D.E.C.R.Y.P.T User manual

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# Introduction

First of all, this document is intended to explain the DECRYPT project to newcomers as well as more experimented SPACE’TECH members. The DECRYPT project is born from a collaboration between 4A’s students project and SPACE’TECH Orléans.

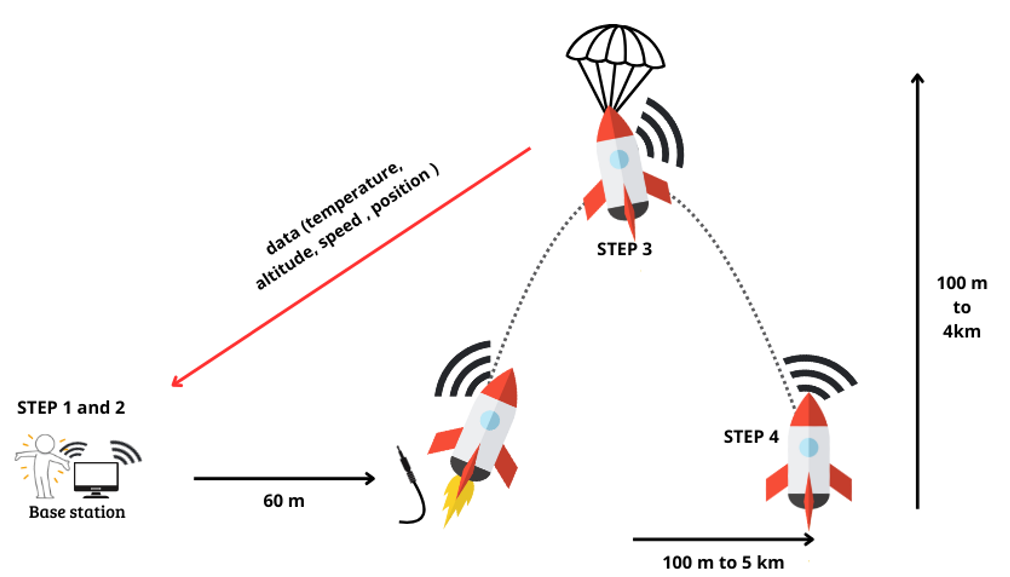
This project is the result of a collaboration between Space’Tech Orléans, a student association, and 4A GPSE students. Space’Tech Orléans is the aerospace association of Orléans University. Every year, they participate in C’Space, an event organized by Planète Sciences that allows them to launch their rockets.

There are two types of rockets: minif, which are 1 meter tall, and fusex, which are larger, exceeding 3 meters in height and designed to carry onboard experiments. The association is mainly composed of members from TEAM, GPSE, and ICM. However, the goal is to make the electronics aspect accessible to everyone.

To ensure proper flight operations, the rockets must include electronic boards that control systems such as parachutes, motors, and data storage. To address this need, three separate boards are designed, each with specific functions. This approach not only separates functionalities but also complies with Planète Sciences' requirements.

# Use case

For the typical scenario it is important to understand that there is no access to the rocket once it is on the launching pad. Only Planète Science’s members will be able to manage the launching phase, during that phase they will test if the LED board is working properly and the parachute hatch as well. The following sketch is a quick explanatory of a typical scenario.



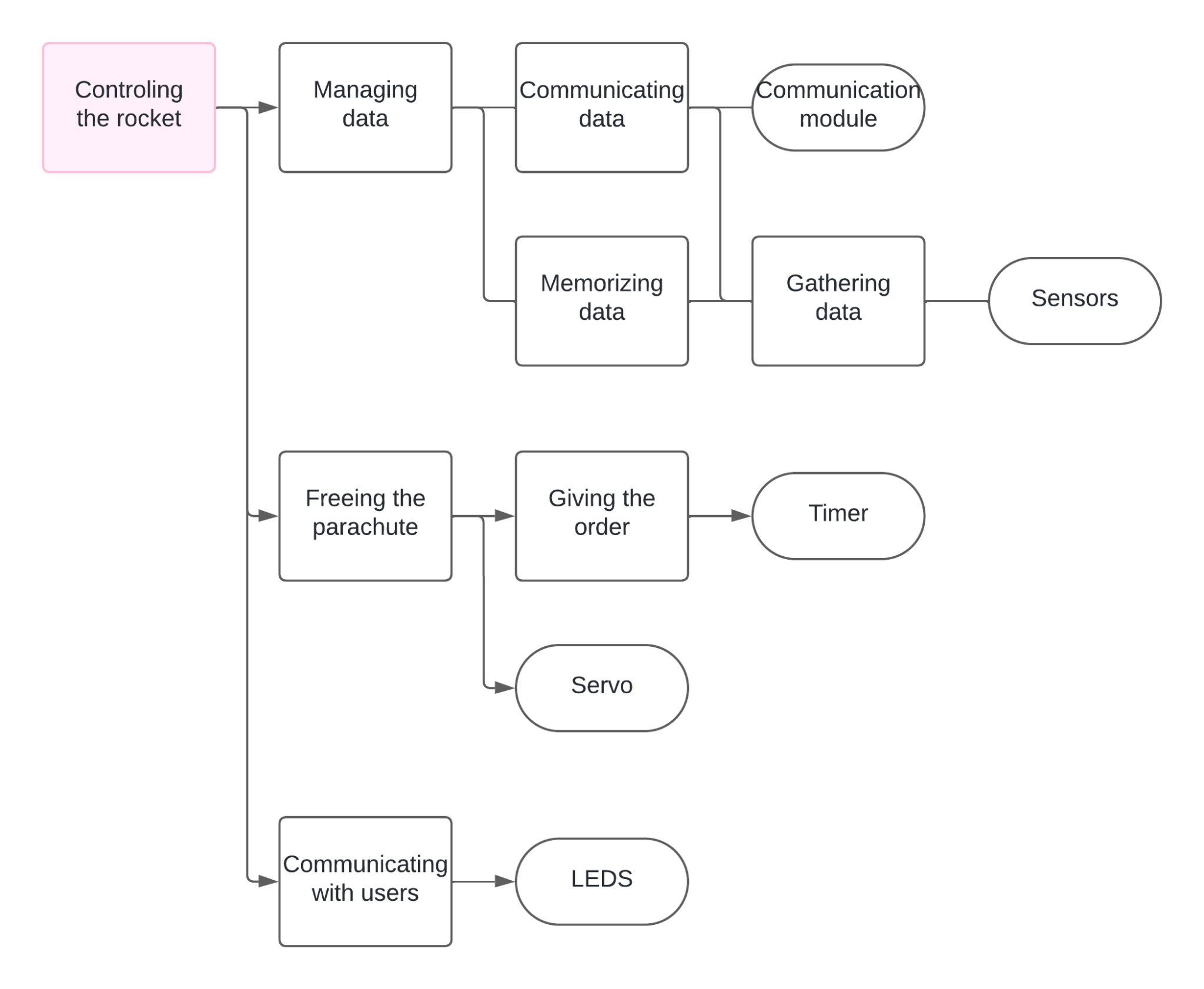
*fig.1 : typical scenario of rocket launching*

Firstly, the scenario starts on the ground when the rocket is put on the launching pad. First a switch is used to turn on the board powering. Then a jack cable is plugged on the rocket. The purpose of this jack cable is to work as an actuator, once the rocket takes off the cable is unplugged which activates board programs. Another switch is then used to open the parachute hatch and put the parachute in it. Once done the rocket can take off.

Secondly while in flight, the rocket is : gathering and stocking data using sensors. On top of that the gathered data is sent to the base station using a communication module. At last once the rocket reaches its peak the parachute is deployed.

Thirdly when the rocket lands a gps module will be activated to find the rocket, because it can sometimes land up to 5km from the base station. Making it easier to find the rocket.

# Functional synoptic diagram



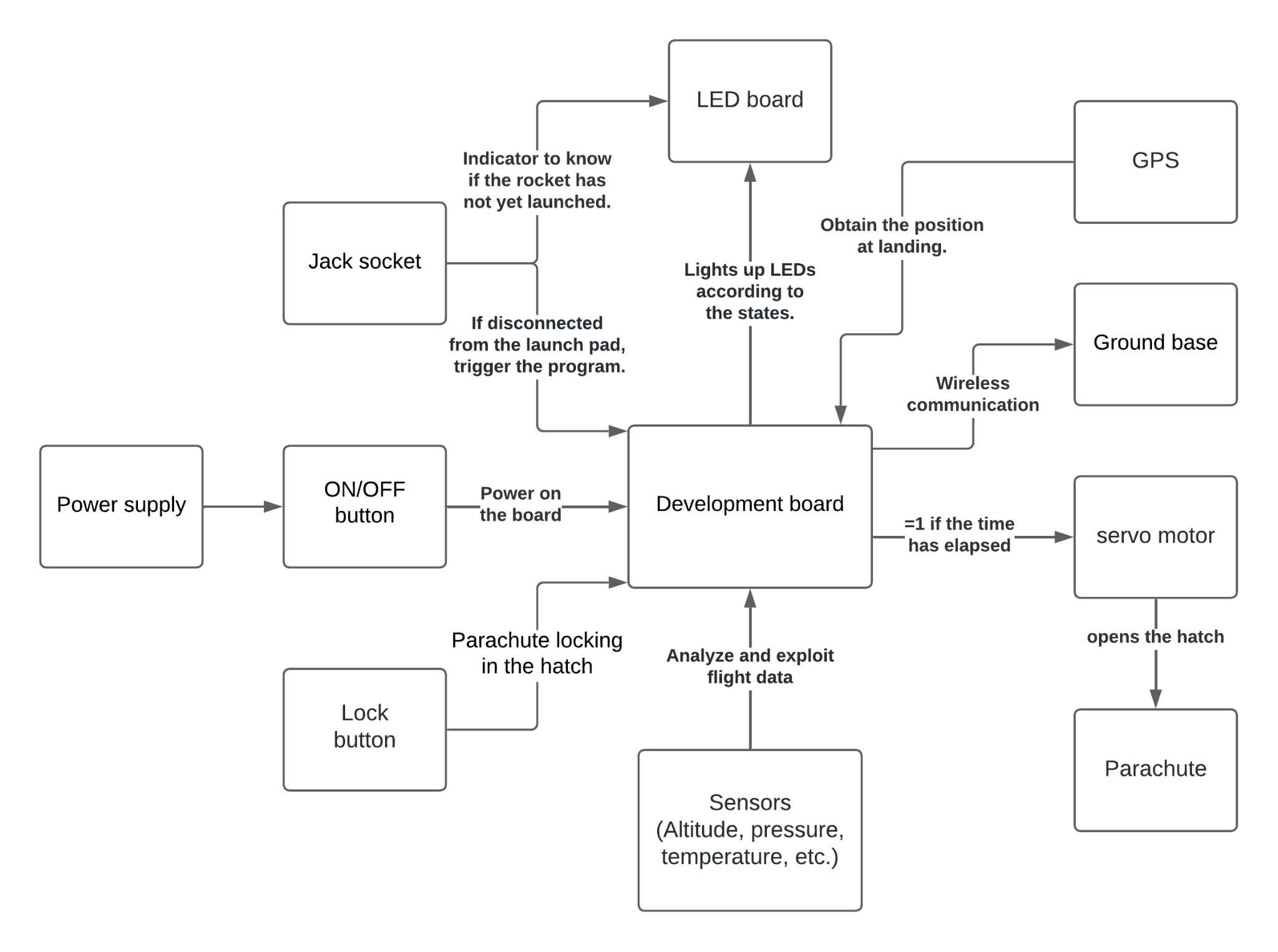
*fig.2 : Functional diagram*

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# System architecture

The following diagram shows the architecture of the system by explaining what is gonna be used and how , in order to fulfill the functions.



*fig.3 : System architecture*

# 1 - Goals of the boards

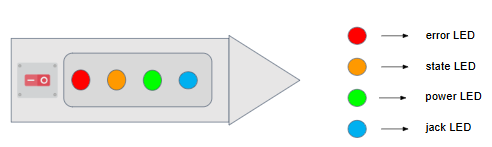
## 1.1 - Goals of the sequencer board

The Sequencer board is an advanced control system designed to perform three essential tasks during the rocket's flight.

1. **Parachute deployment control**

The Sequencer board plays a critical role in ensuring the rocket’s safe descent by managing the deployment of the parachute. The parachute hatch is programmed to open at a precise moment, calculated in advance based on the rocket’s expected apogee. This timestamp is loaded as a parameter into the program before launch. Additionally, to enhance safety and reliability, onboard sensors actively monitor the rocket’s behavior during flight. These sensors detect deceleration patterns associated with the apogee, serving as an additional safeguard to trigger the parachute hatch if necessary. The deployment mechanism is operated by a servo motor directly controlled by the Sequencer board to open the hatch.

1. **LED control and status communication**

The Sequencer board interfaces with an external LED board (Human Machine Interface, HIM) to visually communicate the rocket’s status. The LED board displays key operational states.  
Additionally, the LED board includes buttons for manual controls, allowing operators to close or unlock the hatch as needed. 

*fig 4 : LED board schematic and use of the different LED*

1. **DC/Stepper motor control for FUSEX**:

The Sequencer board includes the capability to control a DC or stepper motor, specifically designed to support functionalities in experimental rockets (FUSEX). These motors can be used for various applications, such as deploying airbrakes. activating separation mechanisms, or powering other experimental features.

## 1.2 - Detecting the launch

To reliably detect the rocket’s launch, the system uses a jack connector mechanism. During pre-launch preparation, the jack connector is inserted into a dedicated socket located on the socket’s side. When the rocket takes off, the jack cable disconnects, triggering the start of the flight sequence.

When the Arduino nano detects a low state (0) on the D2 pin, the onboard program is unlocked, initiating all the rocket’s functions. This system ensures precise activation of flight operations, eliminating the risk of premature or delayed activation of onboard components.

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## 1.3 - Goals of the power board

The primary purpose of this board is to supply a 5 V voltage to the sequencer board and a 3.3 V voltage to the telemetry board. It also includes an additional feature that allows powering servo motors and motors with the option to select their voltage, supporting a maximum power of up to 80 W.

## 1.4 - Features

The power board is divided into two distinct sections:

* A DC-DC regulation for 5V and 3.3V
* A DC-DC regulation section for variable voltage

## 1.5 - Goals of the telemetry board

The goal of the telemetry board is to gather, store and send data. To address these functions, a development board will be embedded on the board as well as sensors and communication modules. The basic sensors will be on the board but it is possible to add new ones afterward. There is also a gps module on the board which will be needed to find the rocket if it lands far from sight. Moreover one of the underlying goals of this project is about making the system simple to understand and easy to tweak.