SOFT COMPUTING

TRAFFIC SIGN RECOGNITION

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Problem Statement

DEVELOP AN EFFICIENT AND ACCURATE SYSTEM FOR RECOGNIZING TRAFFIC SIGNS USING CONVOLUTIONAL NEURAL NETWORKS (CNNS) AND OPTIMIZE THE PERFORMANCE OF THE MODEL BY EMPLOYING GENETIC ALGORITHMS (GA) TO FINE-TUNE ITS HYPERPARAMETERS.

INTRODUCTION

- This project uses a Convolutional Neural Network (CNN) combined with a Genetic Algorithm (GA) to classify traffic signs from the German Traffic Sign Recognition Benchmark (GTSRB) dataset.

Objectives:

- - Design a CNN to classify 43 types of traffic signs.
- - Use a Genetic Algorithm to optimize hyperparameters for better performance.

CONVOLUTIONAL NEURAL NETWORK (CNN)

- **CNN Architecture:**
- - Input Layer: 30x30x3 RGB images.
- - Convolutional Layers:
- - Layer 1: Filters = filters_1, Kernel size = (5, 5), Activation = ReLU.
- - Layer 2: Filters = filters_2, Kernel size = optimized by GA, Activation = ReLU.
- - Fully Connected Layers:
- - Dense Layer: 128 neurons, Activation = ReLU.
- - Output Layer: 43 neurons, Activation = Softmax.
- - Optimizer: Adam, Loss Function: Sparse Categorical Crossentropy.

GENETIC ALGORITHM (GA)

- Steps in the GA:
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- - **Representation:** Individuals represent hyperparameters: [filters_1, filters_2, kernel_size, learning_rate, batch_size].
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- - **Fitness Evaluation:** Validation accuracy of CNN trained with individual's hyperparameters.
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- - **Selection:** Fittest individuals are selected for reproduction. (Selftournment)
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- - **Crossover:** Combines hyperparameters of two parents to produce offspring.(twopoint crossover)
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- - **Mutation:** Randomly alters hyperparameters to introduce diversity.(unifrom integer mutation)
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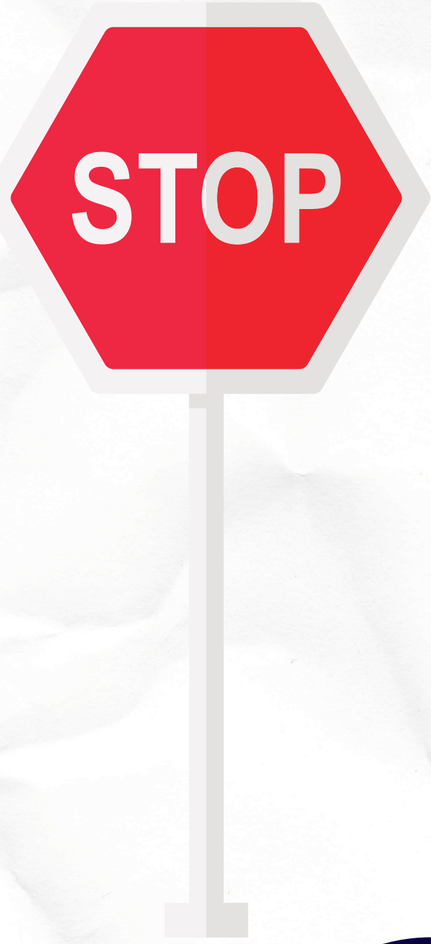
- - **Iteration:** Process repeats over multiple generations to improve fitness.



IMPLEMENTATION

- **Integration of CNN and GA:**
- **- CNN is built and trained using hyperparameters from GA individuals.**
- **- Validation accuracy serves as the fitness score for each individual.**
- **- Best hyperparameters from GA are used to train the final CNN model.**

- **Evaluation:**
- **- Training: 80% of the dataset.**
- **- Testing: 20% of the dataset.**
- **- Final Model: Trained with best hyperparameters over 15 epochs.**

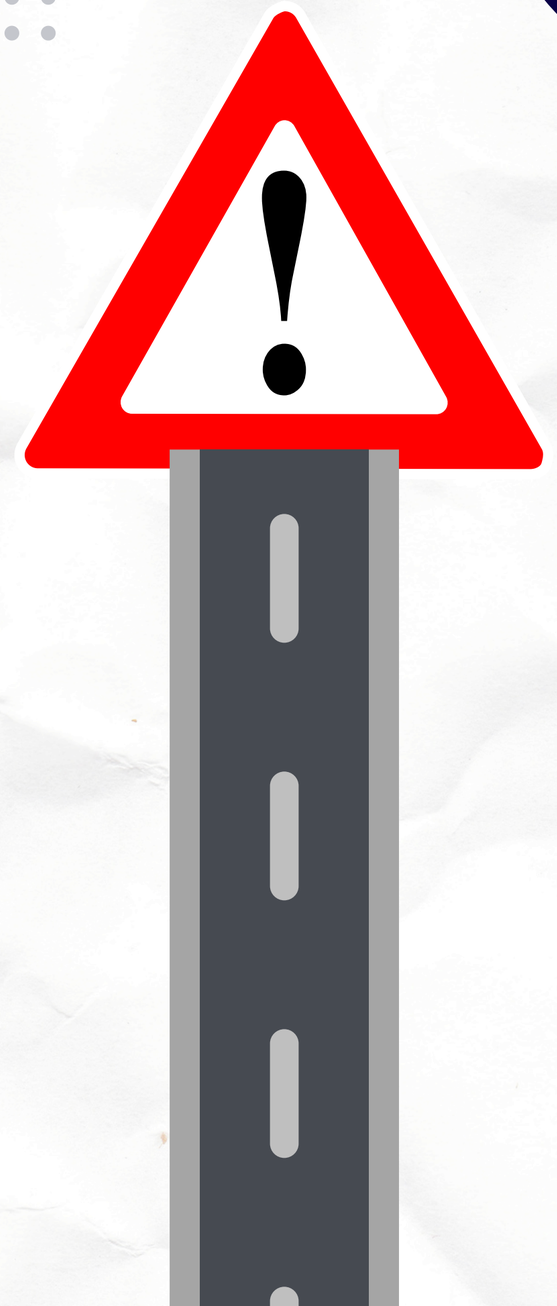
RESULTS AND BEST HYPERPARAMETERS

- **Best Hyperparameters Found:**

- **- Filters (Layer 1): 64**
- **- Filters (Layer 2): 128**
- **- Kernel Size: (3, 3)**
- **- Learning Rate: 0.003060158895**
- **- Batch Size: 27**

- **Performance:**

- **- Validation Accuracy: 96%**
- **- Test Accuracy: 94%.**



CONCLUSION

COMBINING CNN WITH GA FOR HYPERPARAMETER OPTIMIZATION PROVIDES:

- EFFICIENT EXPLORATION OF HYPERPARAMETER SPACE.

- IMPROVED MODEL PERFORMANCE WITHOUT MANUAL TUNING.

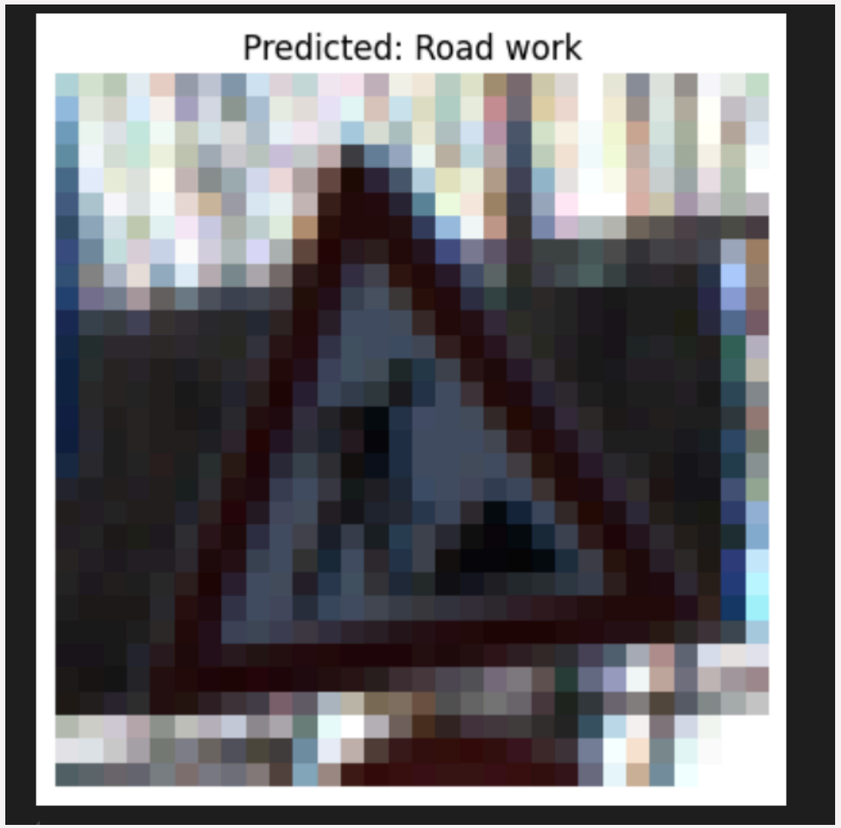
KEY TAKEAWAYS:

GENETIC ALGORITHMS CAN AUTOMATE AND ENHANCE DEEP LEARNING WORKFLOWS.

TRAFFIC SIGN CLASSIFICATION IS A CRITICAL TASK IN AUTONOMOUS DRIVING.

Input:

Output:




Thank
You!