Imperial College London

Department of Electrical and Electronic Engineering

ELEC50008: Engineering Design Project

Group 18: Mars Rover Project Report

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1 Project Management

The project team utilised the Project Management Institute's 5 Phases of Project Management [1] as a guide to ensure all aspects of project planning and management are captured in the team's project management approach.

The approach is split into 5 stages which combines to form a robust project management system.

1.1 Conception and Initiation

Project definition: Design and build a rover system that has autonomous capabilities to detect, avoid and transmit the locations of the obstacles i.e. coloured balls to a server that users can interact with.

Project requirement: The rover system is split into 5 modules, each with its own requirements:

- Command:
  - Enable bilateral communication between user and Control module
  - Enable users to nagivate the rover
  - Plot a map of the locations of the obstacles encountered by the rover
- Control:
  - Enable bilateral communication channels between Command, Drive, Energy and Vision modules
- Drive:
  - Defines the operation of the two rover motors such as:
    - Speed control
    - Direction control
    - Turning method
  - Using the optical flow sensor, measure the distance travelled by the rover
- Energy:
  - Battery charge operation: Profile design, status estimation and melt/explosion prevention
  - Battery voltage balancing and range estimation
  - Implementing PV MMPT calculation algorithm
  - Integrating and testing solar charging system
- Vision:
  - Using the on-board camera detect, avoid and record the location of obstacles encoutered by the rover

[1] PMI: https://www.smartsheet.com/blog/demystifying-5-phases-project-management

1.2 Definition and Planning

Due to the generality of the project requirements, the project team had a significant amount of freedom in meeting the project requirements. The team had identified several design themes that guided the design and implementation choices made during the developement of the rover system:

- **Modularity**

  Having taken into account that the project team spanned four countries with different time-zones and the time constraint of the project, the team felt it was important to incorporate modular design in the development of each rover modules.

  The approach meant each subsystem only had to ensure the pre-agreed connection interface was compatible with the required modules. This was very advantageous due to the following:

  - Each module could independently develop sections of the rover system.
  - The testing strategy [2] was more methodical and could occur early in stages, gradually leading up to a full rover system test.
  - No unnecessary meetings. By reducing the number of meetings the team had, it meant less time was wasted on arranging a time suitable for three time-zones and team meetings were more productive.

- **Scalability**:

- **Open-source**

  Where possible, the team opted to use well-supported open-source development packages such as arduino libraries and the FastAPI framework. This complimented the modularity and scalability themes by ensuring the connecting interfaces are industry-standards and could be easily modified to expand its capabilites.

  Being well-supported, there is ample documentation to support the development and the codebase is well-designed. This meant that the team could reduce the number of unknown bugs, decrease development time and ensure a high-quality codebase.

- **Lightweight**:

[2] Testing was managed by the Integration module

2 Structural design

3 Rover Submodules

3.1 Command

3.2 Control

3.3 Vision

3.4 Drive

3.5 Energy

3.6 Integration

4 Project Issues

5 References