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IoT based Traffic Sign Detection and Violation Control

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ABSTRACT: In the field of Vehicular automation, the detection of traffic signs plays a vital role. The enormous growth has been faced in the field. Even though the technology warns the user about the detected traffic sign, there are chances that the user might violate them, and violating the traffic sign rules might lead to accidents where the life of people would be at stake. Hence, to avoid these problems this project has proposed a prototype in such a way that, it detects the traffic signs using Convolutional Neural Network(CNN)and acts accordingly denying the user's control in real time if he tries to violate the rules in the traffic sign. The prototype contains a Remote Controlled (RC) car, which is controlled with Raspberry pi-3 with a pi camera and Arduino. The live feed from the pi camera is fed into Raspberry pi-3 which detects the traffic signs (speed limit, no left, no right, no U-turn). The Arduino UNO is used to drive the motor according to the processed output from the Raspberrypi-3.

KEYWORDS: Convolutional Neural Network(CNN), Keras, Python, Traffic sign detection, IC L293D, Arduino, IoT cloud, Raspberry Pi3.

I. INTRODUCTION

Traffic sign shave been kept in every road for safety purposes, the signs are kept in calibrated distances from the place of action required, such that the driver can respond with in the due time hence traffic signs are the tool of control for traffic which requires utmost attention, respect, and a suitable action in response from the driver where the negligence of the driver to respond to the signs leads to accidents. I unpropitious traffic conditions, the probability of drive noticing the traffic signs and responding according to it is very less, which may lead to accidents hence these are the scenarios where traffic sign recognition and automatic violation control of the vehicle would play a major role. the sole objective of the proposed prototype is to detect the traffic signs in autonomous by using an effective deep learning technique convolutional neural network (cnn) and control the system according to the road sign detected. traffics signs like speed limits, no left, no right, and no u-turn are generally placed in school or college zones, accident- prone zones, in most probable zones of traffic jams, etc to avoid traffic jams and accidents The main goal of the prototype is to prevent accidents and traffic jams by controlling the speed of the remote controlled (rc) car according to the speed limits and prohibiting illegal turns if the driver in tends to, by detection of traffic signs using the pi camera and raspberry pi3. The built of the system is majorly concentrated on a cost effective ,out of the box solution using a mini embedded computer raspberry pi. to provide fast processed results deep learning techniques, convolutional neural network(cnn) has been used with the help of tensor flow and keras.

II. RELATED WORK

There are three stages in the detection of traffic signs ,traffic sign region of interests (ROIs) extraction, refining the ROIs, and classify them into appropriate classes and further process. ROI is fixed on the grey and Red, Green and Blue(RGB) channels. Then it is assigned to various classes using the Convolutional Neural Network and then trained with huge data [1]. The speed of detection and accuracy is important for the detection of traffic signs and implementing in real-time scenarios. In real-time scenario, the shapes and colour might be distorted. Hence this method of classification is confirmed as this is been proved to be simple and powerful [2]. The images might be small causing difficulties in detection. To detect these small targets, a dilated module is introduced in order to prevent the resolution loss and to retain its features. Then a pass through module is proposed which merges the gained information from the previous layer with information in further layers [3]. The system requires a motor driver ,Bluetooth module, and its software design for users' input, and the mobile application design[4]. To detect the characters in side the traffic sign boards(speed limit boards), a python library known as Kerasis used for classification [5]. The system involves both not-

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time driven data (cloud computing) as well as time-sensitive data(edge computing) since large data has to store .But this computing has its disadvantages. Hence this work collaborates both edge and cloud computing for sanctioning live analytics in wireless IoT networks[6]. The sensor outputs i.e. the raspberry pi outputs are sent to the cloud continuously. Thus, the acquisition, management, processing the IoT big data, and other technical modules are studied in terms of capability and characteristics[7].To add one or more nodes in the network i.e. when we need to add some more sensors according to the user can be achieved by modularity concept[8]. For any system connected to the cloud, a bandwidth of the network, and mobility of the system play a vital role in communication.

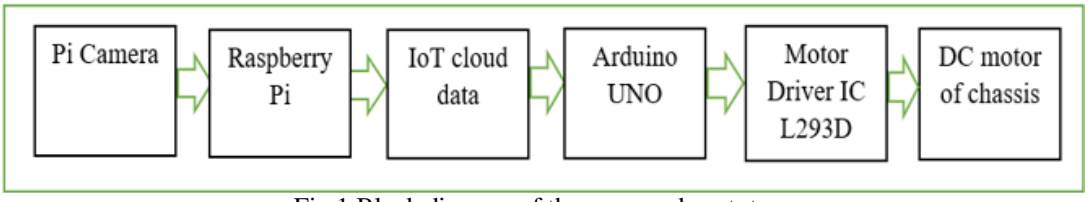

Fig.1.Block diagram of the proposed prototype

III. PROPOSED ALGORITHM

The major working the proposed prototype is the detection of traffic signs using Convolutional Neural Network like speed limits 40 and 60, No left, No right, No U-turn. If the traffic signs have been detected by the CNN method, then the detected signs are encrypted into specific binary codes and they are logged in IoT cloud data .A node MCU continuously receives the logged data and sends it to the Arduino UNO which resultantly controls the motors according to the control sign al that has been sent to ICL293D.

A. Block diagram

The entire block diagram for the proposed prototype isgiveninFig.1.

B. Traffic sign detection using CNN

Python is the language used in the entire process in this particular system .Download German traffic sign dataset(GTSRB) which would contain more than 50000 images of various traffic signs where it is classified into 43 different classes. Filter out the required datasets alone and part them as various classes in order. The dataset should be further classified into training and testing images such that the training images are much more than the testing images which is done with the help of the sklearn package, certain other packages like Tensor flow, Keras, Matplotlib, Scikit-learn, Pandas, PIL and image classification are very important to train the images.

A CNN model is to be built to classify the images into their respective categories where the architecture of the model is used as specified in [12]. Testing using the test dataset is per formed after the completion of training to predict the model and the trained weighted file is to be created. For traffic sign detection in real-time to take place, the pi camera compares continuous images with the trained weighted file, and the outputs are produced accordingly.

C. Integration of traffic sign detection and RCcar

For connecting the RC car to the raspberry pi remotely there is a requirement to opt for IoT cloud applications as it uses Message Query Telemetry Transport (MQTT) protocol which is alight weight protocol that helps in fast data transmission. The raspberry pi sends the data to the cloud and stored as American Standard Code for Information Interchange (ASCII) values in continuous as the traffic signsare been detected. Arduino Uno with the help of Node MCU connects to the network to retrieve the ASCII values in continuous and sends it to the Arduino code and it is thus converted to analog signals.

D. Working of the prototype

Two 200 RPM motors are been connected with two wheels of chassis. The motor is been controlled by Arduino UNO and motor driver IC L293D where one IC can control both the motors at the same time in any direction. The input of the IC L293D comes from the Arduino UNO and the motors are controlled accordingly in effect where the output pins of IC L293D have been connected to the motors of the chassis.

For locomotion of the RC car in forward, backward, left ,right and U-turn will be given as inputs from the Bluetooth module to the Arduino UNO which passes the control to the IC L293D and it controls the motors in result according to the inputs given. The flowchart shown in Fig. 2 gives a clear description of the working of the proposed prototype.

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The forward and backward movements of the prototype require rotation of the wheels in uniform speed whereas to move left, right or U-turn, the prototype would rotate one of the wheels in the forward direction and other in the opposite direction where if the RC car has to turn left then the system requires the rotation of the motor in the left, in the backward direction and the motor in the right, in the forward direction whereas it is the exact opposite to turn right. The violation control performed by the RC car for five different traffic signs had been explained in detail in Table1. For the RC car running in top speed and if speed limit-40 sign is been detected as per the detection algorithm discussed above then an ASCII value of 0100 would be stored in IoT cloud where the ASCII value stored in the cloud would be retrieved by the Node MCU and it would communicate with the Arduino by serial communication. Hence, as the input ofhigher priority has been obtained in the Arduino, the RC car would tend to slow down it's speed to a model speed that has been set for the speed limit-40 by the Arduino and slowing down the speed of RCcar is per formed with the help of IC

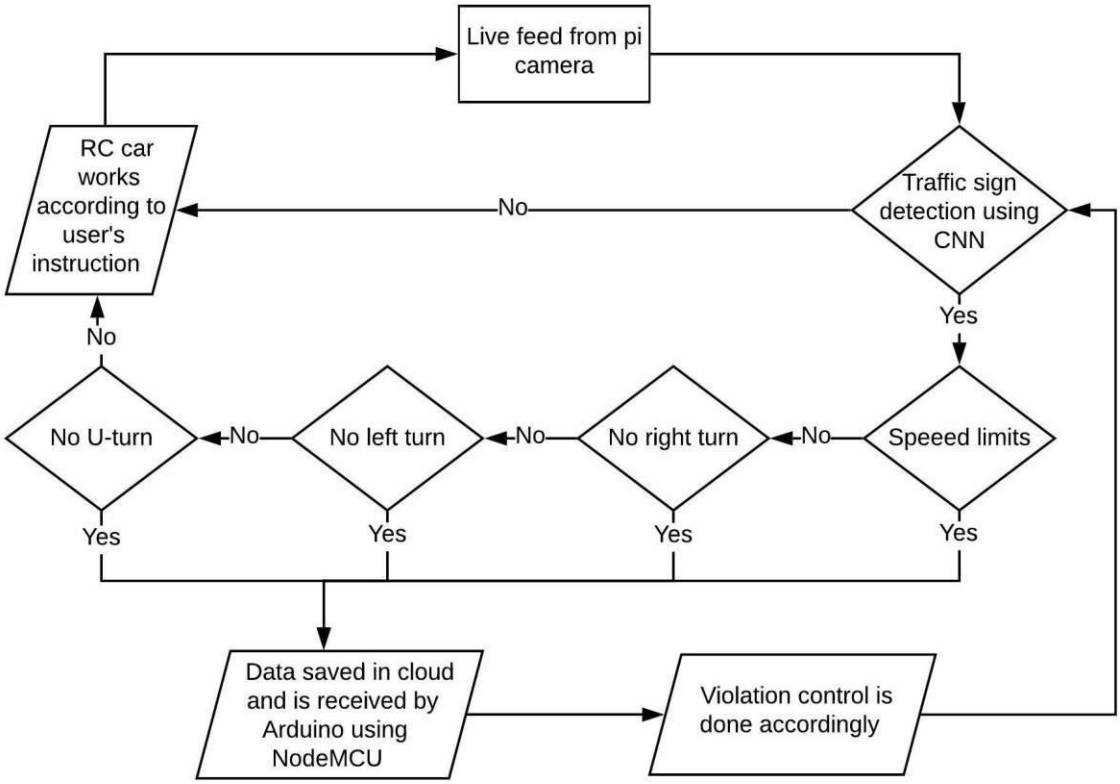

Fig.2.Flowchart for the working of the prototype.

IV. PSEUDO CODE

Step-1**:** Select the number K of the neighbors
Step-2**:** Calculate the Euclidean distance of **K number of neighbors**
Step-3**:** Take the K nearest neighbors as per the calculated Euclidean distance.
Step-4**:** Among these k neighbors, count the number of the data points in each category.
Step-5**:** Assign the new data points to that category for which the number of the neighbor is maximum.
Step-6**:** Our model is ready.

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VI. SIMULATION RESULTS

This section contains the images of the results of the built of RC car, detection of traffic signs ,and the cloud data log.

A. *Assembly of the prototype*

RCcar model consists of six major components ,namely

- Raspberrypi-3
- Arduino UNO
- Pi camera
- Node MCU
- Bluetooth Module
- Motor driver

Fig.3 illustrates the assembly of the components stated above to depict the built of the RC car. Raspberry pi along with the pi camera would be mounted on the battery to have an enhanced view to capture the traffic signs fast and accurately.

B. *Detection of traffic signs*

The images below Fig.4 to Fig.8 depicts the detected traffic sign of each class. The accuracy of detection comes out to be 95% as evaluated by the test data set. The performance of detection is good enough to differentiate the background from the traffic sign and fast enough to detect the traffic sign before it is late to perform the violation control. The speed and accuracy of detection are entirely dependent on the data set that had been used because the count to f images present in each class is different. If the count of images in a class for training is high, it would provide a better result than the one which had fewer images. No left (Fig. 6) is detected precisely and faster than no right(Fig.7)and no U-turn(Fig.8) as the number of images in the dataset for no left was higher than no right and no U-turn and same is in the case of speed limits too, detection of speed limit(Fig.4) is faster and precise than speed limit-60(Fig.5).

C. *IoT cloud data logs.*

Fig.6 illustrates the cloud data log where the raspberry pi had sent the data to the cloud and stored as ASCII values in continuous as the traffic signs are been detected. Arduino UNO with the help of Node MCU connects to the cloud to retrieve the ASCII values in continuous to the Arduino code and it is thus converted to analog signals. The speed of processing data from Raspberry pi3 to cloud and from cloud to Node MCU is very fast and has very little time lag in such a way that it would not affect the violation on time.

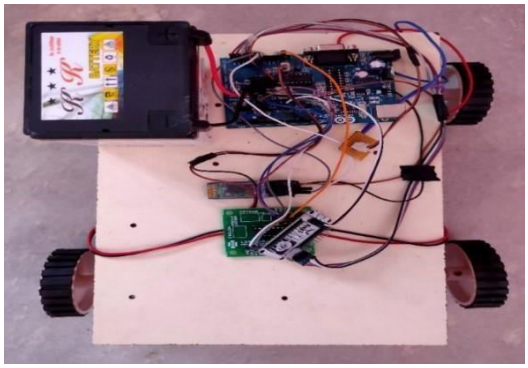

Fig.3.AssemblyoftheRCCar

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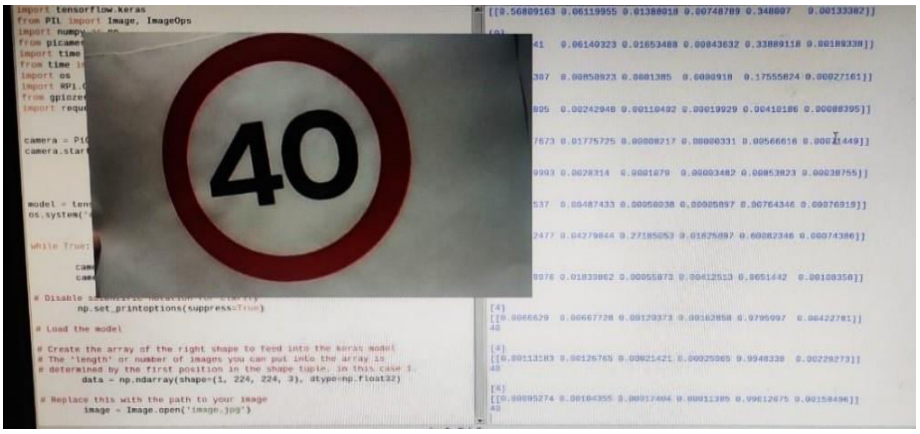

Fig.4.Detectionofspeedlimit40

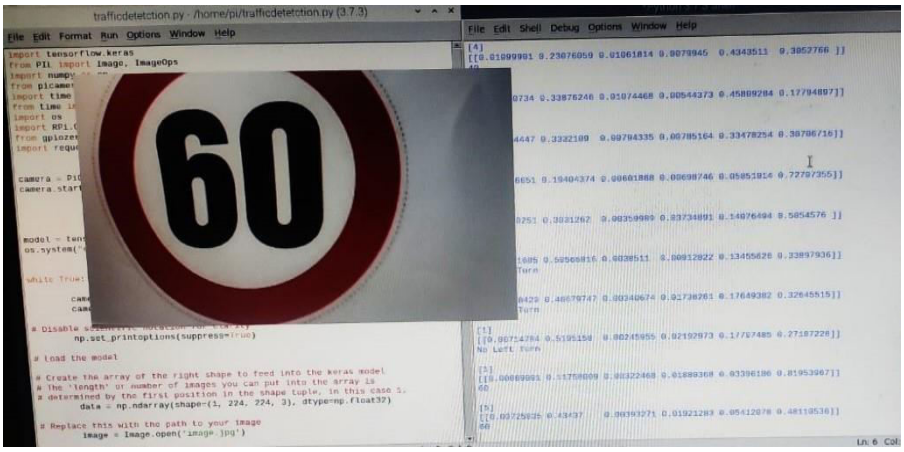

Fig.5.Detectionofspeedlimit60

Fig.6.IoTclouddatalogs

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V. CONCLUSION AND FUTURE WORK

Traffic sign detection using CNN and Keras has been done using python and implemented in raspberry pi 3 where the integration of the RC car model with the traffic sign detection is done by logging the data continuously into the IoT cloud. The major idea of the system is to increase automation which would result in the reduction of human error and an increase in reliability, efficiency, and speed. All methods and algorithms brought up in this paper are implemented in an RCcar with favourable outcomes and detailed description has been made on the method, algorithm and the components used.

For future enhancement, speed, and accuracy of traffic sign detection can be enhanced by various other advanced deep learning algorithms like You Only Look Once (YOLO) can be used with the help of advanced resolution cameras. More automation can be introduced in the RC car by performing automatic violation control in the RC car for many other traffic signs.

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