MOBILE COMPUTING (CS23400/1)
LAB 3 - REPORT

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1 TASK AND CHALLENGES

The goal of this lab was to deploy a lane detection algorithm and to design an algorithm that moves the car along the detected lane.

Although the lane detection algorithm was provided, the hardware and software provided imposed some key challenges to creating a robust self driving algorithm. The car itself had difficulty driving in a straight line because the wheels were skewed slightly towards the right, this means that to drive in a straight path the car would constantly have to adjust the perceived angle of its wheels. Furthermore, the camera attached to the car was limited in its range of vision. This led challenges where the camera was unable to capture the lane within the frame if the car was driving too quickly or if the turn was too sharp. On the software wide, the lane detection algorithm was extremely unpredictable when the lanes were out of frame so a lot of effort was dedicated to making sure that the camera would always be able to capture both of the lanes. Finally, the rate at which the car was receiving lane data was quite slow (a few frames a second), this was a bottleneck in how quickly we could allow the car to drive itself.

2 PROPOSED APPROACH

At a high level, the algorithm we used to drive the car consisted of taking the midpoint of the camera frame and taking the calculated midpoint position of the detected lanes. Ideally, we would want the midpoint of the detected lanes to match the midpoint of the camera frame.

In order to accomplish this we first calculated the dimensions of the frame returned by the camera and set that as the ideal midpoint. Now, for every midpoint returned by the lane detection algorithm we can calculate the distance between that and the ideal midpoint. This then gives us an idea of the direction and angle for which we should point the wheels and should create relatively smooth movement of the car(no sudden jerky movements to adjust or make a turn).

An additional feature that we had implemented in order to combat the issue with loss of lane detection is to create a ”memory” of previous midpoints and use a moving average of these to determine what angle to position the wheels. If the lane readings were to vary drastically this would help to smooth out noisy readings and keep the car on track.

3 RESULTS

We ran tests that varied speed, angle changes, and memory. It was found that the slower the speed the higher the chance the car would successfully drive itself in the lane, low to medium angle changes were more affective than aggressive angle changes, and we found that having no memory (not deploying the memory feature) was more effective than having a memory.

Due to the slow rate at which the lane detection algorithm was able to send data to our car, the car had to move very slowly in order to process the lane in front of it and make adjustments accordingly. If the car moved too quickly, by the time the car decided to make an adjustment, its actual location was no longer in its perceived location.

When deciding how much to turn each wheel when the midpoint was off, we took an iterative approach where we tested varying degree change functions (modest, medium, aggressive). Essentially, this meant changing some scalar value that determined how much to turn based on the distance from the ideal midpoint.

Finally, it was found that having a memory was not as effective as simply making sure that the car could keep both lanes in the frame at all times. Having a memory actually decreased the performance of our car due to the equal weighting of the previous moves, the car did not turn as much was necessary in order to stay in the lane.

Ultimately, we were able to successfully navigate straight lanes, left turns, and right turns. This was done by calibrating our midpoint to angle change algorithm until it was able to complete the course. It also resulted in extremely smooth driving by our car due to the constant angle adjustments.

4 CONCLUSION

As autonomous vehicles become more and more prevalent, it is not difficult to imagine a future where the roads are dominated by autonomous vehicles. Through the experiments that we ran with very simple hardware and software, we were able to relatively easily achieve self driving within a lane. This was done simply by establishing an ideal point to follow and making adjustments along the way as the car deviated from the ideal. In modern autonomous vehicles, the hardware is a lot more powerful and more precise allowing for more complex maneuvers and situations; however, this was a good first step in understanding the difficulties of autonomous vehicles and working towards fully understanding autonomous vehicles.