Design And Implementation of Deep Learning Based Road Pothole Along With Distraction Detection Using Yolov3

Mr.S.Shanmugam[1], Mrs.V.Navitha[2]
[1, 2] Dept of Embedded System
[1, 2] PSV college of Engineering and Technology

Abstract- *Bumps on the road are widely a huge primary disappointment on the surface and on the surface. Potholes are structural damage to the road with a cavity that can cause serious traffic accidents and affect the efficiency of the road. This Project presents a smart system for potholes detection with road sign images detection using computer vision and deep learning technique. Develop and design a deep ANN architecture for pothole and road sign recognition. The system starts by acquiring a pothole and road sign images, pedestrian crossing as data, preprocessing the data by creating image annotation and image augmentation on the pothole and road sign images. We also created sub directories by creating called images and annotation where we placed our training images in the image folder and the annotated files into the single folder that we created. We then train our model using deep learning. By deep learning, we downloaded a pre-trained yolov3 weight file trained on a coco dataset for object detection. Then we set the batch size equal and train from pre-trained model yolov3.After training, we evaluated and saved the educated version. We had a training accuracy of about 99%. We carried out real time road sign on a live streaming video using OpenCV library, we detected potholes by using ultrasonic sensor and the pothole images capture and send mail notification to LNT department by using IMAP protocol for automated E-complaint will be registered so that they can easily reconstruct the roads. After the road sign and pedestrian will be detected means automatically vehicle speed will be controlled with the help of PWM speed controller.*

I. INTRODUCTION

Road networks are key resources as they support the efficient development of individuals and goods. Despite this basic social and monetary work, however, numerous nations spent only half or even less of what might be needed for legitimate road maintenance. Keeping up with the road network is often the responsibility of territorial or nearby government units with limited expenditure. Helpless support brings street deserts that contribute to monetary misfortunes, vehicle damage and fatalities. Early recognition and detailed description of such imperfections would enable conservation to be promoted, leading to lower costs, benefits and greater welfare. Visual inspections are currently the most widespread technique used to assess road condition. Their viability is determined by the availability of the property and the importance of the given street. It is certain that highways with heavy traffic will generally be externally inspected on a daily basis and the passage of vehicles will be constantly monitored. Little used rustic streets are investigated not exactly once a week and regularly have longer periods of undetected damage. Bumps in the road are widely the primary disappointment on and off the surface. They are caused by the contraction and expansion of the road surface as water soaks into the ground. To ensure good traffic comfort, it is necessary and important to regularly examine and repair potholes on the roads. Currently, potholes are routinely distinguished and detected by guaranteed investigators and chief designers. However, this undertaking is lengthy and tedious. In addition, discovery results are consistently emotional on the basis that they rely entirely on employee insight. The case of potholes has spread rapidly in unusual climatic conditions, such as heavy downpours in summer and snowfall, which affects traffic safety and damages the streets. Distracted driving, speeding or other driving errors are the leading cause of accidents worldwide; in any case, the terrible condition of the road is also a critical reason. The condition of the street is ultimately dangerous for many reasons, such as flooding, precipitation, damage caused by e.g. overloading of large vehicles or poor actual maintenance of the road. Pavement condition assessment involves distinguishing and examining unmistakable types of pavement surface pain, such as potholes, breaks, or surface changes, which are significant elements of maintenance. Important transport elements are, for example, obstacles; in addition, they require identification for driver assistance.

OBJECTIVE

- The motivation for developing such a system is clear given the life and cost saving benefits of such a

system. The aim of this work is therefore to develop an automatic system for the detection and recognition of potholes and traffic signs based on the deep learning technique.

- The proposed system has the ability to recognize potholes and road signs in images taken by cameras and processed by ANN networks.
- Most traffic accidents are caused by human error, either by drivers not noticing a certain sign, or by drivers driving against the direction indicated by a certain traffic sign (i.e., a road sign specifying a speed of 100 km and a driver driving at a higher Speed).
- For this reason, this project carries the main goal of developing and improving the efficiency and lifetime of the pothole and traffic sign detection system.
- If a pothole is detected, it means that the information is automatically sent to the LNT department.

II. LITERATURE REVIEW

*[1]*Varona et al. (2020) proposed a deep learning technique to automatically recognize different road surface types and recognize potholes caused by destabilization caused by obstacles or driver actions in a group detection-based application setting. Specifically, they explore and apply distinctive deep learning models: convolutional neural networks, LSTM algorithm, and storage figuration models. Their experiment was conducted with real data and the results showed promising accuracy in solving these two problems. Accuracy is 91% for convolutional neural networks and 78% for recent short-term memory.[2]Anaiss et al. (2019) proposed a virtual road network auditor (VRNI) that persistently checks the road condition and provides selection assistance to directors and specialists. The virtual street network monitor proposes a novel pavement damage recognition strategy dependent on two universal one-class support vector machine models that have been applied to vertical and lateral velocity information. They evaluated this technique based on information from actual school transport arrangements in New South Wales, Australia. The results of their experiments show that their proposed strategy reliably discriminates 97.5% of roadway vandalism from 4% of false alerts identified with considerate inconsistencies such as development joints [2]. Dhiman and Klette (2019) developed two methods dependent on visual inspection of the audio system of the road condition in front of the vehicle. They further planned two models for pothole recognition based on deep learning. They completed a trial evaluation of two proposed deep learning models for accuracy and control and obtained accompanying results: 96.2 and 92.3 for the accuracy and control of the main model, and 65.2 and 53.2 for the second model[3]. et al. (2017) develop a publicly supported framework for pothole discrimination and mitigation in multi-road conditions using accelerometer information from implanted vehicle sensors. Their proposed publicly supported framework limits the transfer of necessary organizational data by deciding the road grade and roll point data in each vehicle into straight, speed-increasing parts that cannot be compared to potholes. They assess their framework against refined and true information, discuss the trade-offs in the number of vehicles and data rates required for accurate localization, and compare the results to the simpler situation of one-way identification. The investigated result shows that as the path further expands, the accuracy rate decreases [4]. Bansal et al. (2020) propose a DeepBus approach for continuous identification of road surface anomalies using the Internet of Things (IoT). The proposed procedure uses IoT sensors to gradually identify potholes. The area of these potholes would be accessible on the relief map in the middle. They viewed an exhibition of different AI models (Logistic Regression, Support Vector Machine (SVM), K-Nearest Neighbors (KNN), Naive Bayes, Decision Tree, Random Forest and Ensemble Voting) with respect to different thresholds (accuracy, F-score, Precision and Recall) and reported that Random Forest is the best model for identifying potholes with an accuracy of 86.8%[5].

III. EXISTING SYSTEM

- In the existing system, they propose a modified YOLO algorithm to solve the problem of class imbalance between "disruptive" and "normal" classes.
- YOLOv2 architecture with two image resolutions of 416 x 416 and 608 x 608 was considered for pothole detection in the test data set. 416 is the minimum grid cell size that can be tested on this architecture, and 608 was the maximum high-resolution grid that the architecture could implement on an available computing platform.
- Faster R-CNN was implemented with VGG16 (also called OxfordNet) and ResNet-18 (residual neural network) backbones. VGG16 consists of 16 CNN layers for which the input image size was 224 x 224, which is suitable for object localization and classification.
- This existing method modified YOLOv2 architecture was trained and tested on pothole dataset where layers could tune learned features about pothole and normal classes

DISADVANAGES

- This method only detects pothole images on the road and the LNT department has no warning information, so.
- This method trained the data in the yolov2 model; the achieved accuracy is 89.4%, less than compared to the proposed method.

IV. PROPOSED SYSTEM

- In the proposed system, we design a deep ANN architecture for real-time detection of potholes and road sign images.
- The model will be trained using a pre-trained yolo-v3 coco weight model that was trained on the coconut dataset to detect various objects. We will optimize the weight parameters of the pre-trained models for the batch size.
- The input video frames can be captured by the camera and the captured video frames are divided into individual frames, then the frames can be segmented, in this process the frame will be converted into original image and background image.
- Image noise can be removed using Gaussian filter, images can be converted to binary image (0,1), binary zeros can be considered as unwanted part and binary as desired part using grayscale conversion process.
- After we have segmented the images we will use as data, we draw a bounding box for each of the images. We will also label each of the images to be known for our proposed model for easy road sign identification. A pothole on the road can be detected using an ultrasonic sensor, and the sensor information can be linked to the software through serial communication.
- The images folder contains the road sign images while the annotation folder contains a DBMS.
- Where we detected potholes, images are captured and that pothole images will be send mail notification to LNT department by using IMAP protocol for automated E-complaint registration.
- Here the road sign, pedestrian detected means the serial communication signal send to vehicle and automatically vehicle speed can be controlled by using PWM speed controller. The serial signal transfer to a Nano microcontroller, the controller will be controlling the vehicle.
- The real time detection of potholes and road signs an image that is carried out using OpenCV, and the model's evaluation in terms of accuracy, of about 99%.

ADVANTAGES

- Our proposed system achieves greater accuracy of 99% compared to existing methods; we trained our model in the yolo V3 training model.
- Using this application, we can detect both pothole and road sign.
- Automatic E-compatibility will be registered in this application, which will help the LNT department in road reconstruction and accident prevention.
- Traffic sign detection and automatic vehicle speed control is very useful for preventing accidents and saving lives.

V. SYSTEM FUNCTION

BLOCK DIAGRAM

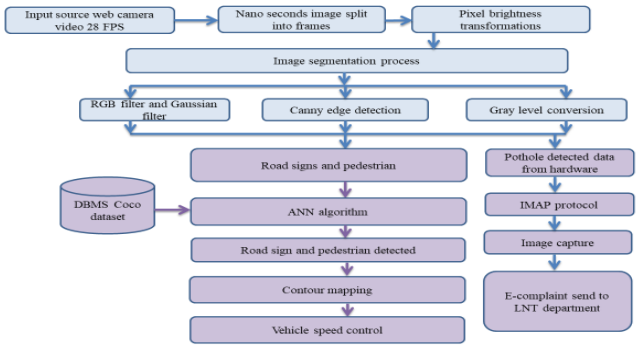

Fig no: 1Software block diagram for proposed system

HARDWARE BLOCK DIAGRAM

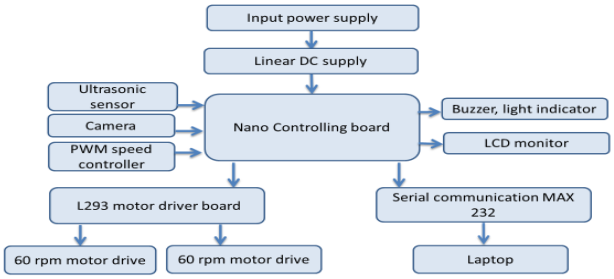

Fig no: 2Hardwareblock diagrams for proposed system

CIRCUIT DIAGRAM

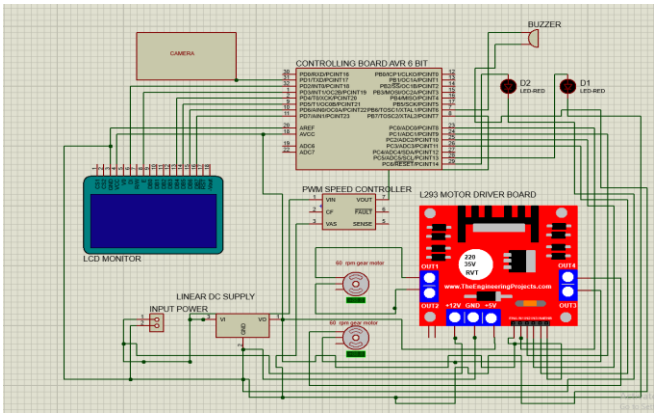

Fig no: 3 Circuit diagram

CIRCUIT DESCRIPTION

- This circuit consists of the main components Nano Controlling Board, 60 rpm. gear motors, (PWM) motor controller, LCD display, ultrasonic sensor, LED light, buzzer and input power.
  - The 12V input power supply is fed to the DC voltage regulator to regulate the voltage from 12V to 5V, then the 5V power supply and then passed to the regulator.
  - Two 60 rpm motors are connected to the output pins of the motor driver, EN1, EN2 pins are connected to the 5V supply. The instruction pins IN1, IN2, IN3, IN4 are connected to the digital pins of the Nano controller.
  - LCD display is connected to Nano Controlling Board digital pins d2, d3, d4, d5, d6, d7 and GND is connected to ground, power is connected to 5V supply.
  - The LED light has two terminals, the positive terminal is connected to the controller and the negative terminal is connected to ground.
  - The buzzer has two terminals, the positive terminal is connected to the controller and the negative terminal is connected to ground.
  - The PWM controller is connected to the digital pin of the controller.
  - The ultrasonic sensor has 4 pins. Data pins are connected to the controller. Gnd pin is connected to ground, 5V pin is connected to 5V power pin.

ARTIFICAL NEURALNETWAORK ANNALGORITHM

• A synthetic Neural community (ANN) is an interconnected organization of nodes, similar to our brain community.

• Here, we've three layers, and each round node represents a neuron and a line represents a connection from the output of 1 neuron to the enter of another.

• The first layer has entered neurons which ship statistics thru synapse to the second one layer of neurons, and then thru extra synapses to the 0.33 layer of output neurons.

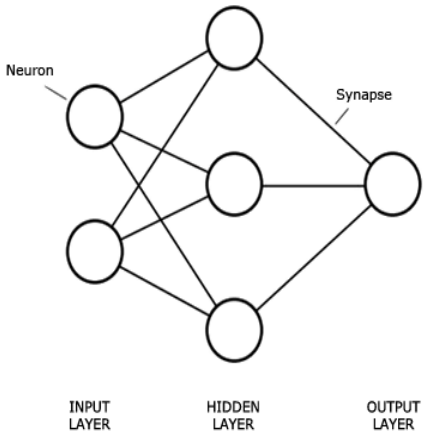

Fig no: 4Artificial neural networks

IMAP PROTOCOL

IMAP stands for Internet Message Access Protocol**.** It is an application layer protocol that is used to receive email from a mail server**.** It also follows the client/server model**.** On the one hand, we have the IMAP client, which is a process running on the computer**.** On the other hand, we have the IMAP server, which is also a process running on another computer**.**

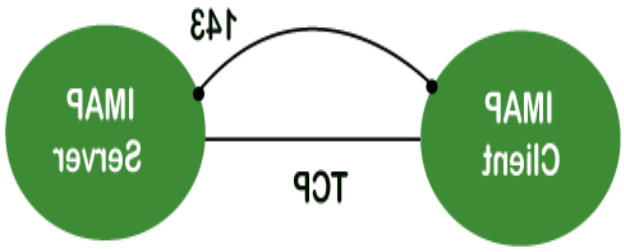

Fig no:5 Client to server communication

The protocol resides on the TCP/IP transport layer, which means that it implicitly uses protocol reliability. Once a TCP connection is established between an IMAP client and an IMAP server, the IMAP server listens on port 43 by default, but this port number can also be changed.

VI. HARDWARE REQUIREMENTS

NANO MICROCONTROLLER

Here are some of its basic features that you need to know if you are thinking of working on this great microcontroller board:

- It includes a total of twenty -two input/output pins.
- 14 of these pins are square measure digital pins.
- Nano has 8 analog pins.
- It has 6 PWM pins between the digital pins.
- Has a 16MHz crystal oscillator.
- It's in operation voltage ranges from 5V to 12V.
- It also supports various communication methods which are: o Serial protocol. o I2C protocol. o SPI protocol.
- It also has a mini USB pin which is used to upload the code.
- It also has a Reset button.

Fig no:6Nano microcontroller

LCD DISPLAY

LCD stands for Liquid Crystal Display. LCDs are widely used as a replacement for LEDs (seven-segment LEDs or other multi-segment LEDs) for the following reasons: 1. Falling LCD prices. 2. Ability to display numbers, characters and graphics. This is unlike LEDs, which are limited to numbers and a few characters. 3. Incorporating a refresh controller into the LCD, relieving the CPU of the task of updating the LCD. In contrast, the LED must be refreshed by the processor to continue displaying data. 4. Easy programming of characters and graphics. These components are "specialized" for use with microcontrollers, meaning they cannot be activated by standard ICs. They are used to write various messages on a miniature LCD.

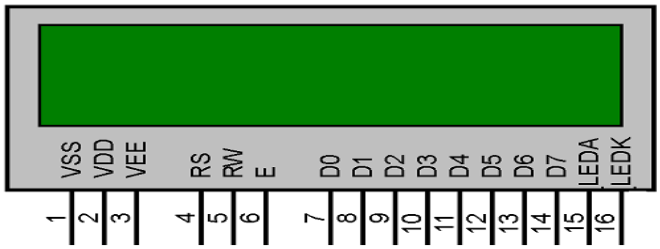

Fig no: 7 LCD display

The model described here is the most commonly used in practice due to its low price and great options. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines of 16 characters each. It displays all alphabets, Greek letters, punctuation marks, mathematical symbols, etc. In addition, it is possible to display symbols that the user creates himself. Useful features include automatic shift notification on the display (left and right shift), pointer appearance, backlight, etc.

L293 DRIVER BOARD

An H-bridge is an electronic circuit that allows a voltage to be applied to a load in any direction. H-bridge circuits are often used in robotics and many other applications to allow DC motors to run forward and reverse. These motor control circuits are mostly used in various converters such as DC-DC, DC-AC, AC-AC and many other types of power electronic converters. Specifically, a bipolar stepper motor is always driven by a motor controller with two H-bridges

Fig no: 8driver board

DC GEAR MOTOR

Geared DC motors can be defined as an extension of the DC motor, whose Insight details have already been demystified here. A geared DC motor has a gearbox attached to the motor. Engine speed is calculated as shaft revolutions per minute and is referred to as revolutions per minute. The gearbox helps in increasing the torque and reducing the revolutions. By using the correct combination of gears in a

geared motor, its speed can be reduced to any desired value. This concept, where the gears reduce the speed of the vehicle but increase its torque, is called gear reduction. This Insight will explore all the minor and major details that make up a gearbox and therefore the operation of a geared DC motor.

Fig no:9 Gear motor

BUZZER

The "Piezoelectric Sound Modules" presented here work on the concept of conversion using natural piezoelectric ceramic oscillation. These buzzers are available in lightweight portable sizes from a small 12mm diameter to large piezo sockets. The word shown in Fig. 6 below is a simple word that, when enabled, emits a continuous beep. A buzzer will be attached to the blink sensor to alert the driver when he first falls asleep.

Fig no:10 Buzzer

ULTRASONIC SENSOR

The HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object, just like bats. It offers excellent non-contact range detection with high accuracy and stable values while being easy to use. Operation is not affected by sunlight or black material, although acoustically it can be difficult to detect soft materials such as cloth. It comes with an ultrasonic transmitter and receiver module.

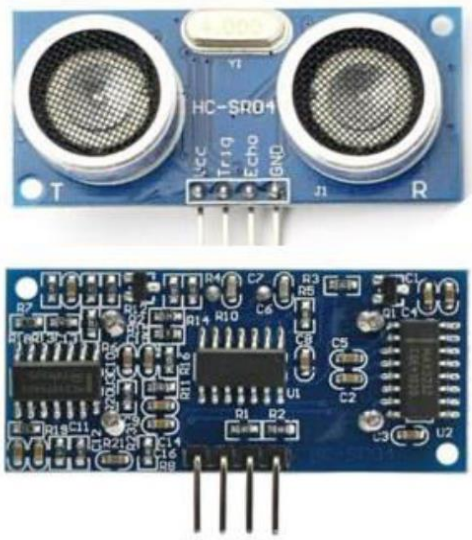

Fig no: 11Ultra sonic sensor

5V LINEAR DC SUPPLY

All voltage sources cannot provide a fixed output due to circuit fluctuations. Voltage regulators are implemented to achieve constant and stable performance. ICs that are used for voltage regulation are called voltage regulator ICs. Here we can discuss about IC 7805. The 7805 voltage regulator IC is actually a member of the 78xx series of voltage regulator ICs. This is a fixed linear voltage regulator. The Xx in the 78xx represents the value of the fixed output voltage provided by the particular IC. For the 7805 IC, it is a +5V DC regulated supply. This controller IC also adds provision for a heatsink. The input voltage to this voltage regulator can be up to 35V and this IC can provide a constant 5V for any input value less than or equal to 35V, which is the threshold limit.

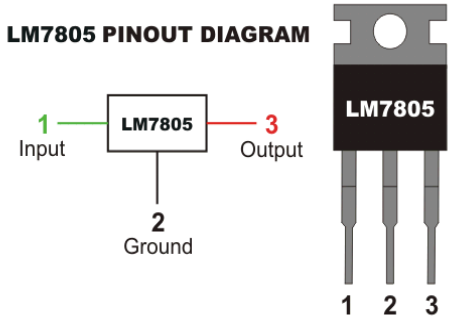

Fig no: 12LM7805 pinout diagram

PYCHARM INTRODUCTION

This chapter gives you an introduction to PyCharm and explains its features. PyCharm offers its users and developers some of the best features in the following aspects •

Code completion and review • Advanced debugging • Support for web programming and frameworks like Django and Flask

Fig no:13PyCharm software window page

PYTHON

The system uses the Python programming language with Google's Tensor flow A machine learning library to build and deploy CNNs. The system uses the Python programming language with the Google Tensor flow machine learning library to build and deploy CNNs. Performance is analyzed based on real scenarios tested on the neural network. The network architecture uses 9 convolution and max-pooling layers followed by 2 fully connected layers. The network is a mixture of classification and detection models. Python is a popular programming language. It was created by Guido van Rossum and launched in 1991. It is used for: • web development (server side), • software development, • mathematics, • system scripting.

Fig.no: 14Python

RESULTS

Our project is real-time detection of pothole and traffic sign images using deep learning technique. An ANN deep learning algorithm was implemented for traffic sign and pedestrian detection. Road sign images will be successfully detected using a deep learning process. A pothole on the road was detected using an ultrasonic sensor. The detected information can be connected to the hardware device via serial communication. we are developing a hardware system for controlling vehicle speed. Pothole detection means sending an e-complaint to the LNT department using the IMAP protocol. road sign recognition means that the vehicle speed is automatically controlled by the PWM controller.

The result screenshots will be given below.

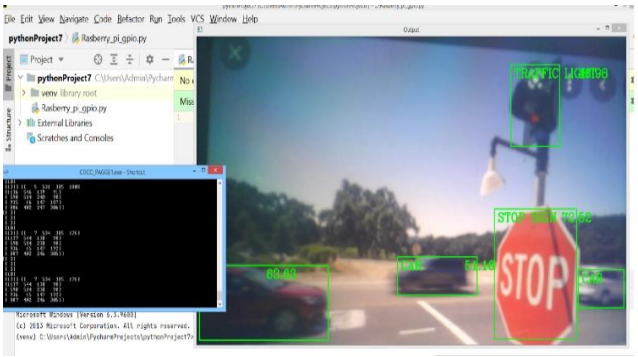

Fig no: 15 detected output images 1

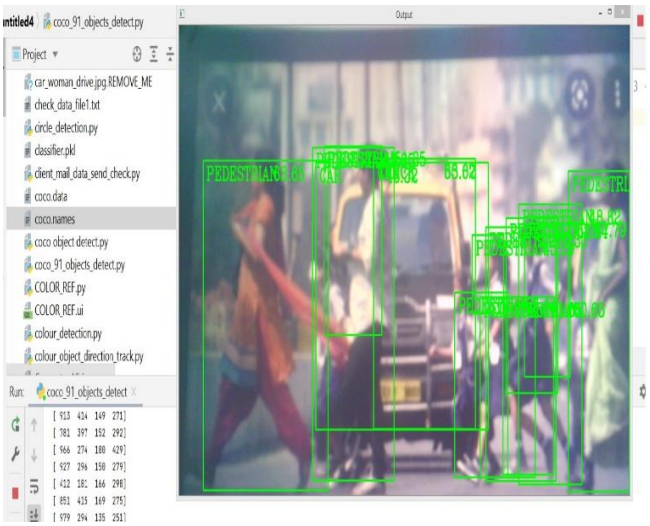

Fig no: 16 detected output images 2

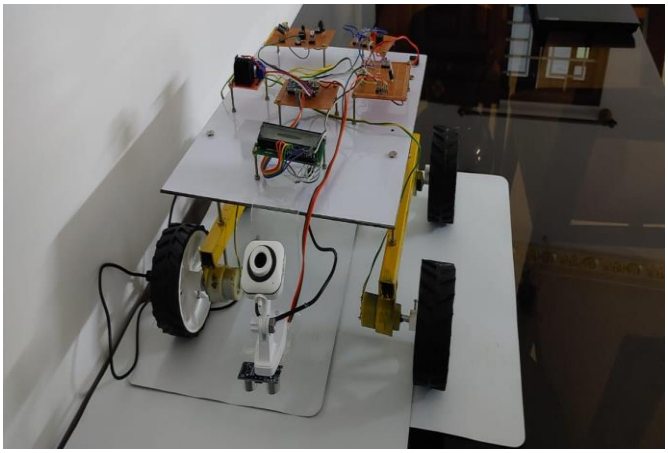

Fig no: Hardware design image

VII. CONCLUSION

In this project, we presented a system for automatic detection and recognition of potholes and speed limit signs in real time with high accuracy. The ANN algorithm provided better results for pothole and traffic sign detection. A method was proposed to extract the black color inside the character, and this method is able to extract the number with different environmental conditions. An artificial neural network was trained to recognize potholes and traffic signs with up to 99% success rate. When using the project after detecting a pothole and it will automatically be registered e-compatible. Vehicle speed is controlled in areas detected by road signs using a PWM speed controller.

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