# Command and Control Subsystem for Regolith Mining Robot

**Team Members - Software Engineering:**

- Pablo Canseco - Software/Communications Lead

**Team Members From Other Majors:**

| | |
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| ● Leyane Mohammed | Project Manager |
| ● Domenick Albanese | Software |
| ● Ronald-Dean Allado | Software |
| ● Kyle Rieder | Software / Consultant |
| ● Mark Thames | Communications / Electrical |
| ● Khalphani Green | Electrical Lead |
| ● Adrian McHargh | Electrical |
| ● Spencer Lower | Electrical |
| ● Nathaniel Voris | Structures Lead |
| ● Zoher Kothari | Structures |
| ● John Breen | Structures |
| ● Jacob Netzley | Structures |
| ● Abigail Stevens | Structures |
| ● Ashle Thompson | Structures |

**Faculty Sponsor / Customer:** _____

**Project Goal / Motivation:**

The project aims to provide robust command-and-control capabilities to FIT's entry into NASA's Robotic Mining Competition (NASA RMC), Project ARES. Project ARES will feature a regolith (lunar/martian soil simulant) mining apparatus, a transport mechanism, a communications subsystem, and a data processing / decision making subsystem. Once robust and reliable control of the robot's electrical and mechanical components is achieved, autonomous control options will be explored in order to give the school a competitive edge in the NASA RMC this coming May, 2016.

**Approach:**

We will be developing the command and control subsystem for the regolith mining robot. The robot will feature a distance sensor, power consumption sensor, transport motors, and mining motors. We will begin by abstracting the motor functionality such that the robot can be controlled using simple function calls. To do this, we will make the Arduino essentially a "pass-through" device in that it sets or reads its GPIO (general purpose input/output) ports based on the values sent to it.

After the Arduino portion has been abstracted, we'll work on the main program in the Raspberry Pi board which will contain all the control logic and data processing. We'll construct a GUI that takes user input and translate it to commands that control the robot in real-time, and work to make sure the robot is responsive when controlled by a human. We'll use input smoothing  and investigate other techniques to ensure robot control is reliable.

Finally, autonomous operation options will be investigated so at the push of a button on the Graphical User Interface (GUI), the robot enters a mode where it will proceed to the mining area, mine regolith, return to the collection bin, and dump the regolith into it.

**Technical Challenges:**

- **Arduino Environment**- We plan to use Arduino embedded system for motor control and sensor operation / data collection. The rationale is because there is widely available community support and documentation with examples on how to achieve most common goals. We'll need to learn to use this environment and adapt it to robot control.
- **Raspberry Pi-** We plan to use a Raspberry Pi single-board computer as the data processing and decision making platform because it comes with networking capabilities out of the box, making communication subsystem development much easier and freeing up time to work on system reliability and robustness. We'll need to familiarize ourselves with real-time operation on a Linux computer.
- **TCP/IP communications-** We intend to communicate with the robot using Wifi during final wireless runs and Ethernet during practice wired runs due to the reliability of this, versus other forms of communication like Serial over radio transceivers. We'll likely need to learn more about client-server programming methodologies and event-driven paradigms.
- **Autonomous robot operation-** We will need to research methods for reliable autonomous robot control since we're not experienced in this field.
- **GUI Development**

**Milestone 1** (Sept 28)**:**

- Research and select hardware to use in the subsystem. We're intending to go with Raspberry Pi and Arduino, but we'll need to do additional research to be sure they are the best choices for our intention.
- Work on Arduino abstraction and be able to control it by sending commands over a serial connection.
- Raspberry Pi "Hello World" program.
- Requirement Document
- Design Document
- Test Plan

**Milestone 1 Task Matrix:**

| Task | Pablo |
|---|---|
| Investigate/Select Tools | with subsystem team member help |
| Requirement Document | write 100% |
| Design Document | write 100% |
| Test Plan | write 100% |

**Milestone 2** (Oct 26)**:**

- Begin GUI development
- Control station < > robot communications progress

**Milestone 3** (Nov 23)**:**

- Finalize GUI
- Work on responsive and robust robot control
- Optimize / minimize communications data throughput
- Begin autonomous operation work / research

"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: _____**