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VR/AR BASED AUTONOMOUS TRANSPORTATION ROBOT FOR INDOOR AS WELL AS OUTDOOR TRAVEL AND NEVIGATION USING GOOGLE PROJECT TANGO

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ABSTRACT

Autonomous robot are a hot research topic in science and technology, which encompasses a great influence on social and economic development. This paper proposes a design for an autonomous robot that's capable of autonomous navigation both Indoor also as outdoor. Using the concept of CNN algorithm, computational geometry and computer vision are used for detection of signboard for outdoor travel. The robot performed quite well outdoors avoiding both static obstacles in addition as dynamic obstacles that presented themselves along the planned path. Lane tracking, assisting the vehicle to stay within the desired path, and it controls the motion model by using previously detected lane markers. The image processing used for lane detection is finished using computer vision techniques. together with lane detection, an autonomous robot must even be ready to detect traffic signs and traffic signals. Ultra-sonic sensors are wont to detect obstacles.

Keywords: Automatic Lane Detection And Tracking, Computer Vision, Convolutional Neural Network.

I. INTRODUCTION

The Robots are designed to work in any surroundings and perform the task on behalf of humans. There are several potential advantage of autonomous vehicles like saving lives as autonomous vehicles will considerably reduce the quantity of crashes, enhanced quality for young or disabled persons. The project relies on autonomous as suggests that of transportation for indoor and outdoor travel. Decision-based actions involve some basic tasks like starting, stopping, and maneuvering around obstacles that are in their way. The robot works autonomously with navigations to redefine ways and avoid obstacles.

The autonomous robot works on a convolutional neural network formula for out of door travel that involves traffic light detection, signboard detection, lane detection, etc. The convolutional neural network may be a variety of artificial neural network which is employed for image processing problems, computer vision tasks like segmentation, localization, obstacle detection, and speech recognition. Several analysis fields specialise in CNN to induce an accurate result. A CNN model includes four layers i.e convolutional layers, Relu activation, Polling layers, fully connected layer. If any of the layers fail to perform their task then the algorithm will never be executed. Convolution is that the opening move to making the whole network. Here, Convolutional operates on two images in two-dimensional (2D) format. One because the input image, and another output image. It helps to know the feature from images by creating a relation between pixels [5]. Within the convolutional layer, we've got to first line up the feature in conjunction with the image and so multiply the pixel value with the corresponding value of filter then add them up driving them with absolutely the value of pixels. Relu layer represents corrected layer unit generated by this layer is to get rid of all the negative value from the filtered image and after change it with zero. The image received from Relu is downscaled within the pooling layer. and therefore the output is connected to a completely connected layer i.e. the particular classification is completed in a very fully connected layer. we've to require the downscaled image and up that in a very single list. then we compare that image with our previously-stored list. The last is that the output layer which supplies the output of the classified image [6].

In Autonomous Vehicle, lane detection is used to assist confine a really specific lane. It plays an important role in moving a vehicle to an alternate lane. Lane detection supported color region, line selection, edge selection.

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Image recognition coding system utilized in conjunction with cameras can enable the popularity of other vehicles, and also the detection and interpretation of traffic signs. Real-time traffic data are often wont to determine the simplest route to be accustomed reach a destination.

II. METHODOLOGY

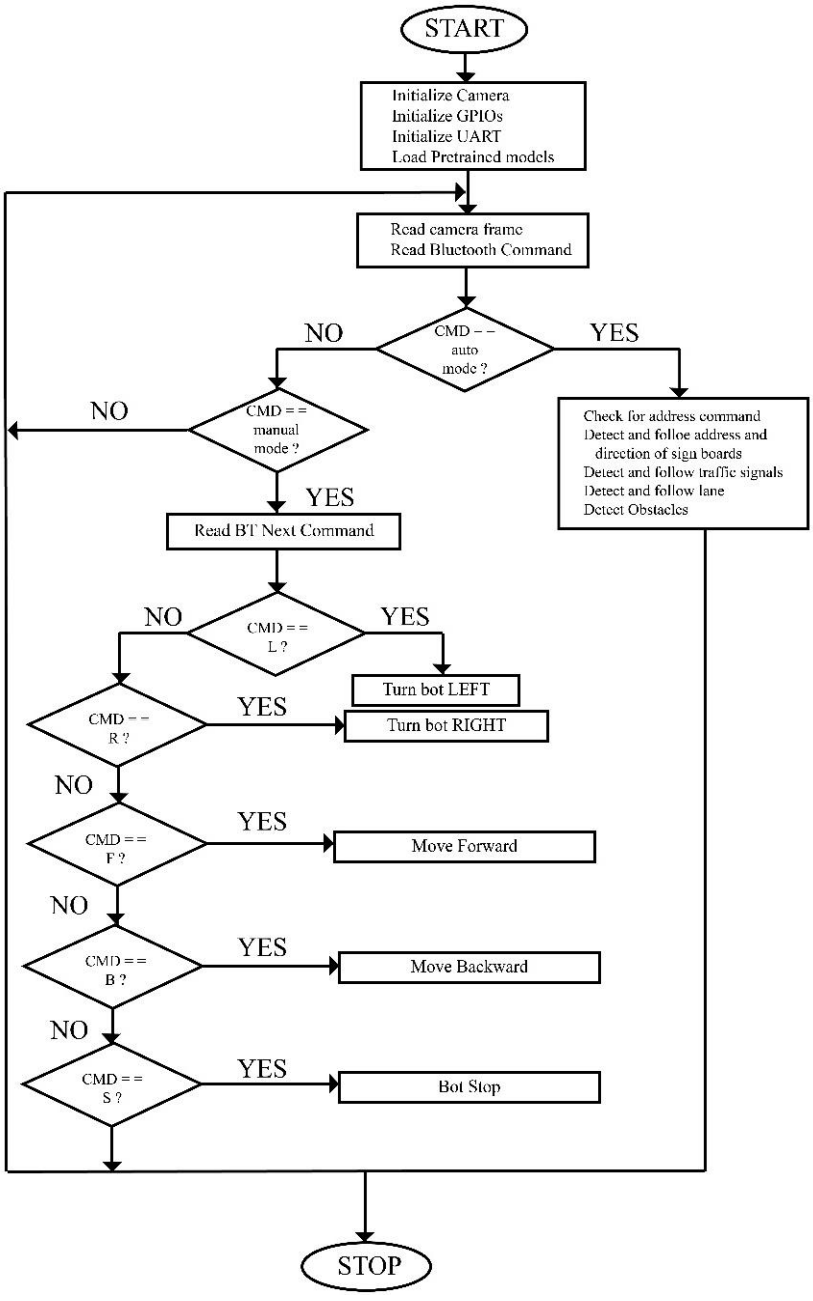

Figure 1: Overview of autonomous transportation robot for indoor as well as outdoor travel and navigation

The overall system is geared toward autonomous robots ought to notice, acknowledge road signs from period of time pictures of signboards, notice lane path ahead, and calculate the space to the road sign to require correct call to prevent / flip / continue driving. it's required to notice the traffic signs on the road and to require correct call in real time in step with state of affairs for safe driving. the aim of this paper is to create a golem that autonomously move itself on a track by recognizing road sign. so as to follow the lane properly, it ought to notice lane and traffic sign properly. The planned system incorporates following elements that is road structure detection, lane detection, obstacle detection, distance calculation to road sign, autonomous driving to detected path.[13]

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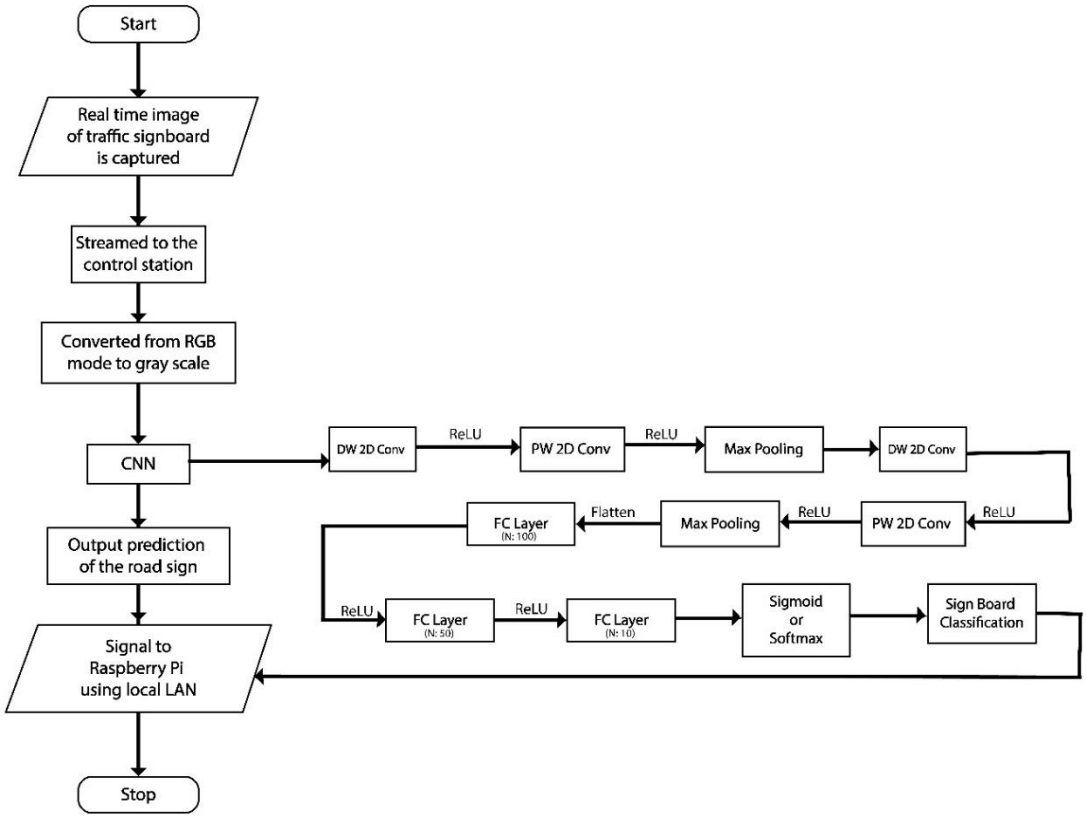

Figure 2: Flowchart for CNN algorithm used for traffic sign detection

According to on top of flow sheet, the input image is taken from the mounted camera on the autonomous automaton of the trail ahead. This feed is streamed to the management station wherever it's received frame-by frame and reborn from RGB mode to grayscale image. This image is given as input to the CNN and therefore the output prediction of the road sign is then fed as signal to Raspberry Pi. It includes activity coaching of the neural network by navigating the automotive over the appointed track. Once trained, the automaton is about on the track and mechanically maneuvers itself in response to the track's curvature. Finally integrates all the on top of functionalities mistreatment Raspberry Pi. Raspberry Pi is employed to relay the signal and to regulate the autonomous automaton. This signal is then sent to Raspberry pi, that controls the motive force motors of the automaton. when obtaining the signal, the raspberry pi relays the signal (forward, backward, left, right) to the motive force motors hooked up to the four wheels on the autonomous automaton. [13]

3.1 CNN based mostly Traffic Sign Detection and Recognition for outside travel: ancient pc vision strategies were developed to sight and acknowledge traffic signs on signboards. whereas applying machine learning to the project, produce a model that with efficiency classifies traffic signs pictures and determine the foremost acceptable options from pictures on its own. whereas mistreatment neural networks strategies the model would require an outsized variety of matrix operation operations which needs a lot of pc vision work. To tackle this downside Convolutional Neural Network (CNN) is extremely helpful as a result of it's been determined that CNN is a lot of economical and quicker than a daily neural network for issues associated with pc vision and pictures. Convolutional Nets models area unit simple and quicker to coach on pictures compared to the normal models. [3]

Steps concerned –

Getting information:

Libraries like OpenCV, PyTorch, Numpy, Pandas, OS area unit used. OpenCV use for Digital Image process (DIP) and pc Vision (CV) functionalities. Numpy library is employed to calculate outline statistics of the traffic signs information set and for multi-dimensional array, matrices multiplication operations and Pandas version one.x is employed to for reading and writing CSV file. PyTorch is employed for Convolutional Neural Network (CNN) design style and Machine Learning Purpose and OS use for file manipulation.

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Preprocessing and Visualization:

Firstly the pictures captured by the mounted camera in period of time is captured and hold on them in an exceedingly small Coyote State card. thanks to pictures having a variable vary of dimensions that ranges from 16*16*3 to 128*128*3 thence can not be passed on to the CNN model. foremost flip the captured image on the coordinate axis to urge the important image and downmarket the image mistreatment interpolation. downmarket each image to thirty two x thirty two x three dimensions. Next, convert these pictures to increased pictures which is able to facilitate our model to search out precise options within the pictures. The RGB image is reborn into HSV and notice solely HSV masking is completed on it image thence preprocessing is a very important step because it reduces execution time and finds the precise region of interest by ROI (region of extraction). Then when preprocessing, image is reborn into downscaled image. This downscaled image is reborn into monochrome (either black or white-colored image). currently pass this image into CNN design because the input image. [3]

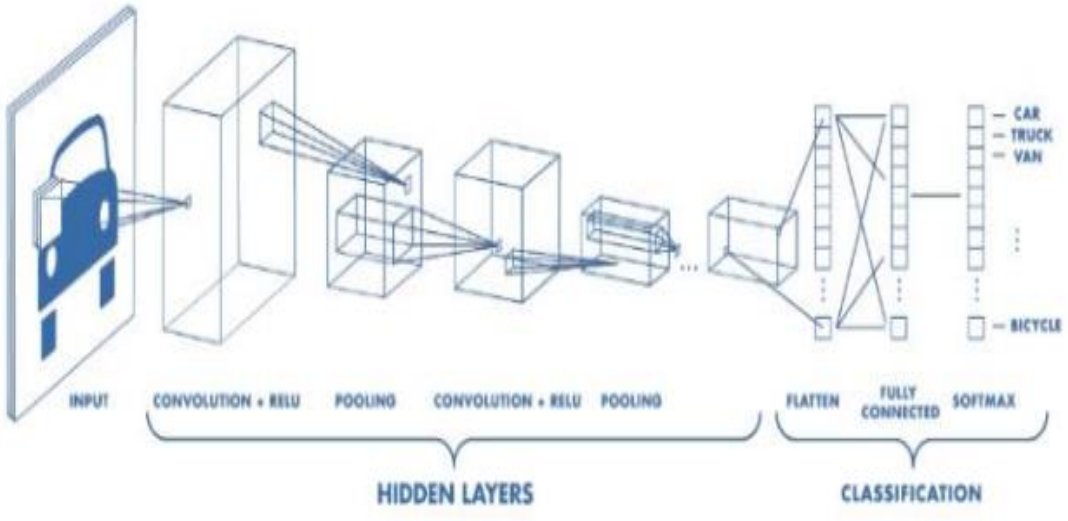

Figure 3: Traffic sign image processing using Convolutional Neural Network [3]

CNN Model Architecture:

The CNN architecture consists of three types of layers: Convolutional Layer, Max Pooling Layer, and Fully-Connected Layer.

1. INPUT layer consists of a 3-D array of pixel values of the image.

2. DW 2D CONV layer will compute the dot product between the kernel and sub-array of an input image the same size as a kernel. Then it will aggregate all the values resulting from the dot product and this will be the single pixel value of an output image. This process is repeated till the whole image is covered. In this process, we will get a single feature map.

3. RELU (Rectified Linear Unit)layer will apply an activation function max (0, x) on all the pixel values of an output image which skip all negative values and we will get a positive feature map of kernel size 1*1 and 16 feature maps.

4. POOL layer is having a 2*2 kernel size. POOL layer will perform downsampling along the width and height of an image resulting in reducing the dimension of an image by a factor of 2.

5. Next we will pass this image to DW 2D CONV, PW 2D CONV, max pooling. The output of these layers is going to flatten to convert multidimensional images into 1D arrays.6. Fully-Connected layer will calculate the class score for each of the classification category.

7. In this way, CNN transform the original image layer by layer from the original pixel values to the final class values. RELU and POOL layers implement the constant function and the parameters are not trained at this layer. Parameters at FC and Convolutional layer are trained with the help of gradient descent optimizer [4]

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Automatic Lane detection and tracking:

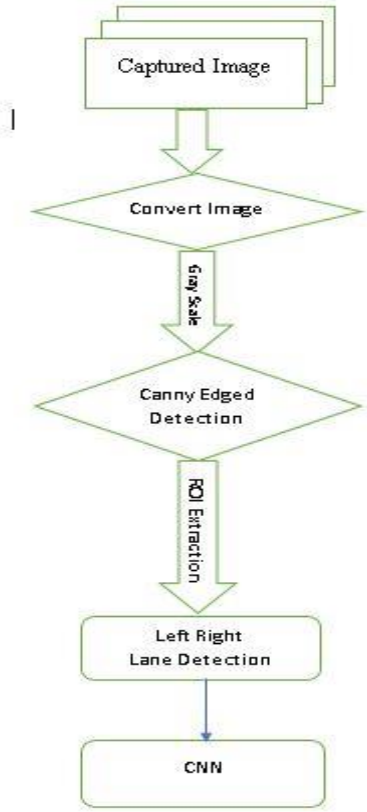

Figure 4: Overview of Lane Detection Algorithm

lane detection, the Camera capture the frames, that frames bear the method of interpolation and clipping then it converts the RGB image into a grayscale image. in this grayscale image, value-added Gaussian blur. when blurring this image, a smart edge detection formula applies, that extracts all real edges of pictures. Once get that image, apply ROI (region of interest) extraction. As ROI extracted image gets it'll pass away totally different CNN design specially train on lane detection and following. [14]

Lane Tracking: Lane Tracking, as already detected lane/road can automaton follow mechanically. controller Raspberry herb with pc vision, it ready to management the motor and their speed will move a automaton in any direction. Once lane pictures square measure detected, one neural network that trains on the lane detection tells raspberry wherever to maneuver. for instance, ROI extracted pictures from the previous lane detection rule pass the ROI grayscale image into the pre-train convolution neural network (CNN).

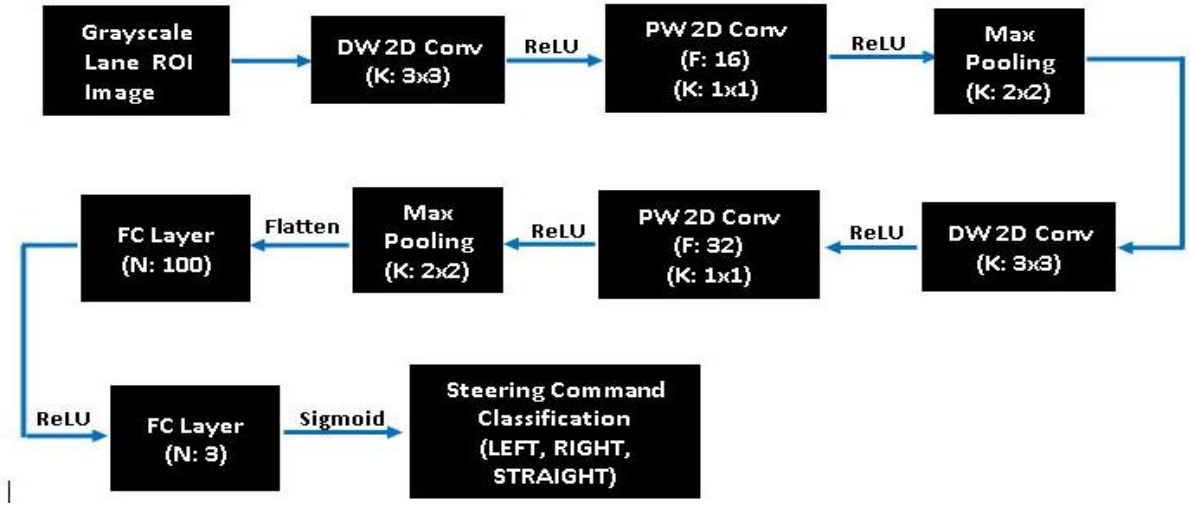

Figure 5: Block diagram of Lane Tracking Algorithm

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In this neural network, the primary layer is depth-wise convolutional during this layer, the input image can convert into feature maps. Results get when filtering that be feature map. In-depth convolutional, depth is adequate the quantity of inputs channels. for instance, applying the grayscale image as input. The grayscale image passes into a depth convolutional network in order that the neural network solely features a single filter applying some activation functions to output image like rectifiers long measure, Relu activation which is able to skip all the negative price. when obtaining a positive feature map have point-wise convolutional, currently pointwise convolutional have kernel sizes of 1 by one.

Input channels can have sixteen filters. than we tend to downmarket victimization gamma hydroxybutyrate actuation. This gamma hydroxybutyrate actuation layer features a window size a pair of|of two} by two that the feature maps that we tend to obtaining second convolutional layer square measure progressing to be downmarket quicker by 2. The downmarket map once more passes to depth-wise gamma hydroxybutyrate actuation. Once the last feature map gets from the last actuation layer then it flattens the image, the flatting perform converts a multi-D feature map array into one D array. thus flatten array fed into the totally connected layer, the primary totally born-again layer that has input adequate planar array and no of output hidden neurons square measure a hundred. the primary totally connected layer goes to induce activated victimization some activation perform like Relu and also the second totally connected layer is that the second hidden layer that has AN output of three neurons. basically, this can be the output layer, having three neurons and people neurons finally passing them through some Sigmoid activation which is able to convert in vary zero and one. no matter result comes in neurons it converts it in zero to one vary. Classification comes from this vegetative cell can move the automaton consequently. thus this can be our steering command.it may well be left right it may well be something between these three in line with the lane or position of the automaton. This totally connected layer is comparable to the easy artificial neural network.

Ultrasonic sensor: It's detects the obstacles by victimization ultrasonic waves. The device head emits an Ultrasonic wave and receives the wave mirrored back from the target. Ultrasonic sensors live the gap to the target by activity the time between the emission and reception. device has four pins -GND, VCC, trig, echo. once it detects the obstacle it blow a sound by employing a buzzer and offers the command to Raspberry Pi for any operating.

III. RESULTS AND DISCUSSION

This autonomous transportation robot is used for navigation it can be operated manually as well as autonomously. In manual mode it works with the help of Right, Left , Forward, Backward buttons and the speed of the robot can also reduce or increase by speed button. In autonomous mode it move autonomously according to detecting lane and traffic sign.

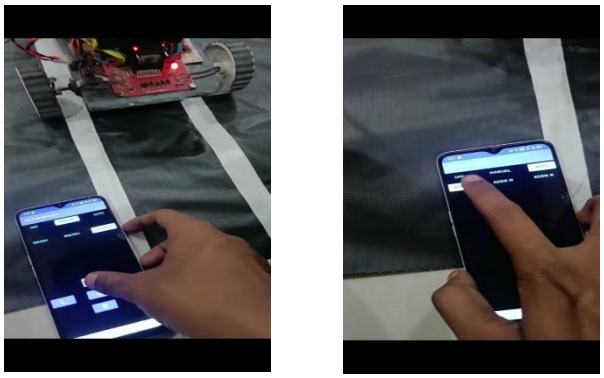

Figure 6: Robot Controlling

To evaluate the lanes and traffic signs recognition system, experiments were performed on the real data collected from roads

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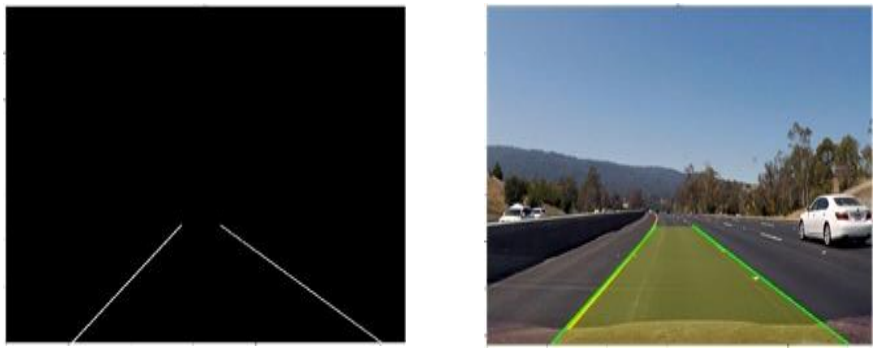

Figure 7: Lane detection

Some sample lane detection results also are provided in Fig 7. It is seen that the performance of the detection algorithm is sort of robust in detecting lanes on urban streets with varying conditions. The proposed approach achieves good results for detecting all the visible lane boundaries especially in clear conditions. The input image is taken from the mounted camera on the autonomous robot of the path ahead. This feed is streamed to the control station where it is received frame-by frame and converted from RGB. Once the robot is set on the track and automatically maneuvers itself in response to the track's curvature. This signal is then sent to Raspbery pi, which controls the driver motors of the robot. After getting the signal, the Raspbery pi relays the signal (forward, backward, left, right) to the driver motors attached to the four wheels on the autonomous robot.

Figure 8: Traffic Signboard Detection Results

In the above fig, there are some sign which is used to train the system using CNN to move accordingly when it matched with the signboards. When image is captured like m->, it will detect the sign and move towards Mahal in right direction. In the above fig, there are some sign which is used to train the system using CNN to move accordingly when it matched with the signboards.

IV. CONCLUSION

In this paper, proposed system adopts computer vision for lane detection rule wherever the lane is detected victimisation smart edge detection rule that helps in extracting all the important edges of the lane. Sign board detection rule is employed for police investigation the sign boards like stop sign board, regulation sign board, etc. and acts consequently. Obstacle detection is finished by supersonic sensors that detects the obstacle distance by the supersonic rays.

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