TRAFFIC SIGN DETECTION AND RECOGNITION SYSTEM USING CNN

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ABSTRACT_ Traffic signs are critical in conveying information to vehicles. Thus, understanding traffic signs is critical for road safety, and ignorance can result in accidents. Over the last few decades, researchers have focused on traffic sign detection. Real-time and precise detections are the foundations of a strong traffic sign detection system that has yet to be realized. This paper describes a voice-assisted real-time traffic sign recognition system that can aid drivers. This system has two subsystems. Initially, traffic signs are detected and recognized using a trained Convolutional Neural Network (CNN). After recognizing the traffic sign, it is narrated to the driver as an audio message via a text-to-speech engine. Using Deep Learning techniques, we create an efficient CNN model for a benchmark dataset for real-time detection and recognition. The benefit of this technology is that even if the driver misses a traffic sign, fails to look at it, or is unable to understand it, the system recognizes it and narrates it to the driver. A system of this type is also vital in the development of self-driving cars.

1.INTRODUCTION

Every nation has put in place appropriate road rules and regulations to guarantee safety because automobiles have become an essential mode of transportation. Among them, traffic signs give important data to the drivers and assist with imparting the guidelines to be continued in that particular region. The motivation behind a traffic sign is to pass on a message rapidly and precisely with least understanding abilities. Carelessness, absence of consideration, absence of commonality, coincidentally or intentionally not seeing traffic signs, diverting driving ways of behaving have been found as significant purposes behind the obliviousness of street signs among the drivers which ultimately lead to street mishaps. Besides, drivers in unurbanized networks might find it troublesome in deciphering the message passed by a particular street sign due on to an absence of knowledge of the a lot of street signs in urbanized regions. Certain traffic signs are often ignored by drivers who believe they are unnecessary. This ignorance is also caused by the drivers' diverse attitudes. Traffic signs can be difficult to understand, which could lead to serious accidents and even fatalities.

This paper proposes a method for narrating traffic signs to drivers and more accurately detecting and recognizing traffic signs in real time to address the aforementioned issues. An arrangement of this sort can be utilized in both vehicle assistive frameworks and independent vehicles. The framework is executed utilizing the Convolutional Brain Organization (CNN) model engineering of Just go for it. With the quicker location rates and streamlined precision of the model, the framework can be utilized as a continuous traffic sign discovery framework. A particular traffic sign's narration of the message can be helpful to drivers while they are driving. The difficulties of missing the traffic signs, not being familiar with them, and their complexity can be resolved through the voice narration.

2.LITERTURE SURVEY

Survey 1 – Proposed By: S.A. Bhaskar et al. (2020)

Methodology: Deep Learning Techniques, Convolutional Neural Network (CNN).

Description: Their study focused on optimizing convolutional neural network architectures and training methodologies to achieve high accuracy in real-time detection and classification tasks.

Outcome: By using CNN, Deep learning the accuracy rate of 0.875 is achieved. Drawbacks: As it rely on manually designed features, limiting their ability to generalize across diverse traffic signs types and environmental conditions.

Survey 2 – Proposed By: G. Zhang et al. (2018)

Methodology: Traditional deep learning techniques.

Description: The study compared different algorithms and highlighted the strengths and limitations of each approach providing insights into the state-of-the-art techniques in the field. Outcome: Using Traditional approaches the accuracy rate of 0.823 is achieved in 2018.

Drawbacks: Processing speed limitations can hinder real time performance crucial for applications like autonomous driving Survey

Survey 3– Proposed By: P.S. Amudhavel et al. (2019).

Methodology: Traditional computer vision techniques with CNN.

Description: Their research aimed to leverage the advantages of both approaches to improve detection accuracy and robustness under varying environmental conditions.

Outcome: Improved the accuracy rate compared to previous years i.e. 0.845.

Drawbacks: Scalability challenges arise with large datasets.

Survey 4 – Proposed By: R.K. Singh et al. (2019).

Methodology: Hardware and Software based solutions

Description: Their study provided an overview of empowering technologies and trends in the field, highlighting area for future research and development.

Outcome: Based on hardware and software solutions the accuracy rate achieved is 0.862.

Drawbacks: It depends on the environment.

Survey 5 – Proposed By: Y. Wang et al. (2020)

Methodology: Deep Learning, Geometric features.

Description: Their approach incorporated geometric constraints to improve the localization accuracy of detected signs, resulting in better overall performance compared to existing methods.

Outcome: The accuracy rate is increased to 0.902. Drawback: Lack of Robustness

3.PROPOSED SYSTEM

We are working on a technique that will allow us to more accurately detect and interpret traffic signs in real time while also explaining them to drivers. This kind of system can be utilized in autonomous automobiles as well as vehicle assisting systems. The convolutional Neural

Network (CNN) model, which has faster detection rates, is used to create the system.

A Convolutional Neural Network(CNN) is a type of deep learning algorithm that is particularly well-suited for image recognition and processing tasks. It is made up of multiple layers, including convolutional layers, pooling layers, and fully connected layers. The architecture of CNNs is inspired by the visual processing in the human brain, and they are well-suited for capturing hierarchical patterns and spatial dependencies within images.

Key components of a Convolutional Neural Network include:

1. **Convolutional Layers:** These layers apply convolutional operations to input images, using filters (also known as kernels) to detect features such as edges, textures, and more complex patterns. Convolutional operations help preserve the spatial relationships between pixels.

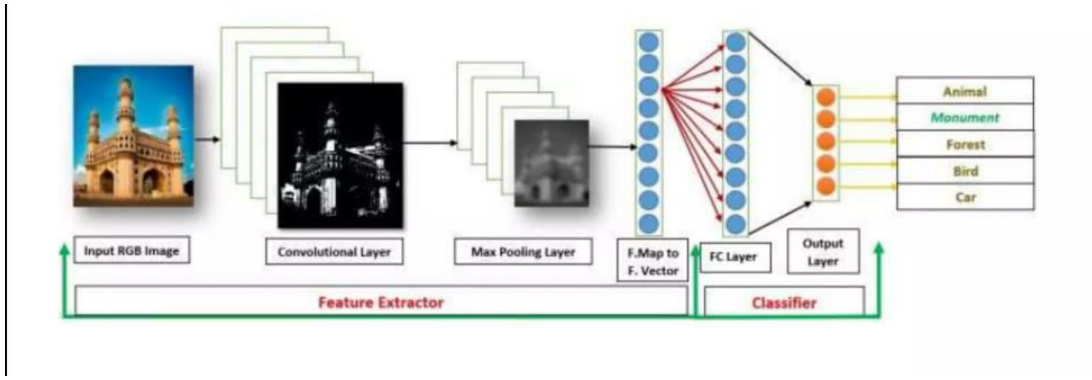

Fig 1: Convolutional layer

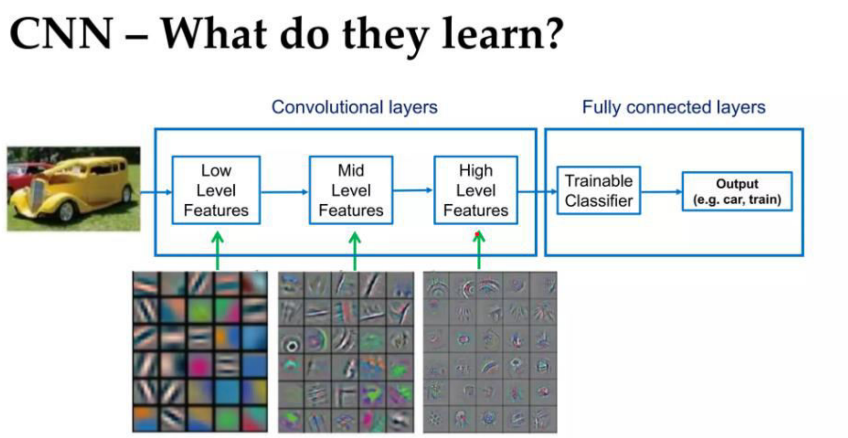

Fig 2: What CNN learn from the images

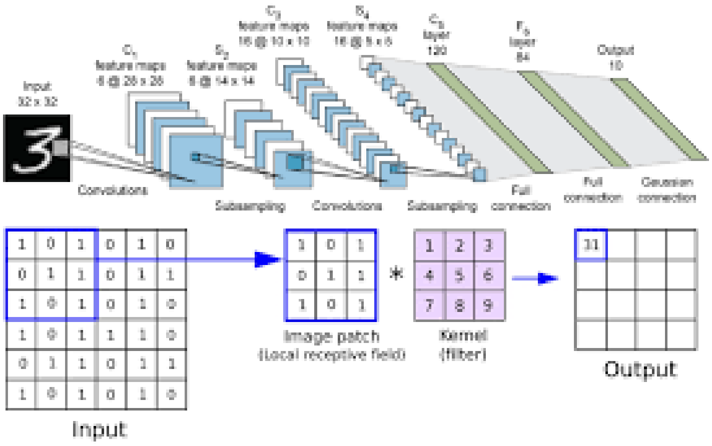

Fig 3: Convolutional layer from input to output image

2. **Pooling Layers:** Pooling layers downsample the spatial dimensions of the input, reducing the computational complexity and the number of parameters in the network. Max pooling is a common pooling operation, selecting the maximum value from a group of neighboring pixels.

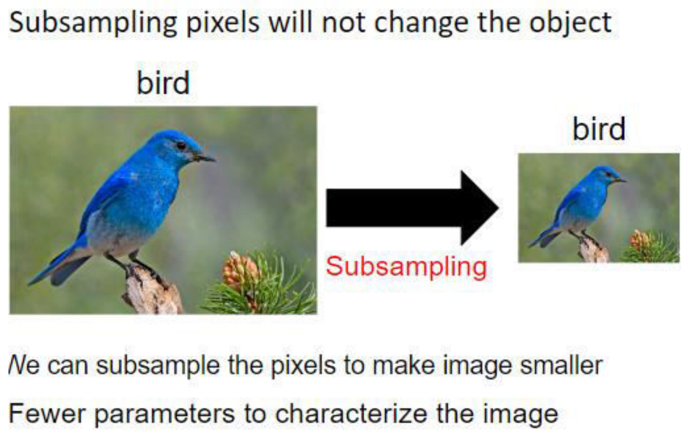

Fig 4: Subsampling in pooling

3. **Activation Functions:** Non-linear activation functions, such as Rectified Linear Unit

4. (ReLU), introduce non-linearity to the model, allowing it to learn more complex relationships in the data.

4. **Fully Connected Layers:** These layers are responsible for making predictions based on the high-level features learned by the previous layers. They connect every neuron in one layer to every neuron in the next layer.

3.1 IMPLEMENTATION

1. UPLOAD DATASET

Using this module we can load traffic sign dataset from the location of the project to Train the CNN algorithm.

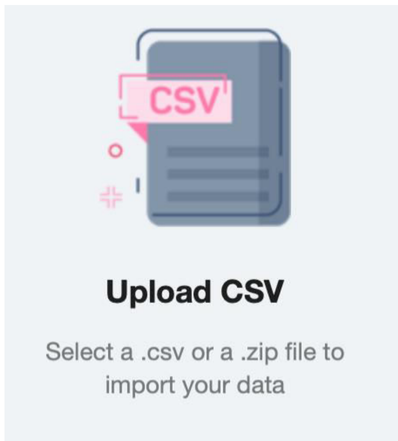

Fig 4: Upload CSV dataset to the model

2. GENERATE TRAINING AND TESTING IMAGES

Image Data Generator: rescales the image, applies shear in some range, zooms the image, and does horizontal flipping with the image. This Image Data Generator includes all possible orientations of the image.

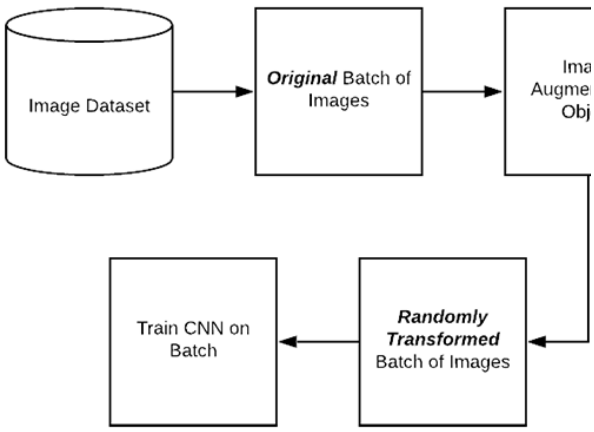

Fig 5: Image data generator

Train_datagen.flow_from_directory is the function that is used to prepare data from the train_dataset directory Target_size specifies the target size of the image.

Test_datagen.flow_from_directory is used to prepare test data for the model and all is similar as above.

Fit generator is used to fit the data into the model made above, other factors used are steps per epochs tells us about the number of times the model will execute for the training data.

Epochs tell us the number of times the model will be trained in forward and backward passes.

3. GENERATE CNN MODEL

In this module we are generating CNN Model with train_datagen and test_datagen generated by ImageDataGenerator class. Here we have training this CNN algorithm multiple time to get the better accuracy using epochs. Finally, we will get the best CNN model with average accuracy 99%.

4. UPLOAD TRAFFIC SIGN

Using this module we can upload test image and pass the test image to the model to recognize traffic sign.

5. RECOGNIZE TRAFFIC SIGN

Using this model will call the CNN Model which is already generated and take the image from the 4th step and pass to model. Then the model will identify the traffic sing. And gives voice alert message

4.RESULTS AND DISCUSSION

CNN model final accuracy

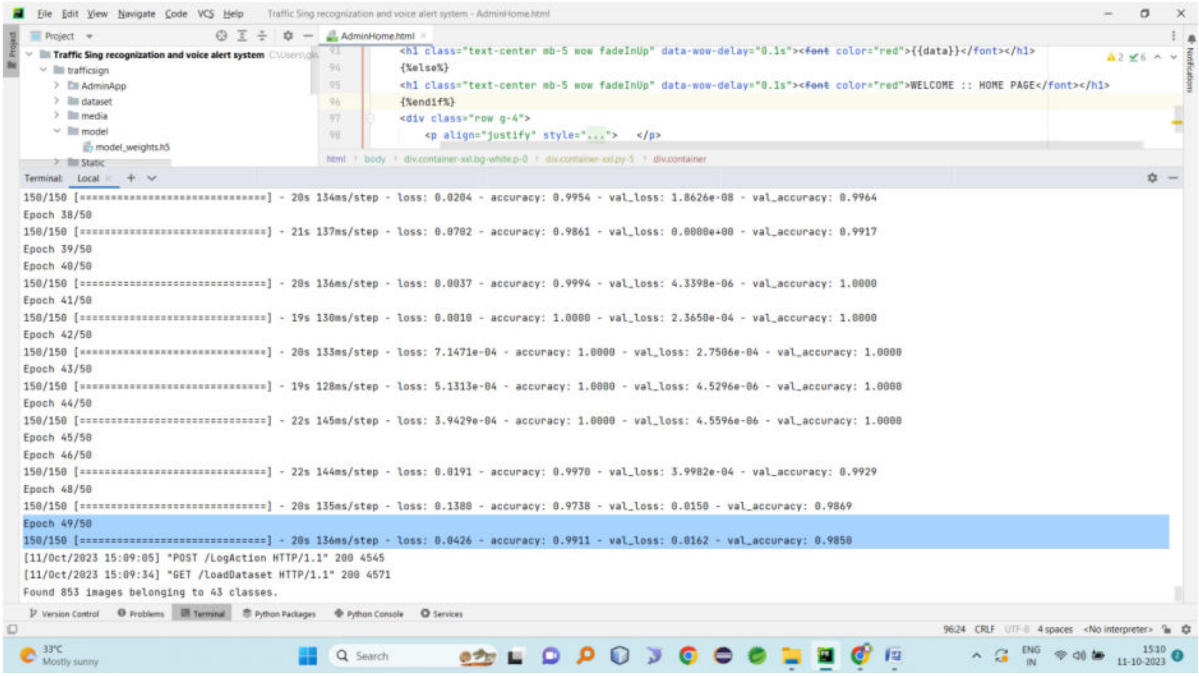

Fig 6: CNN model final accuracy

Upload traffic sign

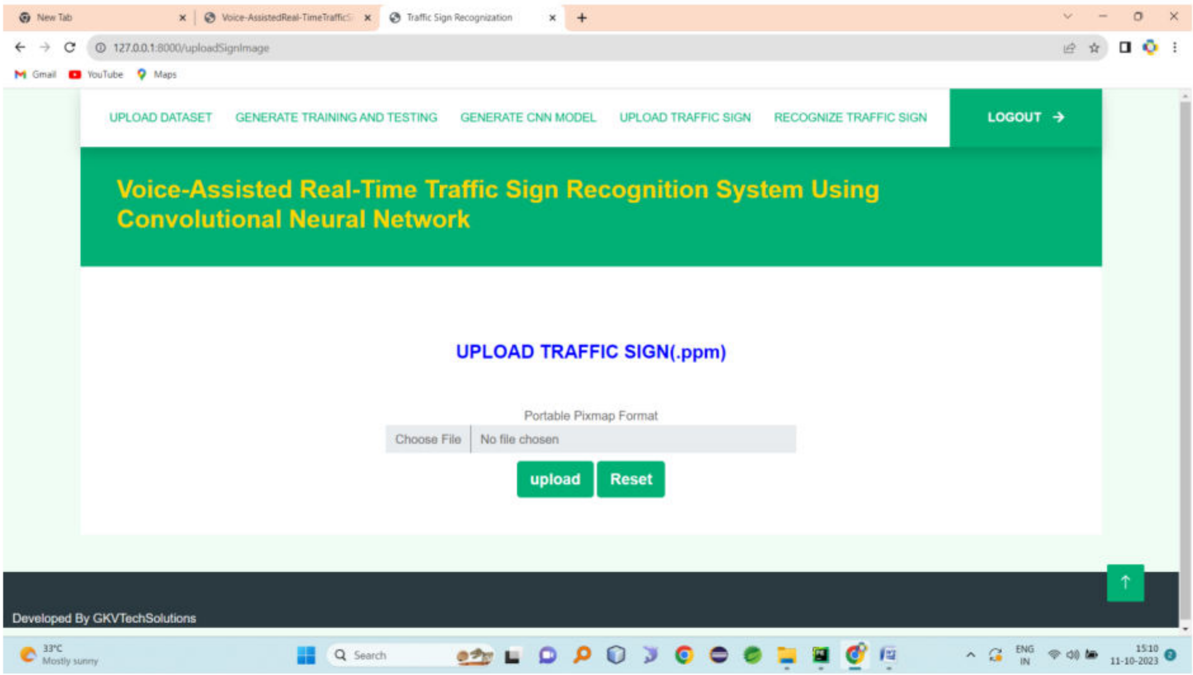

Fig 7: Upload traffic sign

Upload traffic sign image

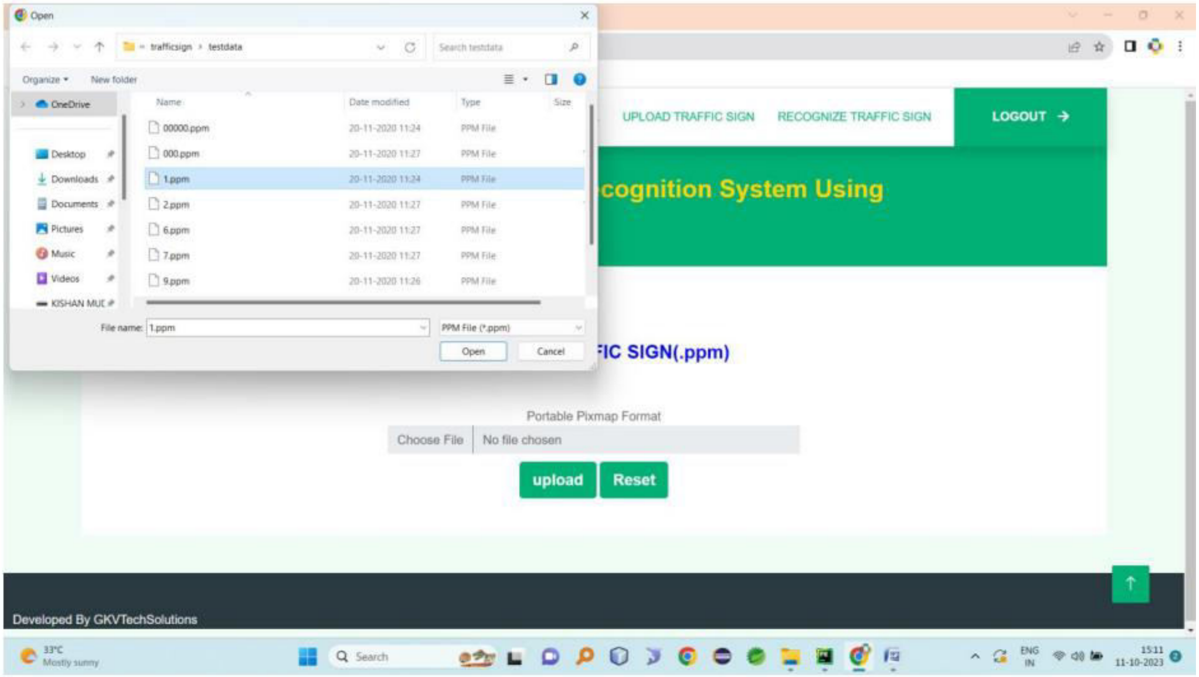

Fig 8: Upload traffic sign image

Uploaded image

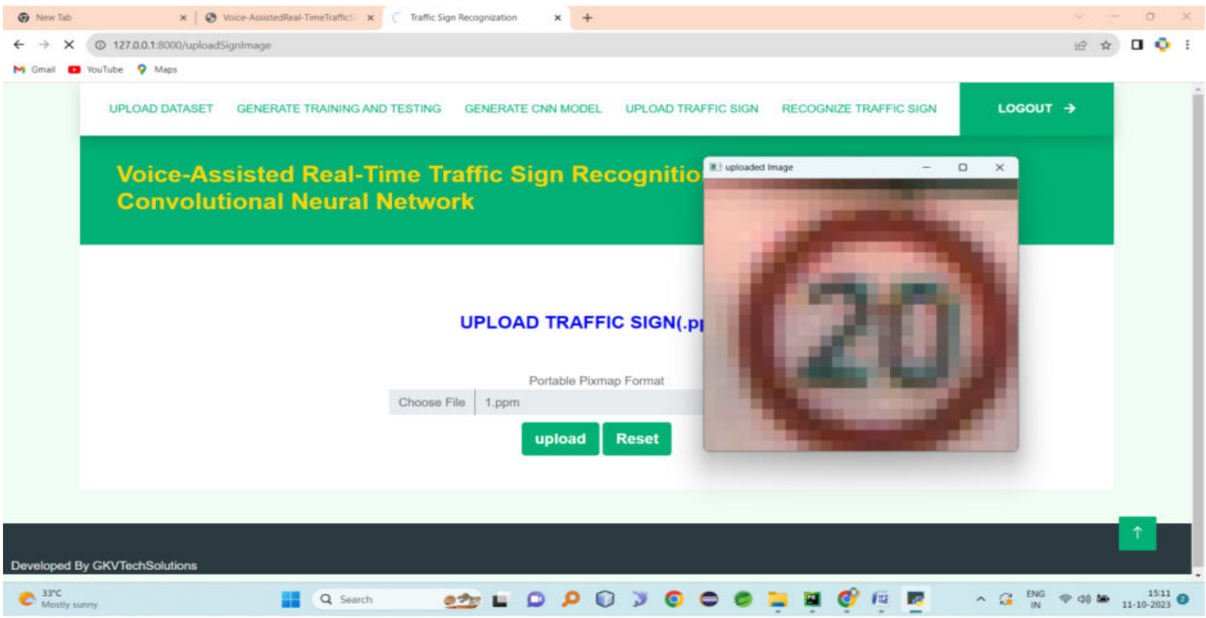

Fig 9: Uploaded image

Upload status

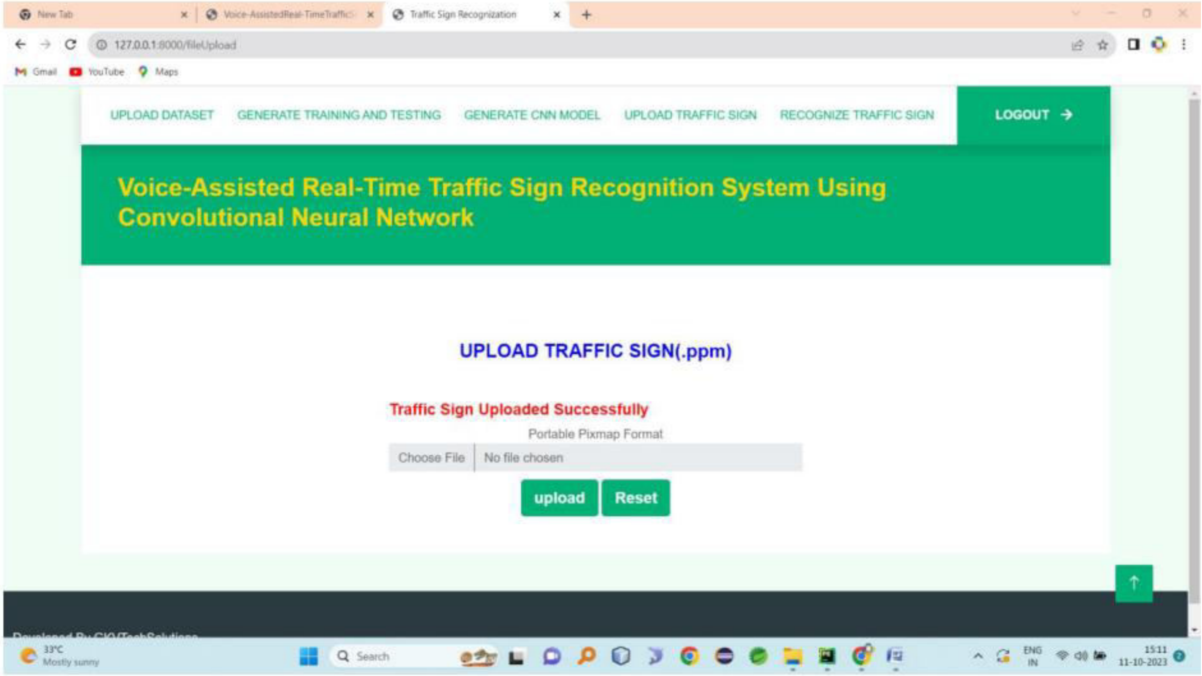

Fig 10: Upload status

5.CONCLUSION

In this paper, we describe a robust real-time traffic sign identification technique with a detection rate of 55 FPS. We also obtained a mean average precision of 64.71%. The current approach's accuracy can be improved further by altering the YOLO architecture configurations and tuning the hyper-parameters while maintaining a consistent detection speed. The negative impact of partially occluded traffic signs, damaged traffic signs, and extreme weather conditions can be further reduced by using strategies such as supplying the CNN with partially viewable signs, applying 3D reconstruction algorithms, and fuzzy C-means clustering.

The model provided in this paper can recognize traffic signs at a very high frame rate of 55 FPS while maintaining a mean average precision of 64.71%. A frame rate of more than 30 FPS ensures real-time performance of the system. Furthermore, the voice assistant feature, along with accurate recognition, can address the majority of the problems created by missing or not being aware of traffic signs.

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