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CS 309
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3 April 2017

Using Hand Gesture To Command BWI Segbots

Introductions:

Although one of the main goals of Building Wide Intelligence (BWI) project is to help the people, BWI segbots currently does not have a way of following a person based on body languages or spoken language apart from direct input. In fact, we currently rely on human teleop or localization in order to make our robots to move to a certain location. Therefore, we would like to implement a feature to allow the Segbots to follow a person based on the hand gesture. This is one of the first steps towards hand gesture operations in the BWI laboratories, and we would like to have this tool in order to make communication with the Segbots easier and increase the human robot interaction. Examples of some commands to implement are following, stopping, etc. This task requires some type of human mapping in order to see what kind of movement the humans are doing.

Previous Experience:

We are currently taking this course and have completed all the assignments. From these assignments, we learned how to code in C++ as well as in the Robotics Operating System (ROS). Also, we learned lately how to work with OpenCV API, which we will use in our project for the purpose of motion detection. The Turtlesim simulator also showed us how to command a robot to a certain position, which we will be similarly looking at to follow a person.

Jamin has some experience in robotics prior to attending college. During this time, he worked with Finch robot which is an educational robot. He worked on simple projects based on sensors that are installed in the Finch such as following the black line, printing different colors based on the range of temperature of the input, and others.

Proposed Approach:

First, we have to check if the being that is giving the command is a human. It shouldn't respond to the robot arm with a similar hand gesture as of humans. Our functionality is meant to be for humans; a way to help people in their daily lives. This will also help the Segbots make sure it is someone that is actually trying to command it. The OpenCV has functionalities to help detect human beings using the Kinect camera.

After we have detected the human being, we will focus on implementing and learning hand gestures. The Kinect camera will be used for most of this research; the "rtcus_kinect_gestures" package will be using the Kinect camera in order to detect human movement and body gestures. With the package, we will focus on generating hand gesture

recognizer. In this project, we will mainly work on two gestures which are meant to publish follow or halt command.The human mapping will allow us to detect what kind of hand movement the person giving commands is having. We will create an existing dataset of gestures that the Segbots will be able to understand.

When the dataset has been created, the next objective will be to use the package to make the robots understand that a person has given a command. Gesture recognizers will be a key importance to this research, and will have most of our focus. An example of a hand gesture is following a person; for this gesture, a person has to most likely move their hand and arm in a forward and backward motion as if you are telling another person to "come here."

After the robot understands that it has been given a command, then now it needs to act on that command. Receiving a "follow me" command would indicate the Segbot to move towards the person until it receives a "stop" command. Currently, we would like the Segbot to follow a person even if they are walking after they have given the command; the Point Cloud Library will be used in order to detect the person that it wants to follow. The robots should also stop if the person gets sidetracked and stops; however, if they start moving again, so should the robots, unless it had been specifically given a "stop" command.

Evaluation of Success:
The way that we plan to evaluate whether we achieved the goal is that:
1. Our robot will understand human hand gesture. As one of the main goal is to contribute on making a personal assistant robot, the robot should understand whether the movement it detects is a human hand gesture. For instance, if it is a robot arm gesture, it should not respond to it.
2. Once the robot understands the hand gesture, corresponding action must be executed. It would not be complete project if the unexpected outcome occurs after the certain hand gesture. Each specific hand gesture results in a unique sequence of execution.Thus, for a recognizable hand gesture, the correct response should be executed.
3. At a basic level, the caller will be on stationary point. Thus, at this phase, we will not test on whether the robot can follow the person, but we will see if the robot can come to the person in the right direction first.
4. At a medium level, the project will assume that there is only one person in its frame who can make the hand gesture. In this setting, the robot will not consider a problem of deciding who the caller is, and instead follow the person in front of it when "follow me" command is published to the robot.
5. At an advanced level, the robot should learn who made a hand gesture. If a person makes a "follow me" command, the robot has to store who the caller is, and follow the person unless the caller sends a halt instruction to the robot. Thus, the robot should be able to detect who is a caller.

Anticipated End Result:

At the end of our research, the use of hand gestures should allow for simpler communication with the Segbots when giving basic commands. This approach was made without worry of the environment to allow for easy access to a robot when needed. We expect the Segbots to comprehend hand gestures and be able to act on the given command. The Segbot should also be able to consistently follow the same person without getting lost.

Schedule:

Date	Planned Outcome
April 3rd	❖ Advice from TA's and mentors ❖ Proposal deadline
April 10th	❖ Detect human hand gesture
April 17th	❖ Make robot to understand specific hand gesture and to distinguish different gestures
April 24th	❖ Make robot to follow the person or stop based on the hand gesture
May 1st	❖ Testing functionality
May 8th	❖ Final Report
May 13th	❖ Presentation Day

Potential Improvements:
- Validation for initialization of the hand gesture: currently, each robot in the lab has a unique name like Bender. Thus, it would be better to initialize the hand gesture by name calling so that we can save unnecessary running process.
- Machine learning: evaluation of its own success by receiving a thumbs up or down in order to indicate if the command that it had acted upon is correct or incorrect.