International Journal of Automotive Technology, Vol. ?, No. ?, pp. ?–?(year)

DRIVER BEHAVIOR ANALYSIS IN SIMULATED JAYWALKING AND ACCIDENT PREDICTION USING MACHINE LEARNING ALGORITHMS

Myeongkyu Lee[1)], Jihun Choi[2)], Sonhui Kim[2)], and Ji Hyun Yang[3)*]

[1)]School of Industrial Engineering, Purdue University, IN 47906, United States
[2)]Traffic Accident Division, National Forensic Service, Wonju 26460, Korea
[3)]Department of Automotive Engineering, Kookmin University, Seoul 02707, Korea

(*Received date ; Revised date ; Accepted date*) * Please leave blank

ABSTRACT– Road safety can be improved if traffic accidents can be predicted and thus prevented. The use of driver-related variables to determine the possibility of an accident presents a new analysis paradigm. We used a driving simulator to create a jaywalking scenario and investigated how drivers responded to it. A total of 155 valid participants were identified across demographics (age group and gender) and participated in the experiment. We collected driver-related data on eight types of perception/reaction times, vehicle-control data, accident occurrence data, and maneuvers used for obstacle avoidance. From the statistical analysis, it was possible to derive six variables with significant differences based on whether a traffic accident occurred. Furthermore, we identified the data's significant difference according to demographics. Artificial intelligence (AI)-classification models were used to predict whether an accident would occur with up to 90.6% accuracy. The data associated with the dangerous scenario obtained in this study were identified to predict the occurrence of traffic accidents.

KEY WORDS : Accident analysis, Classification, Driver Behavior Characteristic, Prediction

1. INTRODUCTION

According to the World Health Organization (WHO) accident report, traffic accidents result in 1.35 million fatalities annually (World Health Organization, 2018). Retting reported that the number of pedestrian deaths increased consistently between 2009 and 2018 in the US, accounting for 17% of traffic accident-related deaths in 2018 (Retting, 2020). Furthermore, the total number of accidents increased by two percent in 2018 compared with that in 2009, but the number of pedestrian deaths increased by 53%. The number of accidents involving pedestrians is consistently increasing. Furthermore, when an obstacle, such as a pedestrian, appears abruptly, it is difficult for the driver or an autonomous driving system to react immediately. This delay might cause a road accident.

We first acquired data on the general behavioral characteristics in dangerous situations and identified the tendencies in the data of general drivers. For this, we set the vehicle speed (60 and 80 km/h) and pedestrian speed (3 km/h), at which accidents are prone to occur, in a simulator, and acquired the data on the general behavior of drivers. In terms of the behavioral characteristics of drivers, we acquired the following data: time to perceive a dangerous situation, time to react to the situation, and method of reaction. We analyzed the acquired data and presented the result on the behavioral characteristics of general drivers. (Han et al. (2021); Lee et al. (2022)) We identified in some data significant differences between the cases with accidents and the cases no accidents. (Perception time, accelerator release time, brake reaction time, steering reaction time, max brake pedal force, and the difference between max and min velocities.)

We were motivated by the idea that if human behavioral data, combined with their demographic profiles, can be used predict the actual occurrence of accidents (or classify whether an accident will occur or not), it could contribute toward improving traffic safety. In addition, we identified that it is possible to predict accidents through machine learning. Hence, the objective of this paper is to present variables for proactively preventing accidents by identifying statistically significant data from jaywalking incidents for predicting (and ultimately preventing)

* *Corresponding author*. e-mail: yangjh@kookmin.ac.kr