IoT Based Traffic Sign Detection and Recognition

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Abstract: In today's world, almost everything we do has been simplified by automated tasks. In an attempt to focus on the road while driving, drivers often miss out on signs on the side of the road, which could be dangerous for them and for the people around them. This problem can be avoided if therewas an efficient way to notify the driver without having themto shift their focus. Traffic Sign Detection and Recognition (TSDR) plays an important role here by detecting and recognizing a sign, thus notifying the driver of any upcoming signs. This not only ensures road safety, but also allows the driver to be at little more ease while driving on tricky or newroads. This paper presents a summary of traffic sign detection and recognition. It describes the characteristics andrequirements and also difficulties between the road sign identification and recognition of the road signs. It shows the color detection from road sign technique used for verificationand classification of the road signs. The paper introduces a traffic sign detection and recognition system that accurately estimates the situation and exact boundary of traffic signs signs using Arduino UNO and color sensor TCS230. During this project, we'll identify the colors of the and recognize the signs accordingly. With this model, we are ready to read and understand traffic signs which are a really important task for all autonomous vehicles. Another commonly faced problem is not being able to understand the meaning of the sign. Withthe help of this Advanced Driver Assistance Systems (ADAS) application, drivers will no longer face the problem of understanding what the sign says. In this paper, we propose a method for Traffic Sign Detection and Recognition using image processing for the detection of a sign and an ensemble of Convolutional Neural Networks (CNN) for the recognition of the sign. CNNs have a high recognition rate, thus making it desirable to use for implementing various computer vision tasks. Tensor Flow is used for the implementation of the CNN. We have achieved higher than 95% recognition accuracies for circular signs on the Belgium and German data sets.

Keywords: Traffic sign detection, traffic sign recognition, color sensor TCS230, Arduino UNO.

I. INTRODUCTION

Traffic sign detection may be a major crisis in intelligent vehicles; traffic sign recognition provides critical information like directions and alerts in autonomous driving or driver assistance systems. In self-driving cars, the passenger can fully depend upon the car automation for traveling. But to realize level 5 autonomous, it's necessary for vehicles to know and follow all traffic rules. In the world of AI and advancement in technologies, many researchers and large companies like Tesla, Uber, Google, Mercedes-Benz, Toyota, Ford, Audi, etc are performing on autonomous vehicles and self-driving cars. So, for achieving accuracy during this technology, the vehicles should be ready to interpret traffic signs and make decisions accordingly. There are several differing types of traffic signs like speed limits, no entry, traffic signals, turn left or right, children crossing, no passing of heavy vehicles, etc. Traffic signs classification is that the process of identifying which class a traffic sign belongs to.

The traffic signs focus on reduction of the traffic load on existing road network through various travel demand management measures. Traffic signs should remove the encroachments, congestion and improve the traffic signal, road condition and geometrics features at intersections. The traffic signs should be as a guidance or speaker on a road network. Traffic sign reduce the traffic congestion along the road and also provide facilities for the road users. Road signs notify road users of regulations and provide warning and guidance needed for safe, uniform and efficient operation. The purpose of road signs is to promote road safety and efficiency by providing for the orderly movement of all road users on all roads in both urban and non-urban areas. The use of traffic sign recognition system is very challenging. Since rain, fog, snow etc, affect the whole system. Another thing is the light variation i.e., shadows, sun, clouds etc. The geometrical shape of the object and the perspective is also a big concern. So, we must be able to come up with a system which can work under light variation and geometrical transformation of the objects in a scene. If we narrow down the scope, we are particularly interested in detection of these signs under low light condition. In short, our objective is to make the system very accurate and efficient. In the detection stage, color information is exploited to detect regions of interest (ROI) that may correspond to traffic signs. The shape of these regions is tested in the classification stage, allowing rejecting many of the initial candidates and grouping traffic signs into classes.

The pictogram contained on each ROI (if exist) is extracted, analyzed and compared with the pictogram database. The best match between the ROI and database pictogram, if high enough, is considered the sign that is more likely to appear in that ROI. Each recognized sign is part of the output result of the recognition stage.

II. LITERATURE SURVEY

The method described by Shustanov, P. Yakimov [1] used for Road Sign Detection and Recognition is image processing technique which consist of a group of (CNN) for the recognition called as ensemble. The recognition rate for the CNN is very high, which makes it more desirable for various computer-based vision tasks. The method used for the execution of CNN is TensorFlow. The members of this paper achieved more than 99 percent of accuracy for circular signs on using German data sets.

Walietal [2] describes how they have used to implement a novel method for sign recognition. They used advanced ARK-2121 technology which is small computer which they installed this tech on the car. The major techniques in the recognition step of the sign were SVM and HOG. They achieved an accuracy of 91% in detection and about 98% average on the classification process.

R. Qian etal [3] describes the analysis and design process of “German Traffic Sign Recognition Benchmark” dataset. The outputs of this project showed that algorithms of machine learning showed very well in recognition of traffic signs. The participants got a very good percentage of 98.98 recognition rate which is as high as human perfection on these datasets.

Liu et al. in [4] is used SIFT matching based SVM for detecting and recognizing broken signs. In this method, images captured from a on board camera and then readjusted by SIFT matching technique to a standard camera axis and compared to a reference image by SVM.

Gao et al. [5] used LCH spacing model.fit.chromatic-adaptation transform, which is called Bradford transform. FOSTS model is then applied for shape analysis. Recognition process is performed by comparing the 49-dimensional vectors representing a current image with template vectors stored in the database that has been classified into several color/shape subgroups with an accuracy of 95%.

III. METHODOLOGY

Traffic sign detection may be a major crisis in intelligent vehicles, traffic sign recognition provides critical information like directions and alerts in autonomous driving or driver assistance systems. you all have heard about the self-driving cars during which the passenger can fully depend upon the car for traveling. But to realize level 5 autonomous, it's necessary for vehicles to know and follow all traffic rules. In the world of AI and advancement in technologies, many researchers and large companies like Tesla, Uber, Google, Mercedes-Benz, Toyota,

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Ford, Audi, etc are performing on autonomous vehicles and self-driving cars. So, for achieving accuracy during this technology, the vehicles should be readyto interpret traffic signs and make decisions accordingly. There are several differing types of traffic signs like speed limits, no entry, traffic signals, turn left or right, children crossing, no passing of heavy vehicles, etc. Traffic signs classification is that the process of identifying which class a traffic sign belongs to. The framework we proposed is categorized into three stages: Detection and feature extraction and recognition. The detection stage is just used tofind a road sign. At the point when a vehicle is travelling at aspecific speed, the camera catches the road sign in nature, and our calculation verifies whether a sign is available in that outline or not available in that perimeter. Distinguishing the traffic sign depends on shape and color. In the feature extraction stage, the proposed calculation characterizes the distinguished road sign. This is accomplished with the assistance of "Convolutional Neural Network" algorithm which classifies the image into sub classes.

In this project, we make a CNN block where predictions are directly preformed across multiple feature levels. For this project, we are using the general public dataset available at Kaggle i.e GTSRB. Our approach to putting together this traffic sign classification model is discussed in four steps:

Step 1: Explore the data set Our 'train' folders contain 43 folders each representing a special class. The range of thefolder is from 0,1,2, up to 42. With the assistance of theOS module, we iterate over all the classes and append images and their respective labels within the data and labels list.

Step 2: Build a CNN model to classify the pictures into their respective categories, we'll build a CNN model (Convolutional Neural Network). CNN is best for imageclassification purposes.

Step 3: Train and validate the model After building architecture, we then teach the model using
Step 4: Test our model with test data set Our data set contains a test folder and during a test.csv file, we've the small print associated with the image path and their respective class labels. Now we are getting to build a graphical interface for our traffic signs classifier with Tkinter. Tkinter is nothing but a GUI toolkit within the standard python library. Here we upload the pictures and classify the image.

This project we'll develop using python. We are getting to develop a model which can detect the traffic sign. We build deep neural network model which will identify which traffic sign is present therein image. We also used PIL library to open image content into array. Our data set contain train folder which carries folder each represents different classes and in test folder we've the small print associated with the image path and their respective class labels.

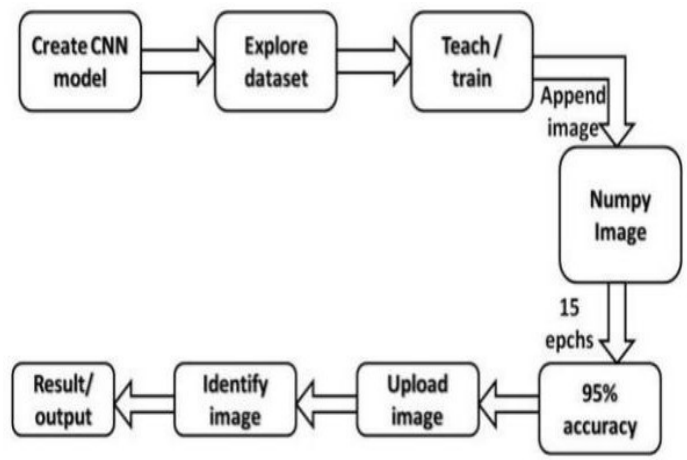

Fig 1: System architecture

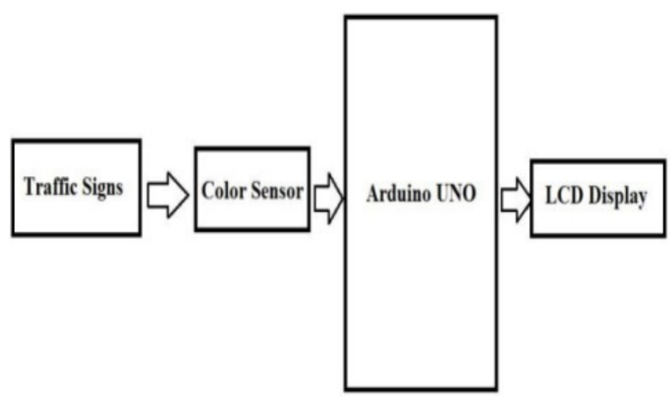

Fig 2: Block diagram of Proposed system

- The figure 2 describes the block diagram of IoT based traffic sign detection and recognition.

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- First, provide the input as traffic sign images that as to bedetected and recognized.
- The color sensor which is used to sense the colors, will identify the type of input traffic image based on the RGB colors.
- The Arduino UNO will take the analog input from the color sensor and converts it into digital values.
- Finally the desired output is displayed on the LCD.

IV. HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements

A. Color Sensor (TCS230)

Colour sensors are developed based on diffuse technology that can detect a wide range of colours. The combination of colour sensitive filters and sensors array perform colour sensing, which is further used to analyse the colour present inan image or in a specified object. The colour measurement process involves a light source to illuminate the surface, the target surface, and a receiver that measures the reflected wavelengths. A white light emitter is used to illuminate the surface. The sensor then activates three filters with three wavelength sensitivities to measure the wavelengths of RGB colours respectively. Based on these three colours, the colour of the material is determined. Modern colour sensing has seen the involvement of fibre optics in the colour detection process. In this technology, the light transmission to the object and back depends on the optical glass fibres, which operate on the principle of total internal reflection. Thisphenomenon causes fibre to act as a waveguide and enables the complete reflection of light. In a fibre optic colour sensor, the white light spot is projected via the fibreopticonto the target surface; the part of light that is reflected back from thetarget is directed onto the detector via the same optical fibre.The reflected light is then separated into long, medium and short-wave light components. and transformed into L*a*b* colour coordinates. Colour sensors are majorly used to gradecoloured products, distinguish coded markings, detect the presence of adhesives or data codes on a package. The technology has a wide range of applications in various industries such as textile, automation, automotive, food, printing, pharmaceutical, and many more. These sensors can also be programmed to identify any one colour or multiple colours for sorting applications, based on the level of sophistication required in the colour measurement process.

B. Arduino UNO

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSPheader and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

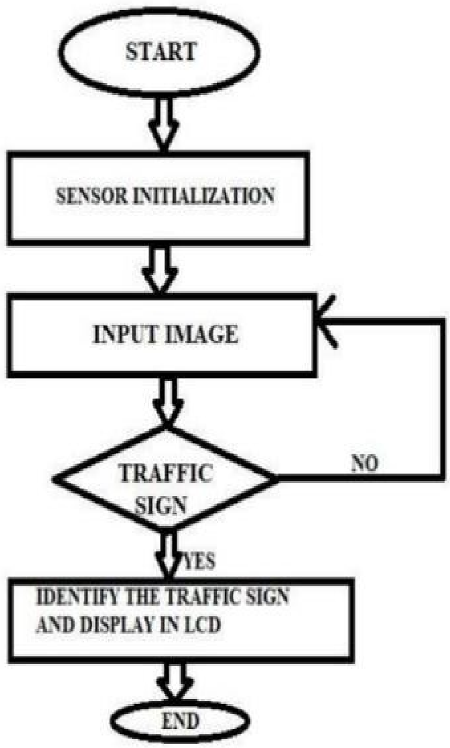
C. LCD (Liquid crystal display)

A liquid-crystal display (LCD) is a flat-panel display or otherelectronically modulated optical device that uses the light-modulating properties of liquid crystals combined withpolarizers. Liquid crystals do not emit light directly[1] but instead use a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden. For instance: preset words, digits, and seven-segment displays, as in a digital clock, are all good examples of devices with these displays. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. For example, a character positive LCD with a backlight will have black lettering on a background that is the color of the backlight, and a character negative LCD will have a black background with the letters being of the same color as the backlight. Optical filters are added to white on blue LCDs to give them their characteristic appearance.

Software Requirements

- Jupyter Notebook

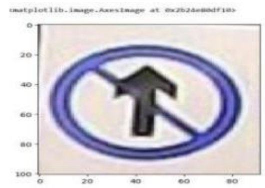
V. WORKING OF PROPOSED MODEL



Step 1: Start
Step 2: Sensor Initialization
Step 3: Input Image
Step 4: Is The Given Image A Traffic Sign If No Go To Input Image If Yes Identify The Traffic Sign And Display In Lcd
Step 5: End

VI. RESULTS

In this project we've successfully classified the traffic signs using color sensor to sense the colors of road signs and identify the signs respectively & CNN classifier with 95% accuracy and also visualized how our accuracy and loss changes with time, which is pretty good from an easy CNN model.

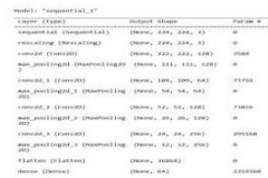


Out[4]:

	ClassId	Name
0	0	Speed limit (5km/h)
1	1	Speed limit (15km/h)
2	2	Speed limit (30km/h)
3	3	Speed limit (40km/h)
4	4	Speed limit (50km/h)

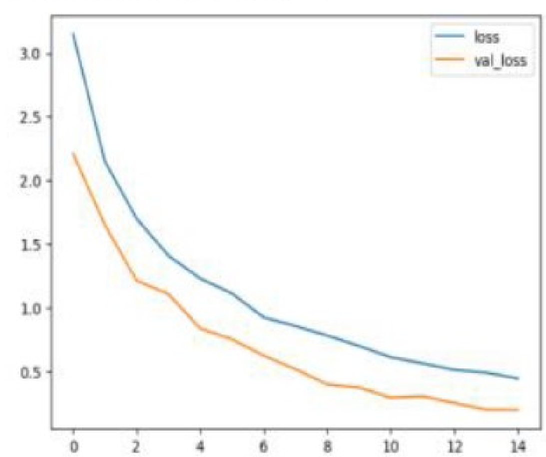
Out[5]:

	ClassId	Name
53	53	Give Way
54	54	No stopping
55	55	No entry
56	56	Unknown7
57	57	Unknown8




```
Epoch 10/15
105/105 [==============================] - 3526s 34s/step - loss: 0.6972 - accuracy: 0.7653 - val_loss: 0.3696 - val_accurac
y: 0.8825
Epoch 11/15
105/105 [==============================] - 918s 9s/step - loss: 0.6090 - accuracy: 0.8004 - val_loss: 0.2902 - val_accuracy:
0.9149
Epoch 12/15
105/105 [==============================] - 952s 9s/step - loss: 0.5607 - accuracy: 0.8135 - val_loss: 0.3024 - val_accuracy:
0.8969
Epoch 13/15
105/105 [==============================] - 1181s 11s/step - loss: 0.5099 - accuracy: 0.8201 - val_loss: 0.2477 - val_accurac
y: 0.9089
Epoch 14/15
105/105 [==============================] - 1343s 9s/step - loss: 0.4880 - accuracy: 0.8375 - val_loss: 0.1967 - val_accuracy:
0.9472
Epoch 15/15
105/105 [==============================] - 902s 9s/step - loss: 0.4421 - accuracy: 0.8522 - val_loss: 0.1937 - val_accuracy:
0.9496
```

Out[20]: <matplotlib.legend.Legend at 0x2b25bd95c70>



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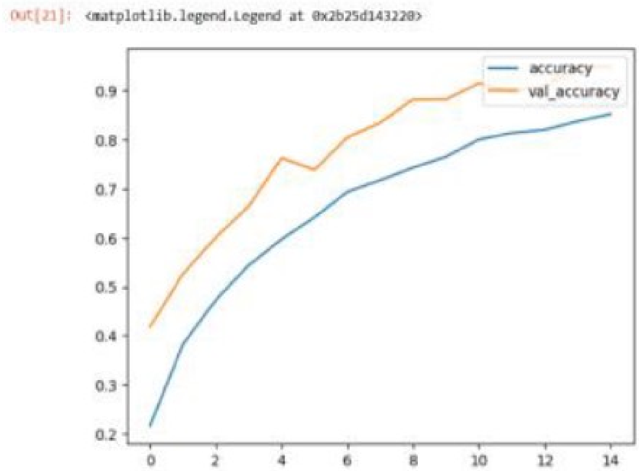

Hardware Output

VII. CONCLUSION

In this paper, we proposed an efficient traffic sign detection and recognition method to the present end; we generalized the traffic sign templates with precise boundaries and high accuracy. To achieve practical detection speed, we have used color sensor to recognize the road signs and we explored the best-performing convolution neural network for both detection & recognition considering the characteristics of traffic signs. By using the images of traffic signs, our method effectively utilizes strong information of target shapes to the drivers. The hardware used in this project is very less when compared to other models, which reduces cost and also free from hardware impairments. Color features extracted using vision models can perform accurate recognition for traffic signs located at a reasonable distance for still images under various viewing conditions. This approach shows a good performance for a wide variety of traffic signs of different colors, forms, and informative content. For detection of a sign, this paper depends on color and shape of the sign. CNN algorithm is preferred more compared to other algorithms since it provides high efficiency and there is a problem if there is a reflection on the sign which impacts its color. Similarly, if the sign is not proper or cut off, the shape of the sign is impaired, thus resulting in improper detection of the sign which leads to fault detection. Another important issue to consider is detection in the night. If the camera used is infrared then there is no problem in detecting signs but in case of no infrared webcam which may not detect signs accurately which causes high chance of accidents. Adding text to speech module in our model makes the driver effortless and makes him to concentrate completely on driving rather than checking for traffic signs. This reduces the occurrence of accidents during night and as well as day time. The hardware used in this project is very less when compared to other models, which reduces cost and also free from hardware impairment

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