Scaled-Down Centralized Autonomy

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ABSTRACT

Despite many educational efforts, the number of deaths on the roadway due to drunk, drugged, and distracted driving persist without signs of lowering. Eliminating drunk, drugged, and distracted driving is a serious challenge that the world has yet to solve. But, many approach this challenge from a human aspect. However, we thought it best to approach this challenge from a technological direction, with the hopes of making the roadways a safer place for everyone. We built a self-driving car that receives a camera feed, reroutes it to a stronger server, and sends instructions back to the car. This method of processing information is different from what current autonomous cars use (processing units within the car), and could possibly make them much cheaper and more available to the public. We were able to build an RC car with lane detection, and object detection.

INTRODUCTION

Grand Challenge: Eliminating drugged, drunk, and distracted driving - by developing Autonomous cars.

Importance of Challenge:

- In 2015, 10% of 32,166 (3,196) fatal crashes in the US were due to distracted driving (National Center for Statistics and Analysis, 2017)
- In 2016, 10,497 US drunk-driving fatalities (National Highway Traffic Safety Administration, 2016)
- 57% increase in manual phone during driving in past 5 years (Kidd & Chaudhary, 2019)
- Autonomous car: Vehicles that do not require human guidance or control (Issitt, 2018)
- Distracted driving: any non-driving activity done during the operation of a vehicle (National Highway Traffic Safety Administration, 2016)
  - Categories: Visual, Manual, and Cognitive
- Levels of Autonomy (Dremali, 2018):
  - 0 - No Automation
  - 1 - Driver Assistance
  - 2 - Partial Automation
  - 3 - Conditional Automation
  - 4 - High Automation
  - 5 - Full Automation
- Current autonomous cars contain the processing power within them - increases price of car (Tesla, 2020)
- Current prices of autonomous cars: >$45,000 (Tesla, 2020)

Knowledge Gaps:

- Current autonomous cars are only “Level 3” (Dremali, 2018)- How can we advance the level of autonomy?
- How can autonomous cars be made cheaper? - ***rerouting information to an outside processing unit***

Hypothesis: Proposing increased advancement of self-driving cars to make them truly autonomous, which can lessen fatalities on the roads by removing responsibility from the driver, and leave it to the software and hardware.

METHODS

Code software for information exchange between sensors, Raspberry pi, and PC. Completed in python - loaded to car, along with code for basic movement. Sensors can now transmit information between car and PC

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Code software for lane detection and object detection - building upon pre-existing code to tailor it to our needs.

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Train software on desired object - put many images into a database and mark the images to feed into the software so that it can perform machine learning and recognize similar objects on its own

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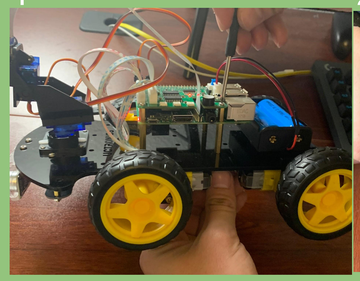
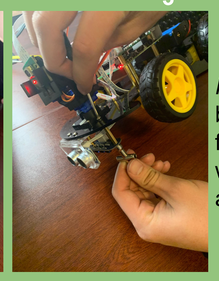
Test car for mobility and functionality on obstacle course - set up a lane (tape), and place the object that the software was trained on in the roadway. Allow the car to run autonomously, stay within the lanes, and detect and avoid the object

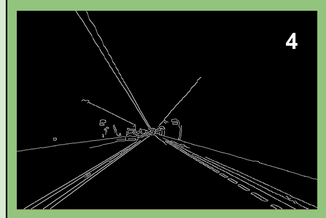
RESULTS

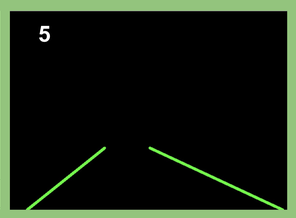




Stage 1 Sensors and Building the Car.

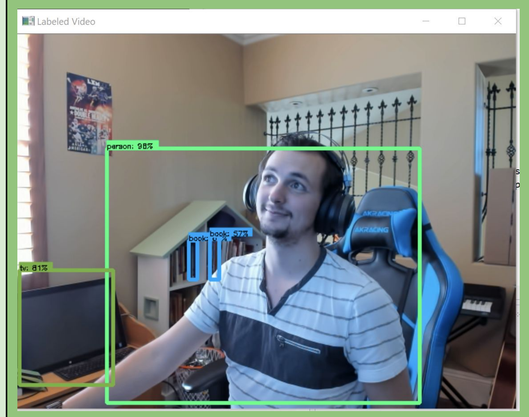
Figures 1-3 (to the left): RC Car built from assembling chassis from kit from different angles with the cameras and sensors attached.





Stage 2: Lane Detection

Figures 4-6 (to the left): Screen captures from the lane detection software. Overlay the image, denote where the lane is, and overlay back over the original image.



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Stage 3: Object Detection

Figure 7: Screen captures from the pretrained object detection software. Software could accurately identify a person (98% certainty), a TV (81%), and books (~57%)

ANALYSIS: We were able to get the RC car functioning with the desired mobility. The car demonstrated the ability to properly transmit information received from its sensors to the Raspberry Pi, out to the PC for processing, and back to the car for action. This proved that it would be possible to reroute information and process it in a different way than what current cars use. This functionality was possible due to the code that our group had written, developed, and implemented. Since we could get object and lane detection working on the computer, it would most likely have worked with the car, and would have hopefully demonstrated autonomy.

ACCOMPLISHMENTS

- **Stage 1:** Completed building the car and established communication between car and PC
- **Stage 2:** Completed the lane detection software
- **Stage 3:** Trained the neural network to recognize many common objects
- **Stage 4:** Attach lane detection and object detection to car and test it out.

QR Code: Link to Video of Car Movement and Lane Detection Screen Recording

CONCLUSION

The autonomous car should mitigate the issues related to distracted driving, by focusing on the machine rather than user error. Not only will self-driving cars be able to alleviate the issues presented, but it can also aid others by allowing for older and disabled people to be on the roads, as well (Souders, 2016). Self driving cars is in the near foreseeable future that would change the world for the better.

In future semesters we will work more with the coding aspect of the project to enable movement and also obstacle detection with the camera interface. To complete such tasks, the utilization of machine learning is pivotal. Due to the time frame allowed, our progress on our autonomous car was limited. It was challenging to upload/collaborate on code since each of our team members lived in different areas with varying time zones. The charger being left behind also hindered our progress since it only allowed us to use the car for a certain amount of time.

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