MENTAL HEALTH ROBOPET COMPANION – ENVI-NAV

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PRODUCT OVERVIEW – MENTAL HEALTH ROBO-PET COMPANION

- Product: In home robotic pet geared toward individuals with moderate-severe mental health conditions
- Target Consumer: Young to middle aged adult who suffers from a behavioral disorder such as depression, anxiety, or bipolar disorder
- Use: Provide companionship, motivation, emotional stabilization, activity notifications, and emergency resources
- Motivation: Speed up recovery time, decrease the relapse rate, and reduce the high number of suicides that occur amongst people with mental health issues
- Details: Product will be a wheeled mobile pet-like robot that will be capable of interacting with its human companion through voice commands, wearable technology, facial expressions, and gestures

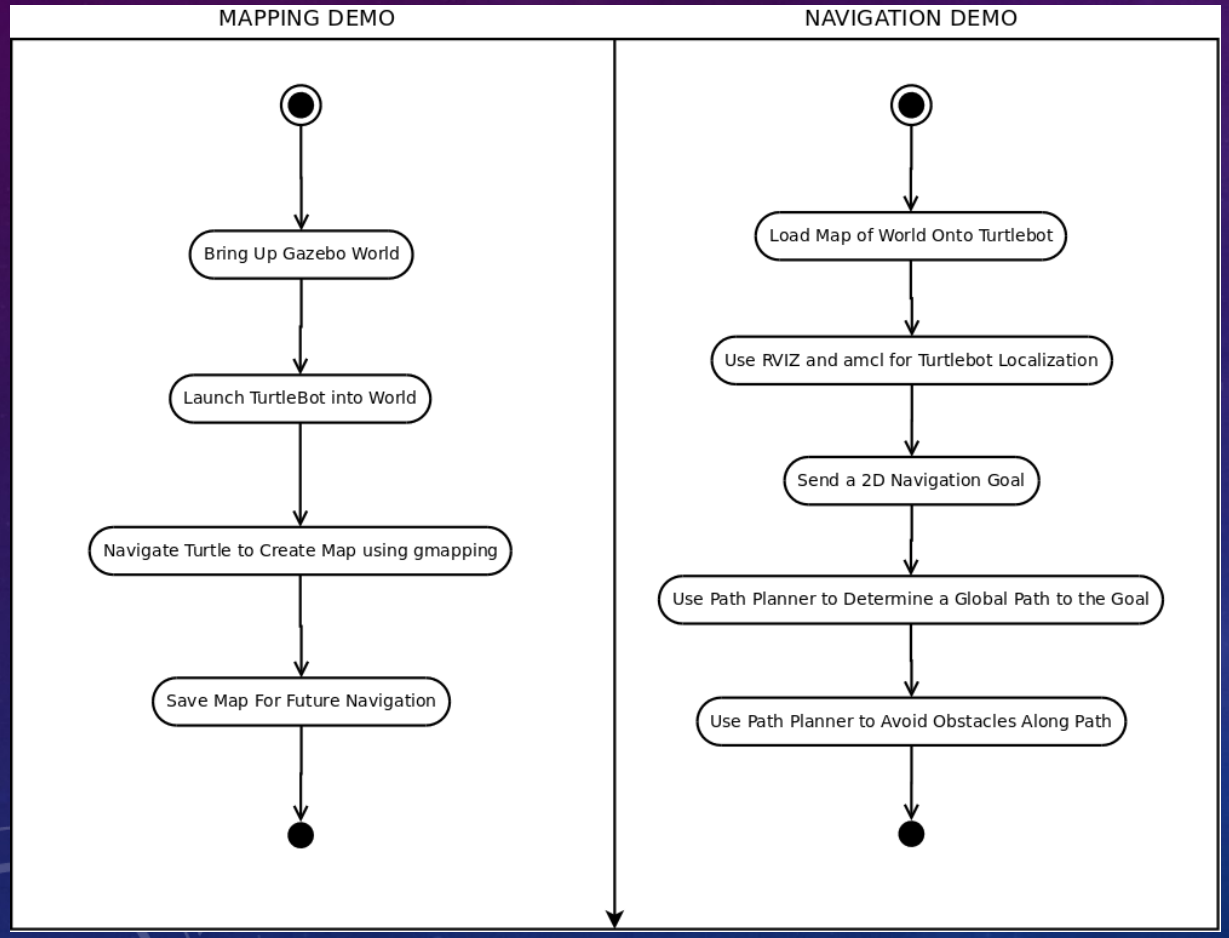
BIO – SAMANTHA (SAM) JOHNSON

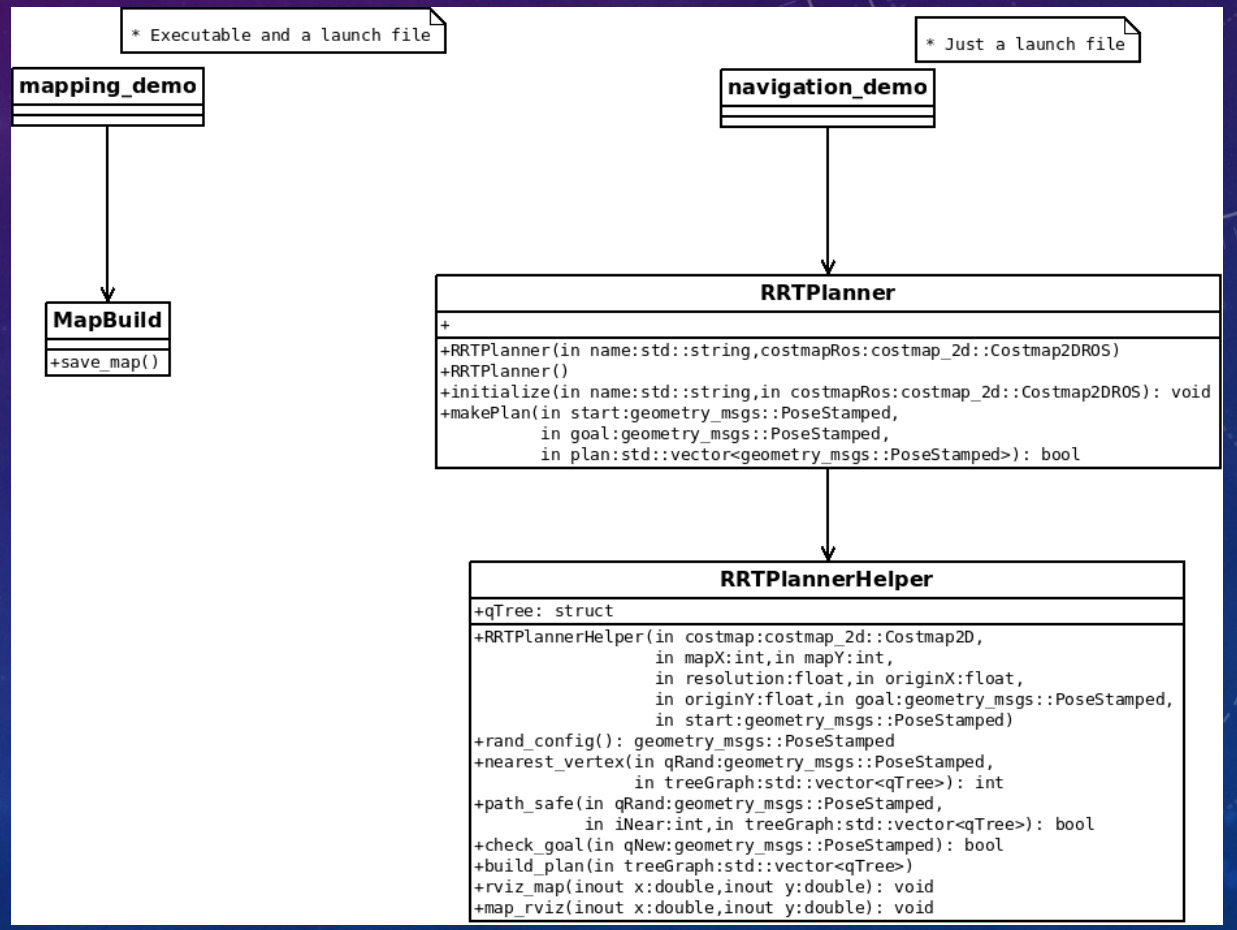
- Graduate of the University of Maryland with her B.S. in 2014, with a major in Aerospace Engineering and a minor in Astronomy
- Part-time graduate student earning an M.Eng. in Robotics
- Full time engineer working for a small aerospace engineering company contracted at NASA Goddard
- Current Task: Software Developer and Real-Time Operations Analyst for NASA's Robotic Conjunction Assessment Risk Analysis (CARA) Team
  - Works operations to keep space safe and debris-less by analyzing orbit data to determine if there are hazards along spacecraft flight path. Provides analysis and maneuver planning support to missions
  - Works as a developer on software releases that are critical to the work of the operators, and works to fix bugs and improve features in the production environment

MODULE OVERVIEW – ENVI-NAV

- Module: Navigation component of the RoboPet
- Details: The robot will be able to gather and store information about its environment, and autonomously navigate to various locations, without colliding into known or unknown obstacles
- Methods:
  - **Mapping** - Initialize the robot in its environment and record a base map, by using the SLAM method. The robot will be guided around the environment and allowed to record and save the map it creates using a laser sensor.
  - **Navigation** - Localize itself to allow it to travel to given locations on the map. The robot will be equipped with a global planner, which will utilize a custom RRT algorithm. An integrated local planner will allow the robot to avoid unknown obstacles that may appear along its path.

SYSTEM DIAGRAMS





DEMOS

CLONE REPO

- Clone repo (https://github.com/sjohns09/envi_nav.git) to catkin workspace
- Ensure that master branch is checked out
- In catkin workspace root directory, run catkin_make.

```
cd ~/catkin_ws/src
git clone https://github.com/sjohns09/envi_nav.git
cd envi_nav
git checkout master
cd ~/catkin_ws
catkin_make
```

MAPPING DEMO

Launches the turtlebot in the custom gazebo world which simulates an apartment environment. Launches rviz, to use for visualization of the built map, gmapping, which will allow the robot to conduct SLAM on its environment, and the keyboard teleop node which allows the user to drive the robot around its environment.

<u>To begin the mapping demo:</u>

- In a new terminal source the setup file ($ source ./devel/setup.bash)
- Launch the mapping_demo launch file
  “roslaunch envi_nav mapping_demo.launch record_bag:=false”
- Follow Instructions in Demo window
- To close the mapping demo press ctrl^C in the terminal window twice (once to close the keyboard teleop and another to exit the launch file).

NAVIGATION DEMO

Launches the turtlebot in the custom gazebo world which simulates the apartment environment. Launches rviz for visualization. Launches the amcl node for localization of the robot, and uses a revised move_base node which will utilize the custom RRT planner to generate a global path plan for the robot.

<u>To begin the navigation demo:</u>

- In a new terminal source the setup file ($ source ./devel/setup.bash)
- Launch the navigation_demo launch file
  “roslaunch envi_nav navigation_demo.launch record_bag:=false”
- Localize the robot in RVIZ and send a goal pose
- To close the navigation demo press ctrl^C in the terminal window to exit the launch file.

SUMMARY

DIFFICULTIES

- Testing
  - The RRT algorithm was difficult to test, due to the need for a costmap_2DROS to initialize, and because it is developed as a plugin and not a node
  - Test cases were developed, but when ran the tests time out, even though execution should not take long
  - Unsure what is causing the timing out even after hours of debugging, everything runs fine when simple dummy tests are tried

FUTURE WORK

- Learned location names which will allow navigation by user voice command
- Improvements to RRT algorithm to speed up processing time and optimization of path
- Implementation on a walking robot to better simulate the pet-likeness of the RoboPet