LANE ASSIST AND OVER SPEED DETECTION OF VEHICLE TO AVOID ROAD ACCIDENTS

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Abstract: With the ever-evolving technology, there have been various developments in the field of Lane Detection and Overspeeding. According to the data for the year 2020, In India the issue of lane crossing accounts for 24.4 % of road accidents. Along with lane detection, overspeeding has been a vital cause of accidents. Despite vital efforts to neutralize the problem, excessive speed remains the number one causal factor associated with serious accidents. Also, the majority (59.6%) of road accidents were due to 'over-speeding' which caused 86,241 deaths and left 2,71,581 people injured, the data stated. So, in this report, we propose an effective method for the lane and speed detection of a moving vehicle which would, in turn, reduce the problems of lane cutting and also would reduce the number of accidents significantly. This project mainly focuses on two aspects 1) Lane Detection 2) Over-speeding. The solution is to develop a device that captures real-time road images using the Camera module and IR sensor module for detecting the speed of the vehicle. The feed of both the modules is given to the Raspberry Pi 3 Model B+ to detect the lane and speed of the moving vehicle. If the vehicle crosses the lane or over-speeds or both then the device sends the data and vehicle's registration number to the central system where all the vehicles of the highway are monitored. This project will help the concerned highway authority to keep a check on the vehicles and also by charging them a fine for every mistake they commit.

IndexTerms: Overspeeding, Lane Detection, Grayscale Filter, Gaussian Blur Filter, Canny Edge, Hough Transform, Google Sheets

I. INTRODUCTION

The problem of lane sagacity is a crucial enabler for better driver assistance systems. Also, it has been an active field of analysis for the past two decades with significant progress made in the past few years. In recent years, research in intelligent transportation systems has received great attention. An intelligent road transportation system is an advanced administration that aims at providing creative techniques related to different modes of transport. One of the most challenging tasks in developing an automated vehicle is lane following based on machine vision technique. This technique includes lane detection. Along with lane detection, overspeeding has been a vital cause of accidents. Despite vital efforts to neutralize the problem, excessive speed remains the number one causal factor associated with serious accidents. So, in this paper, we propose an effective method for detecting the lane and speed of a moving vehicle which would, in turn, reduce the problems of lane cutting and also would reduce the number of accidents significantly. For each practical block, we outline the possible implementations recommended and examine their underlying postulates.

II. LITERATURE REVIEW

Lane Assist and Over Speed Detection: This includes two main technologies such as Image Processing and IoT in which the lane is detected using image processing techniques where many filters and transforms are applied to get the desired output.

Image processing is one of the efficient methods to obtain the desired part from the input image. A lane detection algorithm is presented by considering the geometry information of the camera and road. First, the camera geometry information is used to divide the captured image into the road part and non-road part. Then, the histogram of intensity is applied. Next, a modified Hough transform method is developed to detect the lane markings on the road image by using the road geometry information.[1]. One of the effective researches suggests the use of filters such as canny edge and gaussian blur. Lastly, Hough transform is used to highlight the output on the original image.[2]. The low curvature is divided into various minute straight lines for lane detection purposes. H-MAXIMA transformation and Improved Hough Transform algorithm is used which first represents the region of interest from an input image for reducing searching space, due to which only the required part of the input i.e., the region of interest is extracted.[3]. This paper proposed an algorithm for detecting lanes with shadow interference called lane detection based on vertical direction IPM sub- picture restoration. It also gave some insights on Sobel edge detection.[5]. Other lane detection algorithms conduct image segmentation and remove the shadow of the road. The detected input color image is converted to grayscale image, on which a noise reduction filter is used. After reduction of noise with help of automatic threshold and canny edge filter boundary is detected. Further the left and right boundary was distinguished with the help of Hough transform.[6]. An algorithm for detecting lanes for the driver by using a vision system in the vehicle is described that connects steerable filters. This paper also gave some insight on the canny edge algorithm.[7].

Whereas IoT is used to determine the speed and transfer the data to the main server. Speed is obtained using IR sensors. A lot of research is done on this technology. According to research where two IR sensors are used it describes when a vehicle passes the 1st IR sensor, the timer starts and when the vehicle reaches the 2nd IR sensor the timer stops and the time required for the vehicle to reach from 1st to 2nd is obtained.[4]. Another method is to calculate the speed and position

(GPS coordinates) continuously and store in the memory card so that the vehicle could be alarmed based on the speed allocated in the particular area.[8]

III. PROBLEM STATEMENT

According to various studies and surveys are done by the National Highway Authority of India (NHAI) which comes under the Ministry of Road Transport and Highways. Govt of India there has been an enormous increase in road accidents due to overspeeding and overtaking of vehicles. The Times of India newspaper published the latest survey report on 1st Sept 2020 stating that around 60% of road accidents are due to overspeeding. This negligence has claimed countless lives so far in our country. There is an instant need for an effective solution to this problem. The solution for the problem is stated below:

- **Part 1:** To detect the lane of the moving vehicle and to display the detected lane markings to users on a real-time basis.
- **Part 2:** To monitor the speed of the moving vehicle and compare it with the specified speed limits and if not matched then informing the concerned authority

IV. COMPONENTS

Raspberry Pi 3 Model B+:

The Raspberry Pi 3 Model B+ is the heart of the project. As we know it is called a mini-computer. It controls all the output signals originating from the IR Sensor Module. It processes all the signals and displays the output in the Python Shell. We have used this board because it can efficiently process image processing techniques.

Power Supply:

This is a power adapter for the Raspberry Pi 3 Model B+. Its output voltage and current specifications are according to the Raspberry Pi 3 Model B+. Every model of Raspberry Pi has mixed voltage and current requirements and in addition, the USB type interface is also different. The output specification of this power adapter is 5.1V 2.4A Max with a Micro USB interface.

Webcam:

This is a webcam that is commonly seen mounted on a computer for the application of video calls, video conferencing, and many more. We have used this component for the part where we will detect lanes. The webcam is placed on the vehicle for examining the lanes on the road. It serves as an input for the Raspberry Pi. The input video from the webcam is processed by the Raspberry Pi by implementing different filters & transforms for the detection of various lanes.

IR Sensor:

This is an Infrared Sensor. It has two LEDs (Light Emitting Diode) i.e., transmitter and receiver. The transmitter LED transmits infrared rays and the receiver LED receives these rays and this process occurs when the transmitted IR rays are reflected in the receiver LED from any obstacle. The IR sensor can detect obstacles over a distance of approximately 10-15 cm.

V. WORKFLOW

1. Proposed Method for Lane detection:

The flowchart of the Lane detection algorithm is shown in the figure below. This method comprises three sections. The input is obtained through the camera module on a real-time basis. The captured video is later processed using image processing in which various filters are applied to achieve the desired output. The desired output is then imbricated with the input video. So, after implementing these techniques, we could observe the detected lanes in the video.

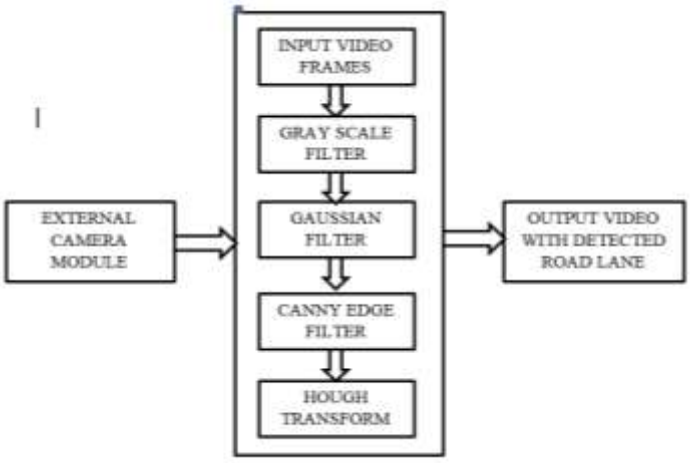

Figure 1. Block Diagram for Lane Detection

2. Proposed Method for Overspeeding of Vehicle:

The flow chart of the speed detection algorithm is shown in the figure below. This method comprises three sections: First, the interfacing of Raspberry Pi with the IR sensor module. Secondly, real-time speed monitoring of a vehicle. Thirdly, updating the server if the user surpasses the specified speed limits along with the vehicle registration number.

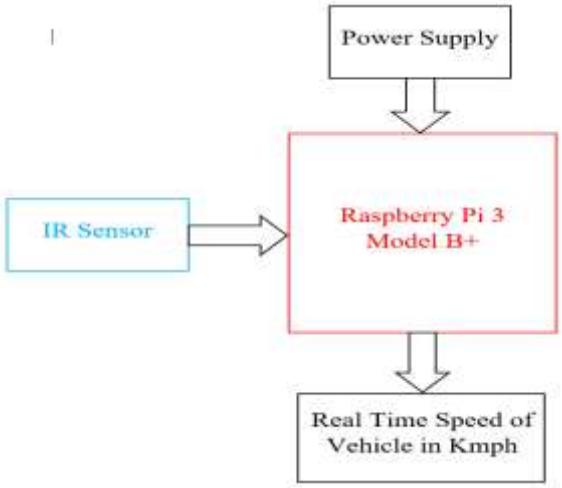

Figure 2. Block Diagram for Speed Detection

VI. IMPLEMENTATION

1. Lane Detection

We are going to use the Hough transform as the main image processing technique for lane detection. The input video captured is fed to raspberry pi so that the video is processed by implementing various filters to obtain the desired output.

1. The input video is processed by applying the "Grayscale filter". Grayscale filters convert the input image into a monochrome image where the light intensity objects are converted to 255 i.e., White, whereas the other dark part from the region of interest is converted to 0 i.e., Black. Thus, only lane markings are extracted. But the detected lane markings have less intensity. So, to improve that we use gaussian blur.

2. Then this video is further processed by applying Gaussian blur to intensify the edges.

Gaussian blur is used for sharpening the edges of the identified output by making the image blur due to which the image output (which in this case is lane markings) gets spread which makes it much more manageable for the raspberry pi to detect the edges.

3. Then the canny edge filters are applied for detecting the edges. Canny edge filter detects the outer edges of any blurred object which makes it easy to detect the lane markings of vigorous intensity. The output obtained provides us with the edges of the lane.

4. To detect the straight line, in the end, the Hough transform is used. In the Hough Transform the output of the Canny edge filter is imbricated with the original input video consisting of the road along with the markings such that we get the desired output which has the detected lane with distinctive colors for side markings and the colored lane in which the vehicle is moving. Thus, we obtain the detected lane.

Figure 3. Original Video

Figure 4. Mask

Figure 5. Region of Interest

Figure 6. Grayscale Image

Figure 7. Gaussian Filter Image

Figure 8. Canny Edge Filter Image

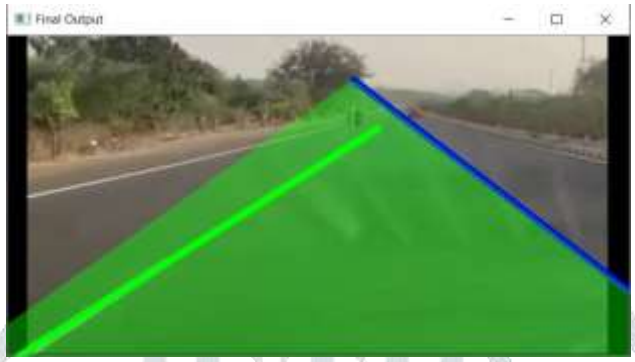

Figure 9. Final Output (Lane Detected)

2. Speed Detection

For detecting speed of the vehicle, we have used an IR sensor module. The IR Sensor Module gives an output = 1 with LED (Light Emitting Diode) = OFF when there is no obstacle in the range of the sensor and gives an output = 0 with LED = ON when there is an obstacle in front of the sensor.

We have placed the IR sensor module near the spokes of the wheel so that the spokes act as an obstacle for the IR Sensor. Our aim of using an IR Sensor Module was to detect the spokes of the wheel, according to which the output of the IR Sensor varies. As we have mentioned above, the IR Sensor gives an Output = 1 when no spoke is present in front and Output = 0 when there is a spoke present. So according to the varying output the interval time between the two spokes and time required for one spoke to pass the IR sensor is calculated by using the time library in the code. As we have found the interval time between two spokes and the time required to pass one spoke then we can calculate the time required to complete one revolution by multiplying with the number of spokes of the wheel and through this we can calculate the revolutions per second (RPS) and further revolutions per minute (RPM) and finally speed of the vehicle in km/hr by using a mathematical formula.

All this mathematical calculation and finding the time required part is done by programming the Raspberry Pi. Initially the speed output comes in more decimal places which can be rounded off to two decimal places by using the function round in code.

Note: Here we have used the 3V3 pin of Raspberry Pi 3 Model B+ as the 5V pin gives a wrong output for the obstacle detection.

Figure 10. IR Sensor mounted on cycle

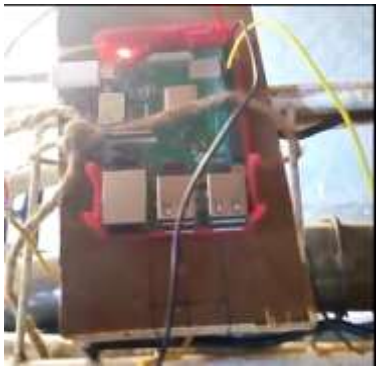

Figure 11. Raspberry Pi mounted on cycle

Figure 12. Detected speed of vehicle

3. Real-Time Speed Monitoring

For Real-Time Speed Monitoring of a vehicle, we are connecting our Raspberry Pi to Google Sheets (we have considered here Google Sheets as an RTO server) by writing a few lines of code for connecting Python code to the Google Sheets. After detecting speed of the vehicle if the user overspeeds beyond a certain specified limit (here we have taken 5 kmph as our limit), then the overspeed data is uploaded on the server (here Google Sheets) and the speed is monitored continuously so that the user never overspeeds and if it overspeeds its vehicle then the Highway Authority will be informed by overspeed vehicle data, Vehicle Registration Number and the Time Stamp (time at which overspeeding is done)

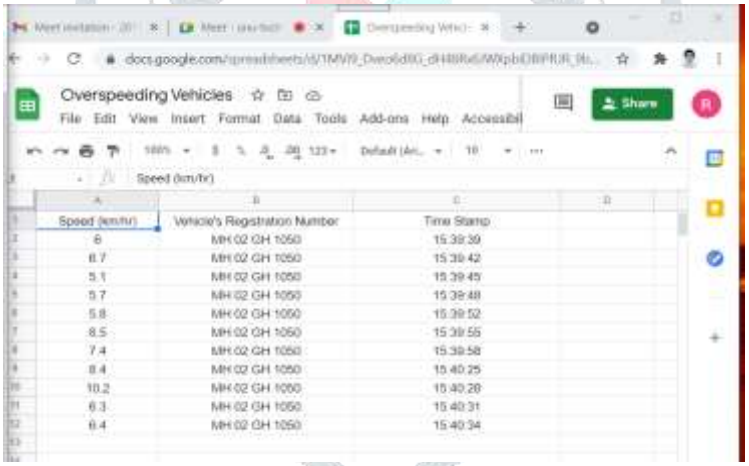

Figure 13. Details of Over Speeding Vehicle on Google Sheets

VII. RESULT AND ANALYSIS

In this paper, the algorithm was implemented on IDLE (Python 3.7). For Lane Detection a video of the highway road was made by placing the webcam on the car and then the stored file was made to run on the lane detection algorithm. So, as you can see that the lane boundaries are successfully extracted which indicates robustness and real-time performance of the algorithm. For Speed Detection an IR Sensor was placed on the cycle and the wheel was rotated so that the IR Sensor can detect the spokes of the wheel and by the Speed Detection algorithm the speed is calculated and if the speed goes beyond limit, then the Google sheets gets updated by the vehicle registration number, overspeed data and the time stamp.

VIII. CONCLUSION AND FUTURE SCOPE

This paper presented the design and implementation of a safety device for the user which will help in reducing road accidents. The proposed device is based on the detection and Real-time monitoring of lanes and speed of a vehicle. The proposed system can be seamlessly integrated with any vehicle's USB port to power the Raspberry Pi and the device can be powered ON. Another advantage of this system is the low-power consumption by the Raspberry Pi. Each device can be manufactured for less than ₹5000 per device. Further extensions include making an application for mobile devices for the ease of user to know about its previous overspeeding and lane crossing mistakes. For speed detection instead of using the IR Sensor module, the speedometer of the vehicle can also be used which increases the efficiency of the speed detection. Based

on the results from the trials the IR sensor can successfully determine the speed of the vehicle and we get the detected speed along with the vehicle's registration number at the server-side if any vehicle tries to Overspeed. We have also implemented the lane detection part using image processing techniques through which we can determine the lanes of the vehicle.

IX. REFERENCES

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