Accident Detection & Traffic Regulation Using Image Processing

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Abstract **- As the problem of urban traffic congestion spreads, there is a pressing need for the introduction of advanced technology and equipment to improve the state-of-the-art of traffic control. Traffic problems now-a-days are increasing because of the growing number of vehicles and the limited resources provided by current infrastructures. The simplest way for controlling a traffic light uses timer for each phase. Another way is to use electronic sensors in order to detect vehicles and produce signal that cycles.**

Proposed system control the traffic light by image processing. The system will detect vehicles through images instead of using electronic sensors embedded in the pavement. A camera will be installed alongside the traffic light. It will capture image sequences. The image sequence will then be analyzed using digital image processing for vehicle detection, and according to traffic conditions on the road traffic light can be controlled.

Index Terms **- Convolutional Neural Network, Traffic Signal Control, openCV, Image denoising; object detection;**

INTRODUCTION

Intersections tend to experience severe crashes due to the fact that several types of injurious crashes, such as angle and left turn collisions, commonly occur there. Therefore, accurate and prompt detection of accidents at intersections offers tremendous benefits of saving properties and lives and minimizing congestion and delay. Traffic accident detection employing computer vision and image processing on freeways has attracted much attention recently. Some focus on abnormal vehicle behaviors causing incidents (e.g., a traffic accident), traffic jams, fallen-down obstacles, etc. They propose a method that employs image-processing techniques and fuzzy theory to predict an incident before it happens. The judgment of whether an incident has happened or not is made using the "behavioral abnormality" of some continuous images. The experimental results obtained show that the proposed approach gives promising results when tested on two different datasets of damaged cars which differ based on the quality, distance of the camera from the object and number of objects in an image. The two datasets were compiled for the sake of the project from various sources. The proposed method can be extended to other vehicles as a part of future work.

The work done includes two contributions. The first contribution includes proposing a novel approach to automatic road accident detection. The second contribution includes a supervised learning method that detects damaged cars from static images, a class of object that has not been detected so far using the techniques of machine vision.

OBJECTIVES

1. To capture images & classify images to check vehicle density, detection of accident & emergency vehicle conditions.
2. To regulate the traffic signal according to above conditions.

PROPOSED WORK

1. Capture Images using USB Camera
2. Analysis of captured Images using different edge detection algorithms and object counting methods on Raspberry Pi platform using Python.
3. Calculate the vehicle density based on image processing techniques to detect vehicles.
4. Generate the traffic signal timings based on a threshold value of traffic using Raspberry Pi.
5. Generate the traffic signal to ensure emergency vehicles (Ambulance) can meander through gridlock roads.
6. Detection of accident & manage traffic signals accordingly.

BLOCK DIAGRAM

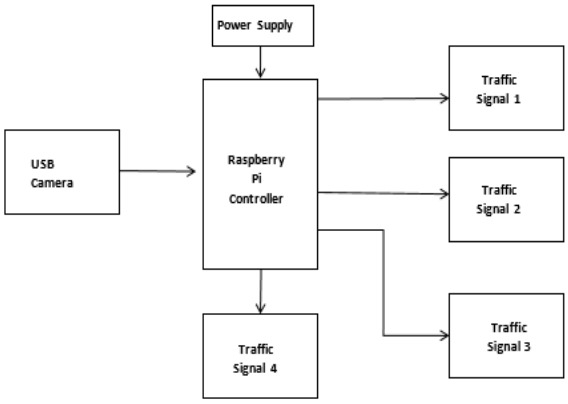


Fig 1. Block Diagram

OPERATION FLOW

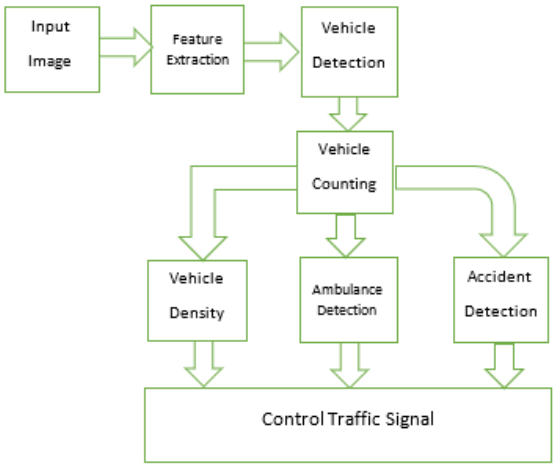


Fig 2. Operation Flow Diagram

DESCRIPTION:

Input Image

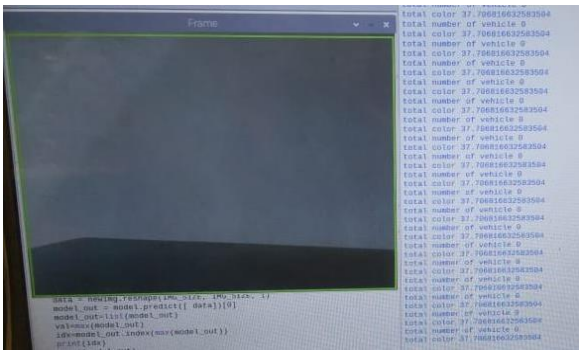
The input video will be reading by each and every frame. Thus by this the input dataset and if any frame in the video is been matched then the accident will be detected. The input video will run using python. Image processing is most commonly termed as 'Digital Image Processing' and the domain in which it is frequently used is 'Computer Vision'. Both Image Processing algorithms and Computer vision(CV) algorithms take an image as input; however, in image processing, the output is also an image, whereas in computer vision the output can be some features/information about the image.

Feature extraction

Features such as the position, area (size) of the MV are used for accident detection. Feature extraction is a type of dimensionality reduction where a large number of pixels of the image are efficiently represented in such a way that interesting parts of the image are captured effectively.

Vehicle detection

The vehicle detection is been detected by the trained data set . Thus if it identified if any vehicle passes through it, then it will be automatically check the trained data set that is the process is been match. If they are similar to each other than detected object is said to be a vehicle.



Image(1) when no vehicle: count will be vehicle 0.

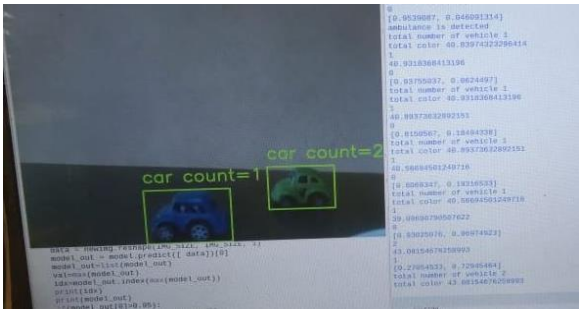


Image (2) when vehicles present: count will be vehicle1, vehicle2.

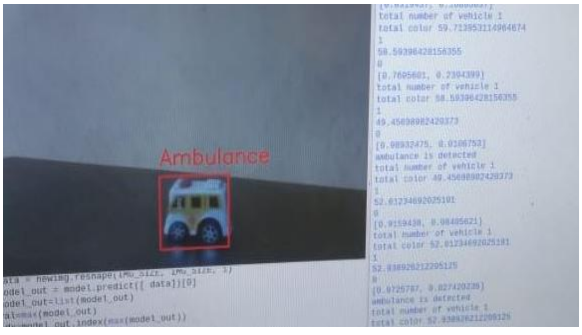


Image (3) when ambulance is present: count as vehicle1 but displays ambulance is detected.

Data analysis

In Machine Learning, Data Analysis is the process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information by informing conclusions and supporting decision making. Image analysis involves processing an image into fundamental components to extract meaningful information. Image analysis can include tasks such as finding shapes, detecting edges, removing noise, counting objects, and calculating statistics for texture analysis or image quality.

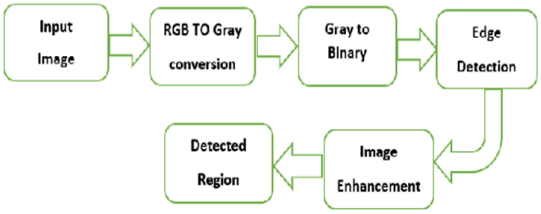


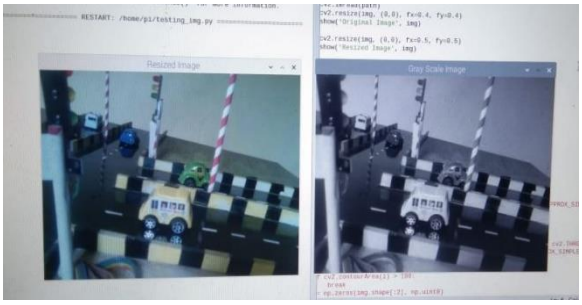
Fig 3. Image Processing Stages

Accident detection algorithm via image processing

Accident detection algorithm generally includes three steps: vehicle extraction, feature extraction of a moving vehicle (MV), and accident detection. Based on vehicle tracking results, we analyzed traffic images and detected the traffic accidents.

Vehicle extraction and tracking

Vehicles are extracted by detecting moving parts in each frame based on a difference equation. This process consists of taking the difference of two continuous frames, binarization, and horizontal and vertical projection, and then extracting parts which exceed the threshold value. For the extraction of moving regions in a video sequence, an input image, a pair of gray-level images, I_{k-1} (x, y) and I_k (x, y) acquired at successive time instants τ_{k-1} and τ_k , respectively. The output is the moving regions in which significant changes have been detected. For the extraction of moving regions, the difference image, $D(x, y)$ is computed: $D(x, y) = I_k(x, y) – I_{k-1}(x, y)$.



Image(4) : Resized image to Gray scale Image Conversion

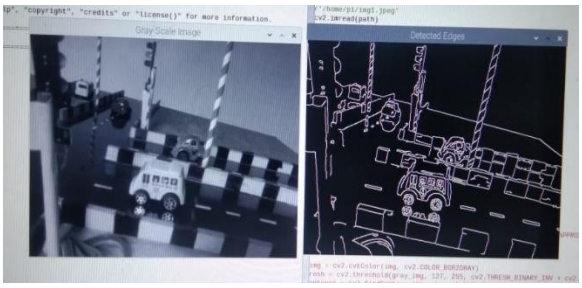


Image (5): Gray scale to Edge detected image

Variation rate of the position

Positions are useful descriptors of objects within images. An image that represents an object consists of positive- valued pixels that is set against a background of 0-valued pixels. Position refers to the location of the object in the plane. The objects centroid (or center of mass) is the point that is used to specify its position.

Variation rate of the area

Area is a commonly used descriptor for regions in the plane. Let R denote the region whose points have pixel value 1. One way to calculate the area (S) is simply to count the number of points in R. This can be accomplished with the image algebra statement S = Σ s. When the vehicle moves away from the camera, the size of the MV decreases, and as it moves towards the camera, the size of the MV increases; however, its variation rate is small. On the other hand, the accidents cause rapid change to the size of the MV. Therefore, we used the variation rate of area as a factor for traffic accident detection.

Accident Detection

The vehicle is detected by reading frames at multiple instances from camera to different variable frames using openCV and then with the help of Tensorflow detection application programming interface (api) these frames are processed and vehicle is detected. After the vehicle is detected its image is stored in different frame. And reading of framing at multiple instances from camera and then these frames are stored at different variables.

When the accident occurs the two image frame gets overlapped with other rms value of the two images opened before is calculated. If the rms value of the images is less than 250, then there is a similarity

between images i.e scene similar to an accident is found.

Finally, the rms can be computed by,

RMS= math.sqrt ((lambda a, b : (a-b) **2, h1, h2)/len (h1))

Here, h1= Image 1st histogram h2= Image 2nd histogram

Histogram: In an image processing context, the histogram of an image normally refers to a histogram of the pixel intensity values. This histogram is a graph showing the number of pixels in an image at each different intensity value found in that image. In digital image processing, histograms are used for simple calculations in software.

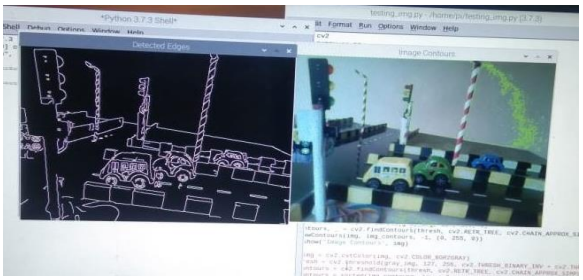


Image (6): Edge detection output

IMPLEMENTATION

Below images shows the system configuration and implementation of project with less hardware components which are Raspberry pi 3b+ model, USB camera, traffic signal, connecting wires, monitor for displaying results.

USB Camera connected to Raspberry pi as input, through GPIO pins signal switching will be display on traffic signal. Image 1. shows the simulation Diagram of model, which shows the connection of camera, Rasperry Pi and Traffic Signal. While image 2. Shows the actual implementation of model.

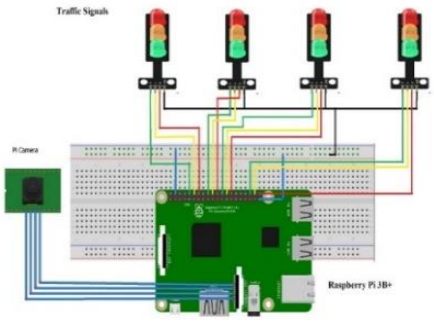


Image (7): Simulation diag

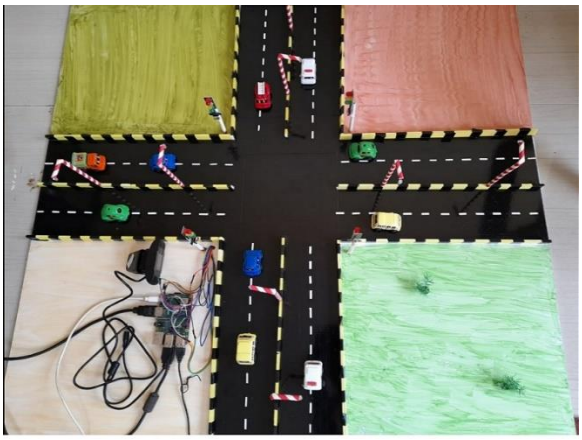
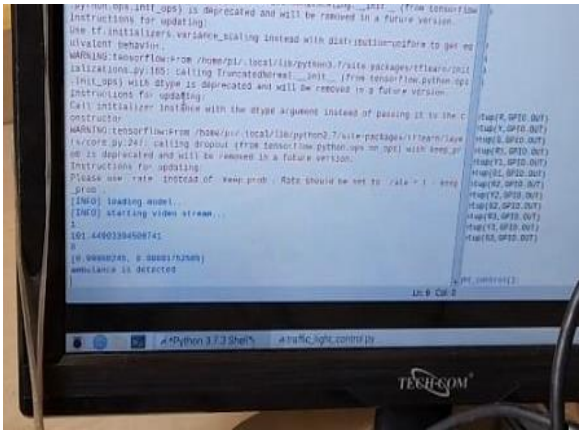


Image (8): Implementation of model

RESULT AND DISCUSSION

As experimental result, ambulance detection, its accuracy and observed vehicle count shows below images. Image 3. Shows the Monitor displaying the result 'Ambulance is Detected'. Image 4. Shows the green signal for car and count the vehicle as 1,2, … if ambulance is there it show the red border across vehicle.



Image(9): Output msg

Image(10): Ambulance Detection

Ambulance Detection Result	Accuracy (%)
1st Observation	94.0638
2nd Observation	101.4490

Table 1. Accuracy Observations

Vehicles are extracted by detecting moving parts in each frame based on Edge detection technique. It calculates the difference between two continuous frames i.e (t-1, t , t+1) frame. Depending on position of vehicle and area of that particular frame, will decide whether accident happened or not.

Image (11): Accident Detection

CONCLUSION AND FUTURE SCOPE

The literature survey review about the paper allow to take a look at the current and upcoming technologies, helps to create the system gives best performance. The designed system is capable to detect accident, emergency vehicle (Ambulance). By counting vehicles according to density traffic signal will be switched. The designed system is cost effective, scalable, fast, improves safety and security of the person on road. In this designed system accident and emergency vehicle is detected by reading frames through webcam as per change in area and position of vehicle. By means of two image frames get overlapped with other rms value. Still there is scope to detect direction of vehicle and speed of vehicle, according to collision prevention also.

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