# Autonomous Localization

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## I. Introduction

The Building Wide Intelligence (BWI) robots currently support two ways of localizing: by requiring users to manually indicate the robot's location or having the users drive the robot while it attempts to localize. We aim to implement a feature that allows the BWI bots to autonomously localize without the aid of the users. We also want the results of this process to be effectively communicated to the users, therefore we plan to utilize LED lights to visually display when a BWI bot is attempting to autonomously localize. In the initiation stage, the lights will turn green to indicate that the process has successfully started and is currently running. At the end of the process, the lights will either turn off to signify successful localization or turn red to signify unsuccessful localization.

## II. Related Works and Previous Experience

Both group members have completed all of the assigned homework. Our experience working with turtlesim on homework two and gridworld on homework three will be essential to our approach on navigation in our project. Additionally, our project draws significantly from the first part of homework four, where we were introduced to the BWI bots localization procedure. We have hands-on experience with the robots that are involved with this project. Furthermore, we will be working with ROS and C++, which we have become familiar with over the course of this class. One member has some experience with Arduino, which we will need to use in conjunction with the LED lights.

## III. Proposed Approach

### i) Autonomous Localization

The robot will call the localization function and begin autonomously navigating around the environment. We plan to use the ROS Adaptive Monte-Carlo Localization (amcl) package to implement autonomous localization: http://wiki.ros.org/amcl. Since the robot will be autonomously driving itself, we will consider two approaches to determining a potential path depending on the time constraints. We will either set a predetermined path using the maps already available or use the gmapping package to construct a map and set a path accordingly: http://wiki.ros.org/gmapping. If we choose the second option, the robot will essentially build a path using the information it gathers from the laser readings and the map it creates. This approach will require us to keep track of the path the robot has taken.

**ii) LED lights**

We plan to integrate LED lights as a way to visually communicate the success or failure of a robot's autonomous localization process. The lights will turn green while the process of localization is taking place, and will then either turn red to indicate a failure to localize or turn off to indicate successful localization. Since the robot already knows when it is unable to localize, we will use this information to determine what color to turn the lights.

**IV. Proposed Evaluation**

**i) Autonomous Localization**

Our primary goal in this stage is for the robot to attempt to localize itself. Successful localization is dependent on the amcl package so we do not expect to get accurate results for every experiment; therefore, the focus of our evaluation will be whether we are able to make the whole process autonomous.

**ii) LED lights**

We will evaluate our implementation of LED lights by checking whether:

1) The lights turn on when the autonomous localization program starts
2) The lights change when the localization process terminates
3) The lights distinguish between success and failure: the lights turn red if localization failed, and turn off if localization succeeded

**V. Expectations/Goals**

- Robot can call localize function itself
- Robot can identify when localization is taking place
- Robot can navigate itself as part of the localization process
- Robot can identify when it succeeds or fails in localizing
- Can turn LED lights on and off
- Can change colors of LED lights based on success or failure in localizing

**VI. Timetable**

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| **Week of April 2nd** | Submit proposal and gather necessary materials |
| **Week of April 9th** | Code localization and test on robot |
| **Week of April 16th** | Integrate LED lights and test on robot |
| **Week of April 23rd** | Fix potential issues, test revisions on robot, and begin final report |
| **Week of April 30th** | Finalize program and finish final report |
| **Week of May 7th** | Submit final report and prepare for presentation |

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| **Week of May 14th** | Present project |