A DEEP NEURAL NETWORK APPROACH FOR TRAFFIC SIGN RECOGNITION

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ABSTRACT
Road signs are crucial for ensuring a safe and orderly flow of traffic. Negligence in failing to read traffic signs and misinterpreting them is a significant contributor to auto accidents. The suggested system assists in identifying traffic signs and alerting the driver through speaker so that he or she may make the appropriate selections. Convolutional Neural Network (CNN) training is used in the proposed system to aid in the detection and categorization of images of traffic signs. To increase the accuracy of a given dataset, a set of classes are created and trained. We used the German Traffic Sign Benchmarks Dataset, which includes 51,900 photos of traffic signs in around 43 categories. About 98.52 percent of the execution was accurate. A voice alarm is broadcast over the speaker when the system recognizes the sign to inform the driver. The proposed system also has a component where drivers of moving vehicles are informed of nearby traffic signs so they are aware of the laws they should observe. The system's goal is to protect the driver, passengers, and pedestrians from harm.

1. INTRODUCTION

Computational models with numerous processing layers may learn representations of data at various levels of abstraction thanks to deep learning. The state-of-the-art in many other fields, including drug discovery and genomics, object identification, visual object recognition, and voice recognition has been significantly enhanced by these techniques. By employing the back propagation approach to suggest changes to a machine's internal parameters that are used to compute the representation in each layer from the representation in the previous layer, deep learning may uncover detailed structure in big data sets. Recurrent networks have shed light on sequential data types like text and voice, whereas deep convolutional nets have made advancements in the processing of pictures, video, speech, and audio.

Numerous technical developments have led to the development of vehicles having an autopilot mode. There are now autonomous automobiles on the road. The market for autonomous vehicles has seen tremendous growth. These amenities, however, are only found in a select few expensive vehicles that the general public cannot purchase. To some extent, we sought to create a system that makes driving easier. We conducted a survey and discovered that India has alarmingly high rates of traffic accidents. According to reports, there are roughly 53 accidents on the roadways per hour. Additionally, these accidents result in more than 16 deaths each hour [18]. When a motorist disobeys traffic signs, they endanger not only their own life but also the lives of other drivers, their passengers, and other road users. We developed this technology as a result, in which traffic signs are automatically identified using the live camera stream and delivered out to the driver so that they may make the appropriate decision. The concept of using GPS to determine the user's position is another area of attention in our system. Additionally, a database will be used to retain all traffic signs and their locations so that the motorist can be alerted in advance of the next traffic sign.

2. OBJECTIVE

A Convolutional Network's design is comparable to the human brain's neuronal connection pattern. The arrangement of neurons in the human brain's Visual Cortex served as inspiration for the design itself. Only in a certain area of the field of vision, referred to as the "Receptive Field," do neurons react to inputs. The visual region is made up of a variety of these receptive fields that enable humans to perceive objects. The model gains the capacity to discriminate between the dominant characteristics and certain low-level features in the pictures after being trained across several epochs, or iterations. The model uses the SoftMax Classification approach to classify them based on this training.

2.1 PROBLEM STATEMENT

Due to the rising number of automobiles on the road and the resulting problems with traffic congestion and accident frequency, the current system of traffic safety confronts difficulties. These safety issues are frequently brought on by human causes, such as poor driving skills and disregard for the law. The current approach suggests using a Capsule & multi-feature fusion network for traffic sign identification to overcome these problems. The accuracy of traffic sign identification is significantly impacted by this algorithm's limits in terms of how well it can adapt to different environmental circumstances, such as inclement weather, fading, and changes in illumination. To overcome the shortcomings of the current technique and assure proper identification of traffic signs in a variety of environmental situations, the problem statement centered around designing a more robust and adaptive algorithm for traffic safety.

2.2 EXISTING SYSTEM

Burgoon et al. employed a DT algorithm with 15-fold cross-validation to reach an accuracy of 60.72% utilizing 16 linguistic characteristics divided into four groups.

Vicario et al. identified hoaxes and fake news on social media using linear regression, logistic regression, support vector machine (SVM), K-nearest neighbor (KNN), and NNs. These features included text (e.g., number of characters, words, sentences, question marks, and negations), user-specific, and message-specific (e.g., number of replies, likes), among others. The validation on a new feature-rich Italian Facebook data set produced a linear regression classification algorithm accuracy of 91%.

Major linguistic components, such as n-grams, punctuation, psycholinguistics, readability, and syntax, were employed by Pérez-Rosas et al. to obtain an accuracy of 76% on two new data sets including seven domains.

Disadvantage of Existing System

- False information, like fake news, which is destructive to society and people, is made possible by the rapid dissemination of data at a high pace with little effort.
- Verifying the identity of users and the messages exchanged is one of the biggest problems with OSNs. Some of the messages that are disseminated via these social networks have the potential to seriously undermine social harmony and peace. These communications, which are now referred to as false news, can also be fatal.

- The current setup is also a sparse matrix. This indicates that using it for computations and storage is not efficient.
- The matrix size increases as the vocabulary size decreases (not scalable to high vocabulary).
- Using this method, not all word connections can be understood.

2.3 PROPOSED SYSTEM

We use a convolutional neural network to create the voice alert and traffic sign board recognition systems in our proposed system. Our system's capacity to find, identify, and infer traffic signs on the road will be of enormous assistance to drivers.

One or more road signs must be identified and categorized using an automated method for recognizing traffic signs from live, colorful imagery.

In this foundational study, we use the voice of the detected sign board to warn the driver about the sign. The technology gives the driver real-time data from traffic indicators, which are the most crucial and difficult responsibilities. Next, provide the motorist an audible warning before any risk arises. The driver can then use this notice to make the necessary corrections to lessen or fully prevent the incident.

Advantages of Proposed System

- The suggested system's accuracy is 97%, and this model ended up providing the greatest accuracy when compared to the other models we examined in the past.
- Our approach additionally includes a popup that reads "No Sign Detected" if a certain image does not contain a traffic sign.
- Despite several missed detections, the detector continues to perform incredibly effectively even in several challenging scenarios.
- The presentation of all traffic-sign detections for a few full-resolution photos represents an excellent performance.
- The system offers an effective deep network for quickly and effectively learning many categories.

3. RELATED WORKS

in their 2011 paper "Traffic Sign Recognition with Multi-Scale Convolutional Networks": This study proposed a multi-scale convolutional neural network-based deep learning method for recognizing traffic signs. The authors suggested additional layers and tweaks to the LeNet-5 design to boost performance. Dan Ciresan and colleagues (2012) published "Traffic Sign Recognition with Convolutional Neural Networks for Efficient Large-Scale Deployments": This work established a deep neural network architecture based on LeNet-5 for the identification of traffic signs. The German Traffic Sign Recognition Benchmark was successfully completed by the authors after they trained the network on a sizable dataset. German Ros et al. (2016)'s "Traffic Sign Recognition Using Deep Convolutional Neural Networks": This study aimed to enhance the performance of deep convolutional neural networks for traffic sign identification. The LeNet-5 architecture that the authors suggested was trained using a large dataset. Compared to conventional machine learning methods, the findings indicated enhanced accuracy.

By Marcelo Bertalmo and Edoardo Provenzi in their 2017 paper "Traffic Sign Recognition Based on Convolutional Neural Networks with Color Transformations": In this study, convolutional neural networks were used to investigate the use of color changes in traffic sign identification. LeNet-5 was integrated with several color spaces by the authors, who then tested the performance on a variety of datasets and saw encouraging results. Aditya Patel and Anand Mishra's (2018) study "Traffic Sign Recognition Using LeNet-5 and Support Vector Machines": Support vector machines (SVMs) and the LeNet-5 architecture were coupled in this study to recognize traffic signs. The authors achieved great accuracy on the German Traffic Sign Recognition Benchmark by using the features retrieved by LeNet-5 as input to an SVM classifier.

4. METHODOLOGY OF PROJECT

With its deep hierarchical design and mini-batch proposal selection process, which enables the neural network to recognize both traffic signs and traffic lights by training them on different datasets, we nearly completely agree with all the articles mentioned above. By using this technique, the issue of instances from one dataset not having labels in the other is fixed. The system offers the concept of traffic sign localization for driver assistance, which helps to give our project a new level [15]. Using a single-color camera and a high precision GNSS (global navigation satellite systems) receiver, the location of the traffic sign may be pinpointed to within one meter. According to [16], assessing a driver's style of driving may also be done using GPS information obtained from the person's mobile phone in addition to traffic signs in the area. It aids in categorizing a driver's aggressive or safe driving style.

MODULE DESCRIPTION:

Dataset:

We created a system in the first module to obtain the input dataset for training and testing. We used the dataset from the International Joint Conference on Neural Networks' German Traffic Sign Benchmark single-image classification task. The dataset comprises of 39,209 photographs of traffic signs and 2068 images without signs. In all, we utilized 41277 images.

Importing the necessary libraries:

Python will be the language we use for this. To create the primary model, partition the training and test data using Sklearn, turn photos into arrays of numbers using PIL, and use additional libraries like pandas, NumPy, matplotlib, and TensorFlow, we must first load the appropriate libraries.

Retrieving the images:

The photos and their metadata will be retrieved. The photographs should then be resized to 30 by 30 as all images need to be the same size to be recognized. Then, create a NumPy array from the photos.

Splitting the dataset:

Create train and test datasets. 80 percent train data, 20 percent test data.

Building the model:

We will utilize the sequential model from the Keras library to create the. The layers will be added after that to create the convolutional neural network. 32 filters and a kernel size of 5.5 were employed in the first 2 Conv2D layers.

The MaxPool2D layer's pool size is set to (2,2), which means it will choose the highest value from each section of the picture that is 2 x 2 pixels. By doing this, the image's size will shrink by a factor of 2. We kept the dropout rate in the dropout layer at 0.25, which indicates that 25% of neurons are eliminated arbitrarily.

We reapply these three layers with a few tweaks to the settings. Next, we apply a flatten layer to turn 2-D data into a vector in 1-D space. Following this layer are a dense layer, a dropout layer, and another dense layer. As the traffic signs in our dataset are separated into 44 categories, the final dense layer produces 43 nodes. This layer makes use of the SoftMax activation function to determine which of the 44 possibilities has the highest likelihood by providing a probability value.

Apply the model and plot the graphs for accuracy and loss:

The model will be built, and the fit function will be used to apply it. 32 batches will be created. The graphs for accuracy and loss will then be plotted. Average training accuracy was 96.3%, while average validation accuracy was 94.6%.

Accuracy on test set:

On the test set, we had an accuracy of 96.7%.

Voice alert:

A Python text-to-speech conversion package is called pyttsx3. It is compatible with Python 2 and 3 and works offline, unlike competing libraries. To obtain a reference to a pyttsx3. Engine instance, an application calls the pyttsx3.init() factory method. It is a highly user-friendly program that turns typed text into voice.

Two voices are supported by the pyttsx3 module. The "sapi5" for Windows program provides the first as a girl and the second as a guy.

Saving the Trained Model:

The first step is to store your trained and tested model into a.h5 or .pkl file using a library like pickle after you are confident enough to use it in a production-ready environment.

Verify that Pickle is set up in your environment.

The model will now be imported into the module and stored in the .pkl file.

5. ALGORITHM USED IN PROJECT

- **Convolutional Neural Network (CNN):**

The Convolutional Neural Network (CNN) algorithm is a type of deep learning method. CNN can take a photo as input, prioritize certain elements within the picture, and separate them from one another. Compared to other classification methods, it requires a lot less pre-processing. In contrast to rudimentary approaches where filters are applied manually, convolutional networks have the capacity to learn the filters or properties in the pictures.

A Convolutional Network's design is comparable to the human brain's neuronal connection pattern. The arrangement of neurons in the human brain's Visual Cortex served as inspiration for the design itself. Only in a certain area of the field of vision, referred to as the "Receptive Field," do neurons react to inputs. The visual region is made up of a variety of these receptive fields that enable humans to perceive objects. The model gains the capacity to discriminate between the dominant characteristics and certain low-level features in the pictures after being trained across several epochs, or iterations. The model uses the SoftMax Classification approach to classify them based on this training. represents how many layers were utilized to create the model. Along with dropout, flatten, and dense layers, there are four convolutional layers and two max pooling layers. The neural network makes use of the Adam optimizer. The image's input dimensions are 30*30*1. The activation function of the ReLU is used in the model. After the Flatten layer, we have a fully linked layer. And lastly, the SoftMax activation function is used to calculate the output.

SYSTEM ARCHITECTURE

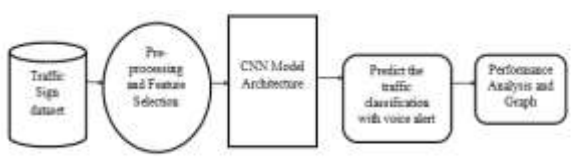

Fig: System Architecture Of Project

6. DATA FLOW DIAGRAM

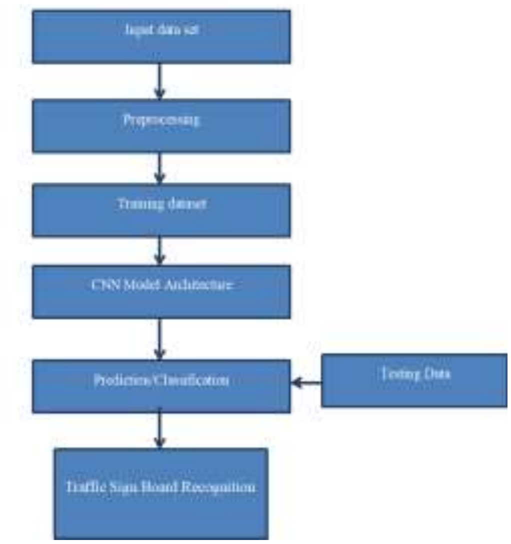

Fig. Data Flow Diagram

7. RESULTS

8. FUTURE ENHANCEMENT

A built-in alert system with a camera in the middle of the car may be added to the prototype. Additionally, it is possible to add the capability of receiving an estimated time to arrive at a certain traffic sign. This system may be enhanced to recognize traffic lights, prompting the user with information about how long it will take them to arrive at a specific signal and its current state. The user may schedule their journey start time properly and can proceed through all signals immediately. Additionally, the API used for driver verification will provide data about the license holder and their license number.

9. CONCLUSION

Convolutional Neural Network is used in the Traffic Sign Board Detection and Voice Alert System implementation. Several CNN models were investigated, and the one that produced the best results on the GTSRB dataset was used. The model's accuracy has increased because of the numerous classes that have been created for each traffic sign. Following the identification of the sign, an audio message warns the motorist, assisting him or her in making the right choices. This study represents a significant achievement in the world of driving since it simplifies the driver's duty without sacrificing safety. Additionally, this system is simple to develop and does not require a lot of hardware, which broadens its use.

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