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AI AND ML BASED ROAD SIGN RECOGNITION USING PYTHON

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Abstract

This thesis is focused on the development ofa convolutional neural network (CNN)-based model for traffic sign detection and recognition. The increase in automobile ownership and traffic has made it challenging for drivers to accurately identifytraffic signs, leading to an increased risk of accidents, loss of life, and property damage. To address this issue, an intelligent traffic sign detector and recognizer is required. Our research demonstrates the potentialimpact of this model on road safety and suggests that it can be an effective tool for reducing the likelihood of accidents and their associated costs.

Introduction

In recent years, the world has seen a rapid increase in automobile ownership, leading to an increase in road traffic. As a result, it has become increasingly challenging for drivers to navigate roads safely, particularly when it comes to accurately identifying and responding to traffic signs.

The main objective of our research is to develop a system that can accurately and efficiently detect and recognize traffic signs in real-world environments. Our system is designed to help drivers navigate roads safely by providing them with accurate and timely information about traffic signs. To achieve this, we train our CNNbased model on a large dataset of traffic signs, which includes a wide range of shapes, colors, and sizes. This training process allows the model to learn and recognize the features of traffic signs accurately, even in challenging environments. Our CNN-based model for traffic sign detection and recognition has several advantages. Firstly, it can accurately detect and recognize traffic signs, which is essential for ensuring road safety. Secondly, it can operate in real-time, providing drivers

with instant information about traffic signs. Finally, our system is scalable and adaptable, meaning that it can be applied to different types of roads and environments.

Literature Survey

Convolutional neural networks are currently the most popular deep learning methods for traffic signal categorization, however because to the inherent limitations of the max pooling layer, they are unable to capture the position, perspective, and orientation of the pictures. The deep learning architecture known as capsule networks is used in this study to provide a novel strategy for the identification of traffic signs that achieves exceptional performance on the German traffic sign dataset.Capsule networks can defeat such intruder attempts and provide more reliability in traffic sign identification for autonomous cars. CNNs are easily tricked by a variety of opponent techniques. On the German Traffic Sign Recognition Benchmark dataset, the capsule network has attained the most recent accuracy of 97.6%.

Convolution Neural Network Design

The project involves the design and implementation of a Convolutional Neural Network (CNN)-based model for traffic sign detection and recognition. The project uses various Python libraries, including TensorFlow, CV2, NumPy, and Streamlit, to develop and test the CNN model. The design of the CNN model involves several key steps, including data pre-processing, model training, and model evaluation. Data pre-processing involves preparing the input data for the CNN model, including resizing, normalization, and data augmentation.

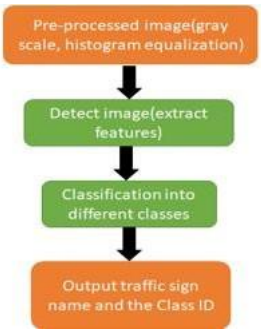


Figure 1: Basic Flow of CNN Model

Convolution Neural Network

Convolutional Neural Networks (CNNs) are a type of deep learning algorithm commonly used in image and video recognition tasks. They are designed to automatically identify and extract features from images by using a series of convolutional layers and pooling layers. In the above project, CNNs are used to detect and recognize traffic signs in real- time video streams. The CNN model is trained on a dataset of images of varioustraffic signs, allowing it to learn to

recognize the unique features of each sign. During the detection process, the CNN algorithm takes in an input image, applies a series of convolutional filters to extract features, and then classifies the image based on thedetected features.

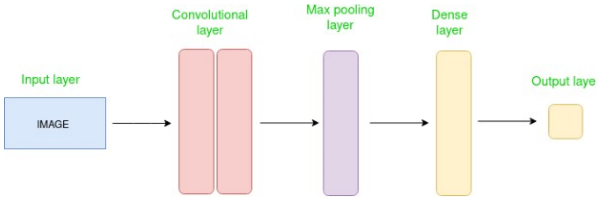


Figure 2: Layers of CNN

Tensor Flow

TensorFlow is an open-source software library for machine learning and artificial intelligence. It is used in a wide range of applications, including image and speech recognition, natural language processing, and recommendation systems. In the proposed CNN-based model for traffic sign detection and recognition, TensorFlow is used as the backend for the neural network, allowing for efficient training and evaluationof the model. The use of TensorFlow in the above project provides several benefits

Convolutional layers: These layers apply a series of convolutional filters to the input image to extract features such as edges, curves, and shapes.

Pooling layers: These layers down sample the feature maps to reduce the dimensionality of the data and extract the most relevant information. Fully connected layers: These layers take the output of the convolutional and pooling layers and map them to the output classes.

Back propagation: This algorithm is used to adjust the weights of the model during the training process, allowing the model to learn from its mistakes and improve its accuracy over time

GTRSB Dataset

Collecting a suitable dataset is a crucial step in developing any machine learning model, and it is no different in the case of the traffic sign detection and recognition system. In this project, we chose to use the GTSRB (German Traffic Sign Detection Benchmark) dataset, which is widely recognized as one of the most popular and well-known datasets for traffic sign recognition making it easy for researchers to access and use for their projects.

The GTSRB dataset is composed of more than 40 different classes of images, with over 50,000 images available for training,

validation, and testing purposes. The dataset is diverse, containing various types of traffic

signs, such as stop signs, speed limit signs, yield signs, and many more. This diversity is essential for training the machine learning model to recognize different types of traffic signs accurately.

To use this dataset for our project, we divided it into training, validation, and testing sets. The training set is used to train the model to recognize different traffic signs, while the validation set is used to fine-tune the model's parameters to optimize its performance. Finally, the testing set is used to evaluate the model's performance, giving us an idea of how well it is working. The GTSRB dataset has several advantages, including its large size and diversity, making it an ideal dataset for training and evaluating traffic sign detection and recognition models. By using this dataset for our project, we were able to train our convolutional neural network model effectively and improve its accuracy in detecting andrecognizing traffic signs.

Applications

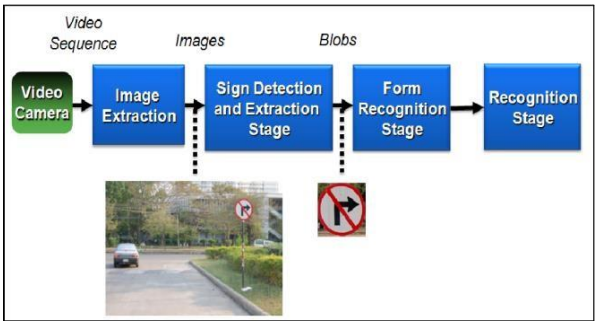
In the context of traffic sign detection and recognition, the applications can be seen in the following areas:

Autonomous driving: Traffic sign recognition is an essential component of autonomous driving technology. Autonomous vehicles need to detect and recognize traffic signs to understand the traffic rules and regulations.

Road safety: Traffic sign detection and recognition can improve road safety by helping drivers to be more aware of traffic signs, especially in low visibility conditions.

Traffic management: Traffic sign detection and recognition can help in managing traffic by providing real-time information on traffic signs such as speed limits, stop signs, and no-parking signs.

Block Diagram



Conclusion

In conclusion, the proposed system provides a simple yet accurate way to classify traffic signs using a Convolutional Neural Network (CNN). The system has been tested on the GTSRB dataset as well as a newly generated dataset consisting of truly existing images of all types of traffic signs. The results showed that the proposed system can classify the

images accurately, even if the background of the image is not clear.

In conclusion, the proposed system has shown promising results in traffic sign detection and classification, and further research can be done to improve the accuracy and efficiency of the system.

Result

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