Driving assistance system – Automatic parking maneuver using Lego Mindstorms

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ABSTRACT - In this paper a conceptual driving assistance system for automatic parking is developed and tested using Lego Mindstorms. A scaled model car is assembled using Lego Mindstorms parts. Using basic yes-no sequences in the parking maneuver flow, the car is programmed to measure a parking space and park automatically (side parking). Based on the successful performance of the parking, the conceptual automatic parking is possible to be improved for actual car.

1. INTRODUCTION

Automatic Parking System (APS) had been developed which has a good maneuver performance for vehicle [1]. The system is equipped with sensors information fusion, position estimation, path planning and tracking algorithm. In order to demonstrate the vehicle verification, the electric power steering system is controlled for tracking the path that had been planned. The parking space is measured up by using ultrasonic sensor. Drivers are able to use a user interactive interface in order to choose and select the parking space if it fits enough for parking the vehicle. After that, the steering movements would take place on the basis of pure pursuit tracking algorithm and also inertial navigation method [2]. Based from a simulation and experiment result, it shows that the system produce good performance through the verification of automatic parking system under parallel parking and reverse parking. Furthermore, the parking space only requires 1.5 times longer than vehicle length. Thus, parking maneuver is more efficient and safer through the utilization of advanced safety technique for automatic parking. An experiment of the system had been conducted using the Mitsubishi Savrin [3]. Sensors are mounted to the vehicle and measure the state of experimental vehicle. The heading angle of vehicle is measured by using Gyro while acquisition of wheel rotation and calculation of distance traveled is being measured by incremental wheel pulse transducer (WPT). On top of that, the vehicle is able to estimate the vehicle positions through the inertial navigation method based on instruments above. Furthermore, there is also other equipment which also built in the system such as ultrasonic sensor and touch panel. The ultrasonic sensor is used to configure environment and are based on time-of-flight (TOF) method, while the touch panel sensor enable the user to interact with the system. The RTK-GPS provides real-time X and Y coordinates and of vehicle's position and also high accuracy of data calculated from sensor data and microprocessor.

In this research, a simple scaled model car is assembled using Lego Mindstorms. A basic parking maneuver program is developed and tested experimentally.

2. METHODOLOGY

The car is assembled using Lego Mindstorms parts with ultrasonic sensor to measure distance. Figure 1 and 2 show the basic dimensions of the car. Lego Education NXT software is used for the parking maneuver programming. Figure 3 shows the parking flow sequences. The parking area is set with buffer for the car to move to fit into the parking spot (Figure 4).

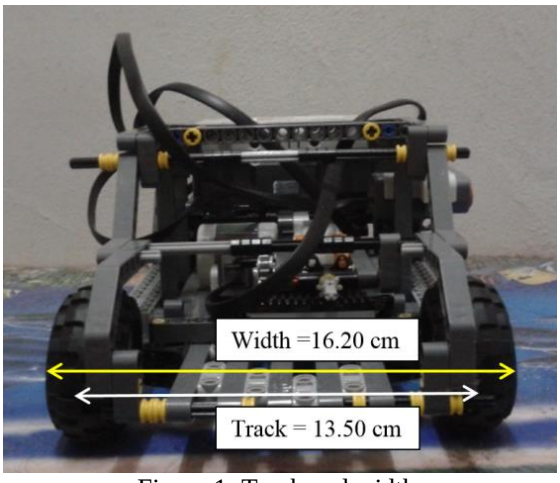

Figure 1: Track and width.

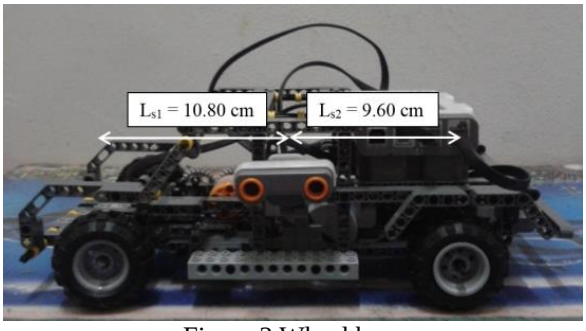

Figure 2 Wheel base

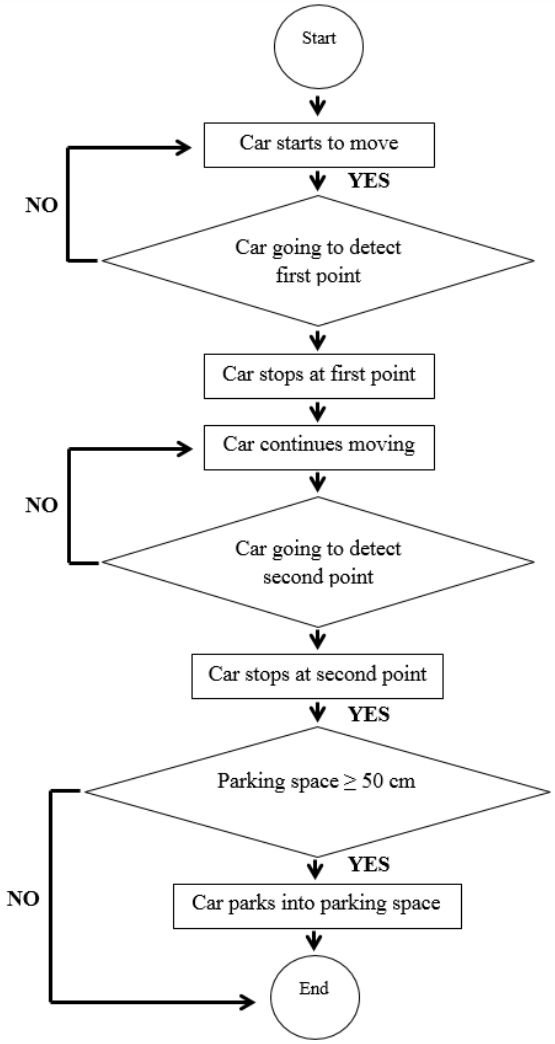

Figure 3 Automatic parking flow

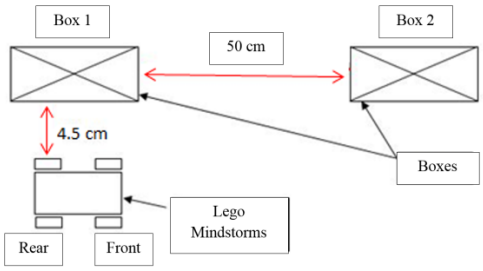

Figure 4 Parking spot

3. RESULTS AND DISCUSSION

Figure 5 shows the actual footage of the car automatically successfully park by itself fitting into the parking spot. The car used only one ultrasonic sensor to measure the parking spot length. Once the length is measured enough (more than minimum required length), the car proceeded with parking maneuver.

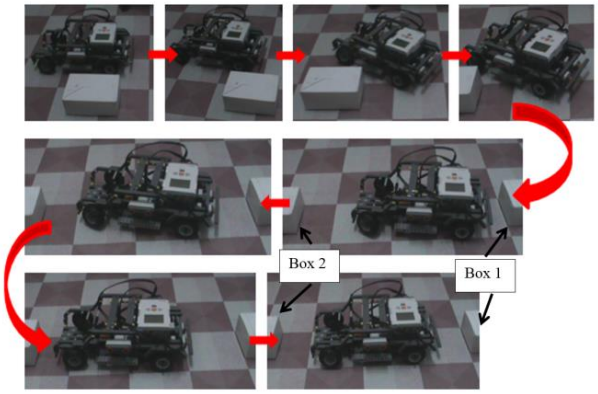

Figure 5: Parking result

4. CONCLUSIONS

A conceptual automatic parking system has been developed and successfully tested. The system used basic yes-no sequences to measure the parking spot and using ultrasonic sensor and moved the car using available motors (front steering and rear-drive). The performance of the car is observed based on the avoidance from hitting the boxes and fit perfectly into the parking spot. The car is considered as non-holonomic type of automatic moving machine. With some improvement using available parts, the system can be applied on actual passenger vehicle to assist driver who has difficulty in doing parallel parking maneuver.

5. ACKNOWLEDGEMENT

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6. REFERENCES

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