CNN

BASED

ROAD SIGN

CLASSIFICATION-

DEEP LEARNING

INTRODUCTION:

Road signs are essential for regulating traffic and ensuring road safety. Automating road sign recognition using deep learning can significantly contribute to traffic management and autonomous driving systems. This project focuses on developing a **Convolutional Neural Network (CNN)-based Road Sign Classification Model** capable of identifying and categorizing road signs into 30 distinct classes with high accuracy. The labeled images of various road signs, which are preprocessed through resizing, normalization, and augmentation to enhance model performance. The project follows a structured workflow, starting with data collection and preprocessing, followed by building and training a CNN model with optimized architecture. Finally, the model is deployed using **Streamlit**, providing an interactive UI for real-time classification and accuracy visualization. This system aims to assist in traffic monitoring and autonomous navigation by accurately recognizing road signs in diverse conditions.

OBJECTIVE:

The primary objective of this project is to develop a road sign classification system using Convolutional Neural Networks (CNNs). With the increasing adoption of intelligent transportation systems and autonomous vehicles, accurately identifying road signs is crucial for ensuring road safety, assisting drivers, and enhancing automated navigation. This project aims to build a deep learning model that can classify various traffic signs using a dataset of labeled images.

The system leverages computer vision and machine learning techniques to automatically recognize traffic signs from images. The dataset contains a diverse range of road signs captured in real-world scenarios, helping the model generalize well to different lighting, angles, and environmental conditions. The goal is to create a robust model that can accurately classify signs into their respective categories, enabling applications such as driver assistance systems, automated traffic monitoring, and smart city infrastructure.

DATASET DESCRIPTION:

The dataset used in this project consists of traffic sign images categorized into multiple classes. It is designed for training, validating, and testing a Convolutional Neural Network (CNN)-based classification model. The dataset plays a crucial role in enabling the model to recognize and differentiate between various road signs commonly found on streets and highways. The dataset actually holds csv file and some image folder. The label data consists of 30 distinct classes, each representing a unique traffic sign. Some of the most common sign categories include:

* Stop Sign
* Speed Limit Signs (e.g., 30 km/h, 50 km/h, etc.)
* Pedestrian Crossing
* No Entry
* Traffic Light Ahead
* Roundabout
* Yield Sign

Each class is labeled numerically in labels.csv, ensuring correct mapping between images and their corresponding sign categories. The image folders are

* DATA Folder: Contains images of road signs categorized into subdirectories, each representing a different class.
* TEST Folder: Holds images meant for final evaluation after training.

The image are in standard formats such as jpg, png and the dimensions Initially, images may vary in size, but they are resized to 64x64 pixels for uniform processing. Images are in RGB format, ensuring that the model captures color-based sign distinctions.

DATASET PREPROCESSING:

Data preprocessing is a crucial step in preparing the dataset for training a robust Convolutional Neural Network (CNN) model. It ensures that the data is properly formatted, normalized, and augmented to enhance the model’s generalization ability. The dataset is provided as a ZIP file containing images of road signs along with their corresponding labels. The ZIP file is extracted, and the images are loaded using TensorFlow’s [image\_dataset\_from\_directory] function. This method automatically assigns labels based on the directory structure.Since images in the dataset may have varying dimensions, they are resized to a uniform shape of 64x64 pixels. This standardization ensures consistency in input dimensions, which is essential for CNNs to process the data efficiently.

* **Resizing**: All images are resized to (64, 64, 3), where 3 represents the RGB color channels.
* **Normalization**: The pixel values, which originally range from 0 to 255, are scaled to a range of 0 to 1 by dividing by 255. This normalization step speeds up model convergence and prevents numerical instability during training.

To improve the model’s ability to recognize road signs under different conditions, various data augmentation techniques are applied. Data augmentation artificially increases the dataset’s diversity by generating modified versions of existing images. The following transformations are used:

* Random Flipping: Horizontally flips images to simulate different orientations of road signs.
* Random Rotation: Rotates images by a small degree to account for variations in how road signs appear in real-world settings.
* Random Zooming: Zooms into images to help the model recognize signs at different distances.
* Cropping and Clipping: Helps the model learn to recognize partially visible signs.

These augmentation techniques enhance the model’s robustness by reducing overfitting and improving its ability to generalize to unseen data. Once preprocessing is complete, the dataset is divided into three subsets to facilitate effective training and evaluation:

* Training Set (70%): Used for training the CNN model by learning patterns in the road sign images.
* Validation Set (15%): Used to fine-tune hyperparameters and monitor model performance during training. This helps prevent overfitting.
* Test Set (15%): Used for final model evaluation, ensuring that the trained model can generalize to unseen images.