Impact of Autonomous Vehicles on Road Safety in Heterogeneous Traffic Conditions

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Abstract

Autonomous vehicles (AVs) can sense their environment and operate without human involvement. These AVs are implemented with a lot of Advanced Driver Assistance Systems (ADASs). Six levels of driving automation have been defined by the Society of Automotive Engineers (SAE), ranging from Level 0 (no driving automation) to Level 5 (full driving automation). Most of the ADAS features can be seen on vehicles belonging to the SAE level 2 or above. A few features, such as Lane Centering (LC)/ Lane Keeping Assist (LKA), Adaptive Cruise Control (ACC), and Automatic Parking, are categorized at level 2. The majority of vehicles in Sri Lanka belong to levels 0 and 1, and some vehicles that belong to level 2 are also available. However, vehicles that belong to Level 3 or above are hardly seen. Autonomous vehicles and ADAS features are fairly new subject areas in the local context. Sri Lanka does not have a developed road network that can fully accommodate autonomous driving. Further, the vehicle composition on Sri Lankan roads is very different compared to that in developed countries, as there is a higher percentage of light vehicles such as three-wheelers and motorcycles. Despite the above differences and challenges, for a country with high congestion in urban areas, many advantages can be obtained from facilitating an A system. These benefits include accident reduction, improved fuel economy, increased lane capacity, reduced travel time, etc. It is proven that automated vehicle technology could result in greater efficiency in fuel/time savings and a significant reduction in congestion without the need for additional capacity. The main purpose of this study is to study the effect of the different ADAS categories and ADAS combinations against the identified accident types to compare the effectiveness of the safety features in the Sri Lankan context. In addition to that, by identifying theoretical and practical road safety issues in a hybrid system where different levels of ADAS vehicles are present, the road safety outcomes can be analyzed with respect to the autonomous levels and the different percentages of each type. Subsequent to the identification of safety features and ADAS categories, accident types, and the causes of the accidents, an organized database was created. An online survey form was developed to gather vehicle and accident details from the public. A descriptive introduction and a set of identified accident categories were included in the survey form so that respondents could provide their vehicle details along with the ADAS features and past accident details. Responses for 200+ vehicles were collected, including around 40%responses with details about one or more accidents that have happened during the last five years. The second stage of this study was to focus on secondary data sources such as accidents recorded by police and the expressway management division of the Road Development Authority. Vehicles involved in fatal accidents were filtered out, considering only cars manufactured after 2005 to accommodate different autonomous levels for accidents recorded in police reports for 2017. Expressway accident records available from 2016 show that the number of fatal + grievous + non-grievous accidents in total is around 100 per calendar year. Around 250 cases were chosen for further study after sorting them by the severity of the accident. For

selected accidents from expressway reports and police reports, the vehicle model and the manufactured year were identified for each vehicle using the database available on the Sri Lanka Motor Traffic Department website. As the next step, accident type combinations and the corresponding ADASs were categorized. Potential accident reduction percentages for each ADAS-accident type category were found. The results show that most of the time, these features individually have the potential to reduce the severity of the accident by around 15%. When two or more ADAS features work together, not only reduces the severity but high accident prevention percentages can also be achieved. Two scores for the safety level and the autonomous level were then obtained by assigning weights to the corresponding ADAS features. In the absence of any detailed studies, those assumed weights were derived by studying the impact that each ADAS can have according to the results of the above study done for ADAS and relevant crash patterns. According to the selected data set and the assigned weights, it is found that the average safety score of the Sri Lankan context for urban, suburban and expressway road sections is 10.7%, and the autonomous level is only 1.8%. Finally, considering the results and the current vehicle composition, advanced driver assistance features were categorized and lined up in the order of being the most effective in the Sri Lankan context.

Keywords: *Autonomous vehicles, Road Safety, Traffic Management, Accident Prevention, Safety Features, Advanced Driver Assistance Features*

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