Robotic Mining Competition

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Client: Robotic Mining Competition team, NASA
Meeting Times: Wednesdays, 4:00pm - 5:00pm; Fridays, 5:00pm - 6:00pm

The goal of this project is to provide the client, RMC, with working software subsystems that will guide the movement and mining of their robot, both manually and autonomously. As the rest of the team is made up of aerospace and engineering students, they do not have the same depth of knowledge in implementing the software needed, specifically for the autonomous movements of the robot. I will help bring Software systems to ensure stable traversal over lunar terrain, both manually and autonomously. Software systems to ensure stable mining of lunar material, both manually and autonomously. This software should also be able to communicate how and when lunar material should be excavated and deposited.

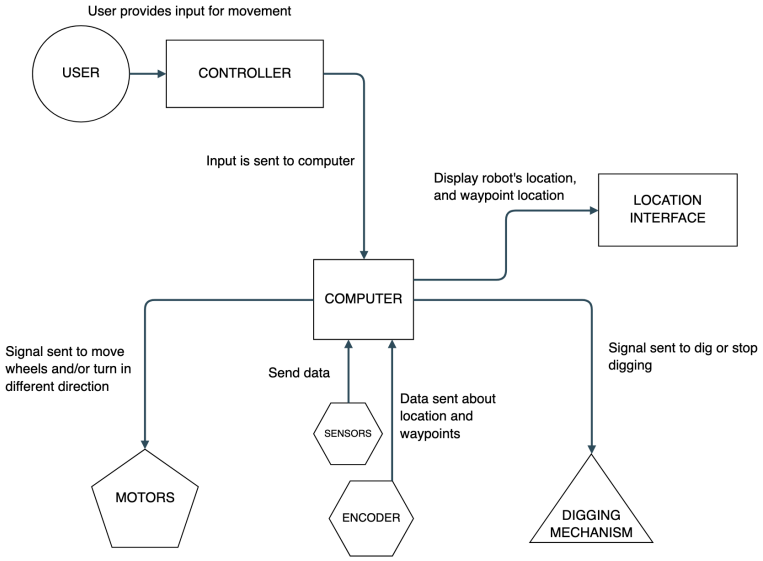
Features:

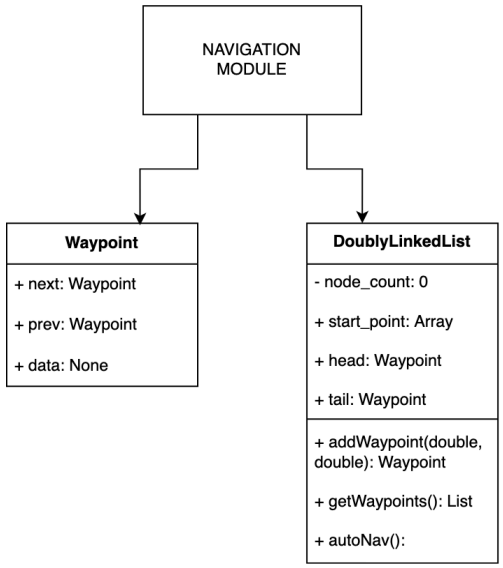
- Base software allowing for use of traversal and mining capabilities.
- A graphical user interface to allow convenient navigation.
- Automated maneuvering software, allowing waypoints to be set manually before moving automatically along that set path.
- Automated mining software, should be able to determine when material should be mined, how much has been mined, and when to stop.

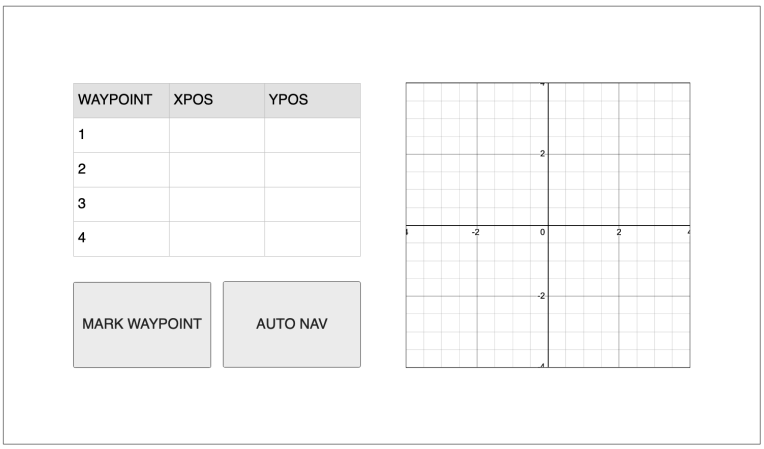
The user interface should be able to show the map of the arena after the initial “satellite” photo has been taken, have a working coordinate grid that the robot moves on, as well as buttons that mark waypoints at the robot’s current position. The automated digging and maneuvering features are novel.

Technical challenges: Working in a simulation has proven a little difficult. I have not been able to work with a working model of the robot yet. There have also been problems with the simulation software freezing while trying to get autonomous movement. The problem has not revealed itself yet, but I plan to use print statements to find the source of the freezing. A few ideas for creating a more complete autonomous system with the robot navigating unexpected obstacles on its own have been thrown around, but the team hasn’t been able to settle on one, mainly due to concerns about the hardware.

Design:


User provides input for movement
USER
CONTROLLER
Input is sent to computer
Display robot's location, and waypoint location
LOCATION INTERFACE
COMPUTER
Signal sent to move wheels and/or turn in different direction
Send data
Data sent about location and waypoints
Signal sent to dig or stop digging
SENSORS
MOTORS
ENCODER
DIGGING MECHANISM


NAVIGATION MODULE
Waypoint
+ next: Waypoint
+ prev: Waypoint
+ data: None
DoublyLinkedList
- node_count: 0
+ start_point: Array
+ head: Waypoint
+ tail: Waypoint
+ addWaypoint(double, double): Waypoint
+ getWaypoints(): List
+ autoNav():



Evaluation:
How will the success of this software be measured?
- Successfully storing waypoint data, and accurately
- Successfully retrieving waypoint data
- Be able to angle the robot accurately with a small margin of error
- Use up a minimal amount of data when the computer is communicating with the rest of the hardware
- Seeing that the robot always successfully follows the entire waypoint path it is given

Milestone 4 (Feb 19): itemized tasks:
- Test, debug and demo the current simulated software
- Achieve proper autonomous movement within the simulation
- Research possible addition of radar to use for autonomous movement
- Develop navigation GUI
- Research on connecting/managing multiple computers

Milestone 5 (Mar 18): itemized tasks:
- Implement, test, and demo automated simulation
- Work on translating the code from the simulation to the hardware
- Develop navigation GUI
- Conduct evaluation and analyze results
- Create poster and ebook page for Senior Design Showcase

Milestone 6 (Apr 15): itemized tasks:
- Implement, test, and demo entire system on built robot
- Conduct evaluation and analyze results
- Create user/developer manual
- Create demo video

Faculty Advisor Approval

"I have discussed with the team and approve this project plan. I will evaluate the progress and assign a grade for each of the three milestones."

- Signature: _____ Date: _____