NaviBot Systems Design Review #1
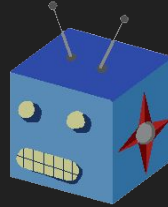
November 22, 2019

Diva Ferrell, Logan Behnke, Peter Aaron Giroux,
Benjamin Peterson, George Cadel-Munoz
Sponsored By: Dr. Michael Leverington
Mentored By: Scooter Nowak

Importance of Robotics and Navigation

Robotics have the potential to transform every aspect of our lives

Automation of historically human tasks is becoming more and more common

Navigation has become particularly prominent

Robotics and Navigation are becoming increasingly more important, but the barrier of entry remains high.

Thirty Gallon Robot Part Deux

Sponsor: Dr. Michael Leverington

- Professor at NAU, School of Informatics, Computing and Cyber Systems
- Interest in robotics
  - Recruitment tool for NAU
  - Tool for teaching & learning about robotics

Problems with the Current System and Process

>> Can we make R.A.T. a self navigating robot?

- Currently, R.A.T. can only move with direct human input.
  - Hardwired XBOX remote, limited length (~5 feet total)
- Mapping
  - Unable to take map inputs
  - Unable to create floor maps
- Localization
  - Cannot determine current location
- The Robot needs to navigate throughout the engineering building
  - Stairs cause a big problem
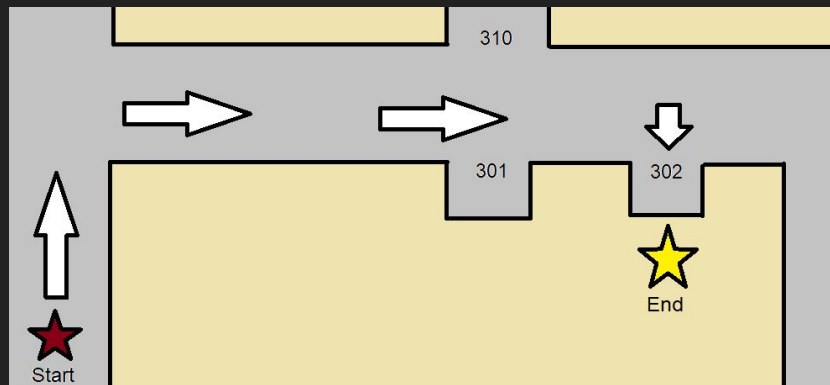 - Crowded hallways, desks, chairs, doorways, people
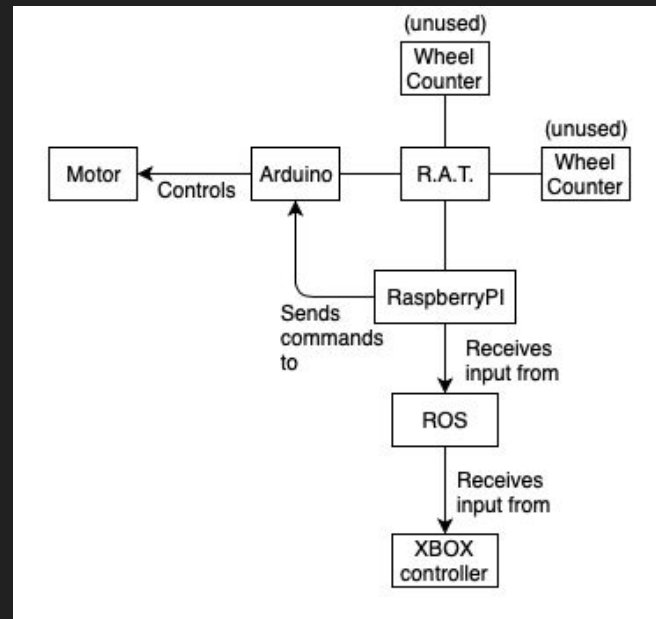
Envisioned Solution

Three key components exists for this project:

- A GUI Module
  - Provides the ability for users to interact with the robot
- A Mapping Module
  - Creates and reads maps, localizes robot
- A Navigation Module
  - Automates robot movements

Requirements Acquisition

Overview:

- Meetings
  - Weekly with Dr. Leverington
  - Occasional meetings with Electrical Engineering Team (hardware related)
- Discussion of current progress
  - Development improvements on project
  - Necessary refinements to key requirements (i.e. language use, environmental constraints)
- Status reports
 - Hardware issues
  - Software troubleshooting

Key Requirements

The robot should be able to:

- Utilize a GUI providing intuitive robot information, status, and operations

- Generate floor maps of the Engineering Building

- Read maps to navigate the Engineering Building

- Use WiFi routers for localization

- Detect objects and hazards, such as stairs
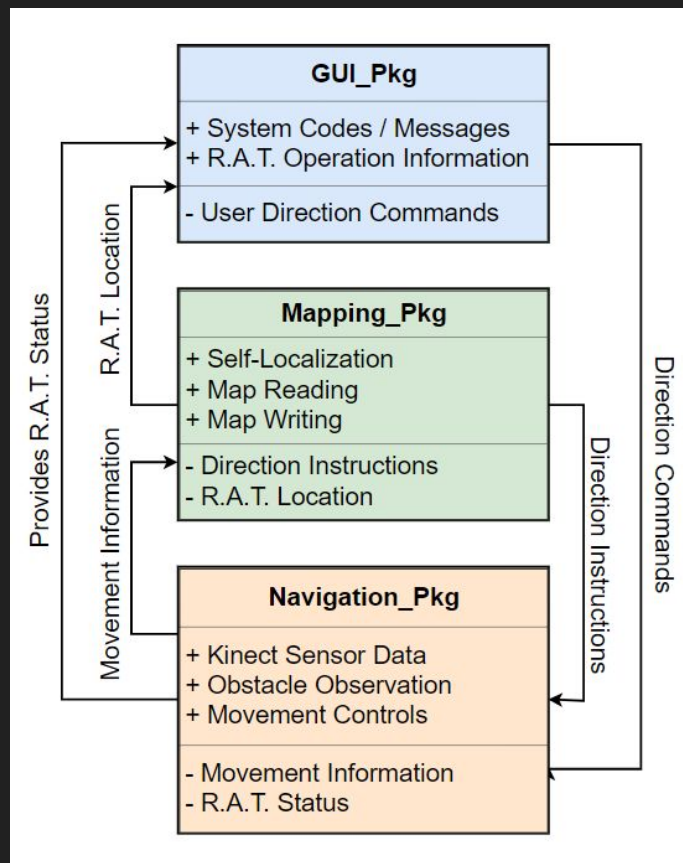
Requirements Breakdown - Navigation
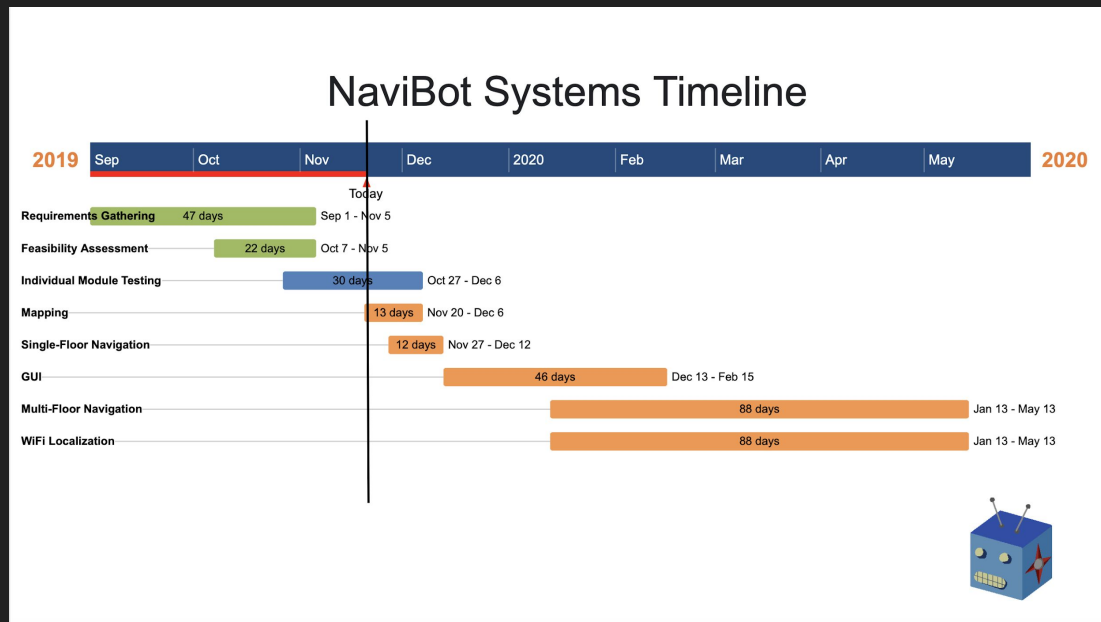

8
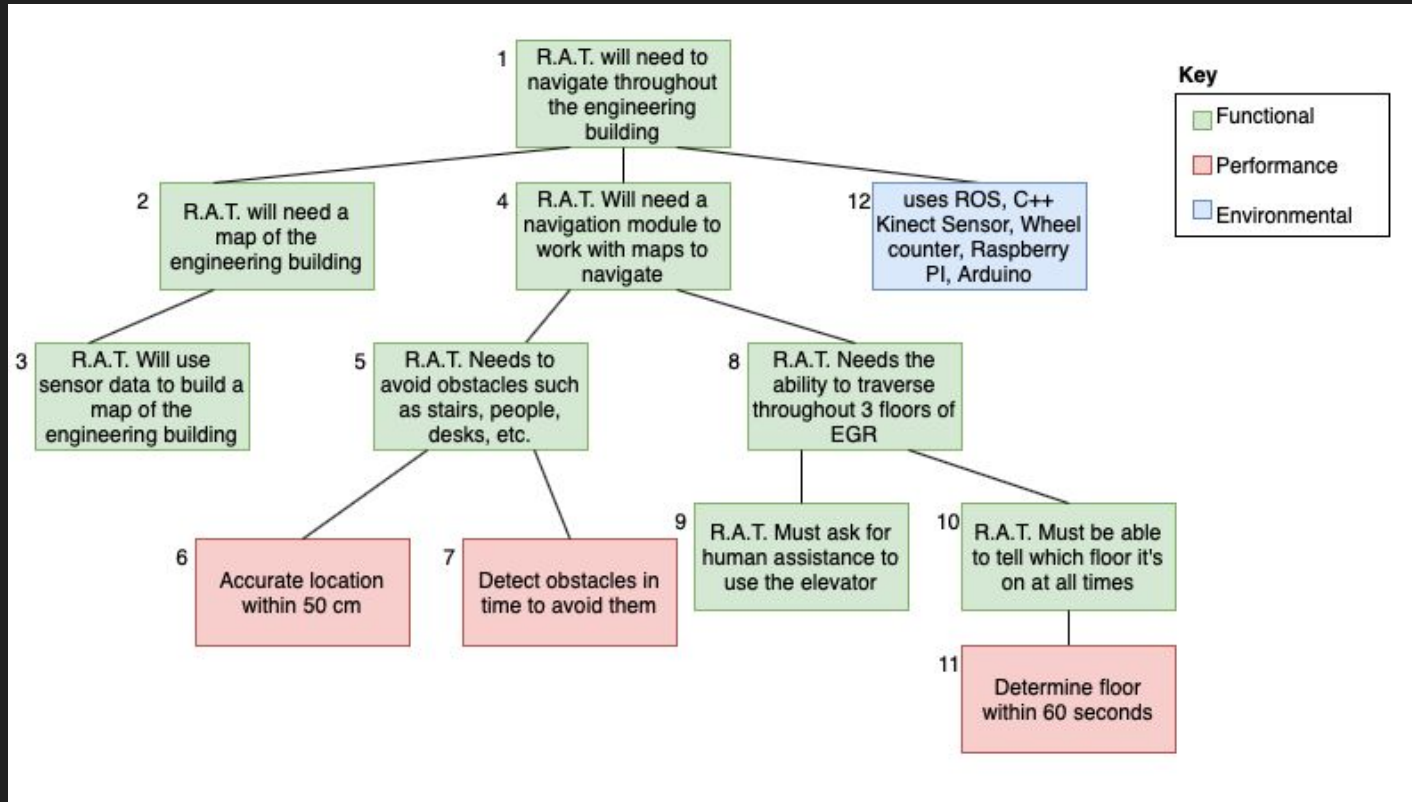
Risks, Challenges, and Feasibility

Risks	Severity	Challenges	Feasibility
R.A.T. doesn't detect stairs	Very high	Accurately getting data from the Kinect sensor	Feasible with gmapping, our navigation package, and the chosen sensor
R.A.T. doesn't avoid obstacles/people	Moderately high	Accurately getting data from the Kinect sensor	Feasible with gmapping and our navigation package
Losing R.A.T. and/or R.A.T. malfunctions	Moderately to very high	Ensuring minimal disconnects between the GUI and R.A.T., and a potential abort command	Feasible with adjustments to acceleration and our navigation package
R.A.T. pings unofficial routers	Very high	Wifi localization using routers	Feasible with wifi localization package

Schedule and Planning

Have testing done & RAT moving by end of Semester

RAT mapping, localization, and GUI building start Winter Break

Next semester: functional GUI, multi-floor navigation, full localization on startup

NaviBot Systems Timeline

| 2019 | Sep | Oct | Nov | Dec | 2020 | Feb | Mar | Apr | May | 2020 |

Today

Requirements Gathering	47 days		Sep 1 - Nov 5
Feasibility Assessment	22 days		Oct 7 - Nov 5
Individual Module Testing	30 days		Oct 27 - Dec 6
Mapping	13 days		Nov 20 - Dec 6
Single-Floor Navigation	12 days		Nov 27 - Dec 12
GUI	46 days		Dec 13 - Feb 15
Multi-Floor Navigation	88 days		Jan 13 - May 13
WiFi Localization	88 days		Jan 13 - May 13

Conclusion

- Robotics is an important and growing field
- Dr. Michael Leverington is looking for a cost effective robot to give tours of the engineering building
- Our main requirements include:
  - GUI
  - Mapping
  - Navigation
  - User Input
- Risks:
  - Navigation
  - Objects
  - Failsafe
  - Wifi

Questions?

How wifi localization will work

GUI mockup

Positioning algorithm

Mapping algorithm: SLAM

More slides?