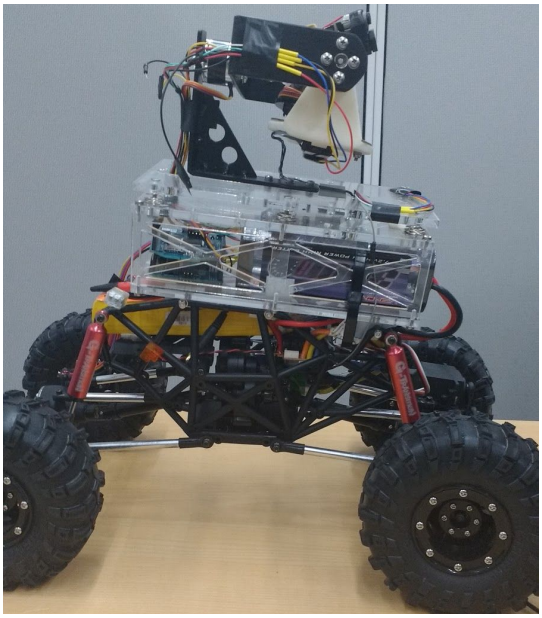
Initial Project and Group Identification
Divide and Conquer

Nerf-Enabled Battlebot with Automated Target Detection using Multiple Sensing



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Sponsor: Lockheed Martin

Senior Design I
Fall 2016

Group 9

Aaron Hoyt	Electrical Engineering
Daniel Agudelo	Computer Engineering
Rafael Ramirez	Computer Engineering
Rachel Gremillion	Computer Engineering

Narrative Description

The purpose of this project is to design a manually remote-controlled ground robot with automated target detection, aiming, and firing capabilities using multiple sensing technologies to participate in the Lockheed Martin Nerf-Enabled BattleBot Competition.

The competition will take place against two other teams tasked with the same project (building a Nerf-enabled battle robot). The robot will be placed on a field with two primary course zones on opposite sides and a keep out zone in the middle. One of these primary course zones will be designated to the robot.

A point system is established where the team with the most points by the end of the battle competition is determined the winner. A team can earn points by demonstrating the following abilities with their robot:

- Shooting an enemy bot with a Nerf ball or Nerf dart
- Shooting designated target zones opposite of the field with a Nerf ball or Nerf dart
- Shooting designated target zones elsewhere on the field with a Nerf ball or Nerf dart

Points can be deducted if the robot leaves its designated zone and enters the keep out zone of the course.

This project will be developed in conjunction with a team of Mechanical Engineering students. The focus of this team (Group 9), as Electrical and Computer Engineers, will be the electrical powering of the system as well as providing the software algorithms for the automated target detection module and managing data transmission within the system.

The robot will combine two sensor modalities such as mid-wave infrared imagery and Lidar point clouds. With these two sensor technologies, the robot will be able to automatically detect its target, aim, and fire accurately a maximum of two Nerf weapon systems. If more than one weapon system is implemented, only one system will shoot Nerf balls while the other system will make use of Nerf darts. The weapon system(s) will be provided with cartridges containing Nerf ammo for the robot. This ammo will be reloaded into the robot automatically.

The user will be able to maneuver the robot manually by remote-control, but will have no control over any other portion of the robotic system such as the aiming and firing system as it will be automatic.

The automatic detection system will also provide feedback to the user wirelessly via a live video feed. This video feed will be highlighting automatically the objects that were detected as a selected target.

Requirements Specifications

The robot should be within the dimensional requirements of 3 ft. x 3 ft. x 3 ft. The robot must be able to automatically detect objects from a distance of 40 ft. The robot must also be able to detect objects and highlight them as a potential target. The robot must be able to determine the distance range and height of target with a hit accuracy of >0.1%.

No.	Type	Title	Description
1	Hardware	Microcontroller	To interface with the camera, the sensors, and the wireless video datalink.
2	Hardware	Battery Power Supply	Will be used to power up the microcontroller, sensors, and wireless video datalink.
3	Hardware	Camera	To provide view of enemy targets.
4	Hardware	Wireless Video Datalink	To transmit video imagery overlays of detected enemy targets wirelessly.
5	Hardware	Chassis (Enclosure)	The framework that will hold the electrical components.
6	Hardware	Multiple Sensors	The system shall utilize two sensor modalities for automatic target detection. The system shall minimally use one sensor modality.
7	Hardware	Accelerometer	To keep track of acceleration in order to improve fire accuracy.
8	Software	Target Detection	Automated detection highlighting video imagery overlays of enemy targets.
9	Software	Target Aiming	Automated aiming once target has been detected.
10	Software	Target Firing	Automated firing once robot has located an enemy target and aims accordingly.
11	Hardware	Nerf Ball or Nerf Dart	Firepower against enemy targets.

12	Hardware	Weapon Systems	The robot shall use a maximum of two weapon systems. If more than one weapon system is chosen, one weapon only is allowed to fire Nerf balls. The other system must use Nerf darts.
13	Hardware	Robot Size	The dimensions of the robot shall remain under 3 ft. x 3 ft. x 3 ft.

Budget and Financing

This project has been sponsored by the company Lockheed Martin. They have allowed a maximum budget of $2,000, with the limitation that the final product be at a maximum as-demonstrated cost of $1,000.

Item Name	**Quantity**	**Cost**	**Total**
Microcontroller	1	$100	$100
Battery Power Supply	1	$30	$30
Cables, Wires and Connectors	1	$200	$200
Camera	1	$70	$70
Wireless Video Datalink	1	$200	$200
Chassis (Enclosure)	1	$30	$30
Distance Sensor	2	$170	$340
Accelerometer	1	$20	$20
Mechanic Dummy	1	$150	$150
Gyroscope	1	$40	$40
Nerf Ball or Nerf Dart	25	$1	$25
Weapons System	1	$50	$50
PCB Components	1	$100	$100
Grand Total			$1,355

Engineering-Market Trade-Off Matrix

All trade-offs must be considered in order to prevent an imbalance within the system. Ideally, considering all positives and negatives will lead to a complete build that will satisfy all requirements listed above.

Legend

↑ Positive Correlation
↑↑ Strong Positive Correlation
↓ Negative Correlation
↓↓ Strong Negative Correlation
\+ Positive Polarity (Increasing requirement)
\- Negative Polarity (Decreasing requirement)

		Range of Detection	Object Accuracy	Fast Processing Time	Dimensions	Cost	Storage Capacity
		+	+	+	+	-	+
Detection Accuracy	+	↑↑	↑↑	↓↓	↑↑	↓	↑↑
Firing Accuracy	+	↑	↑	↓↓	↑↑	↓	
Low Power	+			↓		↑↑	↓↓
Cost	-	↓↓	↓	↓↓		↑↑	↓↓
Range	+				↑↑		

Project Milestones

A clear breakdown of how we will budget our time for both the Fall and Spring semesters has been provided. Individual roles have been assigned to various group members as well.

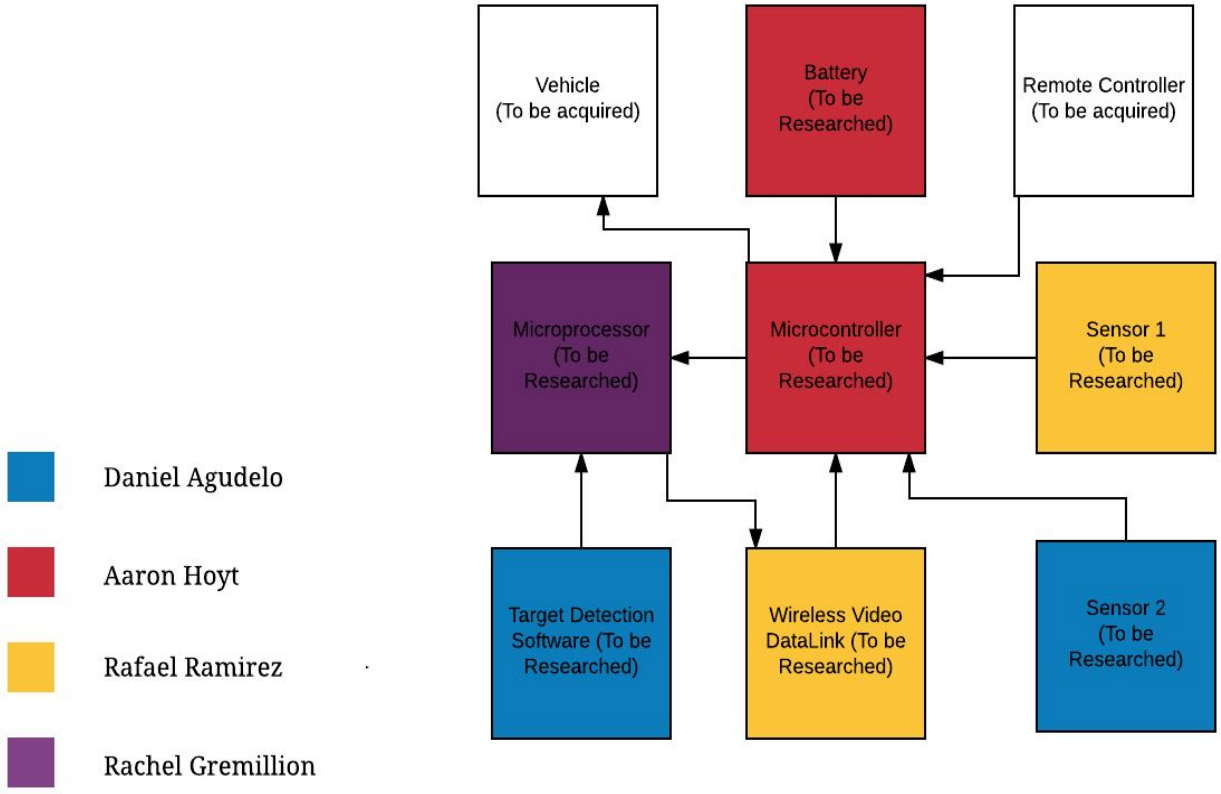
Fall 2016 - Senior Design I					
No.	**Task**	**Start**	**End**	**Status**	**Responsible**
1	Research Project Ideas	8/22/16	9/9/16	Completed	Group 9

2	Initial Project Idea	9/1/16	9/9/16	In Progress	Group 9
3	Prepare Project Meeting Questions	9/9/16	9/22/16	Pending	Group 9
4	Half Hour Meeting	9/19/16	9/19/16	Pending	Group 9
5	Sponsor Meeting	9/21/16	9/21/16	Pending	Group 9
6	Project Documentation Guidelines	-	9/27/16	Pending	Group 9
7	Research and Project Development	10/10/16	10/17/16	Pending	Group 9
8	Table of Contents	-	11/4/16	Pending	Group 9
9	Draft Document	-	11/11/16	Pending	Group 9
10	Group Progress/Milestone Check	11/13/16	11/13/16	Pending	Group 9
11	Prepare Meeting Questions	11/14/16	11/16/16	Pending	Group 9
12	Half Hour Meeting	11/14/16	11/16/16	Pending	Group 9
13	Final Document	-	12/6/16	Pending	Group 9
14	Order Components	-	12/6/16	Pending	Aaron Hoyt

Spring 2017 - Senior Design II					
No.	**Task**	**Start**	**End**	**Status**	**Responsible**
15	Test Components	1/9/17	1/15/17	Pending	Rafael Ramirez
16	Build Prototype	1/16/17	2/26/17	Pending	Group 9
17	Test Prototype	TBD	TBD	Pending	Daniel Agudelo
18	Make Necessary Changes	TBD	TBD	Pending	Rachel Gremillion

19	Finalize Project	TBD	TBD	Pending	Group 9
20	Final Presentation	TBD	TBD	Pending	Group 9
21	Final Report	TBD	TBD	Pending	Group 9
22	Battlebots Competition	TBD	TBD	Pending	Group 9

Hardware Block Diagram



Software Block Diagram