REU_2022_Climbing_Robot

Documentation

This project aims to advance the steel bridge inspection field by allowing a robot to traverse the steel structure while the inspector stays safely on the ground. The inspector can set a location on the bridge they want to be inspected and wait for feedback from the robot. The robot will scan the bridge on its way to the targeted location looking for any other defects that may be present that the human inspector may not be able to identify on the ground. A potential field motion planning software that allows the robot to scan for defects while on its way to the target may locate areas of concern long before a human encounters them. By having a robot inspect, we may be able to prevent bridge catastrophes in the future.

Software: Our potential field uses point-to-point locomotion for a magnetic robot to traverse a ferromagnetic structure. The software created uses a queue to place points on the bridge and retrieve them. The project is being done to save the lives of bridge inspectors who must hang dangerously in the air.

The input for our software to work correctly is a 3D map in .dae or .stl format. The input will allow our Climbing Robot(CR) to initialize the bridge and allow the user to add the orientation on the bridge they would like inspected.

To replicate and run our software, you must have ROS installed http://wiki.ros.org/ROS/Installation. Create a catkin_ws, then cd into the src directory and make another directory called climbing_robot. Once inside the climbing_robot directory, download the source files; then start ROS with the command roscore in one terminal. Open another terminal and run the command rosrun rviz rviz. Next, open another terminal, get into the catkin_ws and use the following command to execute the program: rosrun climbing_robot pathmodel.py.

Hardware: The CR we are using has a bicycle-like frame which allows for a tighter turning radius. The CR used in the testing has been rebuilt with new parts except for one wheel. Brandon Moore engineered the new parts from a former design engineered by Son Nguyen. A new design is implemented due to technical issues like the wheel housing breaking. Another reason for a new design was the Panda Latte melted its pins, and a raspberry pie replaced the onboard computer. Due to the raspberry pie being slightly larger than the Panda Latte and the battery being transitioned into a power bank, the upper housing platform needed to be modified to accompany these new design features.

The magnetic wheels needed to be switched out for smaller wheels at first because they burnt the motor out. Unfortunately, as the project progressed, the smaller wheels did not have enough magnetic force to handle the transfer from one surface to another surface. One solution for the wheels not climbing was to give them treads; this seemed to give them traction, which helped but did not solve the solution. The next option was to put the larger wheels back on the bot to allow a more potent magnetic force.

Warning neodymium magnets are strong and can hurt you if they are not respected. Magnetic wheels need to be handled with care and due diligence. While working on the robot and changing the wheels, standard metal tools may become the enemy and inflict pain. Caution should be used when handling these wheels.

Mapping: To map a small area in 3D, use the application Dot 3D. Download it and run it from your phone with a real sense camera. You may need to add April tags to help your scan merge if the scanning stops halfway through the process. Once you have the 3D scan, you need to edit the file and then upload the .stl file into ROS. After uploading the file, you may need to convert the .stl to a URDF. Converting the files can be done using this ROS package https://answers.ros.org/question/9613/how-to-import-stl-files-into-urdf-files/.

To map larger structures, you may want to have a survey company map the bridge. If you take that route, you may receive a .dwg file that needs to be converted to a .dae. The easiest way to convert the two files is to use the free trial https://cadexchanger.com/. Once you have a .dae file, you should be able to upload it into rviz to see the bridge and plot your path.