DEPARTMENT OF
Engineering

TCU COLLEGE OF SCIENCE & ENGINEERING

Remote Controlled Robotic Arm Vehicle

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SciCom Let's Talk Science

In our project, a control-theory based algorithm would be employed to develop a small electric vehicle that can self-navigate through an unknown course to arrive at the desired location while avoiding obstacles and walls. This project is an extension of our successful project funded last year, in which we were able to operate a partially autonomous car to run around a location and generate a virtual map. Our team expects to grant the car full autonomy like a self-driving car and let it travel through a relative abundance of places to create computer models of critical infrastructures without the help of humans. The success of this project will have a broad impact on society. First, this capability would be useful in self-driving cars, which allow drivers to spend their time more productively instead of driving to work or assist disabled people. Second, the car can generate a simulated model of places that help to analyze unknown locations. Finally, the project can surely create a platform for future TCU engineering students to learn about self-driving car technology and machine learning. This project is expected to succeed due to the achievements we gained from the previous project.

The algorithm will be written in Python/ROS, controlled by Raspberry Pi 3, and tested on a walled course constructed by us. It should be able to navigate a course without having already driven through it. Another special feature is that the car will also precisely arrive at a pre-determined location.

Introduction: In our project, image tracking was employed to provide a honing mechanism for a robotic "scorpion tail" attached to a small Remotely Controlled Vehicle. The car will be controlled wirelessly through a web interface, with mobile phones being the target user. Like the Mario Kart Versus Mode, where multiple cars drive and bump into each other, the vehicle will be controlled wirelessly while the "tail" is actively seeking targets and upon close proximity will "pop" the balloon. Each car will have 3-5 balloons to start, and the objective of the tournament will be to hunt down the remaining cars and “pop” their balloons, until all cars lose their balloons and the victor remains with at least one balloon intact.

Inspiration:

- We wanted to make a real-life version of the popular video game “Mario Kart”
- By making this game into a reality we hope it can promote outdoor activities and get kids off of the TV screen.

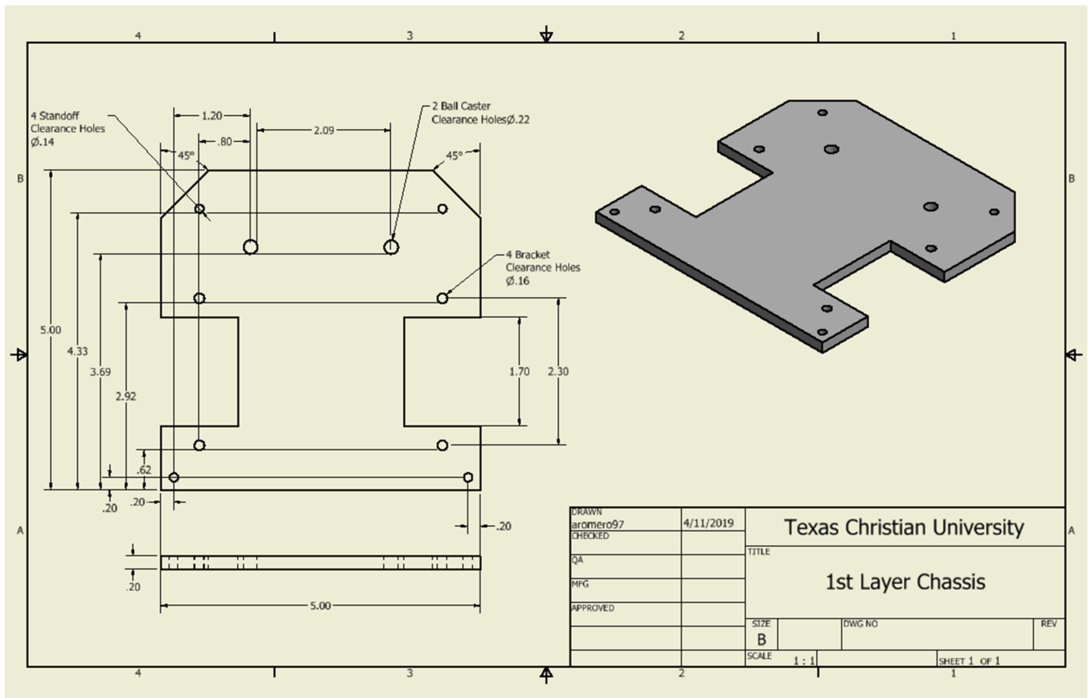
- We based our design off the “Kart” used by Mario in the game.

Mechanical Design:

The structure was designed with Autodesk Inventor to assemble and stabilize all components while simultaneously considering their dimensions and functions. This was achieved by laser cutting and 3D printing fabrication.

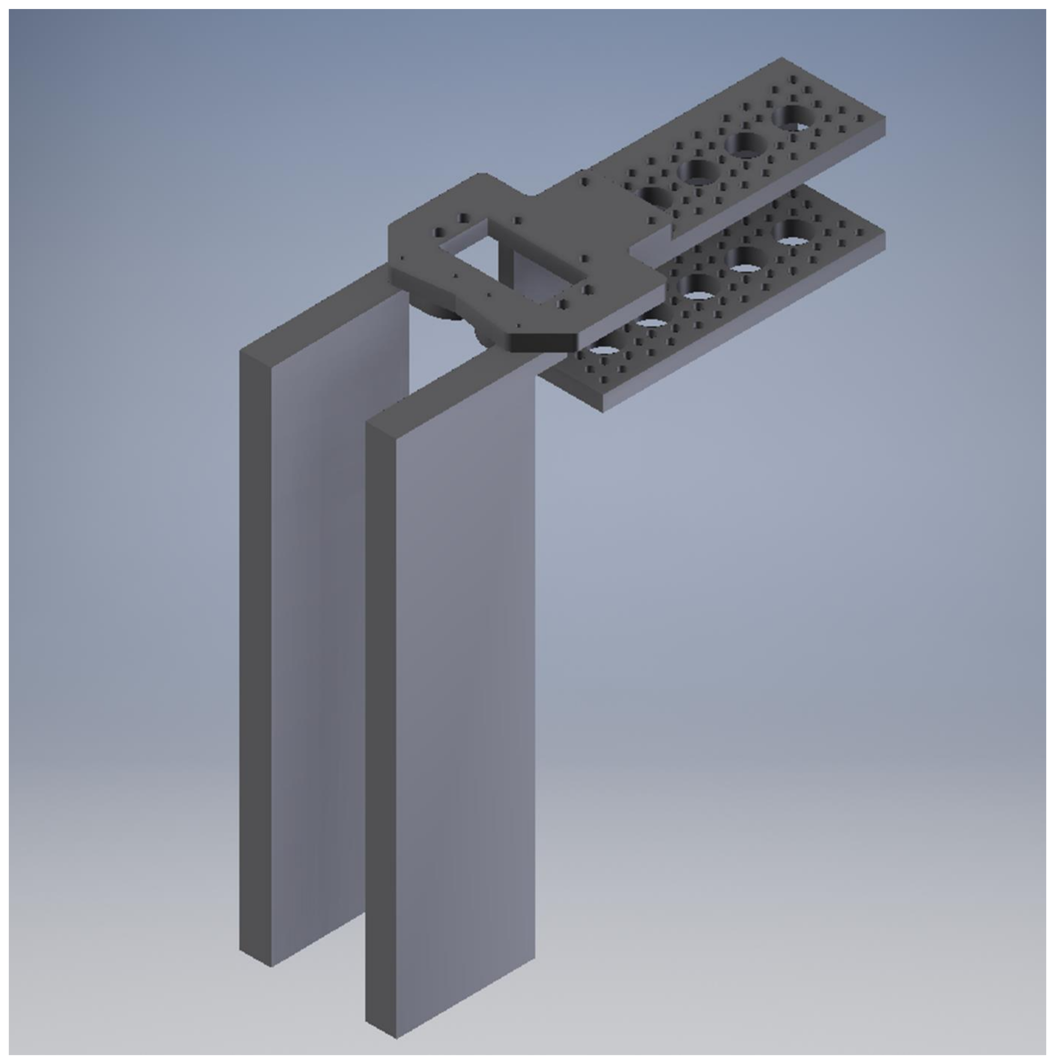
3-Layer Chassis

- Front of the 1st layer was designed with corner edges at 45 degrees to fit two DC motors
- 2nd layer designed to house battery components, a BeagleBone Black, a camera, and robot arm

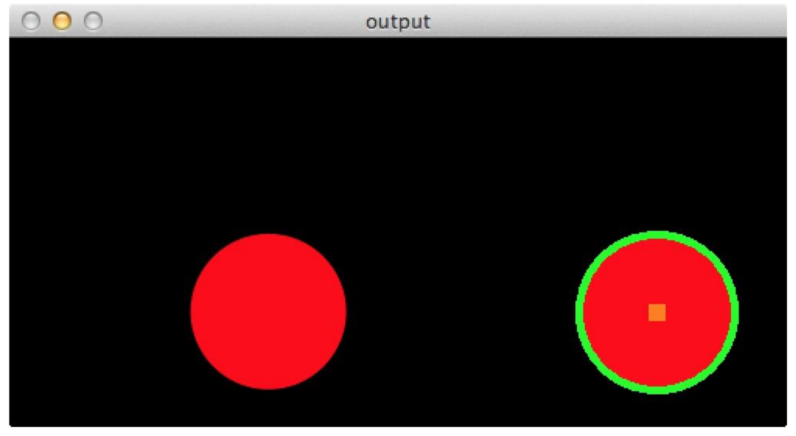


DOF Gripper with Servo Motor

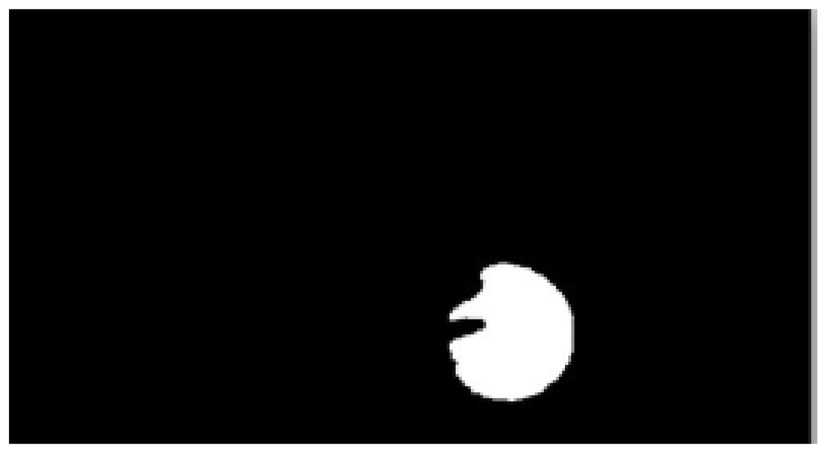
- 180 degree Servo Gearbox was implemented to rotate the Gripper to a clearance state
- Arm designed to reach down to height of baloons
- Servo motor varied the distance between Gripper arms accordingly



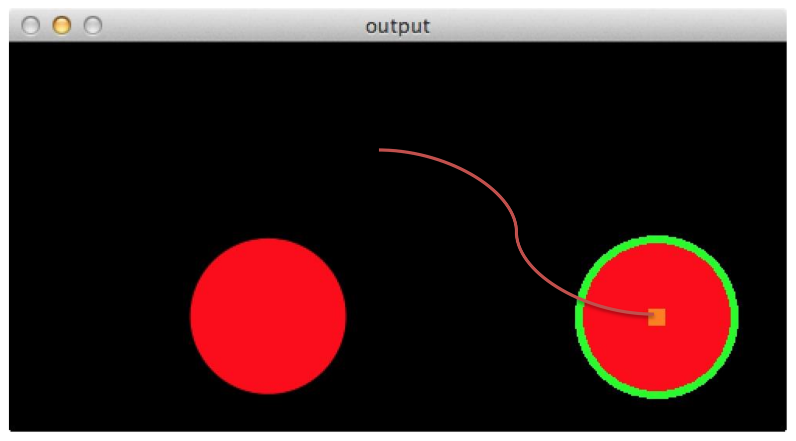
Object Detection and Retrieval:



- OpenCV was used with a range-detector algorithm to detect the color boundaries in our image and use that information to identify a region of a consistent color.



- The contour is found of the color boundary and a circle is mapped to its area. The resulting coordinates of the circle are added to an array.



- The resulting center coordinates of the circles are pulled from the array and are used to draw the past coordinates the circle has passed; the contrail of the circle.

Summary:

- Made autonomous robotic vehicle capable of detecting, picking up, and placing marked objects.
- Plan to compete in compeition again next year.

Acknowledgements:

- TCU IEEE, RAIC, IEEE R5 and Dr. Morgan Kiani for advising, inspiring and assisting with this research.