

**Object Detection Module Project Report**

**1. Introduction**

* **Objective**: To develop an object detection model that can accurately classify and detect various road conditions and turns, which include classes such as Left Turn, Right Turn, Pothole, Road Slide, Straight Roads, and Tunnels.
* **Background**: This project aims to enhance road safety and navigational accuracy by leveraging object detection techniques to identify road features.
* **Dataset Overview**: The dataset comprises 236 images for training, 56 images for validation, and is organized into three primary classes.

**2. Dataset**

* **Source**: The images were sourced and labeled as per the requirements of this project. The dataset was structured into training, validation, and testing subsets.
* **Classes and Labels**: The dataset includes the following classes:
  + **Left Turn**
  + **Right Turn**
  + **Pothole**
  + **Road Slide**
  + **Straight Roads**
  + **Tunnels**
* **Dataset Structure**:
  + **Training set**: 236 images across 3 classes.
  + **Validation set**: 56 images across 3 classes.
* **Files**: Key files include README.roboflow.txt, folders for test, valid, and train datasets.

**3. Methodology**

* **Model Selection**: Explain the object detection model chosen, such as YOLO, CNN, justify the selection based on project goals.
* **Data Preprocessing**:
  + Data augmentation techniques applied, such as rotation, flipping, or color adjustments, to enhance model generalization.
  + Resizing and normalization of images to suit the input requirements of the chosen model.
* **Training Configuration**:
  + **Batch Size**: Specify the batch size used.
  + **Learning Rate**: Mention the learning rate and any schedule or decay methods employed.
  + **Optimization Algorithm**: Specify the optimization algorithm, such as Adam.
* **Loss Function**: Describe the loss function used for object detection and classification, typically a combination of localization and confidence loss.

**4. Model Training**

* **Training Process**: Outline the number of epochs and describe the training environment ( GPU, CPU).
* **Validation Process**: Explain how the validation set was used to fine-tune the model and to prevent overfitting.
* **Metrics**: Mention evaluation metrics like mean Average Precision (mAP), Intersection over Union (IoU), accuracy, precision, recall, and F1 score.

**5. Results**

* **Training and Validation Accuracy**: Report the final accuracy on both the training and validation sets.
* **Confusion Matrix**: A visual representation of model performance for each class.
* **Precision-Recall Curves**: To analyze model performance per class.
* **Sample Outputs**: Include a few sample images from the test set with the model’s predictions and bounding boxes.

**6. Challenges and Improvements**

* **Challenges**: Describe any difficulties encountered, such as class imbalance or issues with data quality.
* **Improvements**: Suggested model or data improvements for future work.
* **Error : runtime error**

**7. Conclusion**

* **Summary of Findings**: Recap the effectiveness of the model in detecting and classifying road features.
* **Potential Applications**: Mention how this module can contribute to applications in autonomous driving and road safety management.