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Computer Science Project

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Lunar IoT Progress Report 1

The Internet of Things (IoT) is a system of devices, each embedded with software and sensors that allow them to interact with one another through network connectivity [1]. This concept of an IoT can be applied in many different environments, one of which is the lunar surface. Alongside Dr. John Schmalzel of Rowan University, our team will be recreating the lunar surface and constructing an IoT within it. Our IoT consists of a command center, rover, battery stations, and objectives. The rover is one of the most integral components of our Lunar IoT system. It must move around between objectives, the order of which comes from the command station, in the most efficient path possible to preserve battery life. When significant battery levels are lost, it must request battery information from battery stations.

Some of the physical materials required for this project are a rover (preferably equipped with lidar technology to assess distance), a camera to attach to the rover for development of computer vision, ESP32 microcontrollers, and a Raspberry Pi to run developed software on the rover. Some softwares and technology that will be utilized in this project are Python, a MQTT broker for device communication, and Robot Operating System 2 (ROS2) for development of rover movement and simulation. Since the group will not always have the physical rover and lunar surface environment readily available to test with, it is important that we develop a high fidelity digital twin for virtual testing, as well construct a battery model for understanding information levels of battery stations and the rover.

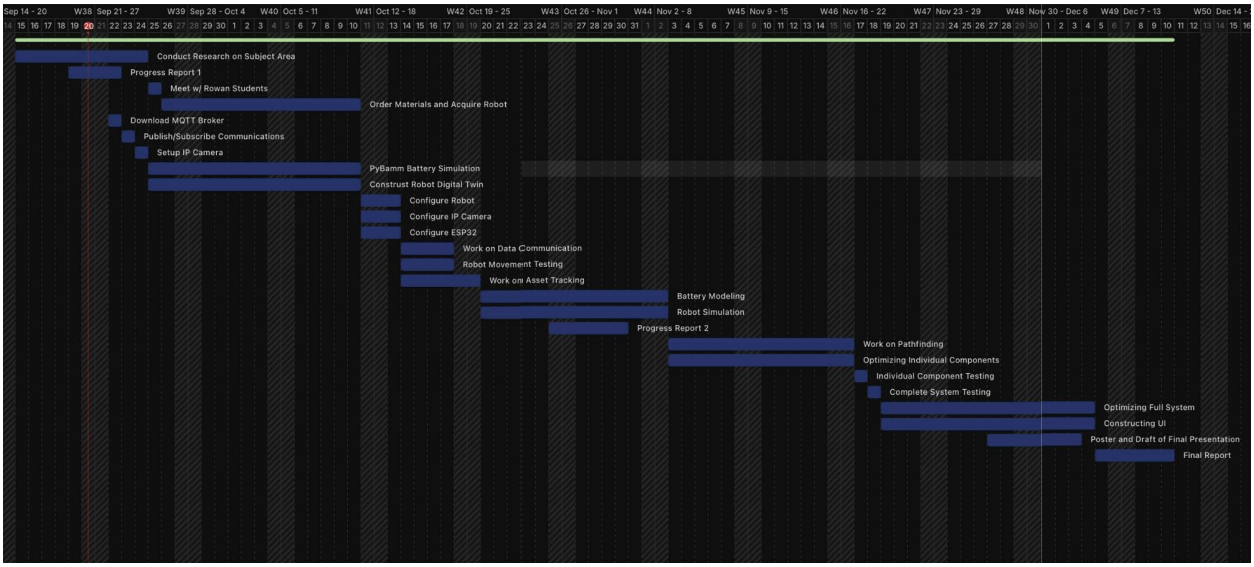
Our group has split the workload of this project into a few categories: MQTT/IP communication, ROS2 development, high fidelity digital twin development and testing, battery modeling simulation, computer vision, and pathfinding. Many of these categories have some overlap and the individuals working on them must interact with each other to ensure their codes work together properly (i.e. computer vision can help the rover identify objectives and power stations in its direct line of sight and pathfinding algorithms can be used to lead the rover to their locations in the shortest amount of time/distance).

Taking into consideration the entire group's interests and skills in programming, Emily and I, as project managers, have assigned the following roles:

- Julie will be responsible for working on ROS2, pathfinding, and digital twin development.
- Samhith will be responsible for working on ROS2, pathfinding, and battery/robot modeling simulations.
- Emily will be responsible for working on battery/robot modeling simulations and digital twin development.
- I will be responsible for working on computer vision and communication over an MQTT broker.
- Lekh will be responsible for working on communication over an MQTT broker, as well as providing some input in all other areas.

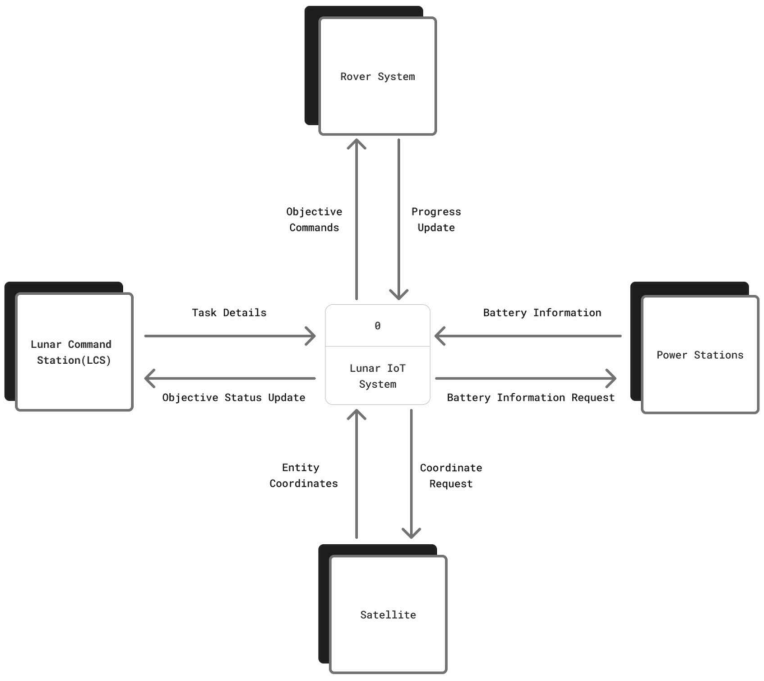
As project managers, Emily and I will also be responsible for scheduling meetings, assessing the scheduling of tasks, and identifying risks and benefits of the project. Below is a Gantt chart displaying a project development timeline. It consists of many tasks, such as ordering materials, configuring the rover and sensors, testing virtually and physically, etc.

With a deadline of December 10 in mind, we will incrementally develop a Lunar IoT that will successfully address the needs of Dr. Schmalzel and his colleagues at NASA.



Emily Claros, Julie Castro, Lekh Patel, Jarod Lopez, Samhith Marni

Lunar IoT Context Diagram



References

1. IBM. “What is the Internet of Things (IoT)?” *IBM*, 16 Sept. 2025, www.ibm.com/think/topics/internet-of-things