Introduction

Currently, many drivers struggle greatly with the idea of parallel parking their vehicles in between two already parked cars. 34% of drivers claim that this is the hardest parking technique, 8% state that they have damaged their car or another while attempting a parallel park. Also, 50% of drivers stated that they will search for a different location to park, just to avoid parallel parking [1]. Finally, parallel parking even ranks among the top 15 most stressful things [1].

Of course, many modern cars come equipped with sensors and aids that help drivers drive and park. However, this process often takes long or will not function properly in a tight space.

This project will combine a hardware and software solution to the issue. Drivers will be able to activate a system that will rotate all four wheels at a 90-degree angle, allowing the vehicle to simply slide in-between two already parked cars with less input from the driver. Also, the addition of sensors will further assist the drivers by displaying if the vehicle can fit into the desired spot.

Methods

In order to demonstrate this new parallel parking system, a scaled down model of a vehicle will be created.

Sensors will be located on the side. The sensors will display distance and a warning if an object (another car) is too close.

Four 360-degree servo motors will be used to power all four wheels on the vehicle with two 90-degree servo located on top that will turn all four wheels to the desired 90-degree angle. This model will be able to parallel park using the 90 degree turn method.

The vehicle prototype functioned with the help of the Arduino Mega and the Arduino coding language. All servo motors were wired into the Arduino Mega and powered using a breadboard power supply connected to two 9-volt batteries. One of which powered the four wheels and one which powered the top two servos. Since the suspension pieces are connected using thin metal rods the Arduino and breadboard had to be mounted slightly above the vehicle base, which can be seen in figure 6. This prevents the rods from getting stuck, hitting or damaging any other on the wiring. After the prototype was completed the parallel parking system was tested. The prototype was successfully able to park between two obstacles.

Abstract

In order to compare the parallel parking system to the current solutions on the market, a working prototype will be created. This prototype was built from a wooden base. The 4 wheels of the car where then attached to wooden “suspension” pieces that were circular and were inserted in the front and back of the base to mimic the front and rear wheels of the vehicle. On top of the base, there were two 180-degree servo motors that would be able to rotate the top portions of the wheels putting them in a perpendicular direction to the desired spot. This base and wheel setup can be seen in figures 1 and 2.

In figure 3 the connection between the back middle servo (180-degree) and the back left servo can be seen. Essentially when the back middle servo rotates at a 90-degree angle, it will pull the back left suspension piece with it, moving it from its forward-facing position to the new 90-degree desired position. On the other side the same principle is applied to the back right wheel. This connection will be repeated for the front middle and back suspension pieces in the front of the model vehicle. A better angle of how both the front middle and rear middle servos are connected to the suspension can be seen below in figure 4. Furthermore, in order to control the model the two joysticks will be connected and implemented. One joystick will function as a control for the forwards and backwards motion of the four 360-degree servo motors. When the joystick is in the forward position the vehicle will move forward, when it is in the rear position the vehicle will move backwards. When the joystick is not being moved, the car will stand still. The other joystick will be used to control the angle of the top 180-degree servo motors. These joysticks will be housed in a 3-D printed controller module in order to make control easier. This 3-D printed controller can be seen in figure 6.

Conclusion and Significance

The parallel parking system prototype was successfully created using a scaled down model. The parallel parking model was able to achieve its main goals which included:

- Parallel parking by turning all four wheels at a 90-degree angle (which helps parking in tight spaces)
- The four servo motors were able to move the vehicle forwards, backwards and to the side with the help of the top servos changing the angles
- Used sensors to notify the driver if the desired spot would be sufficiently large enough to park in
- The parallel parking system was able to execute a parallel park anywhere from 12 to 20 seconds. Current systems on the market took over a minute and were not able to execute a parallel park in very tight spots.
- Although implementing the parallel parking system into vehicles could improve the parking experience for drivers who struggle, making changes to automobiles that could be used on the road would without a doubt be expensive to both test and implement.

Limits, Risk, and Mitigations

- Without a doubt, implementing a new or modified suspension system onto largely manufactured would require testing in safety. Although the goal of this system is only to park the vehicle, the system would also have to be tested in order to understand how the handling and driving are impacted by such a drastic change to suspension.
- In the United States the National Highway Traffic Safety Administration is responsible for keeping drivers safe.
- The system would have to be tested in order to prevent harm or death to users and pedestrians. Besides the harm that can be done to people there can also be damage to property done. Finally on a financial level, the system would have to be tested in order to prevent major recalls.
- For example, if a system were to be implemented on a mass scale and lead to a recall, it could have a very negative financial impact on the company.

References

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