



Emergent Behavior Robot

**Bradley University - Senior Capstone Project
Spring Progress Presentation**

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Overview

- Introduction
- Block Diagram
- Completed Work
- Next Steps
- Future Steps
- Schedule

Introduction

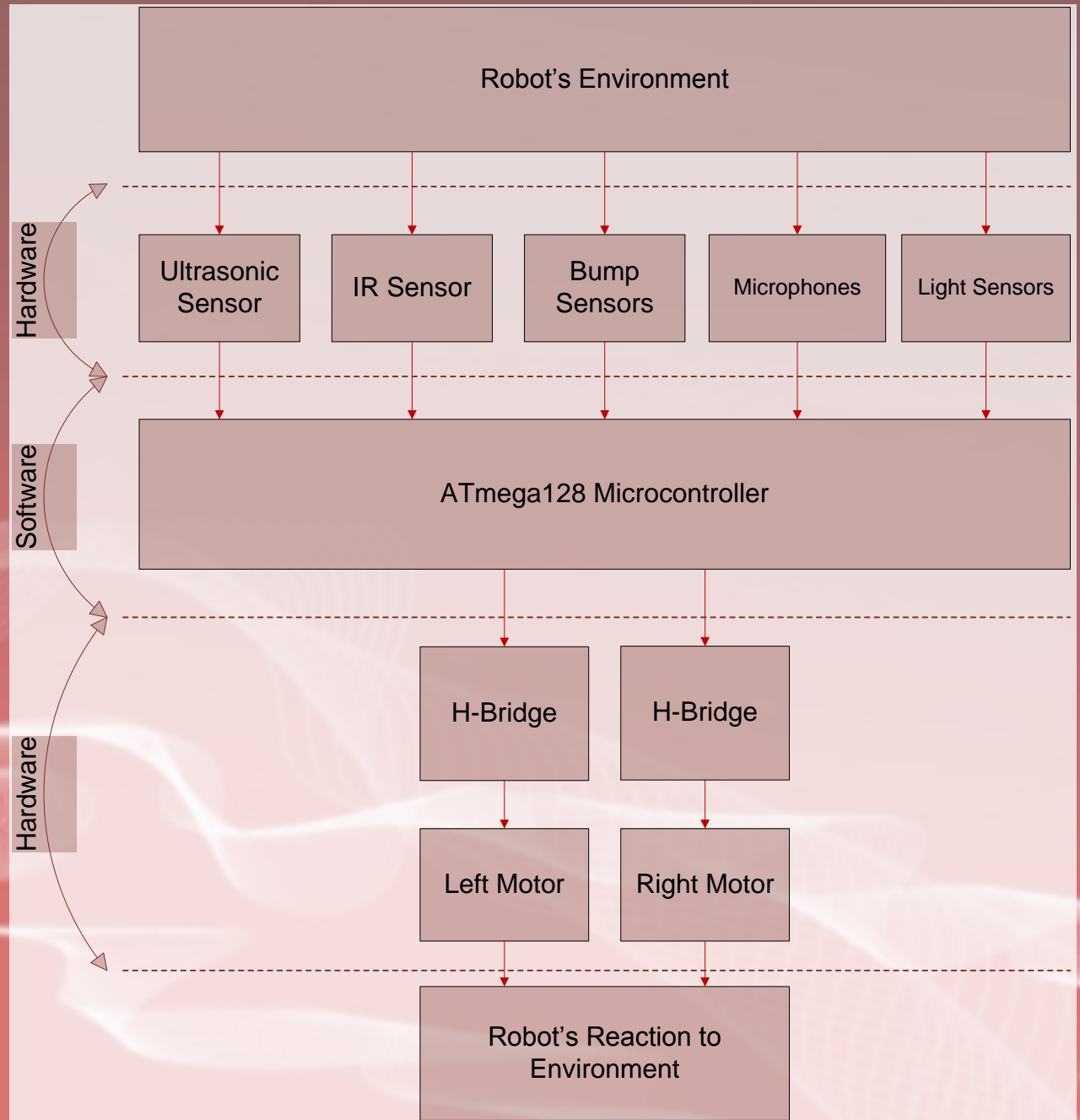
- Study Emergent Behavior
 - React intelligently to a dynamic environment
- Emergent Behavior
 - The result is greater than the sum of its parts

$$2 + 2 = 5$$

Objective

- Create a robot that:
 - Avoids obstacles
 - Seeks and finds beacon
 - Flees from loud sounds
 - Favors darker environments
 - Displays emergent behavior

High-Level System Overview



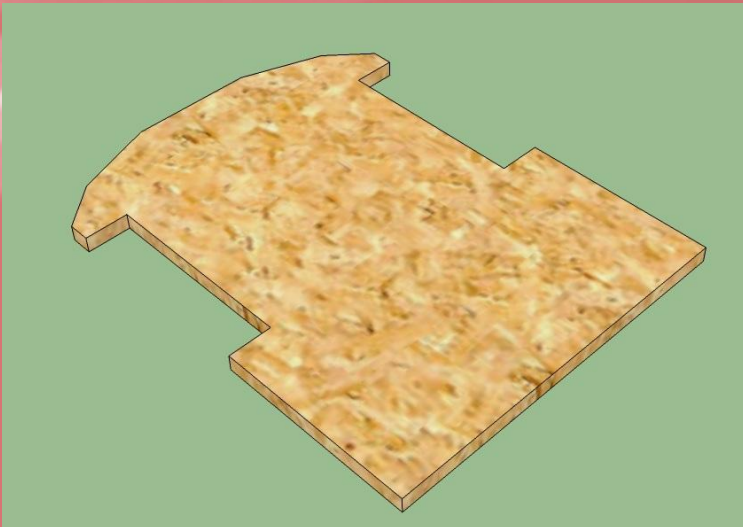
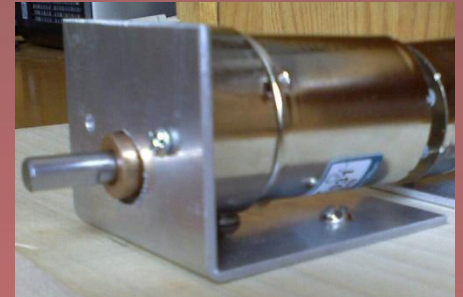
Software - Modes and Task Priority

- **Modes** (all modes include obstacle avoidance)
 - Roam mode
 - Search for beacon
 - Evade mode
 - Travel quickly away from source of sound
 - Find shelter (low light area)
 - Pursuit mode
 - Travel toward beacon
- **Priority** (1 is the highest)

Task	Roam	Travel in low light	Beacon found	Detection of a loud sound	Obstacle avoidance
Priority	6	5 (3 in Evade mode)	4	2	1

Completed Work (1)

- Robot chassis
 - Cut chassis
 - Fabricated motor mount brackets
 - Ceramic drawer pull as rear caster



Completed Work (2)

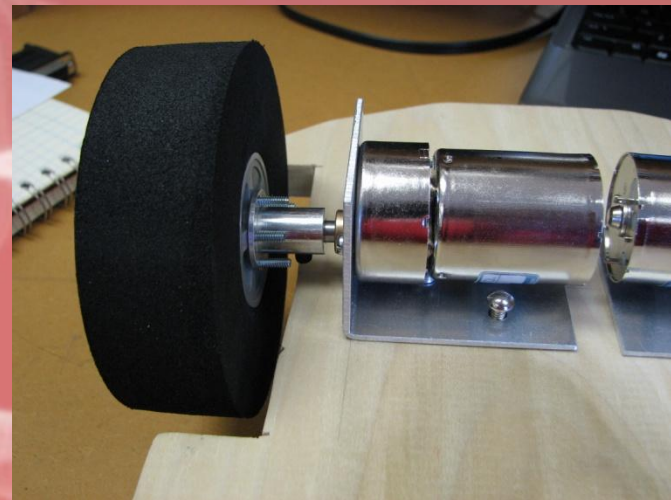
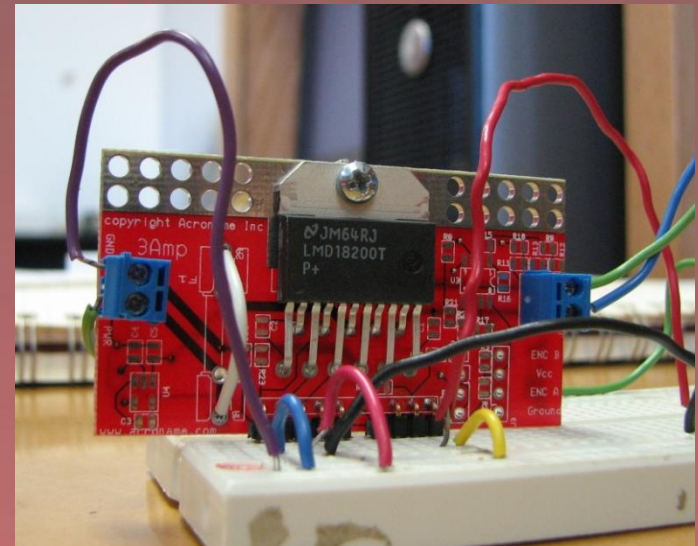
- Parts

- Received

- Sharp GP2D12 IR sensors
 - Hennkwell HG37F DC motors
 - Acroname H-Bridge components
 - Wheels and Hubs
 - Microphones
 - Reflective light sensors

- Ordered

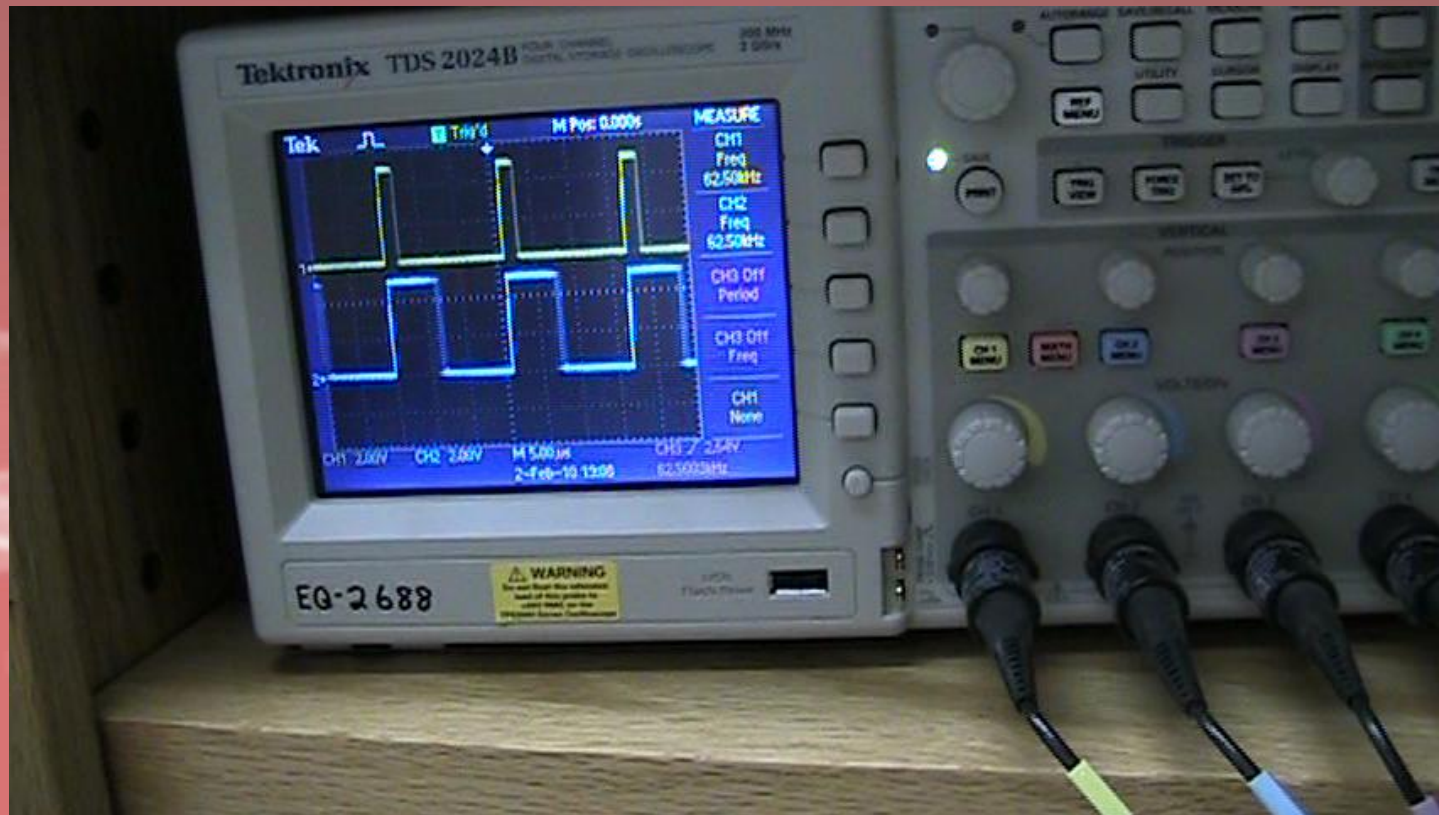
- Bump sensors



Completed Work (3)

- Software
 - Read output from IR sensor using ADC
 - Generate stable PWM at 62.5kHz
 - Interface with H-Bridge
 - Pre-programmed path
 - Basic obstacle avoidance

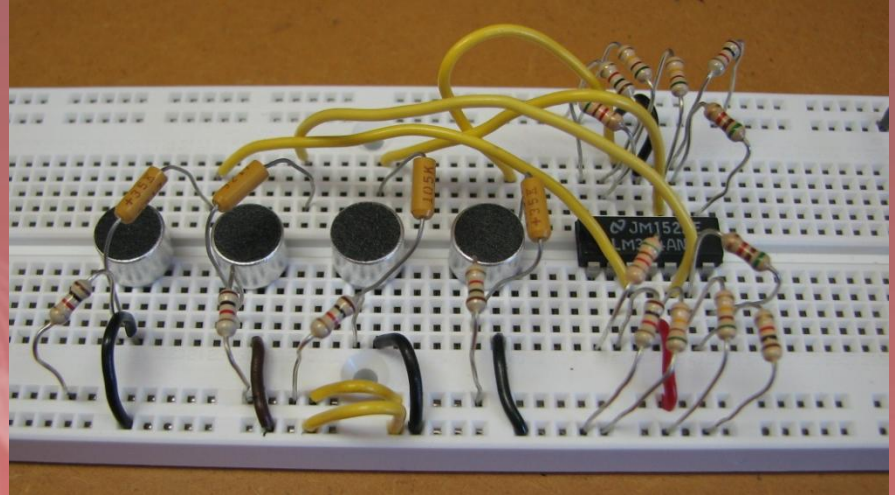
Completed Work (4)



Two IR sensors independently control two PWMs.

Completed Work (5)

- Hardware
 - H-Bridge circuitry
 - Microphone and amplifier circuitry
- Hardware issues
 - H-Bridge unable to reverse direction
 - Issue resolved with external bootstrap capacitors
 - Noise in microphone output



Next Steps

- Hardware
 - Filter noise from microphones
 - Reflective light sensors
 - Ultrasonic beacon
 - 24V batteries
- Software
 - Smarter obstacle avoidance
 - Interface microphones

Future Steps

- Chassis
 - Mount sensors, batteries, etc.
- Hardware
 - Electrically isolate motors and microcontroller
 - Separate battery and Opto-isolators
- Software
 - Determine direction of sound
 - Determine “darker” environment
 - Determine direction of beacon
 - Develop emergent behavior

Schedule

Week	Andrew Elliott	Nick Hanauer
1-3	Research & Website Development ✓	Parts Research ✓
4	Learn ATmega128 ✓	Parts Testing & Research ✓
5	Interface with the Digital I/O ✓	Parts Testing & Finalizing Parts List ✓
6	ADC Setup ✓	Parts Testing & Order Remaining Parts ✓
Winter Break	Construct Chassis ✓	
7	Interface IR Sensors ✓	Motor & H-Bridge Circuitry/Testing ✓
8	Interface Microphones & light sensor ✓	Microphone & light sensor Circuitry/Testing ✓
9	Interface Motors & H-Bridge ✓	Ultrasonic Circuitry/Testing
10-11	Integrating All Sensors	Circuitry Clean-Up & Wire Wrapping
12-15	Final Behavioral Software & Hardware	
16-17	Final Documentation and Presentation Preparation	

Questions?

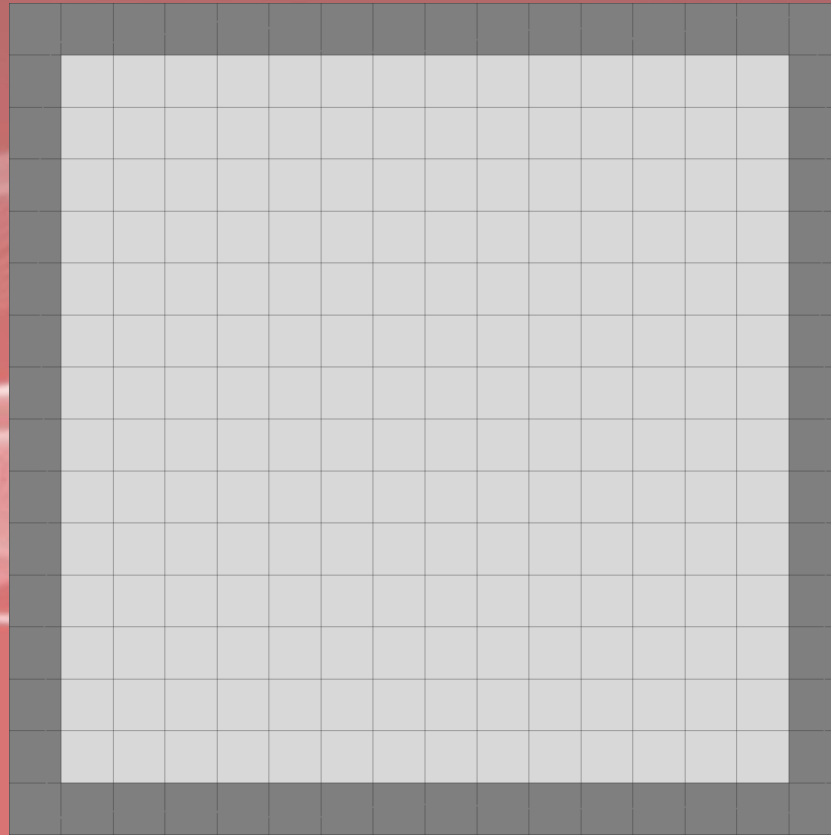
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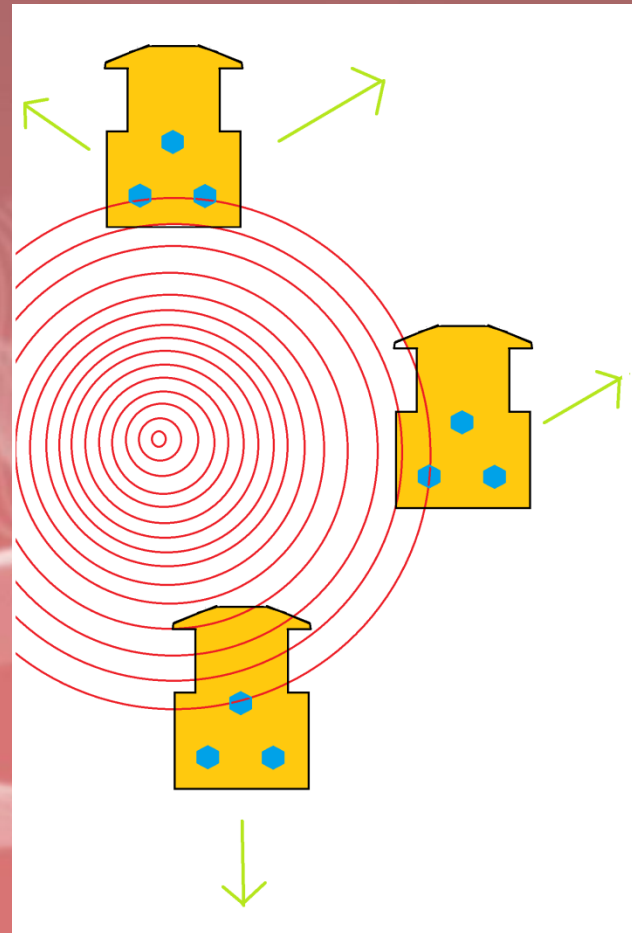
Detecting “Darker” Environment

- Use optical sensor pointed at ground



Detecting Direction of Sound

- Array of three microphones
- Interrupt based
 - Triangulation
 - First to detect



Obstacle Avoidance Paths

