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CS309: Emergency Stop Button Proposal

Introduction

We propose to introduce a new method to halt the robot with an emergency escape in the form of a big red button. When my partner and I were first learning about the segbots, we weren't fully aware as to how they functioned, and if they could cause damage to themselves or something else or even someone else if their code went awry. In many autonomous systems, there is an easy and understandable escape from the autonomous control back to manual control. This is the feature my partner and I wish to introduce to the segbots. Our prime objectives are to increase the safety of the robot and to simplify the user interface. As of now, if a user wishes to stop the robot, she/he has to position themselves behind the laptop and command a new 2D Vector pose to the Rviz window, or to kill the program responsible for actuating the motors of the segbot. Either of these two tasks can be very difficult while the robot is spinning and moving away from the user. My partner and I propose to attach a large red button, which is commonly known for halting a robotic operation thanks to television culture, on the right side of the robot, easily accessible even if the robot is moving.

Expectations

In order to determine if our project was a success, we want to meet the following objectives. First, if the robot is operating autonomously and the stop button is hit, we expect the robot to stop within a fraction of a second. Similarly, we would want the robot to stop if the robot was being operated manually. Finally, we want the button to be easily accessible to the user from all angles.

We would also like to explore and add extra features such as potentially more useful buttons that will improve the user interface of the robot. Some of these buttons could include a demo button, that users can press to make the robot perform a certain task. This can be used during UT Explore or similar showcase events. The emergency stop button would also be very useful in these showcase events because small children could get run over by the robot by accident, or the robot could fall on them if they are left unattended. A resume button could also be added so that if the stop button is hit, the user does not have to relaunch their program in order to resume testing. The resume button could also be included in the stop button if the stop button has a

locking mechanism. Once the stop button is pulled out from its pressed state, the robot would return to its previous running functions. Lastly, we could also include easy to access forward/backward and left/right buttons to navigate the robot manually. A reasonable way to implement this feature is to incorporate a wired gaming joystick similar to the Wii joystick that is used to play Mario Kart. This way, the person operating the robot can be within a wider radius of the robot and still have access to certain controls.

Plan of Action

The minimum necessary parts needed for this proposal include:

- Microcontroller - Arduino (Already on the segbot v2)
- Large Red Button:
    - https://www.amazon.com/uxcell-Locking-Emergency-Mushroom-Station/dp/B008LT2VH2/ref=sr_1_2?s=industrial&ie=UTF8&qid=1490828962&sr=1-2&keywords=emergency+stop+button
- Bolts with nuts to mount to Segbot
- 1x 10 Ω Resistor
- Insulated Copper Wire

Potential additional parts include:

- 3D printed mount for emergency button to attach to the robot
- USB Joystick:
    - https://www.amazon.com/SQDeal-Joystick-Controller-Vibration-Feedback/dp/B01GR9ZZTS/ref=sr_1_6?ie=UTF8&qid=1491261013&sr=8-6&keywords=joystick+usb
- Additional buttons for extra features

We plan to use software to stop the current nodes publishing to the motors, but the button would theoretically be more useful if it was linked directly to the motors. If the button is linked directly to the motors, the user would be certain that the button would stop all motion, even if the laptop crashes, or ROS crashes. This can prevent the robot from bumping into unwanted objects, moving into unwanted space, and prevent injury in case a human or animal accidentally gets in the way of the robot.

First we need to buy the necessary parts, preferably on Amazon Prime so that they can arrive quickly and we can get started on the project early. If the parts take 2-3 weeks to ship then we would only have 1-2 weeks to test our idea, which would be stressful. Next we would write a basic Arduino sketch that could interpret the button press from the emergency stop button, and implement the code with a ROS node. For this stage of the project, we will temporarily mount

the button to the robot using zip ties or double sided tape. We then need to interrupt any commands to the motors by overriding the action move command, or by finding the node that is sending the commands and halting that node. Once this program is successful, we can try set to the current program to pause until the resume button can be pressed, or the emergency stop button unpressed. Finally, we will design and 3D print a housing for the emergency stop button to mount to the segbot. This mounting piece will be designed so that the button will be in a location easily accessible to the user, firmly attached to the robot, and able to be detached without too much difficulty.

Related Work

Creating the basic interface for the emergency stop button would lead to more opportunities to expand the functionalities that stem from such an idea. We can create a smarter interface to work around humans, such as using a wireless remote instead of a wired button. If there is no emergency stop button, things could get out of hand quickly, such as a baby getting their hand stuck in a motor, and not being able to stop the robot because of panic and duress.
We may also add features that map teleop functions to a joystick that can be handheld so the robot operator can manually drive the robot while keeping a safe distance away.

Additional features that build upon the emergency stop button would allow users to prevent crashes and injuries while keeping a safe distance away from the robot. Since the segbots that we are working with are bulky, heavy, and buggy, a way to control the robots from afar will decrease accidents and increase the safety of the robots, especially during manual operation. The additional features would also prevent the robot operator from blocking sensors, allowing the robot to accurately collect data from its surroundings during testing without the need to be directly next to the robot at all times.

End Results

By the end of the project, the robot would have a functional emergency stop button that would stop the robot's actions and running executables at any given time. This would help increase the usability and functionality of the robot by giving the robot operators a way to safely stop the robot in case the robot is about to run into a dangerous situation. The stop button would increase the safety when using the robot, especially when the robot is used for demonstrations in large crowds with small children, or when FRI students are testing a certain feature on the robot. Further work on this project can help simplify manual teleop operations in the form of a wired/wireless remote control or game controller, and even allow for the robot operator to maintain a safe distance away from the robot while the robot is performing and action.