Vehicle Speed Estimation Using A Low-Cost Camera From A Vertical Overhead Perspective

Bernadette Anne B. Recto (1), Margaux Elijah P. Neri (1), Gilson Andre M. Narciso (1), Kenny Brem C. Medina (1)

[1] Department of Geodetic Engineering, University of the Philippines Diliman, Quezon City, Philippines 1116
Email: bbrecto@up.edu.ph; mpneri1@up.edu.ph; gmnarciso@up.edu.ph; kcmedina@up.edu.ph

Abstract: Highly urbanized areas usually experience traffic problems due to large amounts of vehicles and an inefficient road management system. With this, accidents related to vehicles become more and more prevalent these days, the most common cause of which is over speeding, according to the Metro Manila Accident Recording and Analysis System. Vehicle speed can be detected using speed guns for traffic monitoring; however, this device cannot be used for simultaneous speed determination of two or more moving objects on a highway. In this paper, a method of determining the speed of multiple vehicles concurrently passing a roadway is implemented. Commonwealth Avenue, located in Quezon City, Philippines is the selected study area, while a low-cost action camera was used to capture the video footage in a vertical overhead perspective. A camera calibration technique was incorporated in the raw footage in order to determine the intrinsic parameters of the device used and remove distortions that are already present in the camera. Speed estimates were manually derived from video footage of road traffic by decomposing it into frames and measuring the distances in between marked points. The automation of speed estimation using Python OpenCV followed a two-step approach: object detection using background subtraction and object tracking and speed estimation using template matching. The output of the automated speed derivation system was assessed through comparison with real-time speed recorded from the built-in speedometer of a control vehicle and an onboard mobile device with a GNSS tracking application, Waze.

Keywords: speed estimation, vertical overhead perspective, background subtraction, object tracking, template matching