Project Proposal Document

Course: CSE4288 - Introduction to Machine Learning
Team Project - Group 2

Team Members and Contact Information

	Name-Surname	Student Number	Contact Information
1	Arda Öztürk	150121051	ardaozturk192@gmail.com
2	Bora Duman	150121043	boraduman@yahoo.com
3	Duru Baştunalı	150120075	durubastunali@gmail.com
4	Furkan Gökgöz	150120076	furkangokgoz@marun.edu.tr
5	Nidanur Demirhan	150120042	nidanurdemirhan22@gmail.com

Project Title and Description

Project Title: Crosswalk Detection from a Car's Perspective

Project Description:
This project aims to develop a machine learning model for crosswalk detection using YOLOv8 or a similar object detection model. The primary objective is to identify crosswalks accurately under varied conditions, so the system will provide critical information that can be integrated into autonomous vehicle control systems.

Problem Statement and Objectives

Problem Statement:
Crosswalks are essential for pedestrian safety, especially in high-traffic urban environments. Detecting crosswalks accurately is challenging due to variability in crosswalk designs, lighting conditions, and weather effects.

It has been documented that the standard YOLO model do not have crosswalks in their classifier sets.

This project addresses the need for a robust crosswalk detection system that operates efficiently under the given constraints.

Objectives:

1. Develop a machine learning model that detects crosswalks with high accuracy.
2. Integrate the model with YOLOv8 or a similar object detection architecture to leverage pre-trained weights and improve detection speed.

3. Evaluate the model's performance across various environmental conditions to ensure reliability in real-world applications.

Dataset Overview

Dataset:
The project will utilize publicly available datasets featuring urban street scenes captured from a vehicle's perspective, which contain labeled images of roads, vehicles, and crosswalks.

Dataset Description:

- **Source:** Publicly available datasets
- **Content:** Annotated images with labeled crosswalks and other street elements from a car's perspective
- **Preprocessing Needs:** Image resizing, normalization, and augmentation to improve model generalization

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Proposed Methodology

1. **Data Preprocessing and Exploration:**
    - Perform data cleaning and preprocessing, including handling missing values, encoding, and feature scaling.
    - Conduct exploratory data analysis (EDA) to understand data distribution and crosswalk representation across images.
    - Visualize data patterns using histograms, heatmaps, and scatter plots.
2. **Model Development:**
    - Train a YOLOv8-based object detection model, fine-tuning it specifically for crosswalk detection.
    - Experiment with alternative models if necessary, comparing performance in terms of accuracy and detection speed.
3. **Model Evaluation and Optimization:**
    - Evaluate the model using precision, recall, and F1-score.
    - Implement cross-validation and hyperparameter tuning to optimize detection accuracy.
    - Analyze error cases to identify common sources of detection errors and potential improvements.

Timeline and Milestones

1. **Week 1:** Team formation, project selection, and submission of proposal.
2. **Week 2:** Data acquisition, preprocessing, and exploratory data analysis.
3. **Week 3:** Initial model development and training.

4. **Week 4:** Model evaluation, optimization, and error analysis.
5. **Week 5:** Final model refinement, report compilation, and presentation preparation.