Prediction of Driver Behaviour in Different Driving Path by using Electric Buggy Car

Hasri Haris, Wan Khairunizam, Hafiz Halin

Abstract*: Each human has the capability to make decisions and respond to situations completely on its own based on their intelligence level and experience. During driving, ability makes the driver alert and know what they need to do in a certain situation. This paper aims to investigate human behaviour while driving the electric vehicle at the desired path. The electric buggy car is used and set up with equipment and sensor as an Electric Vehicle (EV). Several sensors used to collect data and certain criteria subjects are selected with the purpose to study their driving pattern. The speed, steering wheel angle, heading, and position of the buggy car is collected throughout the human navigation experiments. The behaviour of the human while driving in the straight path, turn left and turn right will be collected at the end of experiments.

***Keywords*: Human Behaviour, Electric Buggy Car, Electric Vehicle, Steering Wheel Angle.**

I. INTRODUCTION

This autonomous driving is progressively pulling in open enthusiasm because of different research extends over the previous years. Generally, regular vehicles were utilized with huge exertion, and a wide range of sensors set on the rooftop. The development of electro-portability gives the opportunity to totally new vehicle ideas. By splitting ceaselessly from great approaches, it is conceivable to consider and incorporate self-ruling crashing into the vehicle engineering concerning IT and sensor frameworks, vitality the executives and plan. These sorts of autos are the overhauled variant of electric vehicle (EV). As of late a great deal of EVs and related vehicles, for example, a mixture vehicle has been created to tackle condition and vitality issues brought about by the utilization of an inner burning motor vehicle. Growing such vehicles for taking care of nature and vitality issues is an extraordinary thought. Right now, numerous kinds of research distribute specialized papers in diaries, which are identified with self-sufficient EV.

Decision making important for an autonomous vehicle as it is decided the safety and comfort of the passenger. In Malaysia, 80.6% of the fatal road accident caused by human error [6]. The statistic keeps increasing every year. Lin Li et. al tried to make an autonomous system to imitate human driver habit in term of acceleration and overtake [10]. They develop a personalized system after analyzing the human driver's various properties such as gender, age, driving experience, personality, and emotion. To achieve ideal comfort for passengers, the develop controller need to adapt a human-like control method. Artificial intelligence controller was able to imitate human-like decision-making ability. To develop human-like controller, preliminary data are gathered. The data are analyzed and used to create a Fuzzy controller in the future.

The path tracking for autonomous vehicles requires the control of the steering wheel in order to follow the selected path [7]–[9]. The point of this examination to build up a Fuzzy controller that uses the analysis' information to build up the controller for an electric surrey vehicle. The human route information was utilized to diminish the automated and unnatural inclination as the traveller utilize self-sufficient vehicles. The human route trial is the investigation that assembles information from the human driver as they pass through planned ways. The conduct of the human while driving in a straight way, turn left and turn right will be gathered toward the finish of investigations.

This paper sorted out as pursues: System Description examines the technique utilized in the examination. Investigation Setup depicts the human examination arrangement in the exploration. Results and Discussion introduces the results and dialogues. At last, an end toward the finish of the paper.

II. SYSTEM DESCRIPTION

A. Electric Buggy Car

The Yamaha electric buggy car (Figure 1) has chosen to develop an Autonomous Electric Vehicles for this project. The electric buggy car was easier to modified and install with several sensors. It was powered by 48V batteries and equipped with an 8.5 kW DC motor for the acceleration. The specification of the electric buggy car used shown in Table 1.

Figure 1: Electric Buggy Car

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Parameter	Dimension
Length	231 cm
Width	111 cm
Weight	249 kg
Wheelbase distance	163 cm
Top Speed	30 km/h
Battery	48 V DC
Steering system	Rack and pinion gear
Brake	Mechanical brake cable system to drum brake

Table 1: Electric Buggy Car Specification

B. Vexta AXHM230K-GFH DC Motor

A Vexta AXHM230K-GFH DC engine was introduced at controlling shaft so as to control directing wheel point. The detail of the DC engine appeared in Table 2. The apparatus proportion between controlling wheel riggings to Vexta engine rigging is 35:26. The turn of the guiding wheel point recorded utilized a rotational encoder B106. The encoder can peruse up to 500 heartbeats for each pivot and can gauge at least 0.72° for each heartbeat. The apparatus proportion among guiding and engine rigging are utilized to decide the controlling edge turn. The establishment of riggings, engine and encoder appeared in Figure 2.

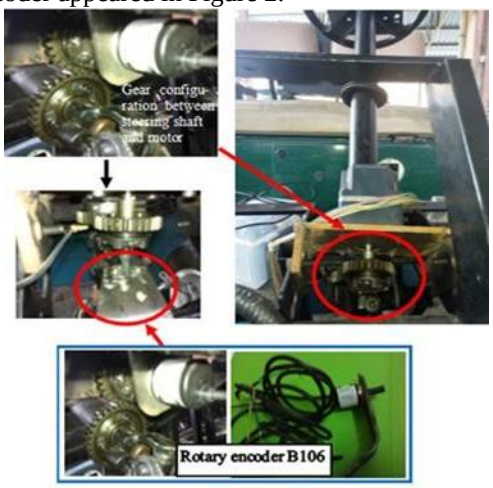


Figure 2: Rotary encoder B106 attach to the steering shaft

C. GPS BU-353-S4

A GPS module was utilized to explore the AEV. The BU-353-S4 fueled by a SiRF Star IV GPS chipset was chosen for the route. The capacity of foreseeing satellite situations for as long as 3 days ahead of time, and will convey a CGEE-start time of fewer than 15 seconds under most conditions with no system help. The exactness of the BU-353-S4 was under 2.5 m radii. The longitude, scope, speed and heading data were removed for the way following. The longitude and scope information was utilized to decide the present and next waypoints for the AEV. Speed information was utilized to screen the quickening of the AEV. Heading information was utilized to decide the objective course.

II. DESIGN OF EXPERIMENTS (DOE) AND PATH SELECTION

Human navigation experiments were conducted to gather the related data for the development of the Fuzzy controller. The position, heading, speed, and steering wheel angle are collected for this purpose. The details explanation for the human navigation experiments and selection of the path discussed in the experimental setup.

The selection for the human navigation paths was based on past research in autonomous vehicles. The path selected by the past researcher was the combination of straight, left and right turn. Several researchers selected a path with a combination of straight, left and right turn to test their autonomous systems (Bae et al., 2013; Jo et al., 2014; Perez et al., 2012; Wu, Lee, & Chang, 2007). While Andersen, Chong, Eng, Pendleton, & Ang (2016), tested their autonomous vehicle at a custom circuit at the Singapore University. The paths included the bezier curves and straight path.

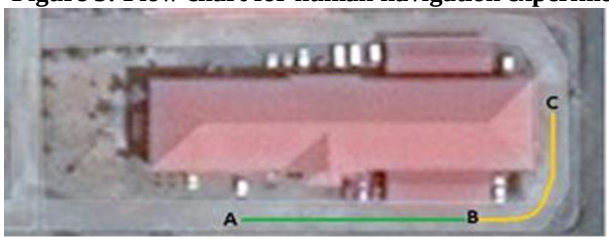
The human navigation experiments follow the selected paths. The paths selected was near the Automotive Engineering building at Institut Kemahiran MARA, Beseri, Perlis. The path consists of a straight path, left and right turn (Figure 6). The experiments for each path was done separately. The experiments to gather data in the straight path executed first, and then followed by left and lastly right turn.

III. EXPERIMENTAL SETUP

The human navigation experiments were done to collect data for the development of the Fuzzy controller. In order to design a supervised controller, the preliminary data were collected. The rule-base for the Fuzzy controller was designed based on the analysed data.

Figure 5 shows the flow chart for human navigation experiments. The 5 selected subjects were screened based on their driving experience. The subject must have a certified driver license and driving experience below 10 years (Hong et al., 2009). Figure 6 shows the selected path for human experiments at the Institut Kemahiran MARA (IKM), Beseri. The path consists of a combination of straight, left and right turn. The length of the selected path was about 40 m. Point AB is a straight path. The left turn was from point B to C. Point C to B is for the right turn. The subjects will repeat the experiments for 5 times for each path.

Figure 5: Flow chart for human navigation experiments



Point A ➡ point B - straight path
Point B ➡ Point C - left turn
Point C ➡ Point B - right turn

Figure 6: Selected path for the experiment

IV. RESULTS AND DISCUSSION

The human navigation experiments show the characteristic of speed for each subject while navigating through the different paths. All selected subjects produce the same driving characteristic for the straight, left and right turns. The results for straight, right and left paths are discussed in this section.

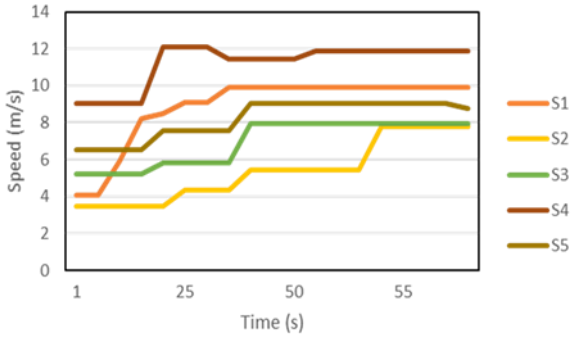


Figure 7: Result For Straight Path

Figure 7 shows the speed results for the paths of the straight line for all the subject. All subject has driven an electric buggy car on the straight path. Data from the straight line experiments have collected and convert to the graph. From the graph, results shown different characteristic on speed on a straight path during starting where #S2 start with slow speed and #S4 start with high speed. Speed on a straight line for #S1, #S3 and #S5 were consistent after 40 seconds from beginning. While speed on a straight line for #S4 was consistent after 51 seconds and speed on a straight line for #S2 was consistent after 54 seconds.

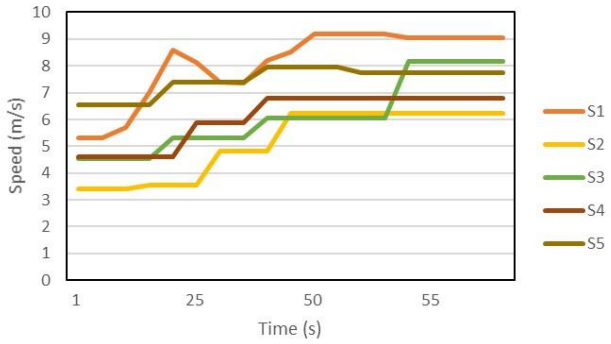


Figure 8: Result For Left Turn

Figure 8 shows the speed results during the left turn for all the subject. All subject has driven an electric buggy car and make the left turn on the selected path. Data from the left turn experiments have collected and convert to the graph. From the graph, results shown different speed characteristic on the left turn where #S2 start with slow speed and #S5 start with high speed. Speed for #S1 and #S3 was consistent after 54 seconds from the starting of the left turn. While speed #S2 was consistent after 45 seconds, speed #S4 was consistent after 40 seconds and speed #S5 was consistent after 52 seconds.

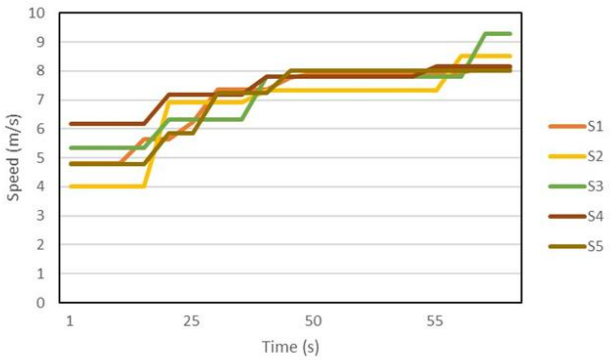


Figure 9: Result For Right Turn

Figure 9 shows the speed results during the right turn for all the subject. All subject has driven an electric buggy car and make the right turn on the selected path. Data from the right turn experiments have collected and convert to the graph. From the graph, results shown different speed characteristic on the right turn where #S2 start with slow speed and #S4 start with high speed. Speed for #S1, #S2, #S3 and #S4 seen not consistent until 55 seconds from the starting of the right turn. While speed #S5 consistent after 45 seconds from the starting of the right turn.

From the overall result shows above, we can see the difference of character of human behaviour during driving at a straight path, left turn and right turn.

V. CONCLUSION

The advancement of the fluffy controller that utilized human conduct during basic leadership capacity to choose the significance of each activity and choice. The driving encounters of the chose subject's drivers to produce a similar driving example for the straight, right and left turns. The standard base was made dependent on information from the human drive on a structured way. The fundamental motivation to make a controller that mimics human conduct is to make a self-governing vehicle traveller feel more secure and agreeable. The exhibition of the fluffy controller still in the testing stage. For the following stage, the self-sufficient vehicle will be tried on a planned way with the created fluffy controller.

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