"AI-Based Lane Recognition for Micromobility Users using Neural Network compression techniques and a Low-Spec Microcontroller Unit"

The rise of Micromobility as a primary mode of transportation across the globe has brought about the need for effective rules and regulations governing the usage of E-scooters and E-bikes. As such, we have developed an AI-based solution of ‘Lane Recognition’ to address this problem. Our solution utilises AI Computer Vision technology to identify whether a Micromobility user is using the designated lane or not. To achieve this, we have developed and deployed a Convolutional Neural Network (CNN) model to an extremely low-spec, power-efficient camera-integrated Microcontroller Unit.

The training dataset includes open-source images from the internet and frames captured with our camera module from multiple major cities worldwide. We developed a multiclass classification Neural Network model, small yet robust enough to be fitted into the Microcontroller Unit with just **2 MB** of each SRAM and Flash memory by utilising Neural Network **unstructured pruning** and **full-integer** 8-bit model quantisation techniques. We share the results of a short demo performed on the streets, which proves the efficacy of our lane recognition solution. We conducted various experiments with a Microcontroller simulation environment. The experiments were performed on a small subset of the original dataset using a simple CNN model architecture and different input image resolutions and their colour modes such as **160X160 Grayscale/RGB** and **96X96 Grayscale/RGB**. The purpose of these experiments was to compare Microcontrollers with different colour depth cameras, Static RAMs, storage and computing power and decide the optimal one according to the use case. The empirical results showed **84.85%** Test Accuracy with 160X160 RGB images which was **7.34%** more than 160X160 Grayscale and **11.85%** more than using 96X96 Grayscale images with approximately 2.3 seconds of a tradeoff in model inference time using high-resolution RGB images over low-resolution Grayscale. This led us to the conclusion that better image classification model performance can be achieved with RGB colour mode images. Moving forward, we are working on designing a better model architecture by incorporating a fusion of channel shuffle and spatial attention mechanisms. We believe that this will further improve the accuracy and efficiency of our lane recognition solution, which in turn, will enable us to better manage the riding behaviour of Micromobility users.