Creation of control Interface for Mars Robot
Grupo 17

Interação Pessoa-Máquina

Trabalho Prático

Amadeu Marques Up201804974
Manuel Sá Up201805273
Rubén Zamora Belinchón Up202002320
Francisco Javier Ortal Ruiz Up202002321

Section 1:

1.1 Description of the problem:

We need to create a prototype of a system that is executed with a graphical interface, distributed by 3 monitors. The robot has to explore the planet Mars, collecting information with multiple sensors. It sends information to the planet Earth checkpoint periodically and provides new guidance on what to do next.

1.2 Identifying the biggest challenges:

We have considered some challenges that can difficult the development of our system.

We don´t get real-time connection from the robot, we only get updates from it around 20 minutes. This could be a problem if the robot suffered any damage because we will lose important details and we will not be able to send next instructions to the robot.

The robot provides antennas to send and receive information. We have to take into account that we could have complications to communicate with the robot because of the distance between both planets.

It's important to contemplate that the robot owns some cameras. We have to be sure that they don't suffer damage. In addition to the battery the robot has 2 sliding solar panels that manage to charge the electronics battery. We are likely to have complications if the sliding solar panels stop working properly.

1.3 Stakeholders

The main stakeholders for our project can be business related with space or planetary investigation or for governmental organizations. Other stakeholders can be scientists who work or are interested in Mars and have the information needed to collaborate in our project.

Other stakeholders can be programmers for the design of all the panels, the correct functioning of all the different functions our interface can give.

Finally we would need engineers to link the robot and the interface so in order we can make our work correctly, it is one of the most important things because if not all of our work would be useless.

1.4 List of the desire background for the operators:

We all think that the operators who work with our interfaces should have the following knowledge:

- First of all, they should know all the functions of the interface, how to control all the panels and how to manage the information given by the robot.

- The most important thing should be computer knowledge, to have complete control with all the panels, terminals and commands used in our interface like the management of the memory or the communications.

- Another important thing they should manage is geographical knowledge, it is really important for the use of the robot when it is moving and to know how the coordinates work in order to know the location of the robot at real time.

- They should know something about climate, in order they know what to do according to the climate conditions they have and also predict what the weather will be like in a near future to make the correct decisions for the sake of the robot.

1.5 Most innovative aspects for the solution:

During the development of this part of the project, the group created some features that improve and innovate the interface. Some example are:

- All the interface windows are open and distributed all over the screens, which makes it easier to analyse data at the same time. The order of the windows can be changed on the screen, depending on the user's necessity..

- A 3d model of the robot in the telemetry window to analyse every part of the robot but clicking in it and being able to preview the robotic arm status;

- Location history and snapshot with data gathered in each location saved in the location window;

- The implementation of a mini map in the corner of the big monitor, with the capability of maximizing to the whole screen, in case we need a bigger analysis.

Section 2:

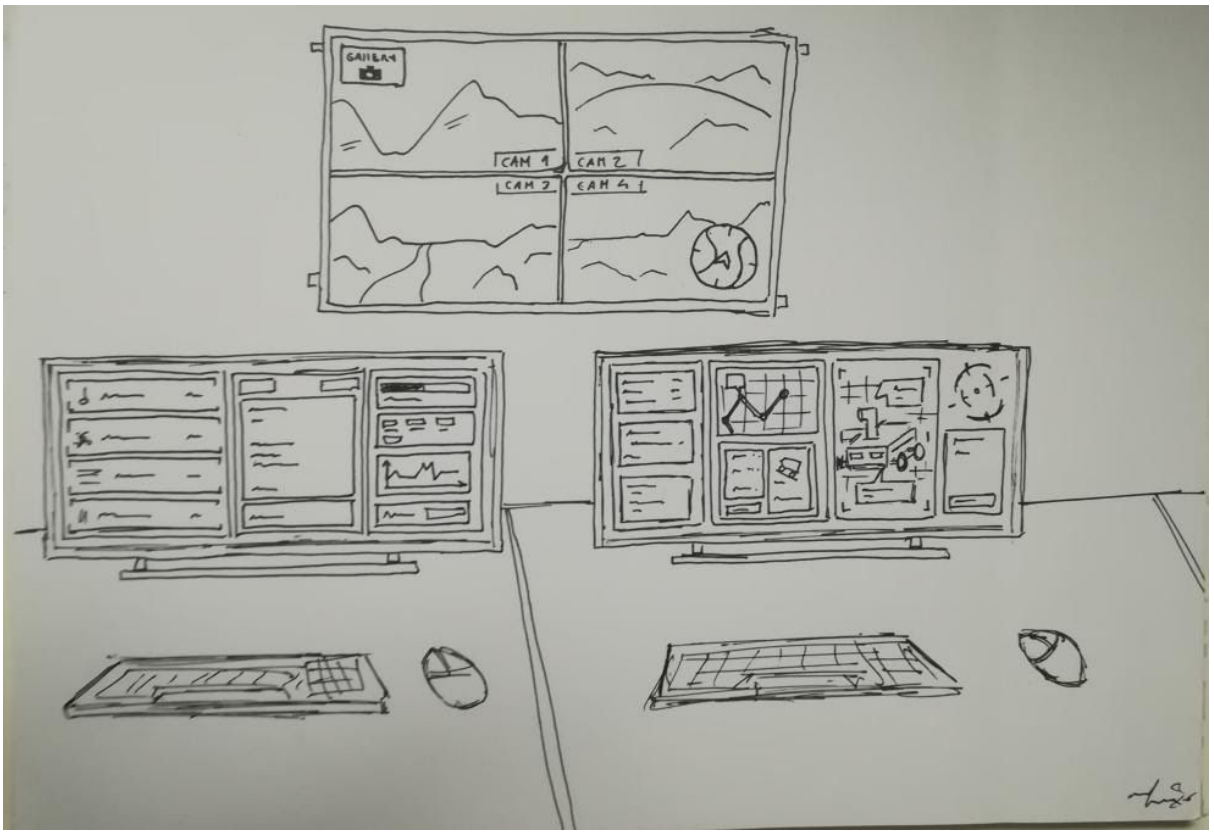
2.1 / 2.2 Metric description, sketches and functionalities to implement:

For this project, we have developed metrics to manage and interact with all aspects of the robot such as it’s locomotion, communication, telemetry, cameras, energy and environment data. We have decided to present all the information in different floating panels so they can be easily moved and shaped both within and between monitors.

The image below shows an example of a suggested panel layout, having the operator on the left controlling communications, data, and maintaining the robot’s internal computer through disk management and cleanup, installing updates and getting files from the robot.

The operator on the right controls all the locomotion of the robot and manages it’s telemetry and energy.

In the middle we have the 100inch monitor that displays maps and pictures and it is visible and accessible by both operators.



- Right Screen:

Energy:

The energy control panel is divided in 3 subpanels:

Nuclear energy subpanel:

- **STAT** - Indicates the status of the nuclear battery (ON for being used, OFF for not being used and ERROR if there is a malfunction).
- **ENERGY** - Shows the percentage of energy remaining as well as a time estimate of the duration of this energy.
- **TEMP** - Monitors the battery's internal temperature

Electric subpanel:

- **STAT** - Indicates the status of the electric battery (ON for being used, OFF for not being used, ERROR if there is a malfunction and a CHARGING to indicate it's charging).
- **ENERGY** - Displays the energy remaining in the battery and a time estimate until depletion (or remaining charge time if being charged).
- **SOLAR EFF** - Efficiency of the solar panel (To determine if it's a good time to charge).

Energy Manager : Shows how much energy is being consumed and what it is being used for.

Locomotion:

In the locomotion there is a satellite map that indicates the position of the robot and marks the itinerary of the robot. The operator has the option to save points of interest that show up as nodes in the map, this saving operation records all the data of the robot (speed, temperatures,coordinates, energy levels…) and saves it so it can be reviewed later. Upon clicking a node a pop-up window is shown that allows the operator to access the snapshot of the robot data, the pictures taken in the location and allows him to order the robot to return to that node.
Below the map is located a panel with the current coordinates of the robot,the total distance traveled by the robot, a small robot model that serves as a gyroscope, indicating the inclination of the robot and a save button that allows us to save points of interest.

Telemetry:

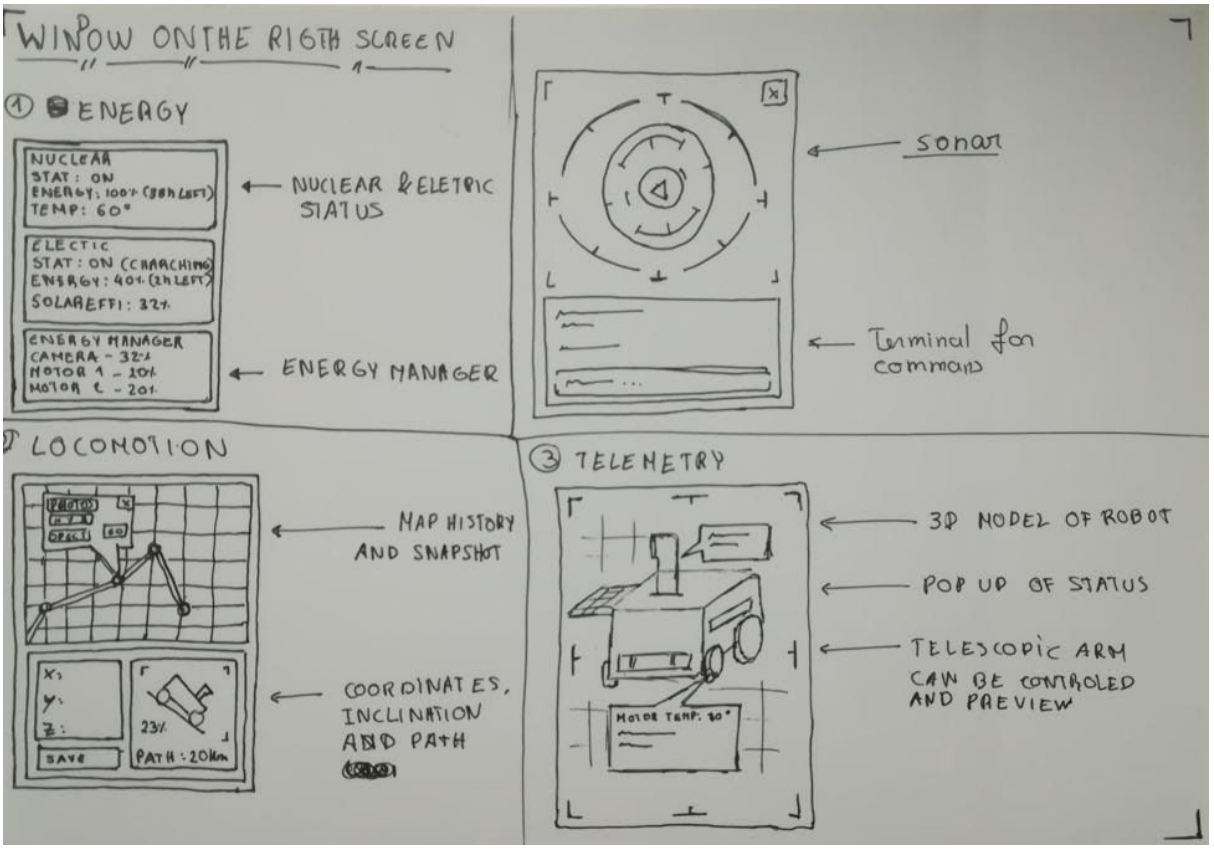
The telemetry panel is composed by an interactive 3D model of the robot, this model allows the operator to consult information about the motors by clicking each individual motor to show its information (speed, efficiency, temperature, power, torque,speed), there is also the possibility to get information on each sensor by or component of the robot (like the antennas) by clicking in them, if there is an abnormal reading in any of the components the model will change its color in that specific area. With this 3d model it's also possible to preview the motion of the telescopic arm and cameras, allowing the operator to make all the adjustments necessary before sending the instructions to the robot.

Sonar:

The sonar panel contains a sonar that shows us what the 360º surroundings of the robot look like in terms of terrain to inform the observer of any potential dangerous routes for the robot.

Terminal:

The terminal panel is present in both operator's workspaces and allows them to send instructions to the robot (for instance moveTelescopicArm to replicate the position of the 3D model arm).



-Left Screen:

Overall Data:

This window controls the conditions of the current location of the robot, and it alerts changing the text color to red if some condition is considered dangerous to the integrity of the robot. It analises the following points:

- Temperature(Cº);
- Luminosity(%);
- Wind Velocity(km/h);
- Density(g/dm³).

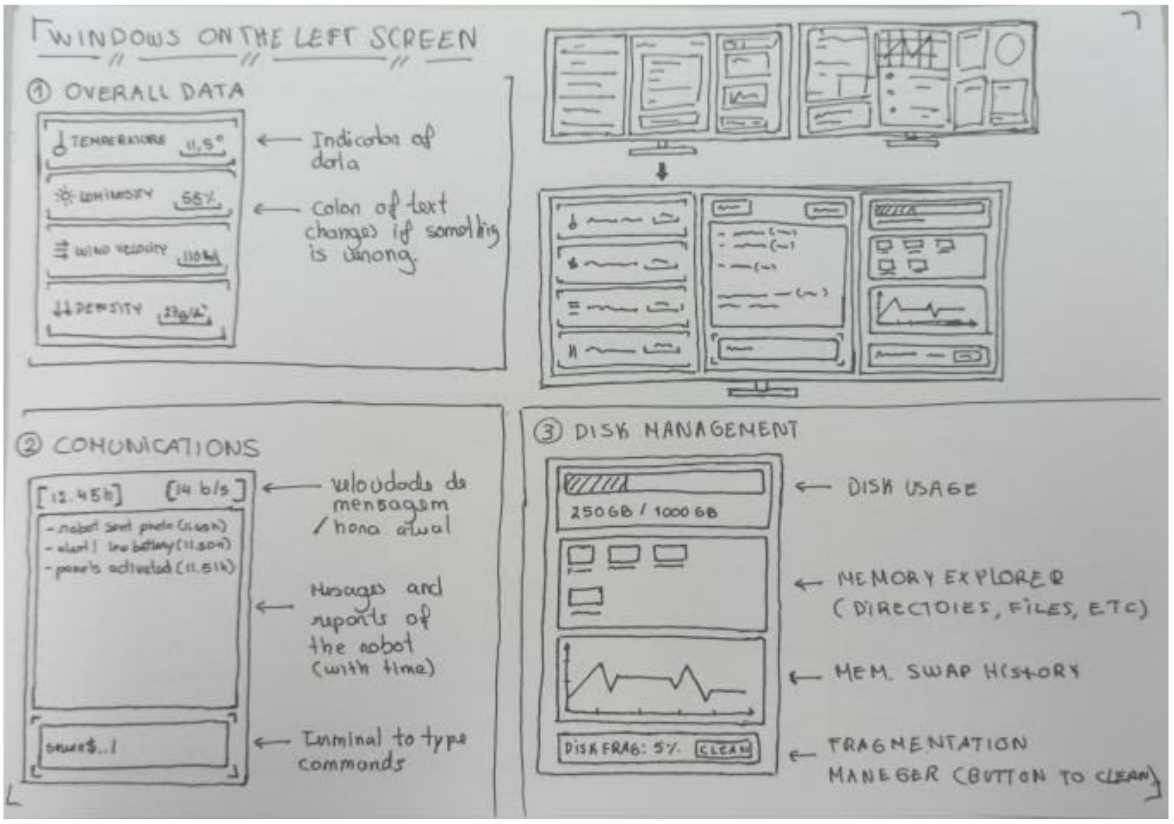
Communications:

The Communications window is responsible for presenting the history of actions, alerts and commands that the robot has reported, and the respective time that the robot reported it. It also has a terminal for inputting some necessary commands and messages to the robot. On the top corners we have a clock and the message velocity in b/s.

Disk Management:

This area of the screen is dedicated to control and manage the robot's memory disk. It has four different functionalities. This are:

- A bar that indicates the percentage of space used by the robot;
- A window with all the directories and files in the disk, which can open, read and edit files;
- A graphic that indicates when was the memory of the disk altered and the specific time;
- The percentage of the disk fragmentation and the respective button to unfragmentate the disk (the memory disk will not be available during this process).



-Main Screen:

Cameras:

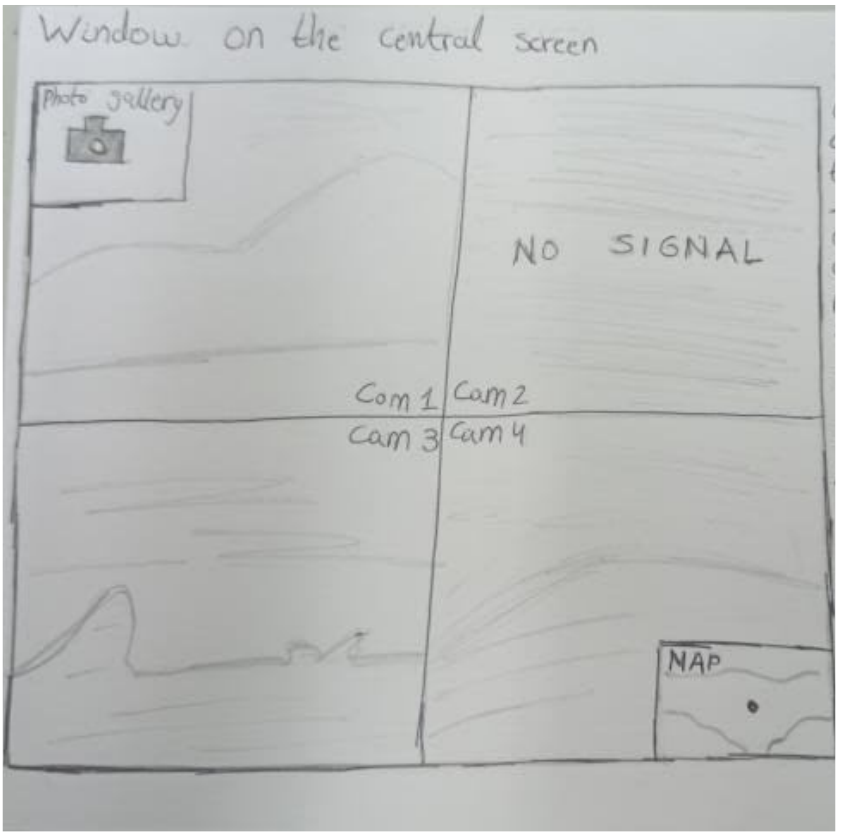
They are a very important part for precepting the surroundings of the robot. In the screen are displayed the last photo that each camera took, dividing the screen in four. If we want a more detailed analysis of a specific picture, we are able to maximize it to the whole screen. We can access the rest of the pictures in the next topic.

Gallery:

In the top left corner of the screen, there is a button to access the gallery. There, we can find every picture taken by the robot, the time it was taken and the respective camera. we can maximize it to the whole screen, just like in the previous point.

Map:

On the bottom right corner of the screen, there is a semi transparent circular mini map, which indicates the exact location and orientation of the robot. If we want a more detailed check on the robot's location, just like the previous features, we can maximize the map to the whole screen.



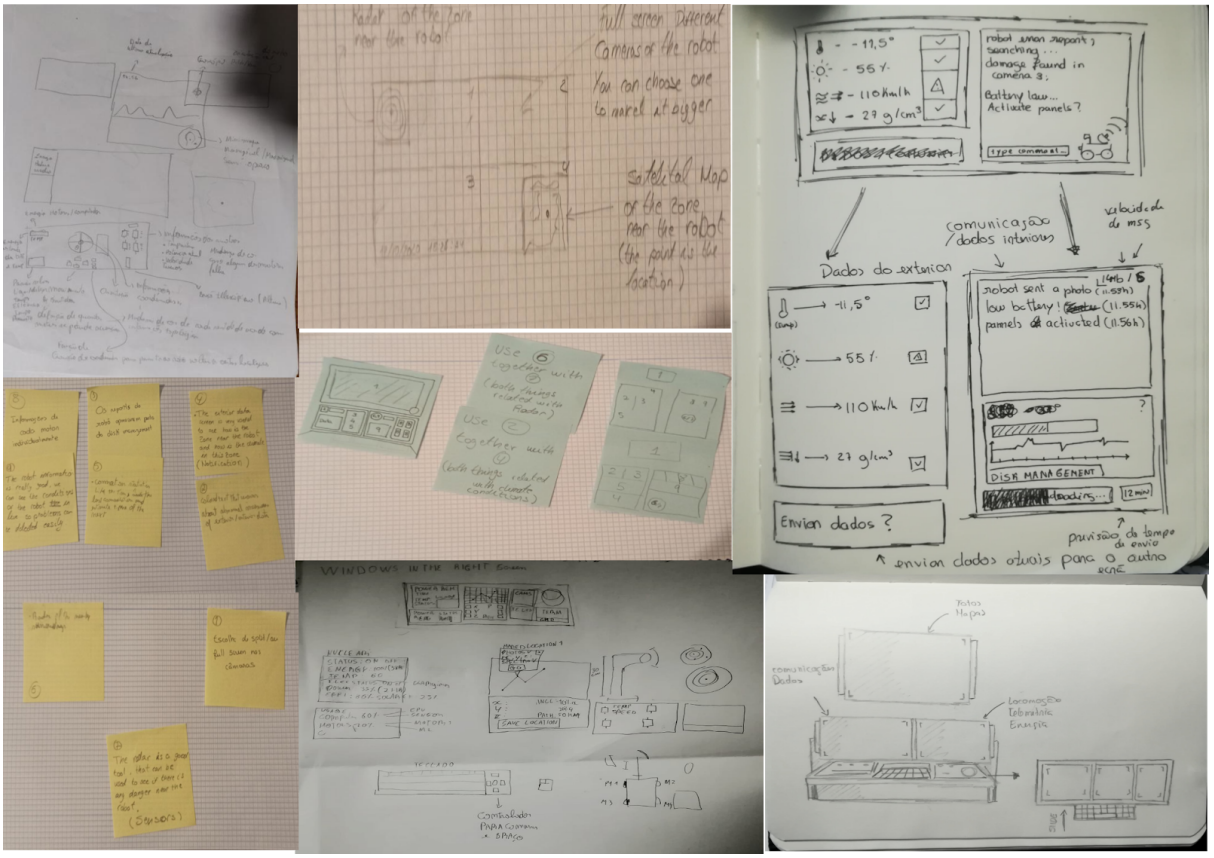
2.3 How to interact with the interface:

As mentioned before in numerous occasions, all the interface and the metrics are being controlled with mouse and keyboard. Some actions require more specific input, so we implanted two terminals for specific actions.

2.4 Iteration process / Conclusion :

During classes the groups brainstormed and came up with some ideas, we were able to communicate well despite the language barrier and we came to agreement easily.

The pictures below show parts of the process that resulted in the development of the “final” sketches shown above. Some slight alterations were made but the main ideas and bundling of metrics were kept since the beginning.



In conclusion, although some minor obstacles, this first part of the project was made relatively easily and with a promising future ahead.