



# The Battle Roach Robot

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## Abstract

Robotics is becoming a leading technology in the modern world, encompassing integrated computer controlled systems that are capable of interacting with their environment in order to carry out specific tasks. The objective of the robot project was to create a fully autonomous battle robot able to adapt accordingly to a dynamic environment.

The robot's mission was to navigate, take corrective courses of action in the presence of obstacles, locate, identify and extinguish the "enemy" territory's target lights before the enemy robot extinguishes the Battle Roach's home target lights.

Stevens Institute of Technology provided their custom-made PIC microcontroller and a pre-assembled chassis to serve as the foundation for the robot. The Battle Roach's design and construction used a set of requirements and guidelines which allowed modifications on the Stevens equipment to comply with the physical needs required for a successful mission. Once completed, the Battle Roach must compete against a champion battle robot on the battlefield to test its effectiveness. Multiple disciplines, such as mechanical, electrical, and programming software were involved in the process of the creation of the fully autonomous battle robot.

## Objectives



Battle arena with obstacles, target lights, and navigational light

- Construct an autonomous robot able to navigate through an obstacle course shown above
- Construct an effective obstacle evasion bumper system
- Be able to determine friendly/enemy territories
- Be able to detect, identify, and extinguish enemy target lights
- Win a competition against a champion battle robot

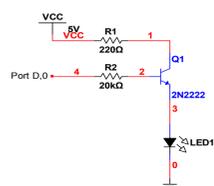
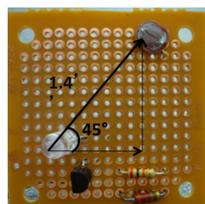
## Methodology

During the pre-construction process, a conceptual design matrix was evaluated in order to choose the best possible design for the Battle Roach Robot. The robot requires target light sensors, a floor color recognition sensor, a directional navigation sensor, and an effective bumper obstacle evasion system. Therefore, a prototype was constructed that employed three target light sensors, a Beacon light sensor, a Floor Sensor Module for floor color recognition and a three-part bumper design as part of the main design.

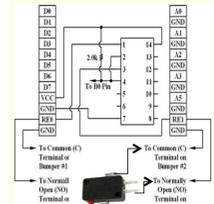
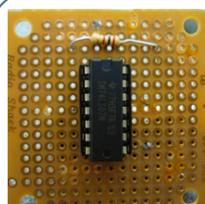
Robot Enemy Target Light Locating/Obstacle Avoidance Subsystem

Robot Enemy Target Light Locating/Obstacle Avoidance Subsystem									
Goal: Identify the Conceptual Design with the Highest Probability of winning the competition									
All Combinations									
	Conceptual Design 1	Conceptual Design 2	Conceptual Design 3	Conceptual Design 4					
Number of Bumpers	2 Bumpers	2 Bumpers	2 bumpers	3 Bumpers					
Shape of Bumpers	Rounded - Front Split	hitting two side pieces	circles overlapped	Pointy - Front Split					
Number of Target Light Sensors	2 front, 1 back	3 front	6 in. above roof	3 front					
Height of Beacon Sensor	on roof	12 in. above roof	back	3 in. above back					
Position of Beacon Sensor	mid-back	back	Front behind LED	Front Behind LED					
Floor Sensor Module Photo Resistor Location	Rear	Front behind LED	Front Behind LED	Rear					
Acceptance Criteria	Weight (By % of Acceptance Criteria (apply last))	Importance of Conceptual Design in meeting Acceptance Criteria	Weighted Score	Importance of Conceptual Design in meeting Acceptance Criteria	Weighted Score	Importance of Conceptual Design in meeting Acceptance Criteria	Weighted Score	Importance of Conceptual Design in meeting Acceptance Criteria	Weighted Score
criteria									
Doesn't draw down the battery	5%	7	0.35	7	0.35	7	0.35	4	0.2
Doesn't confuse the navigation light with target lights	30%	4	1.2	9	2.7	7	2.1	6	1.8
complexity	15%	6	0.9	8	1.2	8	1.2	4	0.6
Crosses from Friendly to Enemy Territory in 15 seconds	10%	5	0.5	8	0.8	7	0.7	5	0.5
Extinguishes both target lights in 35 seconds	10%	4	0.4	8	0.8	9	0.9	9	0.9
After crossing over, the sub system detects light 1 and extinguishes it. Then it detects light 2 and territory after crossing into enemy territory	15%	7	1.05	9	1.35	9	1.35	9	1.35
		7	1.05	8	1.2	8	1.2	8	1.2
Total Percentage =			100%	5.45		8.4		7.8	

## Data



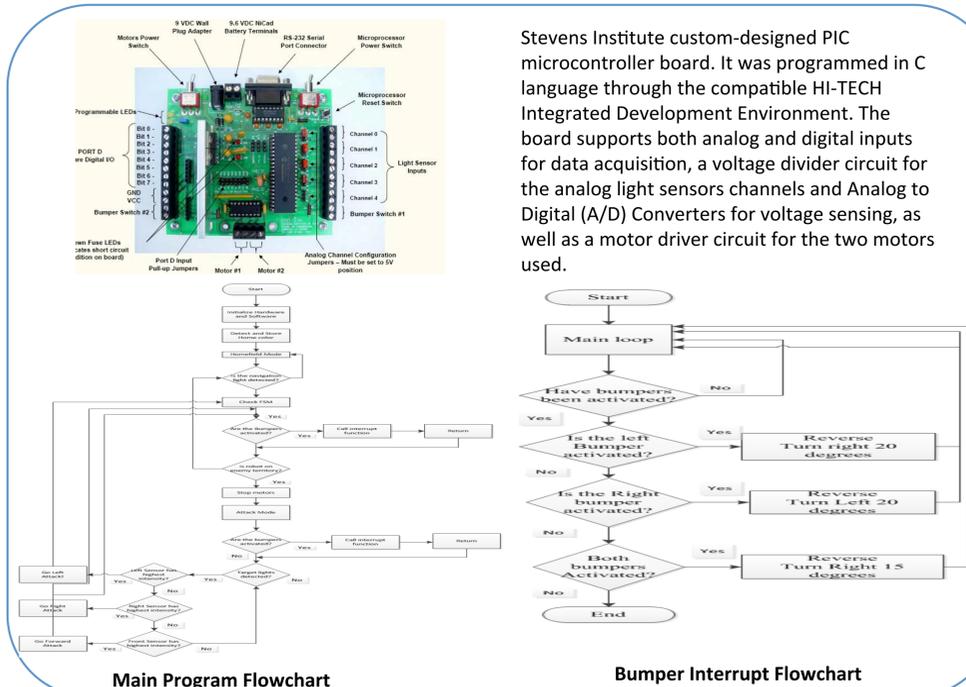
**Floor Sensor Module (FSM)** – designed for floor color recognition. The reflection of the emitted light from the LED to the floor would differ when in a high reflectivity color (white) vs. a color with low reflectivity (black)



**Bumper Interrupt Support Board (BIS)** – a hardware interrupt designed for easy ON/OFF logic. Composed of a 74LS07N Hex Buffer IC, a pull-down resistor, and two micro-switches acting as bumpers.



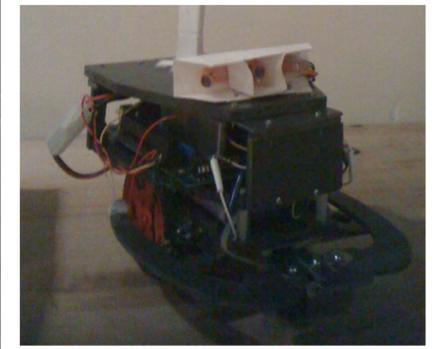
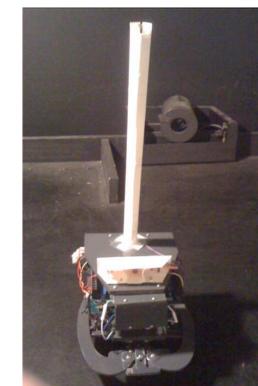
Close-up of bumper positioning with three-piece bumper design activating the micro-switch.



## Results

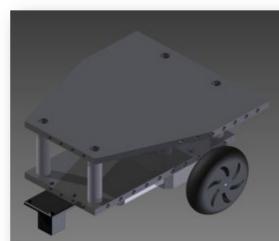
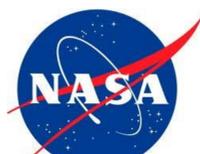
The Roach Robot was able to:

- Navigate autonomously through the obstacle course
- Employ a successful bumper system for obstacle evasion; however, the radius must be reduced to avoid too much usage of the system
- Detect its location in the arena with an effective Floor Sensor Module (FSM) for color recognition through color reflectivity thresholds and a Beacon light sensor tower
- Detect targets; however, it still has trouble in extinguishing only enemy target lights
- The battle robot competition has not taken place

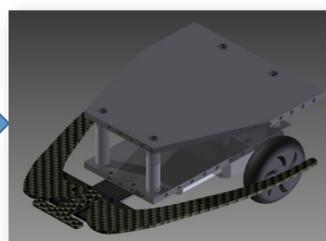


## Acknowledgements

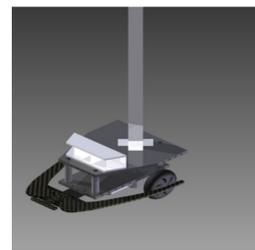
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Professor Joseph Miles  
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Chassis



Chassis with bumper system



Chassis with bumper system and target sensor positions and beacon light sensor tower



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