Road Sign Detection and Localisation

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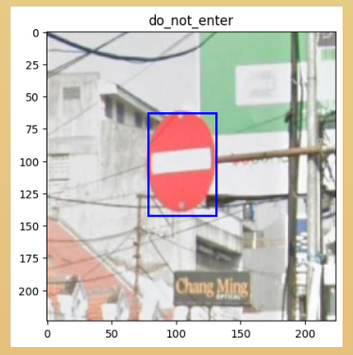
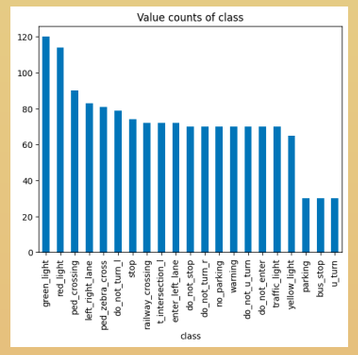
Overview

- Creates an AI model to identify road signs from visual inputs.
- Gathers diverse traffic sign data to train the system effectively.
- Leverages convolutional neural networks for feature extraction.
- Implements dual-output neural architecture for classification and localization.
- Employs modern loss functions and optimization for precise learning.
- Tests model against validation set to gauge real-world performance.
- Aids in automating vehicle navigation and driver assistance systems.
- Contributes to safer driving by alerting to road sign information.
- Has potential integration into smart city infrastructure for traffic control.

Data

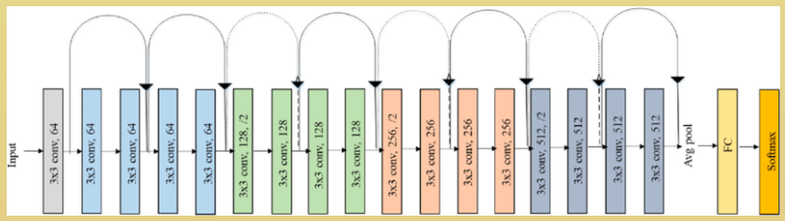
- Sourced from Roboflow Universe, ensuring a rich variety of traffic signs.
- Includes 1502 images, each with detailed bounding box annotations.
- Covers 21 unique traffic sign classes for comprehensive model training.
- Data is preprocessed for uniformity: grayscaled and resized to 224x224 pixels.
- Bounding box coordinates are recalibrated to match new image dimensions.
- Images and annotations are converted to tensors for model compatibility.





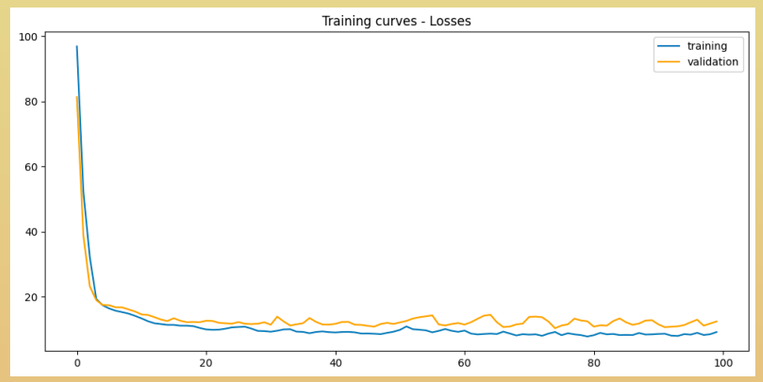
- Distribution of sign classes visualized to inform training balance.
- Data augmentation techniques considered to enhance model robustness.
- Dataset curated to challenge and validate the model's detection capabilities.

Model



- Based on a modified **ResNet18** architecture, optimized for sign detection.
- Initial convolutional layer adapts the network to three-channel inputs.
- Includes separate linear layers for bounding box and class predictions.
- Utilizes pretrained weights for quicker and more effective learning.
- Configurable output features to adapt to various sign shapes and sizes.
- Employs **SmoothL1Loss** for bounding box precision and **CrossEntropyLoss** for accurate classification.
- Optimized with **Adam** with 0.001 learning rate, balancing fast learning and stability.
- Designed for dual tasks: recognizing sign types and locating them accurately.
- Model structure allows for flexibility and scalability in future enhancements.
- Utilized GPU for faster computations and training of the model.

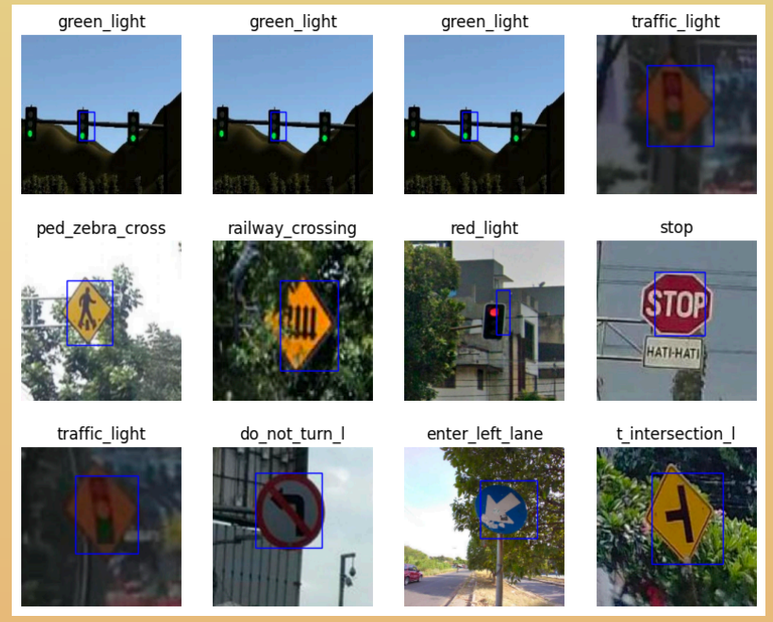
Training



- The loss curves for training and validation are rapidly decreased and maintained a steady rate.
- This indicates that the model has converged and has reached minimum error.

Results

- Model achieved high accuracy in classifying different road signs.
- Bounding box predictions showed precision in localizing signs.
- Validation tests indicated strong generalization to unseen data.
- Performance fluctuations identified areas for further optimization.
- The model is tuned to achieve much better scores.
- Demonstrated potential for real-world application in driver assistance systems.
- Results underscored the efficacy of the chosen architecture and training approach.



Conclusion

- Successfully developed a machine learning model for road sign detection and localization.
- Demonstrated effective use of a diverse dataset and advanced neural network architectures.
- Achieved promising results in both sign classification and precise localization.
- Identified areas for improvement and future model enhancements.
- Project lays a strong foundation for integration into autonomous driving and traffic management systems.
- Highlights the potential of AI in enhancing road safety and navigation efficiency.