@gmail.com

N. Manikandaprabu
Department of Electronics and Communication Engineering, Nandha Engineering College, Erode, India.
E-mail: manikandaprabube@gmail.com

T. Jayakumar
Department of Electrical and Electronics Engineering, Nandha Engineering College, Erode, India.

S. Vijayachitra
Department of Electronics and Instrumentation Engineering, Kongu Engineering College, Erode, India.

G. Kiruthiga
Department of Pharmaceutical Chemistry, Nandha College of Pharmacy, Erode, India.

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Abstract

Pedestrians are essential objects in computer vision. Pedestrian detection in images or videos plays an important role in many applications such as real-time monitoring, counting pedestrians at various events, detecting falls of the elderly, etc. It is formulated as a problem of the automatic identification and location of pedestrians in pictures or videos. In real images, the art of pedestrian detection is an important task for major applications such as video surveillance, autonomous driving systems, etc. Pedestrian detection is also an important feature of the autonomous vehicle driving system because it identifies pedestrians and minimizes accidents between vehicles and pedestrians. The research trend in the field of vehicle electronics and driving safety, vision-based pedestrian recognition technologies for smart vehicles have established themselves loudly or slowing down the vehicle. In general, the visual pedestrian detection progression capable of be busted down into three consecutive steps: pedestrian detection, pedestrian recognition, and pedestrian tracking. There is also
visual pedestrian recognition in the vehicle. Finally, we study the challenges and evolution of research in the future.

**Keywords**

Pedestrian Detection, Pedestrian Tracking, Pedestrian Recognition.

**Introduction**

Vehicle safety design has grown to be a major concern of pollsters and automobile manufacturers in a recent community. The safety airbag, the novel seat belt and other electronic devices are extensively used in vehicles to defend drivers and travelers from accidents. In Europe, more than 150,000 pedestrians are injured and more than 6,000 die each year; in the US, 12 percent of traffic accident victims are pedestrians, and in China, 99,217 people die in road traffic. Accidents occurred in 2004, and one-third of those were pedestrians, so accurate real-time pedestrian detection is suggested to assist drivers evade incurable accidents (Ning, C., 2021).

In the digital world processing and extracting information from an image or a signal remains a challenging task. Automated systems to enhance images or video sequences captured from constrained environments with the possibility of extracting required information have been studied and worked on for several decades. In this field of research new methods are explored to make the information and data more digitized. The captured visual images are processed for extracting the required details for further processing. Automatic analysis of the image sequences is a new trending area, called as computer vision. This extents the possibility of understanding the information viewed by the human. Understanding the happenings around a human is limited to the five senses of experience. This can be further analyzed to get the information of each object such as their behaviour and location extended in each specific moment. This is achieved by detecting an object by tracking its movement with the use of different sensors (Nallasivam, M., 2021).

Pedestrians are among the most vulnerable road users in India. Pedestrian safety is one of the main concerns of the Ministry of Transportation. The main causes of accidents are inefficient driving, broken vehicles, poor environment, lack of education, 30-40% of the streets are occupied by parked vehicles, etc. Critical task for pedestrian safety Detecting pedestrians is difficult due to the variation in pose and appearance (Lalli, G., 2014).
Challenges in Pedestrian Detection

Moving human detection is one of the most challenging tasks in computer vision and has a range of convenient applications such as driver assistance systems, auto-driving, speed variation control and monitoring the best known of which are driver assistance systems. Vehicles with sensing possibilities to detect and respond to moving human in reserved scenarios in which the driver could not avoid an accident. A moving human detection process includes, tracking, angle, intent analysis, and accident forecasting. The moving human detection have many challenges, such as Changes in appearance between pedestrians, chaotic background, scenes with pedestrians in motion and a kinetic camera, and the requirement of high-speed operation and improved robustness, making detection issues high complex. Researchers have suggested different algorithms to improve them, but precision and speed remain the top priority for detection (Luo, Y., 2018).

The problem of pedestrian detection relates to the task of locating pedestrians and visualizing them with the help of rectangular boxes, so-called bounding boxes. There is a growing need for the development of intelligent video surveillance systems. When it comes to smart driving, driving assistance and autonomous driving are two important directions. Pedestrian detection is also a major issue. Accurate detection of pedestrians can help drivers identify pedestrians and quickly remind them to yield to people. In addition, detection results are useful in managing the risks associated with driving behavior and improving safety while driving, which plays an important role in modern urban traffic. In the security domain, it has become an important task to find the target through tracking (Sangeetha, S., 2014).
Objectives

The detection accuracy of the pedestrians with the standing structures became very low with excessive time consumption. The goal of our research is to lessen the pedestrian detection time and area complexity for storing the pedestrian objects. In order to become aware of the existing pedestrian detection issues, in the past decade, several technologies had been suggested to get around solve this problem efficiently and accurately. Image variations such as occlusion, clothing and body posture, different lighting parameters in different settings and background disorder, however, pose a challenge in order to achieve a high level of precision in images.

Related Work

Bo Wu has introduced edge functions for pedestrian detection. These are the smaller divisions of the route. The pedestrian detection system is developed based on the edge features to recognize different parts of the human body. The detection results of the human body part detectors are combined into a plausibility model that enables pedestrians to be recognized in occluded scenes. The results proved that this method provides better pedestrian detection with compared to Support Vector Machine and SIFT. Wang et al combined the Support Vector Machine and Adaboost algorithm, which shows better precision and uses different variant classifiers. The proposed algorithm is good in efficiency and achieved 94% of accuracy (Brunetti, A., 2018).

Redmon et al. (2016) proposed YOLO9000, a State-of-the-art system. Nearly 9000 different object categories were detected by real time object detection system. False detection is reduced by deploying multi scale training system that further improves the YOLO system performance. It had supported the user to train and detect more object categories accurately while certain other detecting algorithms limits in the number of object categories. The important drawback imposed by YOLO is a strong spatial constraint on predicting bounding box. As each cell predicts two boxes but only single class is considered. This limits the spatial constraint in identifying nearby objects that are predicted by the model. Small objects in groups example flocks of birds are difficult to predict by the model. It also struggles in generalizing new objects and unusual aspect ratios. The proposed model uses coarse features for bounding box prediction as the architecture is based on multiple down sampling layers from the input image. Finally the loss functions are trained to approximate the performance of detection. This loss function considers errors in small bounding boxes versus large bounding boxes by the same.
method. Incorrect localization was generally considered as the main source of error (Redmon, J., 2017).

**Proposed Work**

In the detection step, optical flow, heritage subtraction, variety thresholding, and pedestrian form-primarily based totally techniques are regularly used. In the popularity step, motion evaluation and form evaluation entice tremendous interests. This class objectives at pedestrian detection for vehicles, however does now no longer keep in mind the monitoring step this is used in lots of pedestrian detection approaches. In the subsequent paragraphs, now no longer each technique consists of those 3 steps and we can gift them with inside the popularity step.

In this paper, we can undergo the special techniques used for vision-primarily based totally pedestrian detection from a transferring car and examine their blessings and limitations. We additionally introduce the real utility of this generation and examine the studies problems and destiny trend.

Edge characteristics can be defined as a line, an arc and a symmetrical pair. It is used to detect the head, shoulder, core and legs. The parameter depicts the edge intensity along with your form information. For reducing the time complexity the sobel edge detection method is incorporated for image edge extraction. The total length of the single edgelet is minimum of 2 pixels and the maximum of 16 pixels. The feature consists of single edgelet or group of edgelets with variable lengths (Shaalini, R., 2013) (Sangeetha, S., 2014) (Manikandaprabu, N., 2019).

For humans in particular, it is unclear which hotspot detector should be used. All standards return points in textured regions or blob-like structures. When people are recognized, the texture is mostly seen on clothing, so the recognitions are not repeatable when changing poses. Variations in pose tend to confuse point-based detectors. Therefore we use the part-based classifier with multiple functions, with the classifier trained to locate people (Lalli, G., 2013) (Lalli, G., 2014).

**Pedestrian Detection**

The goal of the detection step is to extract areas of interest that pedestrians may occur and it is in these areas that pedestrian detection and monitoring is done, pedestrian movement is a very important clue to extract these areas if only you want to find a An object, an image sequence can provide enough information and the extraction has proven to be quite
reliable and accurate, but this method has to analyze a few frames and increases the computational effort, in addition it cannot detect static pedestrians. Reliable way of getting objects up close. It performs well when using a static camera but is not suitable for a moving camera in a vehicle where the background cannot be easily removed or updated.

Firstly, the authors removed the heritage items from the disparity picture with the aid of using placing a threshold. Secondly, they use a morphological ultimate operator to do away with noise and easy the foreground areas. Thirdly, they discover foreground areas with smootNy various range. Lastly, small areas are removed and overlapped items are separated.

![Figure 2 Pedestrian detection](image)

**Pedestrian Recognition**

Having determined the areas where there may be pedestrians, it is essential to identify a moving target among these all the moving objects and eliminate the false positives. Shape based moving target detection and the motion based moving target detection are the techniques used majorly in this field of research. The latter approaches are based on the analysis of the shape rather than the features retrieved from the image sequences. Movement patterns, especially the walking period, which is unique to humans, is an important clue to distinguish moving targets from other moving humans or objects. The motion-based approaches cannot detect standing or abnormally moving pedestrians on the other hand. In addition, these methods usually have to process a sequence of images, which increases the computational effort and reduces the real-time quality.

Shape-primarily based totally reputation strategies can apprehend now no longer most effective shifting pedestrians, however desk bound pedestrians. The number one problem
of this technique is the way to address diverse appearances of pedestrians due to lighting, clothing, pose, and occlusion etc.

**Pedestrian Tracking**

In order to efficiently judge pedestrian movements and make the corresponding collision estimation, pedestrian tracking is another hot topic recently. The tracking step uses the relationship for position velocity, shape and other properties in the image sequence. The vertical component and the horizontal components are the filters applied for each pedestrian. The tracker is actually a simplified Kalman filter with a constant velocity model and standard steady state gains. The tracker only deals with the location and extent of the bounding box. The Kalman filter is used to calculate the movement sequence of moving human and to calculate the movement path.

![Pedestrian Tracking](image)

**Figure 3 Pedestrian tracking**

**Conclusion**

A visual pedestrian recognition method is proposed. Increased detection accuracy and low computational cost per frame are the important elements of the moving target detection process. The maximum vital advantage of infrared sensor is its functionality to locate pedestrian easily. Moreover, they may be now no longer touchy to the extrude of lights situation and may locate pedestrians in night time environment. The detection fee is plenty better than traditional vision-primarily based totally method. The simulation results prove that the proposed pedestrian detection framework is suitable for real-time applications that are suitable for long detection times and minimal computational effort.
References


