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Autonomous Vehicles Parking Using Neuro-Fuzzy

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***Abstract*— Due to high population, traffic congestion problems have become a major issue in today's world. So it is a need to solve the parking problems and provide an efficient solution for parking of the vehicles. Advanced vehicle Parking is an efficient solution for traffic congestion. The objective of this paper is to design an advanced vehicle parking system which will automatically park the vehicle without the help of driver. As everything in the modern world is going automatic, we have built a system which can automatically sense the empty parking slot and the vehicle is parked automatically. This system not only reduces the human efforts, but also reduces the consumption of space. The advanced vehicle parking assures full safety of vehicle and its owner. This system has shown the concept of an automatic vehicle parking system.**

***Keywords*— Autonomous parking; Neuro Fuzzy; Parallel parking; Pic Microcontroller; Parking Algorithm**

I. INTRODUCTION

In this modern world, parking of vehicles has major issue in the world. Because population is growing drastically which indirectly reduces the space available for parking. Due to this high population, traffic congestion problems have become a major issue in today's world. So it is a need to solve the parking problems and provide an efficient solution for parking of the vehicles.

Car parking is a major problem in urban areas in both developed and developing countries. Following the rapid increase of car ownership, many cities are suffering from lacking of car parking areas with imbalance between parking supply and demand which can be considered the initial reason for metropolis parking problems. This imbalance is partially due to ineffective land use planning and miscalculations of space requirements during first stages of planning. Shortage of parking space, high parking tariffs, and traffic congestion due to visitors in search for a parking place are only a few examples of everyday parking problems. Advanced Car Parking is an efficient solution for traffic congestion.

[4] Many parking algorithms and route planning have been studied. For instance, fuzzy control is applied to the automatic parking process. Another work demonstrated that the feasible controls of motion (steering and backward/forward) approximately following a feasible parking path regulated by trigonometric functions are iteratively generated and applied during the automatic parking process. Between iterative motions, the real-time vehicle location data from the sensor feedback monitor the parking maneuver to correct the following motion and avoid collision. There are other works emphasizing on optimizing the parking path to either the shortest time or route by studying the generic non holonomic constraints of the vehicle routes with various mathematical functions, such as circular, trigonometric, and polynomial functions. These paths have non-

constant curvatures and usually require lengthy periods of orbit planning and continuous wheel steering for path tracking, resulting shortening tire lifetime.[4]

To simplify the control process, a straight forward algorithm with fixed turning curvature was proposed and is partially adopted in the setup of this project. The design of this system in which the parking has no intervention of human at all. This system has not only reduces the human efforts, but also reduces the consumption of space. The advanced car parking assures full safety of vehicle and its owner.

II.CURRENT AUTOMATIC PARKING SYSTEMS IN THE MARKET

[11] Many automobile manufacturers provide optional automatic parking assistant systems including Toyota, Ford, BMW, Audi, Mercedes-Benz, and Chrysler. However these systems need human 4 monitoring and accelerating/braking inputs and are not completely automatic. Bosch [12] is developing a fully automated parking system by calculating a parking maneuver and monitoring the surroundings, and it allows the driver to leave the car and activate an autonomous parking from a smartphone. All these systems have similar parking strategies and maneuvers with just different levels of automation.

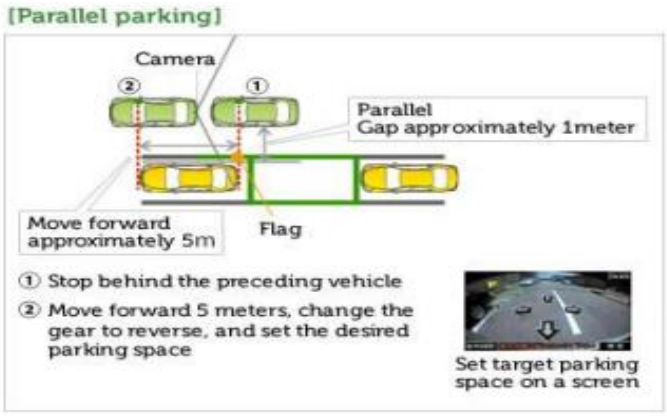

Fig 1. Toyota's Intelligent Parking Assist For Parallel Parking

[11] Take Toyota's Intelligent Parking Assist12 for parallel parking as example, the vehicle moves forward by a certain distance (around 5 meters) after detecting a suitable parking space, then the system assists steering the wheel monitored by sensors while the driver controls the accelerating and braking, as shown in Figure 1. The system demonstrated in this paper is fully automatic similar to the one of Bosch with a parking space finding function. After the parking procedure is started on a street, the vehicle moves slowly keeping an appropriate distance from the road side parked cars. Once a suitable space has been detected, the car moves forward with a certain distance and then drives backward to park the car automatically. The whole procedure is monitored by ultrasound sensors.

III. PROPOSED METHODOLOGY

The project is focused on achieving a single task (automatic parking) by integration of sensors and actuators controlled by microcontroller and strategy planning/coding, therefore the vehicle platform is not built from the parts but from modifying a RC toy car instead for saving the time. There are generally three kinds of parking patterns: parallel, front/back-in perpendicular, and with an angle (usually 45 degrees), and this project is just focused on the parallel parking. The modified toy car is expected to do the following tasks in a complete automatic parking process:

1. Drive along an imitated road-side environment and detect the distance from the car to the road-side obstacles such as parked cars or just curb on the right hand side.
2. Once the length of a parking space larger than the length of the car plus a buffering distance is detected, the car will stop automatically.
3. Perform a smooth and efficient parking behavior according to the relative positions of the car and the parking space.

The automatic car parking system has the following major components:

1.The vehicle consists of a 7V DC motor in the back and a servo motor in the front.

2. PIC 18F4550. PIC Micro-controller controls the car's driving DC motor and turning servo motor. The sensors are connected to the PIC Micro-controller and integrated in the system, therefore the parking strategy and algorithm can be programmed and uploaded to PIC Micro-controller.

3. HC-SR04 ultrasonic sensors, shown in Figure 2(a). Currently four ultrasonic sensors are mounted on the car. Two sensors are setup on the right side to measure the distance between the car and the road-side objects. The other two sensors are mounted on the front and the back bumpers of the car in order to prevent collisions during the parking process.

4. L298N H-bridge high current motor drive shield. Arduino's maximum DC current from VCC and GND pins is merely 200 mA. This shield provides up to 2 A current to drive the car's motors. See Figure 2(b).

5. A frame is used to support the ultrasonic sensors. It keeps the sensors stable in order to obtain the most accurate measurement data.

Fig 2(a) HC-SR04

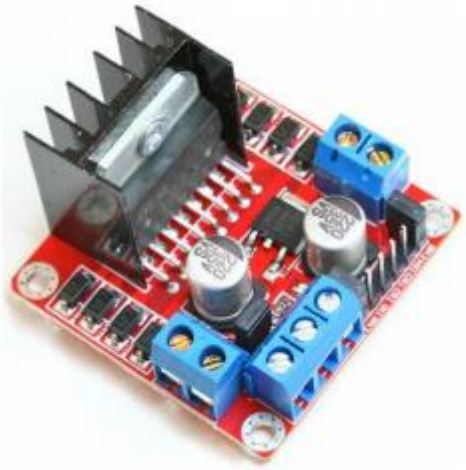

Fig 2(b) L298N

IV. RESULTS

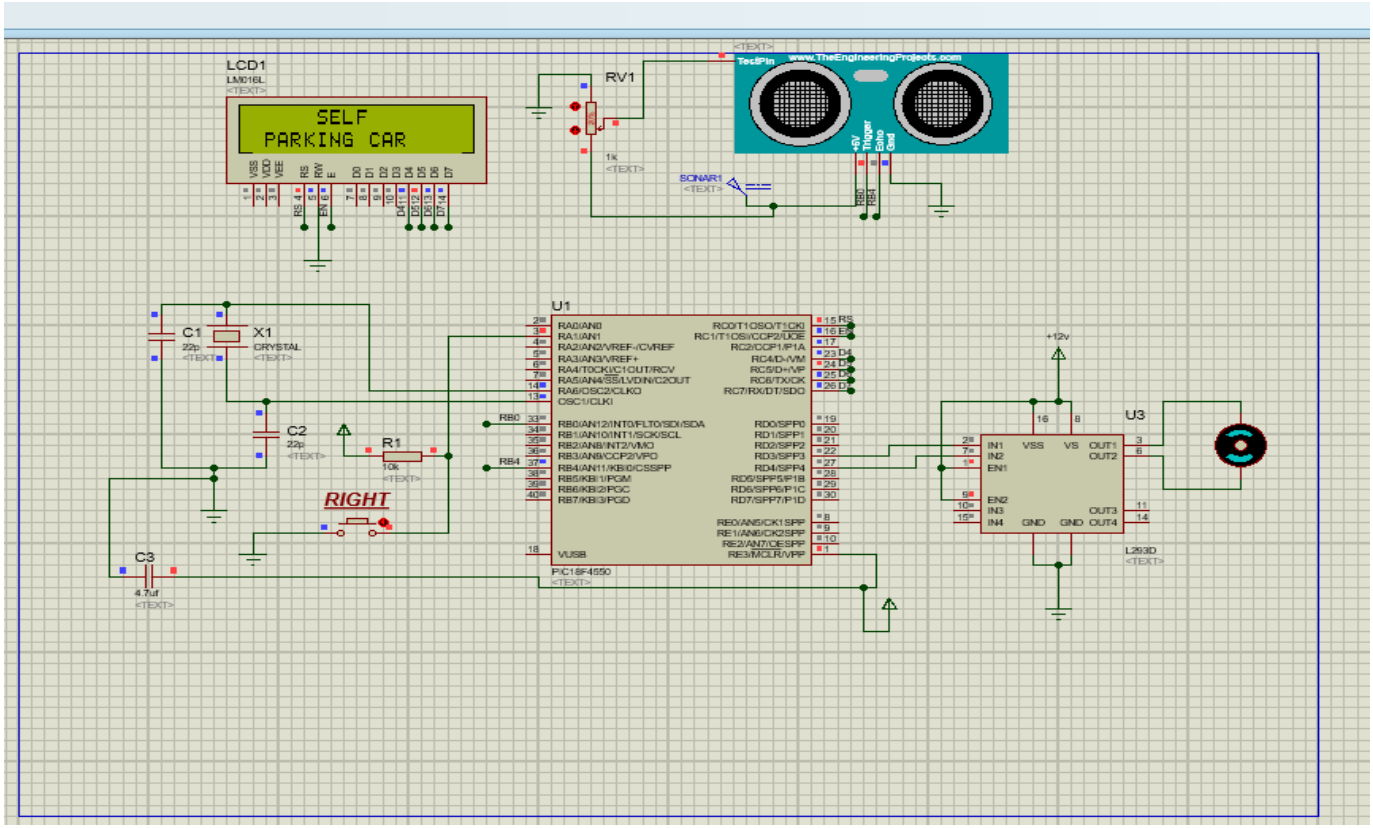

Fig.4.1 Introduction to Self-Parking car

After pressing the switch, parking algorithm is initialized and “Self -Parking Car” message is displayed on the LCD display.

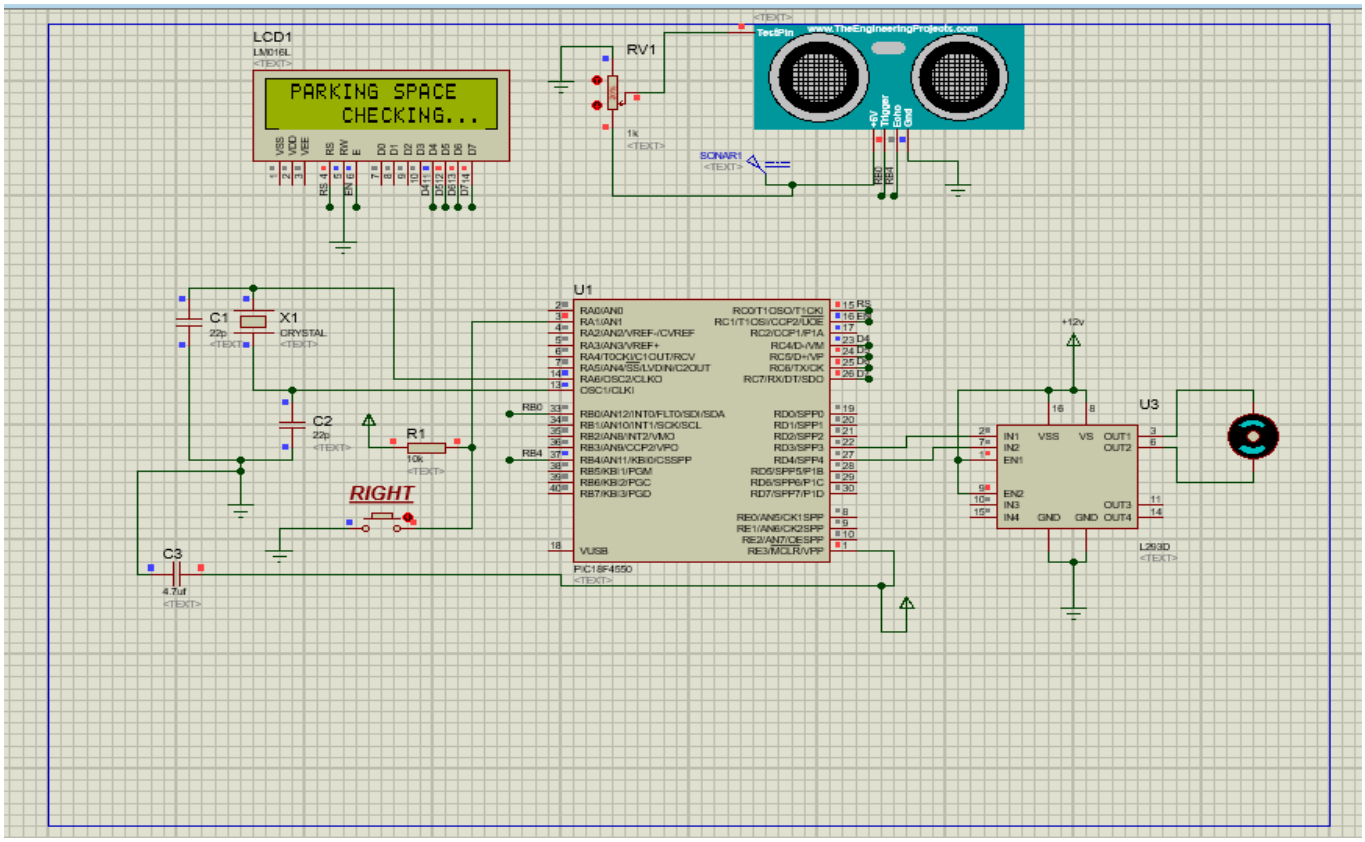

Fig.4.2 Parking Space Checking

Continuously monitoring the distance and verifying if the distance is available or not.

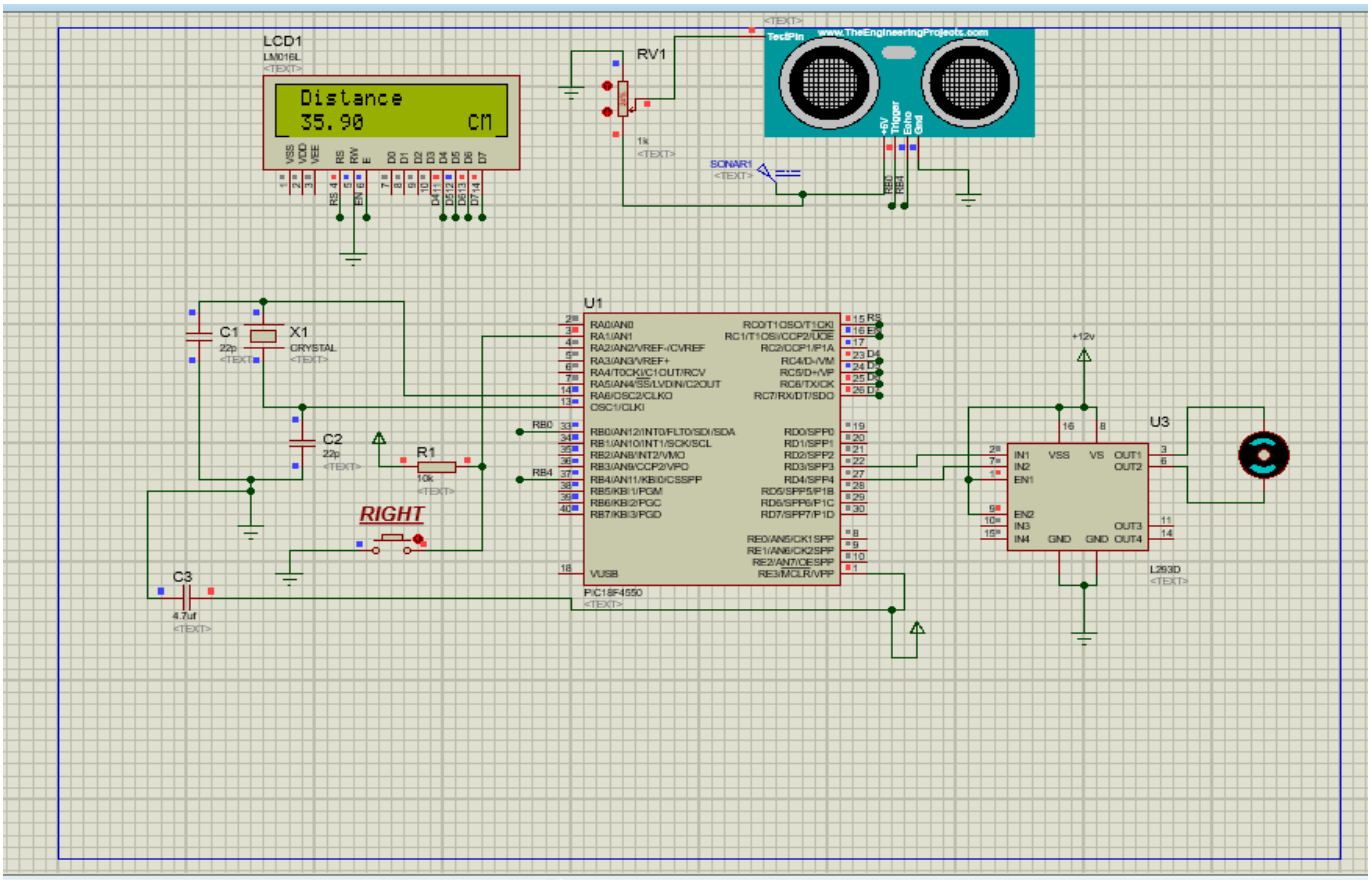

Fig.4.3 Displaying the available distance

Displaying the available distance on the LCD display and checking for required space.

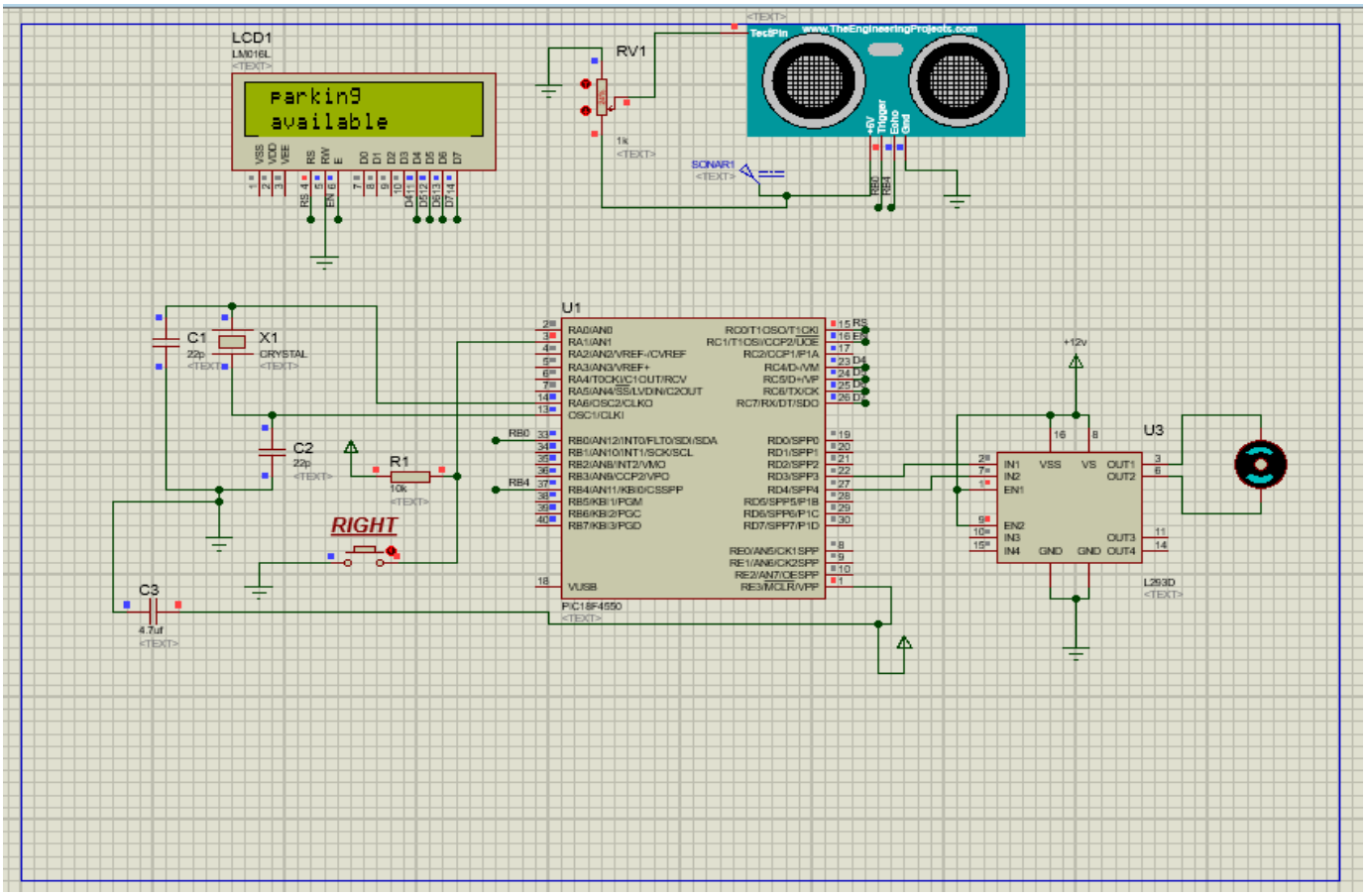

Fig.4.4 Parking available

If the available distance which is displayed is greater than equals to the required distance, then “Parking available” message is displayed and parking procedure is initialized.

V. CONCLUSION

We have focused on the most difficult case of parallel parking which is the case when the parking space dimensions cannot be identified. The current work is focused on reducing the time to park the Car and save the fuel. This type of technology could be implemented in Self Driving car in which most of the functionalities would be Autonomous. The proposed automatic-driving car is successfully simulated and tested.

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