International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)
doi : https://doi.org/10.32628/IJSRSET22937

OpenCV Based Automatic Detection of Pedestrian Crossing Platform Using Congestion Monitoring - A Survey

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Article Info
Volume 9, Issue 3

Page Number : 52-57

Publication Issue :
May-June-2022

Article History
Accepted : 01 May 2022
Published: 07 May 2022

ABSTRACT

Road traffic congestion and pedestrian accidents are one of the major issues being faced worldwide. The reasons behind these accidents are mainly due to the risk when crossing or walking on road in urban and rural areas under heavy traffic. In order to avoid such circumstances a new idea is proposed- "Automatic uplifting of pedestrian crossing platform using traffic congestion monitoring". The pedestrian and traffic congestion is constantly monitored using an IR (Infrared) sensor module. At the time when pedestrian density is more, the traffic signal turns red for the vehicles and let the pedestrian walk through uplifted crossing platform. The proposed system consists of motorized platform placed on the zebra crossing line which automatically uplifts when the infrared sensor senses and count the crowded pedestrians at the signal point. This method ensures safety in pedestrian crossing and will also not let drivers to break the rules, which may lead to accidents

Keywords : Infrared, Traffic Congestion Monitoring, Automatic Uplifting

I. INTRODUCTION

Every year pedestrian fatalities constitute around 12 percent of all traffic fatalities causing approximately 4,000 deaths and 59,000 injuries. The fatalities are more frequent in urban areas due to a higher volume of pedestrians than in rural areas. For safe accommodation of pedestrian and bicycle traffic, transportation planning requires an accurate estimate of the occupancy of walkways and bike lanes. Hiring human resources to count pedestrians at various locations at different times of the day over a long period is a cost-ineffective solution. The need to explore automated techniques that detect and count pedestrians stems from the following demands.

- Economical collection of data pertaining to bicycle and pedestrian traffic which is required for transportation planning.
- Alerting drivers to pedestrians in the vicinity of vehicles for accident avoidance.

A methodology ideal for alerting systems may not be suitable for estimating pedestrian volume. This thesis focuses on providing a cost- effective solution for pedestrian counting to aid transportation planning. The term pedestrian encompasses upright people, people in wheelchairs and people on skateboards. The objective of the thesis was to implement an automated system for efficient, economical and accurate collection of pedestrian and bicyclist traffic data. An

automated counting system can be deployed on a wide scale only if the system provides a pedestrian count with at least 85% accuracy.

Among the prevailing techniques, computer vision-based methods are suitable for counting with 85% accuracy. Two approaches are considered to detect and count pedestrians, a zone-based approach using an Auto scope camera and a vision-based shape detection approach using a low-cost camera. The first approach makes use of a traffic camera that is typically used for vehicle monitoring. The configuration of the inbuilt software is modified to suit pedestrian counting requirements. The vision-based shape detection approach scans for a pedestrian shape in an image and makes decisions based on advanced machine learning algorithms. The scope of the thesis includes an evaluation of the two approaches for pedestrian counting in terms of accuracy, cost and ease of deployment. Pedestrian detection presents challenges caused by human articulations and outdoor environmental conditions due to weather and lighting. It is very difficult to detect pedestrians in various poses, angles and clothing. Pedestrian traffic is highly irregular with movements in random directions and multiple entry and exit points in a frame. Occlusion, which refers to obscuration from view, presents a major challenge. The camera used to provide detection algorithm input should be mounted at a suitable height and angle to capture clear images of pedestrians. Variable lighting conditions, the presence of shadows and camera position should be considered during detection algorithm design.

II. Literature Survey

N. Diazet al. (2018), developed an autonomous traffc light system using PIR sensor and Raspberry Pi, based on the PIR sensor (passive infrared sensor) the microcontroller control lighting of the traffc intersection based on the times that programmed with Python code which sends a signal to the microcontroller when in the traffc light the PIR sensors detect IR radiation. The Raspberry pi was programmed using the Python, the structure built with several parts: Python Code, Circuit Schematic, simple design of the traffc light, and printed circuit board [1]. A. H. Akoum (2017), designed a system in which flter method was used, this method flter the image only show the vehicles and separate all waste, after that display the number of cars in the image. According to the number of boxes that detected around the vehicles it gives the number of vehicles, the web browser used as a graphical user interface, many future improvements can be used to the counting vehicles, tracking and detection system can be expanded to real-time live video [3].

M. M. Elkhatib and A. S. Alsamna (2019), designed a system consists of two part of implementation; frst, to control traffic light more effective using embedded system and image processing and second used wireless and Bluetooth connection from android application to control traffc light signals, using image processing and embedded system, the system capable to detect the number of vehicles simultaneously in each lane, the green light will be longer where there are more cars in one lane than the other, in this method as a system controller, they used Arduino and for detection and counting cars used C++ environment and OpenCV library [6].

El. H. Imad (2019), proposed some solutions such as machine learning, internet of things, and closed-circuit television system, the first step is determined the number of outgoing and incoming cars in the traffic light by installing sensors in the roads and collecting data from them, also there are other sensors installed on the roads to determine emergency cars (for example, ambulances, polices, etc.) also an agent installed at each traffic light, which collect data from sensors that installed in the roads of an traffic light a pan–tilt–zoom camera installed at each traffic light it

takes images of that roads and send them to the agent [7].

L. F. P. Oliveira et al. (2019), in their work developed a controller of traffic light and centralized it, able to communicate with other traffic lights through wireless network, it has been used magnetic IR sensors and digital camera to determine number of vehicles in that

lane of intersection, also several wireless sensors installed, it allows creating strategic plans to control traffic and synchronizes it and prioritizes certain traffic that has more vehicles and maintains stability, vehicle speed. Two control circuits designed, one for direct current lamps and the other for alternating current lamps, are designed to control the different types of traffic lights. Control the traffic light period, collect data from sensors, and communicate with the RF module for that microcontroller circuit have been used [8].

T. A. Kareem and M. K. Jabbar (2018), proposed the system which is consists of hardware and software part. The frst circular hardware part is a model which includes four lanes of a traffic light, also it has Global System for Mobile Communications (GSM) system. The lamps of the traffic light and GSM are connected to Arduino UNO. All signals that are coming from the GSM to software and converted to lamps of traffic lights are controlled by Arduino, second circular hardware part is same model of the first part except GSM it replaced with IR remote. The goal of their paper is to open the traffic light in the emergence cases, using GSM system and IR it control the closing and opening of the traffic light, designed for emergency vehicles, especially with ambulances by opening the traffic light in the lane which the ambulance came using IR system or GSM [9].

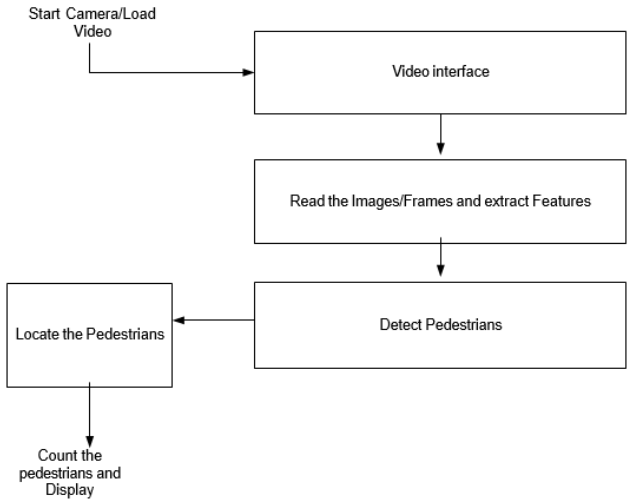
M. B. Natafgi et al. (2019), have used reinforcement learning to implement traffic light system and Lebanese traffic used as a real data for testing. It used a software simulation tool for testing and training. This tool can

simulate the traffic lane and interact with neural network. On the roads, the sensors installed to detect cars. The controller have used the data of sensors to calculate the number of vehicles and time delays in those traffic lights it saves that data every hour in the database. Q-learning has been used to train the network. The proposed system tested using the traffic simulator SUMO [10].

M. Z. Ismail et al. (2019), developed a system for traffic light for emergency cars to pass the traffic intersection where the traffic road jammed with long queue of cars and change traffic light from red to green. The main tools have been used are Arduino and sensors through Bluetooth. Sensors with Bluetooth are located at emergency car and at the traffic light the Arduino and Bluetooth are located. The controller is Arduino mega and Bluetooth module is HC-05. The advantage of this system is saving time when emergency car comes to the traffic then the traffic light will change the light to green [11].

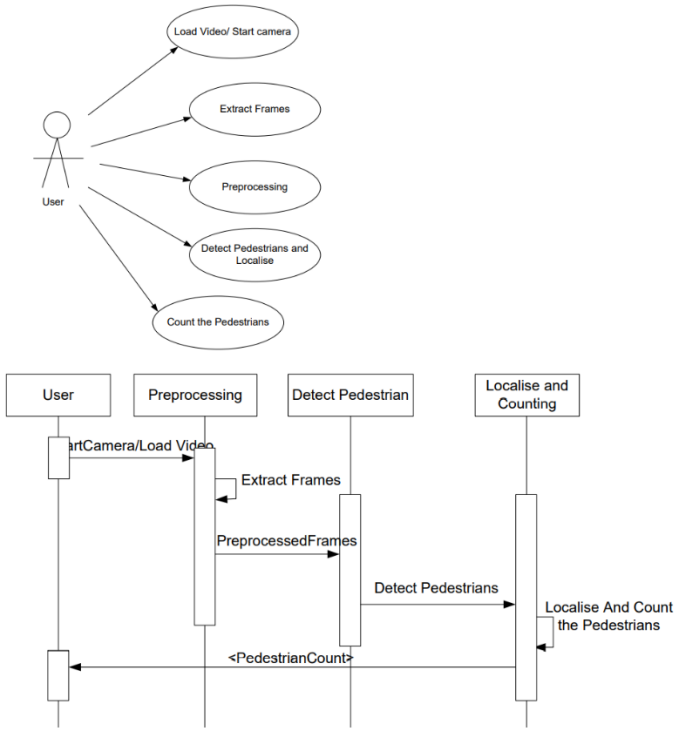
III. SYSTEM ARCHITECTURE

System architecture is the conceptual design that defines the structure and behaviour of a system. An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system. It defines the system components or building blocks and provides a plan from which products can be procured, and systems developed, that will work together to implement the overall system.



Use Case Diagram of The System

A use case diagram is a type of behavioral diagram created from a use case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases.



IV. SYSTEM METHODOLOGY

a) Existing System

Based on Candidate generation, the first step in pedestrian detection, involves the identification of potential pedestrians and the generation of candidates in the form of images. The earliest pedestrian identification techniques were Doppler Effect-based techniques, which involved signal wave transmission. Presently, most candidate generation techniques are based on computer vision and require the processing of pixelated images. Vision-based methods are appropriate for counting purposes since they address some of the disadvantages of Doppler Effect based techniques. The following sections outline the principles behind some candidate generation methods.

b) Proposed System

Proposed Work is to build a Pedestrian Detector for images and videos using OpenCV. Pedestrian detection is a very important area of research because it can enhance the functionality of a pedestrian protection system in Self Driving Cars.

We can extract features like head, two arms, two legs, etc, from an image of a human body and pass them to train a machine learning model. After training, the model can be used to detect and track humans in images and video streams. However, OpenCV has a built-in method to detect pedestrians. It has a pre-trained HOG (Histogram of Oriented Gradients) + Linear SVM model to detect pedestrians in images and video streams.

c) Algorithms Steps for work

1. Import necessary packages and define the model

To extract necessary data from the image we'll use the cv2.HOGDescriptor() method and set the descriptor object as HOGCV.

- Using setSVMDetector(cv2.HOGDescriptor_getDefaultPeopleDetector()) method we initialize hog detection object with svm detection for detecting people.

2. Reading images/frames and preprocess
- cv2.imread() function reads images from a given path.
- If image width is greater than defined max_width then apply imutils.resize() function to resize the image to defined max_width.

3. Detect Pedestrians
- detectMultiScale() detects the objects from the image and returns their x and y coordinate, height, and width.
- The winStride parameter indicates the step size in both the x and y location of the sliding window.
- The padding parameter indicates the number of pixels in both the x and y direction in which the sliding window ROI is "padded" prior to HOG feature extraction.
- The scale parameter controls the factor in which our image is resized at each layer of the image pyramid

4. Draw rectangles around each detection in the frame
- Count parameter tracks how many objects are detected
- Using the cv2.rectangle function we draw a bounding box around detected objects
- cv2.putText function draws a text string in the frame

5. Post-process output data to filter out the best results
- non_max_suppression is a function of the imutils package
- Here the argument overlapThresh=0.5 means if any bounding box overlaps other boxes more than 50% then the box will be removed

6. Detect real-time from Video
- First, create a VideoCapture object and set it as cap.
- You can replace "video.mp4" with your camera id (i.e 0) if you want to capture video from a webcam.
- In the while loop, we read all the frames from our capture object.
- And then we'll go through the same process we did until now.

V. RESULTS

In this Project we developed pedestrian detection system using opencv and python. We applied a HOG descriptor and linear Support Vector Machine algorithm to perform all the tasks.

VI. CONCLUSION

In this project we have developed pedestrian detection system using opencv and python. We applied a HOG descriptor and linear Support Vector Machine algorithm to perform all the tasks. And taking the video we detect the pedestrians and count them. Based on the threshold based on the pedestrian count we do control the signals.Further we can consider detecting the other objects which helps for the detection for various objects and get the count. And also we can include latest novel hybrid algorithms to improvise the performances.

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Cite this article as :

Kantharaju. V, Chandu Priya V, Kousalya S, Parvati, Nagaveni B C, "OpenCV Based Automatic Detection of Pedestrian Crossing Platform Using Congestion Monitoring - A Survey ", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Online ISSN : 2394-4099, Print ISSN : 2395-1990, Volume 9 Issue 3, pp. 52-57, May-June 2022. Available at doi : https://doi.org/10.32628/IJSRSET22937
Journal URL : https://ijsrset.com/IJSRSET22937