Autonomous Target Robot

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Background:

The autonomous target robot project is a naval research project. The purpose of the project is to design, program, manufacture, and test an autonomous vehicle that can locate pre-determined GPS coordinates and present a target to the shooter. This is a new project at UCI, and the team is a small group of undergraduate engineering students from the MAE department. We designed the robot during Fall quarter, and manufactured and tested it during Winter quarter.

Functionalities:

Navigation:

Given a GPS coordinate, the robot is able to navigate using an on-board path creation algorithm to this coordinate within about 7-10 feet in poor conditions, and a minimum of 3 feet in optimal conditions. The robot uses an onboard compass to orient itself as it navigates to the GPS coordinate.

Communications:

The robot is able to wirelessly receive and transmit data back to a controlling arduino board. This controlling arduino board can be programmed with a path that the ATR can follow. The controller then sends specific GPS coordinates to the robot that we want it to navigate to.

Target Apparatus:

The target apparatus is 3D printed with switches imbedded in different locations. The purpose of the switches is to indicate when and where the target is hit. That information will then be relayed back to a computer. The target is also connected to a servo motor which rotates when the switches trigger.

Costs:

1.) Buck Converter
$6.50
2.) LSM303DLHC 6 Axis Mag./Acc.
$6.68
3.) Active GPS Ant.
$9.70
4.) NEO-M8 GPS
$15.03
5.)Arduino Mega
$22.60 x 2
6.) L293D Motor Shield
$6.89
7.) HC-12 Transceiver
$12.92 x 2
8.) 11.1 V LiPo
$70.00
9.) 9V DC Motor GR 1:45
$10.00 x 2
10.) Servo
$15.00
11.) Chassis
$126.00
12.) Miscellaneous (3D printing, wiring, etc.)
$30.00

Total: $366.84
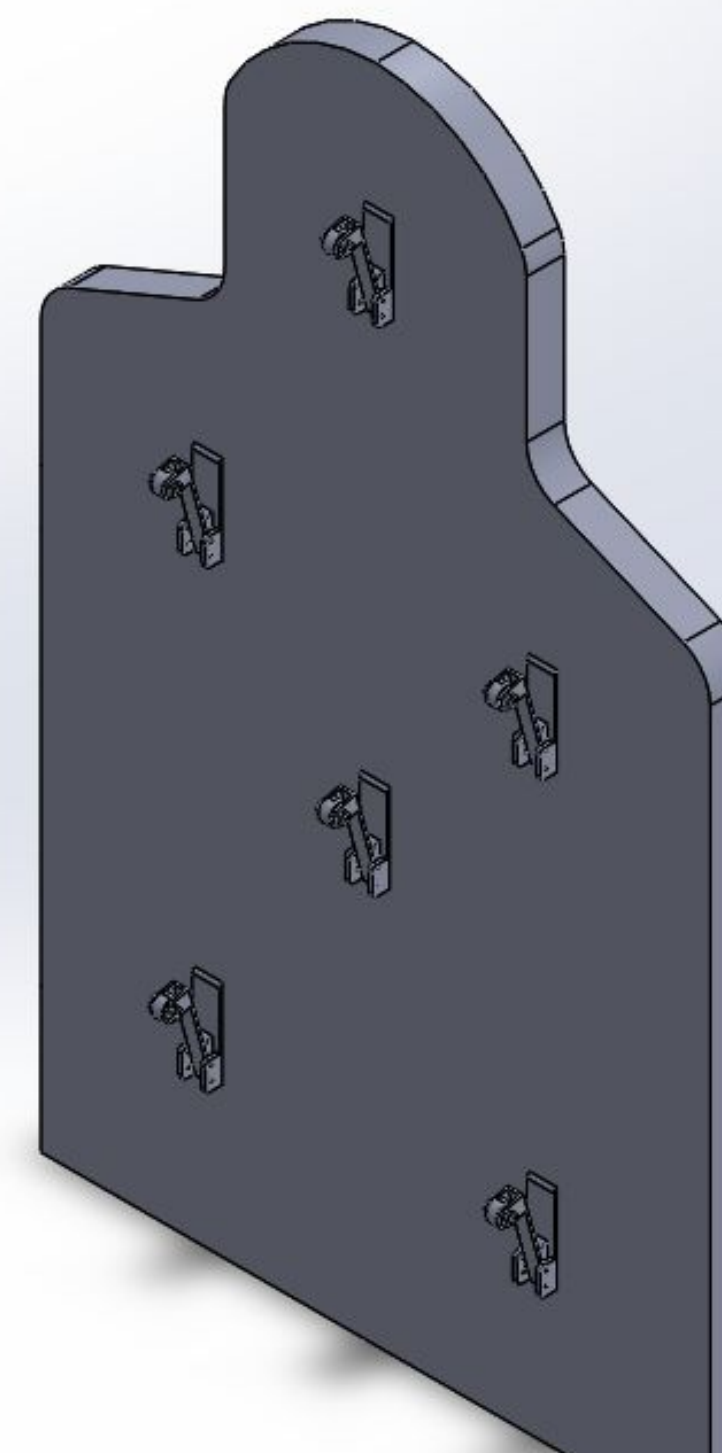
Technical Challenges:

- **Navigation Capabilities:**
  Most of the issues encountered on the navigation side of development has been mostly related to dealing with the inherent issues of working with arduino and expecting high amounts of precision. Wireless communications between two Arduinos can frequently corrupt data, trying to manipulate large numbers that require a lot of digits of precision on Arduino can lead to many errors.

- **Target Apparatus:**
  The most difficult challenge that occurred with the target apparatus was developing a way for hit detection. The end solution is to use switches. To protect the switches, a protective shield is placed over them in the shape of the target but split into different sections. Having the shield split means that each switch would have its own section, so when that section is hit a switch will trigger. This solved the issue of having to hit a switch directly.
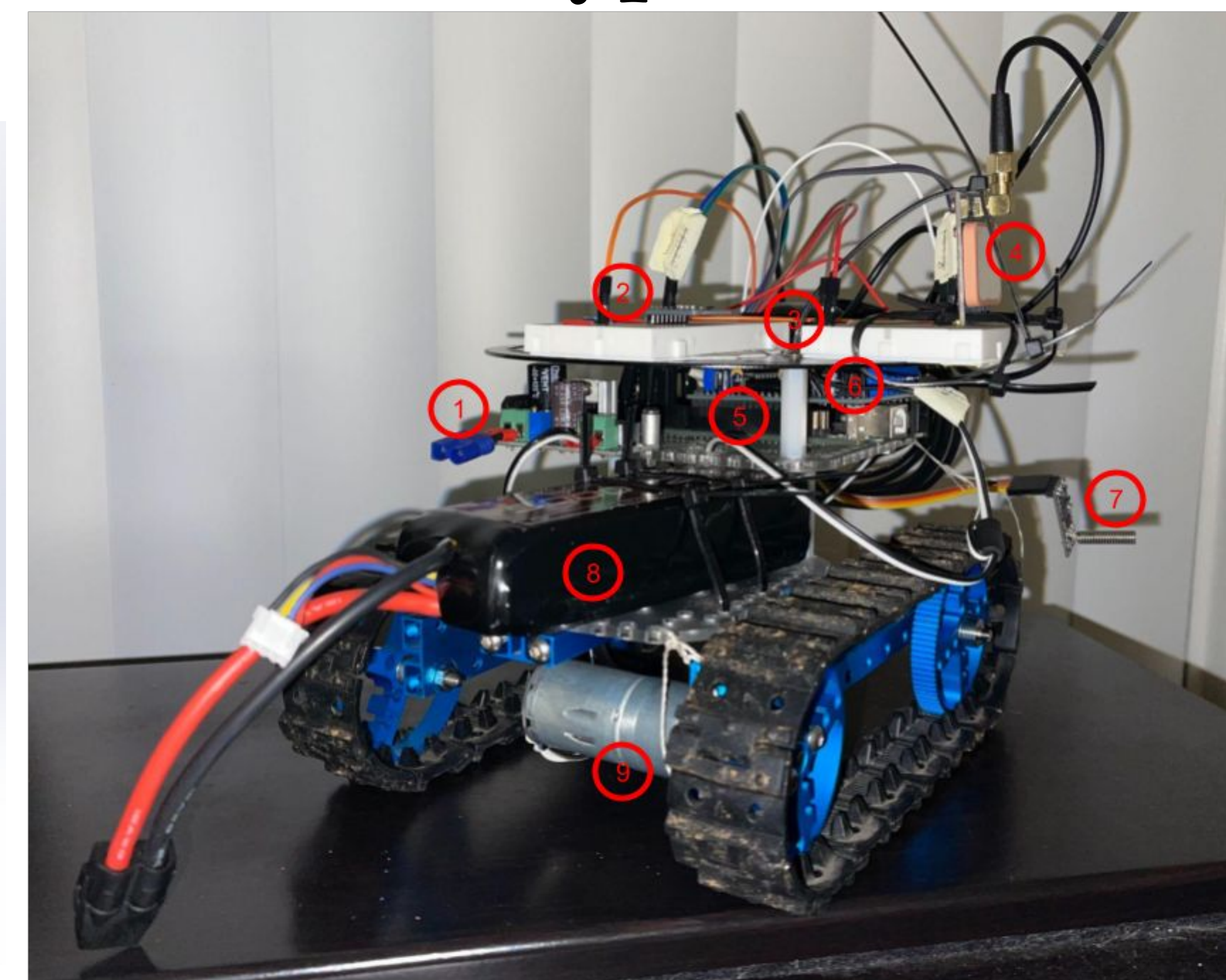
MATLAB Simulations

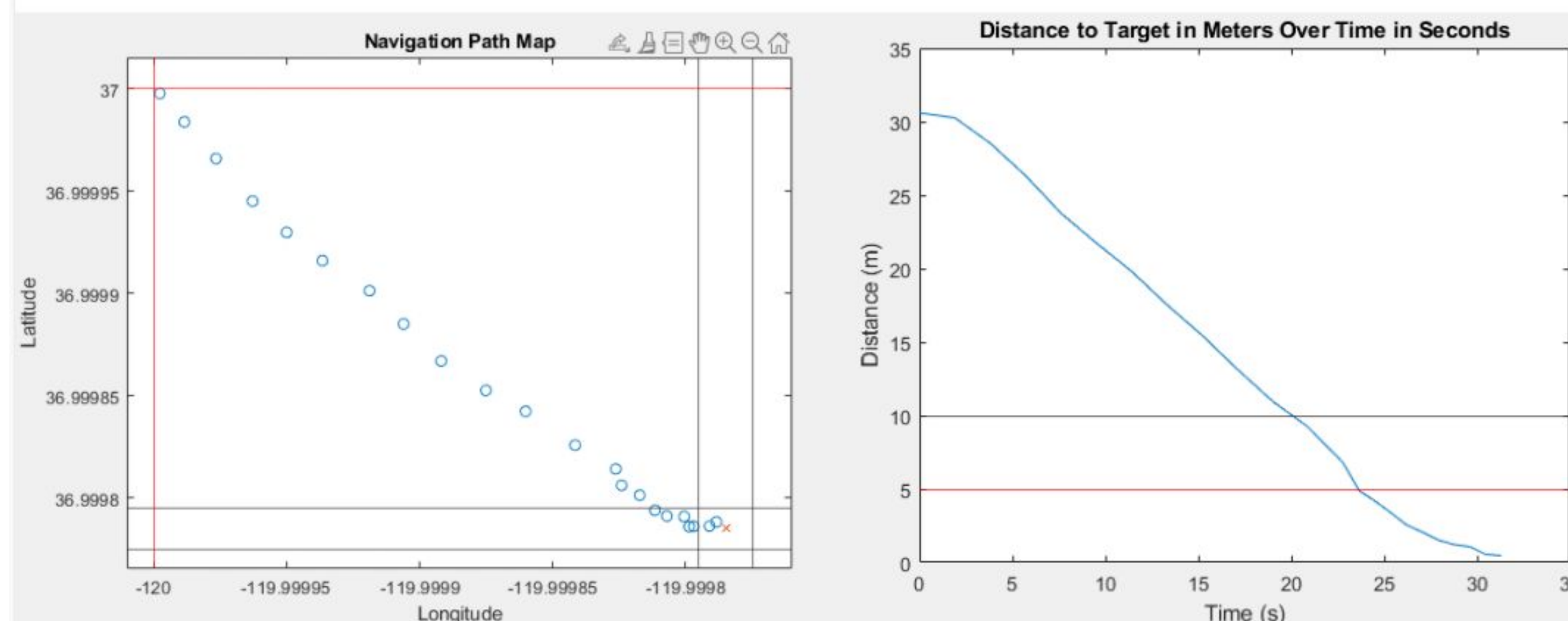**Figure:** projected robot path plot

Figure: robot distance vs time plot

Target

Prototype