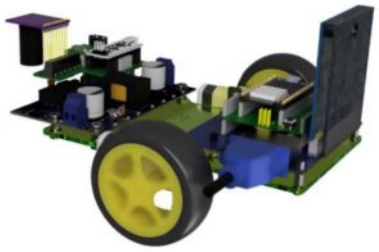
1 Aim

The aim of the project is to design and build an autonomous rover system that could be used in a remote location without direct supervision.



The rover will have the following main functionalities:

- Receive movement commands and send status data through a processing unit.
- Detect and avoid obstacles in its working area.
- Build a map of its local working area including obstacles on an offsite data store.
- A charging station will be designed and implemented to charge the rover batteries.

2 Timeline

- **11 - May**: Introductory session
- **12 - May** - **26 - May**: Design and practice sessions
- **14 - June** - **25 - June**: Assessment period

3 Deliverables

- Report containing:
  - Design process of the Mars Rover
  - Technical specifications and details of components
  - Reflection essay on coursework lecture

  Report should **not exceed** 40 pages.
- Video demo on Mars Rover operation
- Oral exam

4 Project submodules

The Mars Rover project is composed of six submodules which are managed by each individual member of the team.

4.1 EEE: Drive (Alyson)

Drive subsystem handles the movement of the rover, parts including the frame, motors and optical flow sensor.

Responsibilities:

- Direction control
- Distance measurement
- Speed control
- Turning method

4.2 EEE: Energy (Ivy)

Energy subsystem handles the power system of the rover, provided through the solar panels.

Responsibilities:

- Battery charge profile design
- Battery charge status estimation
- Battery balancing algorithms
- Charge batteries
- Prevent explosion/melt
- PV MMPT algorithm

4.3 EEE: Integration (Izzah)

Combines the subsystems of the rover together.

Responsibilities:

- Developing the central processor of the rover and ensuring correct functionality of all sub-systems.
- Manage communications between the onboard rover systems and the cloud command processes.
- Build, maintain and assist in debugging the other modules.

4.4 EIE: Command (Xin)

Allows remote control of the rover by connecting to the control subsystem and accessible via a web browser/mobile app.

Responsibilities:

- Create a web or mobile dashboard to control the rover remotely and receive information from the different subsystems.

4.5 EIE: Control (Igor)

Using ESP32 microcontroller, handles communication with all the subsystems via different communication protocols. The ESP32 will have a unique IP address and will be used as an access point.

Responsibilities:

- Communication management between:
  - Motors
  - FPGA
  - Cloud command
  - Charging station

4.6 EIE: Vision (Ebby)

Enables the rover to detect and avoid obstacles to achieve its target destination.

Responsibilities:

- Use on-board vision and software to identify obstructions and objects of interest such as:
  - Move the robot around the terrain according to instructions from cloud command.
  - Avoiding obstructions.
  - Closed loop monitoring of position.
  - Sending commands to the motor control.

5 Project management

Due to the nature of the sub-systems, module development are relatively independent. Particular care should be placed on the following sub-systems:

- Command (EIE)
- Control (EIE)
- Integration (EEE)

as it handles the end-points and data flow of the systems.

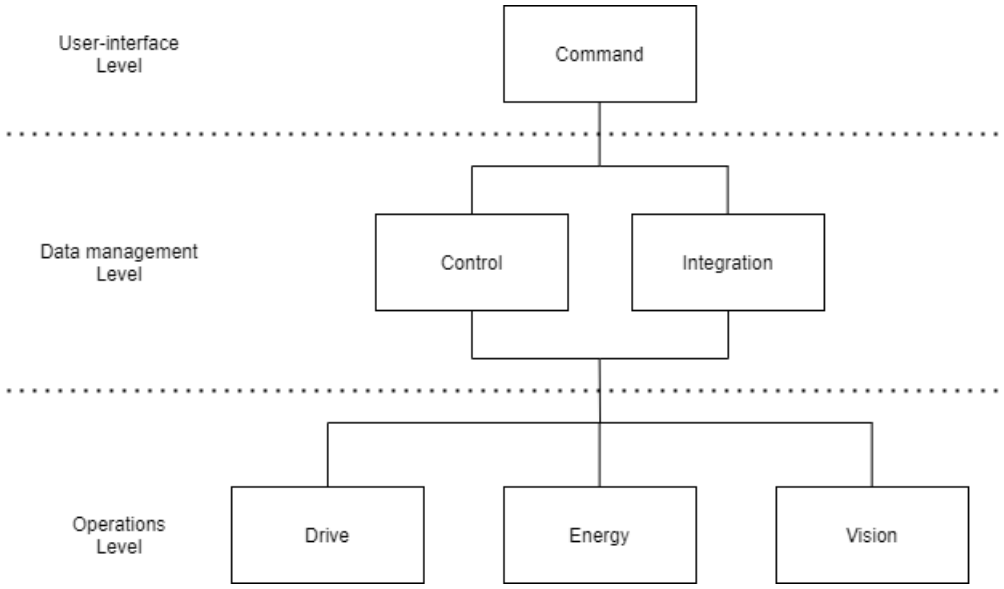


Figure 1: Project sub-system hierarchy

Project sub-system heirarchy represents the different layers in the rover system that each handles different aspects that brings the overall system together. Any changes in the base layers needs to notify the respective upper layers to ensure compatibility is met.

- **User-interface level**: Responsible for the user experience aspect of the rover system and, ensuring a stable and seamless communication link between the rover and user interface.
- **Data management level**: Serves as the bridge between the user and the functional sub-systems.

  Integration serves as the oversight component of the Operations level, providing neccessary support and communication between all the respective modules. This module also ensures and records all testing done in each of the sub-systems.
- **Operations level**: Critical in ensuring correct rover operation in each of their respective domains.

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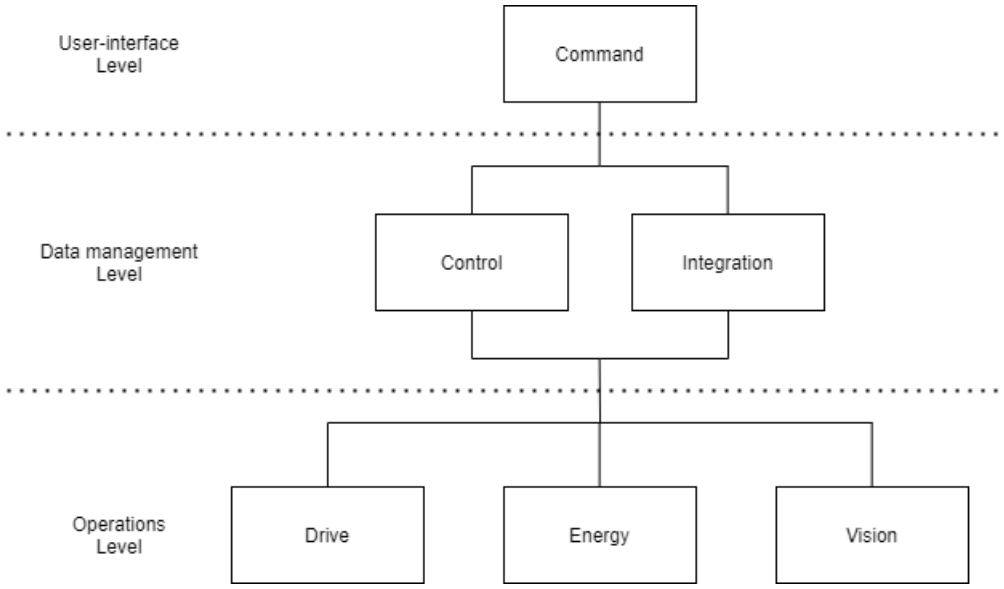

Figure 2: Project sub-system hierarchy

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7 Assessment breakdown

- 40%: Design [**Report + Oral**]
  - 40%: Design process from problem definition to implementation
  - 20%: Structural design of Rover
  - 20%: Functional design for Rover and for each module
  - 10%: Inter-module communication
  - 10%: Project management
- 40%: Implementation [**Report + Oral + Video**]
  - 50%: Rover operation
  - 30%: Module implementation
  - 20%: Problem solving (case with evidence)
- 20%: Personal statement [**Oral + Personal statement**]
  - 100%: Confidential personal statement

7.1 Design

This component will dictate the overall themes and structure of the report. Main design themes of importance is:

1. Energy efficiency
2. User to system confirmation
3. Minimalism to reduce failure points

Terms to clarify:

- **Structural design**: Design based on the actual physical structure of the rover
  - Due to height of vision camera, care is taken to scan carefully
  - Chart for data flow between submodules
- **Functional design**: Design based on the intended functionalities of the rover

The last two points (Inter-module communication + Project management) will be handled together with the following evidence provided:

- Project management chart
- Meeting minutes
- Communication heirarchy chart

7.2 Implementation

Report will mainly handle "Module implementation" and "Problem solving":

- **Module implementation**:

  Brief summary of how each sub-module functions, use ample diagrams to simplify the explanations.

- **Problem solving**:

  Our team spans four countries so it is a great starting perspective to talk about. Potential links to "Project Management" component.

7.3 Personal statement

Personal statement will include:

- Which other students did you help, and in what way?
- Who helped you, and in what way?
- What was your experience. For each student, or their communication: was this prompt, clear, and honest?
- Is there anyone on your team who you feel has particularly contributed more or less than average (give reasons)?