PHOENIX MAVRIC

Mars Analog Vehicle for Robotics Inspection and Construction

Gage Lochner

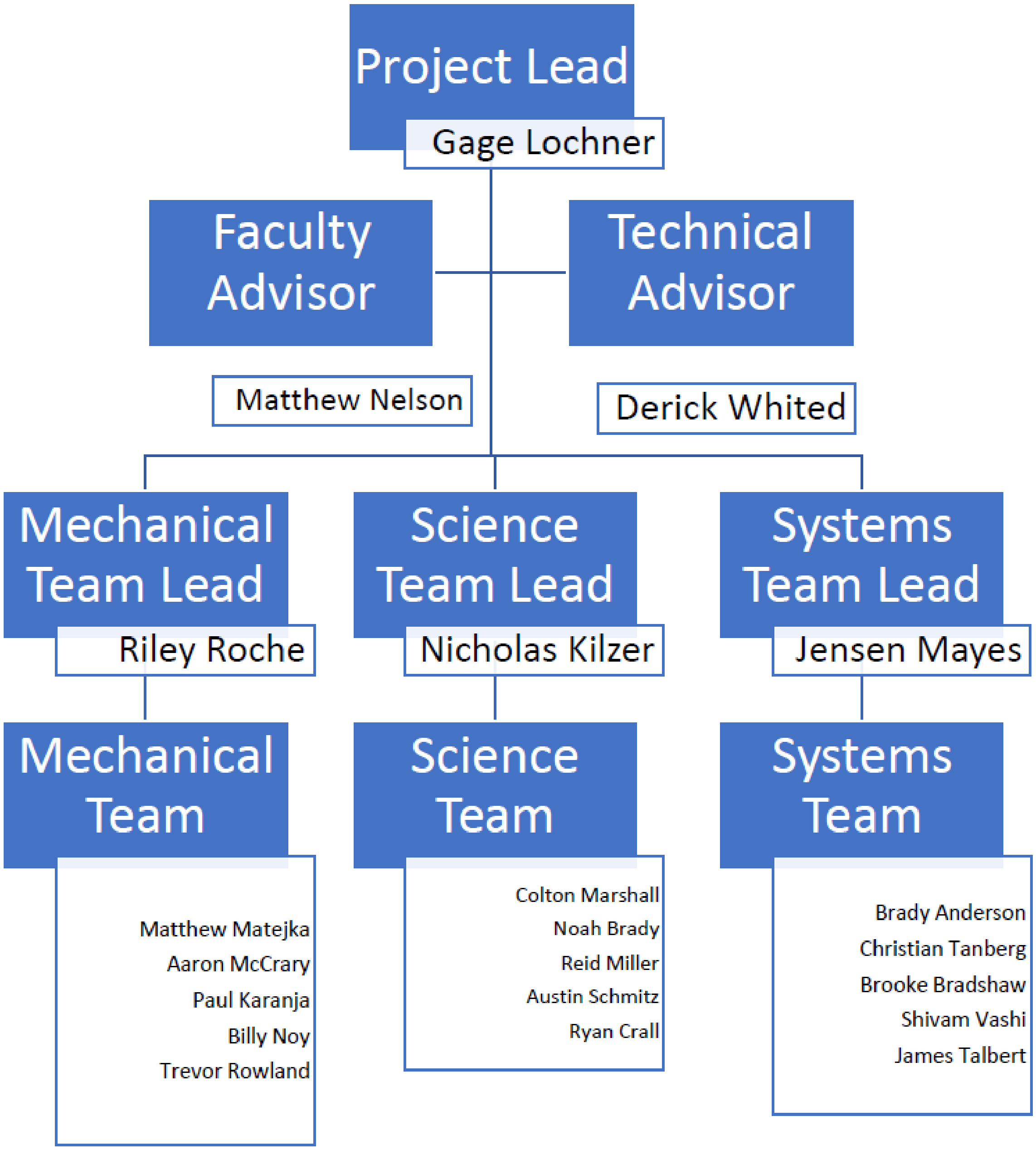
Project Information

Project Name	MAVRIC	**# semesters in service**	18
Project Classification	Competition team	**Budget Requested**	$8,000.00
Project Student Leader	Gage Lochner	**Budget Approved**	$7,850.00
Project Member Size	19	**Budget Spent**	$3,117.78

The project has 3 teams. The team leaders are Riley Roche, Jensen Mayes, and Nick Kilzer.

The stakeholders for the project are: M2I, ISGC, Danfoss, Quality Manufacturing, Emerson.

ORGANIZATION CHART



PROJECT MISSION STATEMENT

MAVRIC, or the Mars Analog Vehicle for Robotic Inspection and Construction, is a student lead team focused on building the next generation of Mars rovers.

PROJECT GOALS

The primary goal of the project this semester is to finish the rovers' feature set and to polish the operational capabilities and practice operating the rover remotely before the May 30th competition.

PROJECT DELIVERABLES

This project will produce a competition ready rover for URC, or the University Rover Competition, by the end of the spring 2019 semester.

PROJECT SUMMARY

MAVRIC is a student lead engineering group working on Phoenix, our rover entry to the 2019 URC events. Phoenix is the first new rover in 5 years and has been a work in progress since July of 2017.

The primary goal of Phoenix was to create a testbed rover that could be upgraded and evolved over time. This rover would be used to confirm design ideas, manufacturing practices, and allow for newer ideas to be tested with minimal impact to the other systems. Most of the rover was built on campus in the last year. To help accomplish these goals, the rover subsystems were designed to be as modular as possible, and to use common and simple connection points and interfaces.

The rover is designed to accomplish several tasks at competition. The tasks of URC are created with the future operations of rovers on Mars in mind. The primary theme of the competition is to have 4 missions similar to what a rover setting up for a manned Mars mission may require. All missions at competition are completed by teleoperation, without line of sight, and may be up to 1 km away.

During the autonomous mission of the competition, the rover will navigate between gates marked by tennis balls with supplementary gps coordinates. The rover must decide when it has reached the end of each gate within the mission, and must display this to the base station and on board the rover. Terrain will progressively become more difficult, and the most difficult stages may not have direct line of sight between the start and end points.

For the science mission, the rover must have the ability to detect life onboard the rover. This must be done with no distributions to the sample area. No hazardous materials or items with contamination risks may be used.

The extreme retrieval and delivery mission has the rover traverse difficult terrain while carrying small payloads to GPS coordinates. As the stage progresses, the distance from the base station and difficulty of the terrain will increase.

The final leg is the equipment servicing mission, which requires the rover to perform several dexterous operations on mocked up equipment systems. There is only minimal terrain at this mission. Tasks include operating screwdrivers, keyboard, joysticks, and securing electrical connectors.

PRESENTATION SUMMARY

MAVRIC is currently finishing up work on Phoenix, our first new rover in 5 years. As we begin to wrap up its final design phase, we will begin to work on a second-generation version of Phoenix.

Thanks to the continued support of M2I and ISGC, Phoenix is easily MAVRIC's most successful rover. The overall system is incredibly stable, and has allowed work to progress at a steady pace. Due to this steady pace, the rover feature set has been able to be expanded greatly in the last year.

Each of the 3 teams will be presenting their work on the rover over the last 4 months. We will be discussing a number of topics, and each team will also be discussing future plans.

The Mechanical Team has focused on improving Phoenix's robotic arm for the first half of the semester. A shoulder upgrade to reduce frictional losses was designed and is currently being machined and assembled. The end effector was redesigned and is being assembled and tested. Potentiometers are being added to each joint to provide accurate feedback on the position of the arm. Camera mounts were added at various locations on the rover to provide all-round vision for the rover operators. Planning for weight reduction tasks, including research into the potential use of composites instead of aluminum in some areas, was completed.

The Systems team has been working meticulously this semester to fully prepare the rover for competition. We have been able to establish the software backend for feedback from the arm and have been able to fully integrate this into the base station. For the base station we have been improving our GUI to make it more user friendly and convenient for competition. We have also been working on the autonomous system where we have been improving our programming for the GPS navigation as well as adding an IMU to determine the rover's orientation and a Pixycam for object detection.

The Science team has made significant progress in manufacturing and design refinement of Phoenix's science system. All major parts have been ordered and almost all have been tested. All 3D printed mounts have been made, fitted, and modified if necessary. The science plan has been developed further, and the spectra libraries have been expanded upon. The prototype print for the spectra collector has been made and tested. Science Team is currently working on further improving the spectra collector, developing MATLAB code for spectra analysis, and completing the laser orientation system.