Autonomous Sentry Robot (ASR)

Initial Project and Group Identification Document

Senior Design I

2/5/15

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Project and Group Members

Our group consists of Brian Dodge (EE), Nicholas Musco (EE), and Trevor Roman (CpE). Our project will be an Autonomous Sentry Robot with navigation and mapping capabilities. As of now, we have no sponsors or contributors but will be looking in to this in the near future.

Project Narrative

The Autonomous Sentry Robot is a multifaceted security system for use in enclosed buildings. The ASR will be equipped with a variety of sensors and a camera, allowing it to autonomously navigate and dynamically map it's place in space. From this map, it will plot an efficient path to patrol within this space, and it's camera and vision capabilities will detect changes in the environment or motion. If changes are detected, the ASR's owner will be alerted through a mobile app, and they will be able to access its camera feed, as well as take control of it's movement.

The robot is meant to be fully functional even when operating autonomously. When no users are around it will need to keep track of its power level and return to the charging station when necessary. The robot must also be able to account for objects that are not picked up by the camera. Sonars and tactile sensors will be employed to ensure the robot doesn't drive over an unseen object. Above all, the ASR must be low power, low maintenance, low latency, easy to operate, and able to map, navigate, and detect reliably.

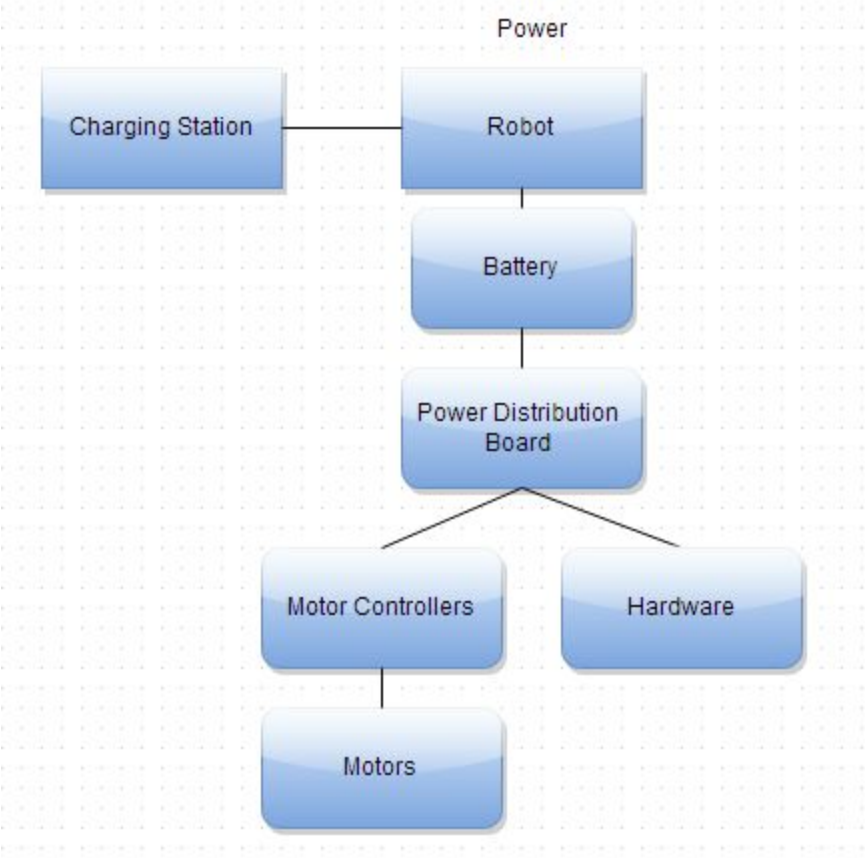
The motivation of this project is to combine our collaborative interests in the areas of computer vision and robotics to deliver a useful product.The primary use of the ASR would be for mobile remote surveillance; where the ASR can be trusted to competently patrol an area and relay any intrusions to it's user. This can be useful to homeowners, private businesses, or anywhere else security is a concern.

Requirements

- Must be equipped with sufficient sensors to detect collisions, distance, and depth
- Must be equipped with sufficient sensors to build a reliable map of its environment
- Must be able to detect motion or changes in the environment instantaneously
- Must be able to autonomously navigate and map in real time
- Must reliably operate, react, and make decisions within 1-3 seconds
- Must be able to operate for at least 5 hours on a full charge
- Must be able to find its docking station and successfully dock to charge
- Must be able to operate reliably in light or darkness
- Must have 75% certainty of detections before alerting its user
- User must receive alert notifications from ASR within 5 seconds of detection
- Must be low profile, no more than 1ft high, and 1.5ft wide
- Must be able to detect pitfalls, stairs, and other doom from which it cannot escape
- Must alert user if damaged or stuck
- If stuck, must attempt escape for at least 10 seconds before alerting user, then continuing to try and escape
- If successful at escaping, must alert user within 10 seconds of certainty
- Must move smoothly with low vibration to keep the camera steady

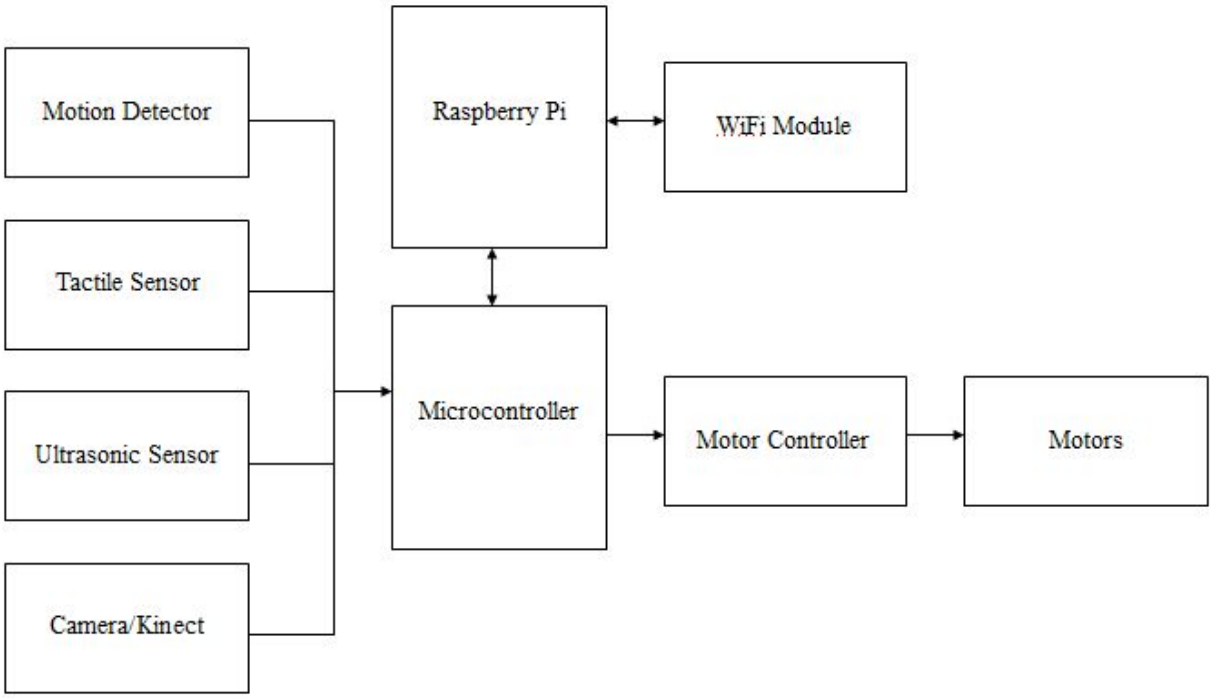
Power Block Diagram

- Administrator: Nicholas Musco
- Status: To be Acquired/Designed



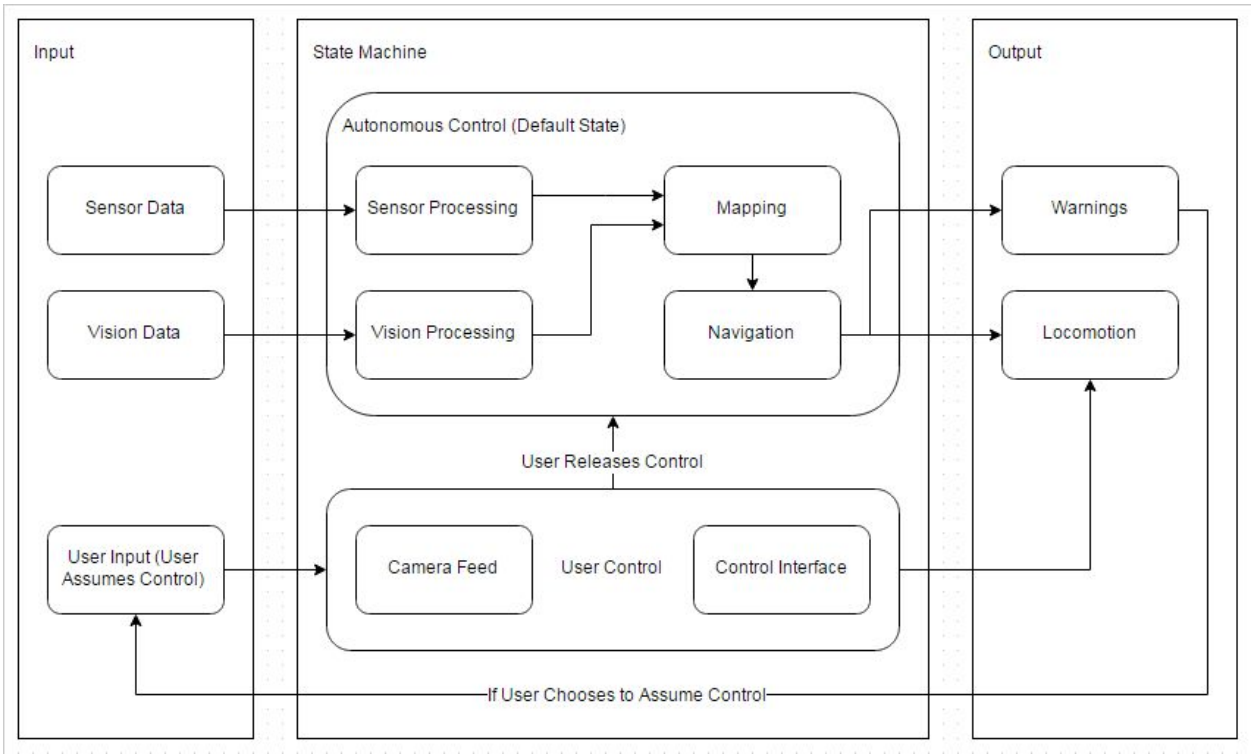
Hardware Block Diagram

- Administrator: Brian Dodge
- Status: To be Acquired/Designed



Software Block Diagram

- Administrator: Trevor Roman
- Status: To be researched



Budget and Financing

Note: All items that appear on the table are to be acquired. Also the robot will be funded by the members of the team unless sponsors can be found.

Part	Quantity	Unit Price	Total
Robot Chassis	1	$399.00	$399.00
Mecanum Wheels	4	$59.99(For pack of four)	$59.99
Microsoft Kinect	1	$24.99(Used)	$24.99(Used)
Ultrasonic Range Finder - LV-MaxSonar-EZ1	2	$25.95	$51.90
Human Sensor Module Pyroelectric Infrared	1	$4.44	$4.44
Microcontroller (ATmega2560)	1	$10.45	$10.45
PCB	1	$70.00	$70.00
Raspberry Pi 2 Model B	1	$35.00	$35.00
WiFi transmitter	1	$10.00	$10.00
MK ES17-12, 12 Volt, 17 amp-hour sealed lead acid battery	1	$89.00 (set of two)	$89.00
Battery Charger	1	$97.00	$97.00
Misc	N/A	N/A	$50.00
Grand Total			901.77

Milestones

Spring 2015	Summer 2015
1. Research and Development 2. Select parts to be used 3. Finish circuit design 4. Preliminary software prototyping and experimentation 5. Finalize parts list, suppliers, and prices 6. Order Parts and PCB 7. Design Paper	1. Receive Components 2. Assemble mechanical components 3. Assemble electrical components 4. Program movement and control over WiFi 5. Program mapping 6. Program object tracking 7. Program mobile application 8. Finish prototype 9. Exhaustively test the prototype 10. Make necessary modifications 11. Build final robotic platform 12. Final documentation