Lighting the Way to Safety

Danyaal Ali, Shivam Patel, Frank Valdez

Introduction

The BWi robots right now do not have indicators that inform its surroundings of its movement information. The purpose of this research proposal is to utilize the current Light-emitting diodes of the robot to translate its movement information to a visual representation. In addition, the research project aims to introduce new behavior elements with the light representation of movement.

The information transfer through the LED lights on the exterior of the robot will give individuals passing by information regarding the robot's direction and speed status. For example, the orientation of the robot will indicate the direction of motion. In addition, the use of colors inherently linked with actions such as "GO" or "STOP" will allow the research project to study the behavioral impact that the colors of the LED lights have on the perception of individuals around the robot. We hope that this addition to the robot helps improve interactions with people and safety while completing tasks.

In a general idea, the purpose of our research project is to integrate the use of LED lights onto the exterior of the robot that emit colors that naturally link to certain actions that humans perceive. In an additional layer, the lights will then be placed in controlled environments in which surrounding individuals will be studied if they understand the triggers of the lighting complex.

Related Works in Robotics

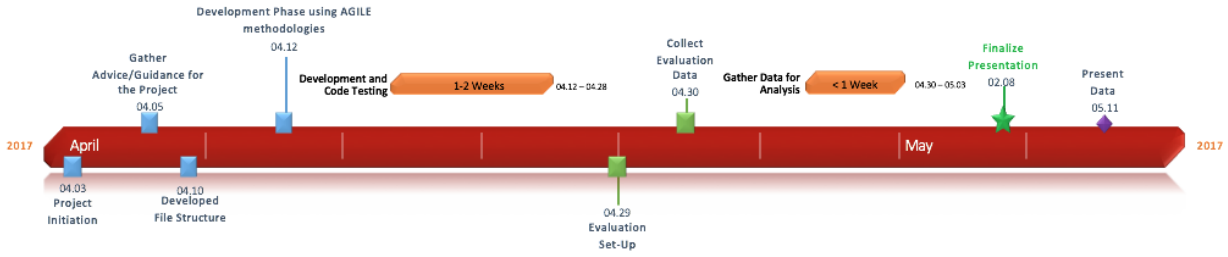
There have been similar projects from past students that utilize the LED lights to communicate movement such as turning left and turning right. These movements were displayed to the outside world by the blinking of lights, similar to modern automobiles. We look to extend this implementation to help the robot navigate through the building and interact with people around it.

Another related project, not necessarily in robotics, is the creation of traffic lights. Historically, red has been linked with stop, green with go, and yellow with slow down. Our project will implement this color system as well in order to effectively communicate with others

around it of its intended movement. These colors have become part of convention, so we will use these to convey messages of the robot's movements.

Proposed Approach

The initial timeline for the project is outlined below:



The general proposed approach to complete the research assignment deals with the segmentation of the tasks necessary to develop and execute the research topic. From the start, deliverables made in this research proposal are evaluated and given a time allocation for completion.

In a walk through, the approach to completing this research project starts from the development of the code that will implement the different results from the BWI robots. In terms of the specific implementation of the project, we decided that information regarding the absolute speed, direction, and rotational movement of the robot will be sent to the light configuration. After the data is sent, the lights will interpret the data to create a certain result. From there, validation of the implementation will be checked. Lastly, data regarding the human reactions to the robot will be collected through an experiment conducted at the Gates Dell Complex.

Proposed Evaluation

The whole purpose of our final project is to add some sort of additional functionality to our robots. Not only do we want our endeavor to establish something unique in functionality, but we also want it to help improve the communication system between the robot and its surrounding environment of humans and potentially other robots. But how will we assess the productivity and utility of our implementation? We plan on conducting extensive experiments

with the robots after we have implemented the lights. We will be testing two main aspects: the effectiveness of the lights and the human behavior/reactions to the robots.

The lights will be using the LED strips on the robots to properly represent the movements of the robot, as it maneuvers through the building and completes various tasks. We can test how effective the lights are by assigning the robots different tasks and seeing how well the lights correspond to the actions that the robot is conducting. These will include assignments to go directly to a specific office as well as specific actions and routes that would present the most challenges to the robot.

The next part we need to evaluate are the interactions between the robots and its environment. We will test this by assigning the robots multiple tasks while other people are around. While the robot is navigating through its route, it will display signals of its actions. Then we will see how effectively others are able to catch on to the signals and what they represent. We also plan on surveying the individuals that see the signals. We will ask them if these signals helped them maneuver around the robot in an easier fashion.

Our goal is to gather data on the functionality and effectiveness of the signal lights on the robot. We hope that the data which we gather is supporting to our implementation, so that we can properly increase the safety of the robot and essentially its surroundings.

Summary of Anticipated End Result

We anticipate to fully implement this stop, go and slow down visual LED system into the SegBot. With the implementation of this system, we believe that we can ensure the safety of those around the robot, but more importantly the robot itself.

This system will be especially effective at events such as Explore UT as young children tend to swarm the SegBot and not give it space. Although the SegBot is programmed to stop when it senses people, our system will effectively communicate whether the SegBot intends to move forward or not. Hopefully, this will significantly decrease the chances of a child standing in front of it when it flashes green, in turn decreasing the chance of a collision and making the SegBot a much more safe and user friendly robot. When people are trying to navigate around the building, using this system of communication will help them avoid getting in the way of the robot's task. This will, in turn, improve the safety of the building and also help the robots complete their tasks easily and more efficiently.

We also hope that this system will alert users to give the SegBot space needed when slowing down to a stop or when it is starting to move forward again. Similar to the auditory cue of the Minerva bot that alerted visitors to move when its path was obstructed, we intend to

continuously flash the LED lights red to visually alert others around the SegBot to give it the space it needs to complete its next move.

Our vision is that we can add this functionality so that it is useful when strangers are roaming around the building and are unfamiliar with our robots. Instead of being confused and messing with the robot, the individual can have a better idea of what the robot is doing by noticing the LED cues that are emitted by the robot. We hope to truly help increase the functionality and add to the utility of our robots.