Poseidon Way-Finding Design Review

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Big Picture

- Affordable robot that can give tours and easy to build
- Stepping stone for learning about robotics
- An autonomous navigation robot

The Thirty Gallon Robot

What is the robot, the overall goal:

- Phase 1 - Robot platform, hardware, movement and programmability
- Phase 2 - Navigation, localization, and pathfinding
- Phase 3 - Proof of concept, tours of engineering building

Can the team make the robot move?

- The Hardware doesn't move on its own.
- Currently no software architecture that employs the use of the components.

Solution Statement

We are focused on implementation of phase one. Our plan is to implement two major modules:

- Autonomous Movement
- Obstacle Avoidance

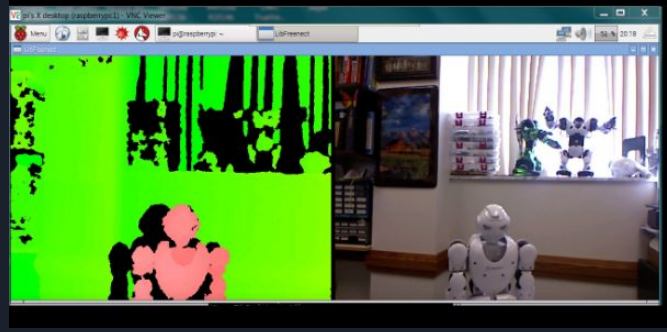
Robot uses a raspberry pi as the central computer and controller.

We will use Robot Operating System (ROS) for our software framework. Using this and python, we can interact with the raspberry pi and its various components like motor drivers and sensors.

Requirements

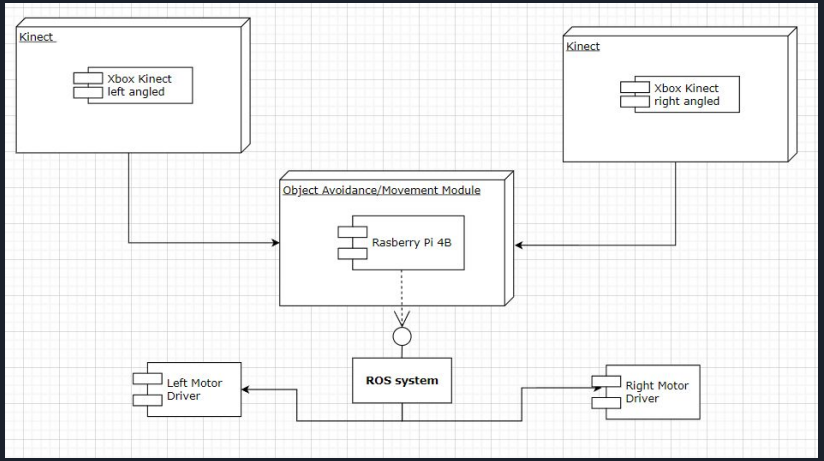
- Autonomously move down the long hallway of the second floor engineering building
  - Move at the average human walking speed
- Avoid any obstacles in the way
  - These obstacles may be random
  - 1 to 3 meters away
  - At least ½ meter tall
- Detect when the robot has reached the end of the hallway
- Be able to turn around and come back
- Detect when it has returned the starting point and stop moving

Obstacle Avoidance



- How are obstacles to be detected?
  - Xbox 360 Kinect sensors
  - One on each side of the robot at a horizontal 30 degree angle
- Sensors send signals to the Raspberry Pi
  - The system needs to quickly determine obstacles to avoid running into them
- The software plots a course around the object
- The pi then sends the signals to the motor drivers
- The motor drivers then activate the motors and move the robot around the obstacle
- Finally the robot continues its route down the hallway

Software architecture



- 2 Xbox Kinects
  - One angled left
  - One angled right
- Raspberry Pi
  - Runs the Robot Operating System (ROS)
  - Kinect library “libfreenect”
- Motor Drivers
  - Sends signals to the motors

Challenges

Risk	Likelihood	Severity	Mitigation
Hardware Malfunction	Low	Low-Moderate	Hardware checks, correct connections, verified functionality
Robot Being Moved By Objects	Very Low	Low	Warning signs
Obstacle Avoidance Miscalculation	Moderate	Moderate	Automated and Manual testing. Simulation tests. Bug checking

Project Plan/Schedule

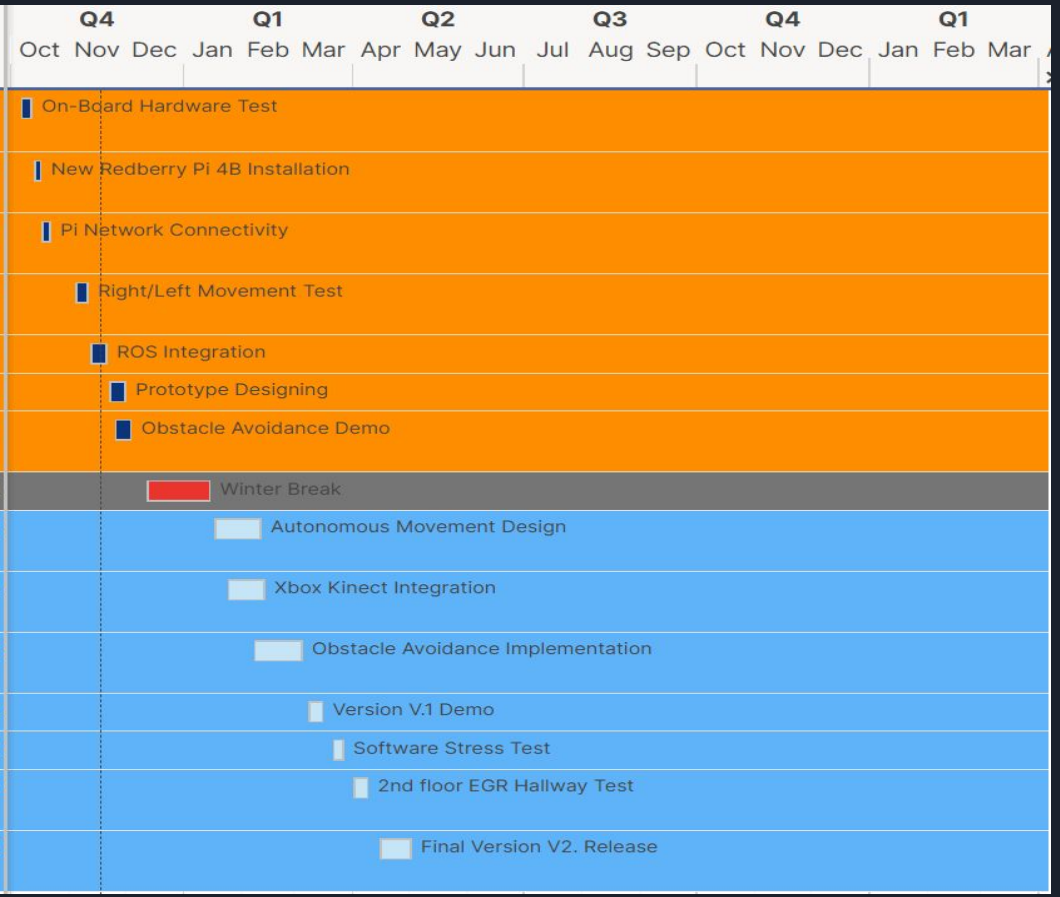
- Completed
  - On-Board hardware test
  - New Raspberry Pi 4B Installation
  - Basic Movement Test

- Currently working on
  - ROS Integration
  - Python Movement Library structure

- Plan for the rest of the semester
  - Prototype Designing
  - Obstacle Avoidance Demonstration

Project Timeline

Task Name	Start Date	End Date
On-Board Hardware Test	10/06/21	10/11/21
New Redberry Pi 4B Installation	10/13/21	10/16/21
Pi Network Connectivity	10/17/21	10/21/21
Right/Left Movement Test	11/04/21	11/10/21
ROS Integration	11/12/21	11/20/21
Prototype Designing	11/22/21	11/30/21
Obstacle Avoidance Demo	11/25/21	12/03/21
Winter Break	12/12/21	01/14/22
Autonomous Movement Design	01/17/22	02/10/22
Xbox Kinect Integration	01/24/22	02/12/22
Obstacle Avoidance Implementation	02/07/22	03/04/22
Version V.1 Demo	03/08/22	03/15/22
Software Stress Test	03/21/22	03/26/22
2nd floor EGR Hallway Test	04/01/22	04/08/22
Final Version V2. Release	04/15/22	05/01/22



Conclusion

- Proposed architecture and approach towards solving the movement and object avoidance problems is optimal and future proof
- Dr. Leverington looks forwards to fully automate the robot for indoor touring purposes in the future