Autonomous Targeting Robot

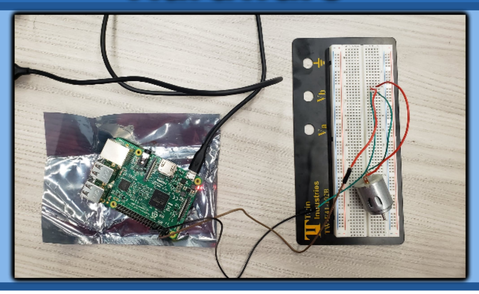
UCI Samueli School of Engineering
University of California, Irvine

William Hartono, Brandon Kuo, Simon Lee, Alexander Yamamura
Professor Kassas and Dr. Maaref

Background

- In its current state, the military has an accuracy rate of around 20 - 30% when shooting at moving targets. This bad accuracy rate could be a crucial factor in a life or death situation when deployed.
- Robots are becoming increasingly prevalent in the military have been shown to increase the overall quality of training and skills of soldiers

Hardware



Materials

- Raspberry Pi
- GPS,
- Intertial Measurement Unit (IMU)
- Robot Chassis
- Motors
- Motor Controler
- Battery Pack

References

H. Seck, “Thousands of Marines Participating in Robotic Target Study,” Military.com, 26-Sep-2018. [Online]. Available: https://www.military.com/defensetech/2018/09/26/thousands-marines-participating-robotic-target-study.html. [Accessed: 14-Nov-2019].

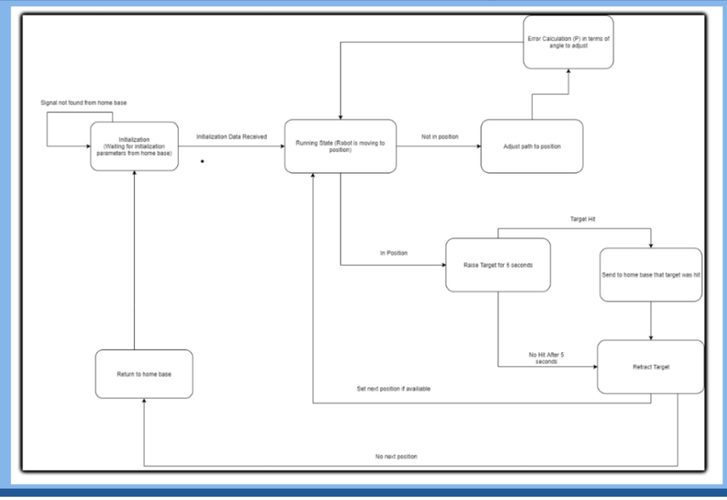
H. Seck, “These Marines Are Becoming Crack Shots Thanks to Robot Targets that Move Like Humans,” Military.com, 22-Jul-2019. [Online]. Available: https://www.military.com/daily-news/2019/07/22/these-marines-are-becoming-crack-shots-thanks-robot-targets-move-humans.html. [Accessed: 14-Nov-2019].

“Understanding PID Control, Part 1: What Is PID Control? Video,” Understanding PID Control, Part 1: What Is PID Control? Video - MATLAB. [Online]. Available: https://www.mathworks.com/videos/understanding-pid-control-part-1-what-is-pid-control--1527089264373.html. [Accessed: 14-Nov-2019].

Challenges

Challenges:
- Lack of funding resulted in delayed hardware materials, however, as a result we have been focusing a lot on researching potential problems
- To determine the correct location and current movement, we needed to combine sensor information from GPS, Compass, and IMU. We found that the problem requires the use of a Kalman Filter, which estimates current state of hardware and re-issues commands based on these estimates
- For proper GPS navigation and orientation, we needed to research and implement control loops, specifically for course correction and ensuring that the target is facing the base station
- GPS sensor accuracy can become an issue if outputs are not precise enough, as will compass errors since target locations must be within a specific boundary.
- UI unit conversions from GPS outputs of latitude and longitude to more workable units on the satellite image and for calculations.

Control Loop Diagram



Goals and Milestones

Project Goals:
- The goal of the project is to build an autonomous robot that will travel to a series of random GPS locations and to raise a target at each position.
- The robot will keep track of the hits on the target and will return to the origin location.
- Overall, we hope that the robot will train the military’s overall accuracy rate and has been proven to increase hit rate on a moving target to 80-90%.

Software Milestones:
- User Interface:
  - Able to generate a list of random GPS locations and plot each on a map
  - Able to create a bounding box to limit the distance that the robot can travel to
- Raspberry Pi:
  - Established connection between UI and Raspberry Pi
  - Able to send and receive data from UI and Raspberry Pi

Hardware Milestones:
- Acquired funding necessary to buy most of the parts
- Tested Motors and Motor controller for use in chassis
- Movement within the robot

Future Work

- In the future, we plan to expand on our design by adding the target to our robot.
- In addition, we plan to improve on our current design by fine-tuning the use of GPS and other sensors as well as the movement and orientation of the robot.