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Use of Deep Learning as an Alternative to Manual Counts in Sri Lanka

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Maintaining a count of vehicles on roads by vehicle category is important for purposes of traffic monitoring, analysis and prediction. To overcome disadvantages in manual traffic counts, this study focuses on computer vision-based deep learning methods of counting vehicles using videos. This study aims to (1) identify the best camera orientation for improved accuracy and to (2) compare the accuracy of classified vehicle counts based on deep learning- with manual counts at site and actual counts in laboratory using video playback methods. It does so to examine the possibility of automating the classified vehicle counts (CVC) which are currently performed manually in Sri Lanka. While manual classified vehicle counts were collected at site, these were also captured on video for the purposes of this study. This was done under different camera orientations (angle projections) using a mobile phone with a 1080p@30fps inbuilt camera. A new deep neural network (DNN) was trained to classify vehicles using a limited dataset, and OpenCV vehicle detection with SSD Mobile Net API was used for deep learning vehicle counting. According to the study, the best camera angle orientation for detecting vehicles is achieved by placing the camera directly opposite to vehicular movement and at a horizontal inclination of 25˚ ($\beta = 0^{\circ}$ and $\alpha = 25^{\circ}$). At this orientation, the highest accuracy of 76.5% was achieved. The study found that both manual and deep learning methods result in error; former due to human error and the latter due to limited training and computation power. However, even with limited data training, deep learning was only 7% less accurate than manual counting, This study observed that the alternative method (deep learning) was a cost-effective solution in terms of human resources, operational difficulties, less pedestrian and vehicle distractions etc. The primary video data collection contains all vehicle types, but this study was limited to only two classes of vehicles: namely cars and motorbikes. Future studies will be done in different locations to generalize initial research.

Keywords: *Vehicle Detection, Camera Orientation, Deep Learning, Video Traffic Counting, Manual Vehicle Counting*