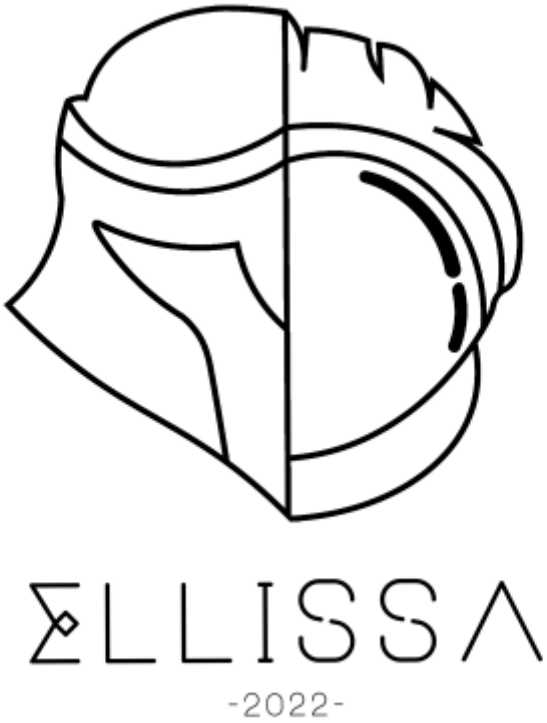
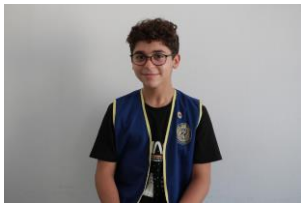
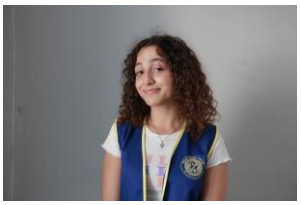
First Skills Club Engineering Class:
Space Rover Prototype Mission Engineering Notebook.



Mission name: Qart Hadasht; The New City.
Team Name: Team Ares.
Rover Name: 3ellissa.

1. Team Introduction:

- **1.1 Team Members:**

<table>
<tr>
<td> 
Eya Lahiani, 15
Engineering Notebook Writer
Head of the Intake Mechanism Sub-team</td>
<td> 
Ahmed Abdnenadher, 14
Team Coordinator</td>
</tr>
<tr>
<td> 
Mohammed Hedi Ben Jmeaa, 15
Head of the Laboratory Mechanism Sub-team</td>
<td> 
Yasmine Kharrat, 16
Head of the Drivetrain Mechanism Sub-team</td>
</tr>
</table>

- **1.2 Sub-Team Members:**

Intake:	Drivetrain:	Laboratory:
- Yasmine Kharrat - Ahmed Abdnenadher	- Mahdi Madani - Eya Lahiani - Ahmed Abdnenadher	- Yasmine Kharrat - Eya Lahiani - Ahmed Abdnenadher

- **1.3 Supervisors and Mentors:**

<table>
<tr>
<td> 
Alaan Ben Ameur, 20
Supervising coach</td>
<td> 
Aziz Dammak, 20
Supervising coach</td>
<td> 
Yacine Boujelbene, 18
Supervising coach</td>
</tr>
</table>

<table>
<tr>
<td> 
Ms. Faten Khalfallah Hammouda
Mentor</td>
<td> 
Mr. Rabbah Hammouda
Mentor</td>
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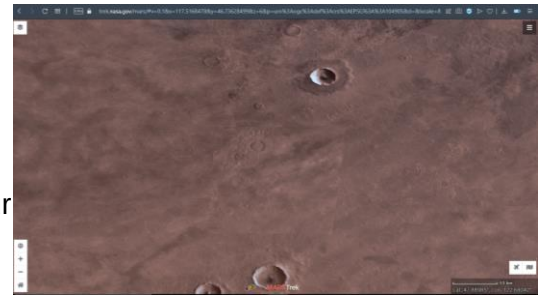
2. Mission:

- **2.1. Defining the Mission:**



Utopia Planitia, Mars, Lat: 42.97896°, Lon: 122.3728°

Inspired by the very recently-made Mars Rovers sent by multiple countries around the world, Team Ares from Tunisia decided to catch up and start making a purely Tunisian-made Mars Rover Prototype.
Mission Qart Hadasht (Translated to The New City), is our rover's mission. Its aim is to explore a real-life prototype of Utopia Planitia, Mars and learn more about its geology and get accustomed to the red planet's environment.

And thus we,Team Ares, would like to introduce you to the 3ellissa (Ellissa) Rover.

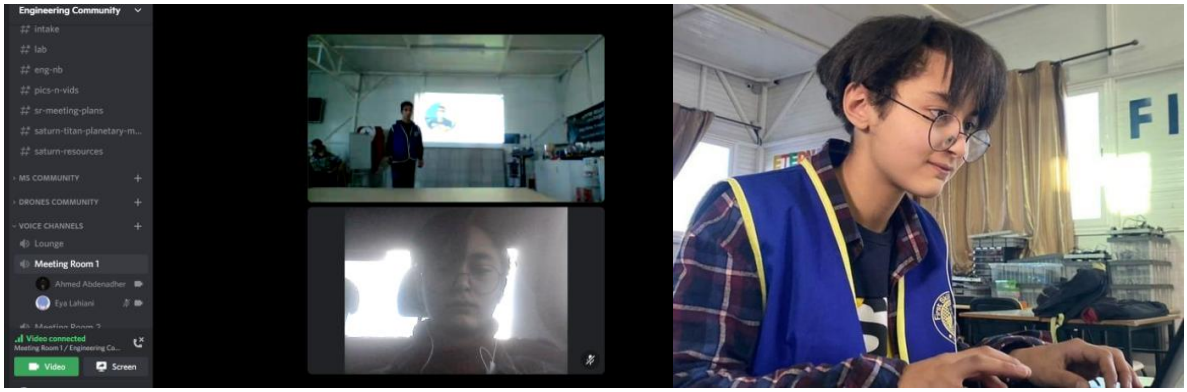
- **2.2. Accomplishing the Mission:**

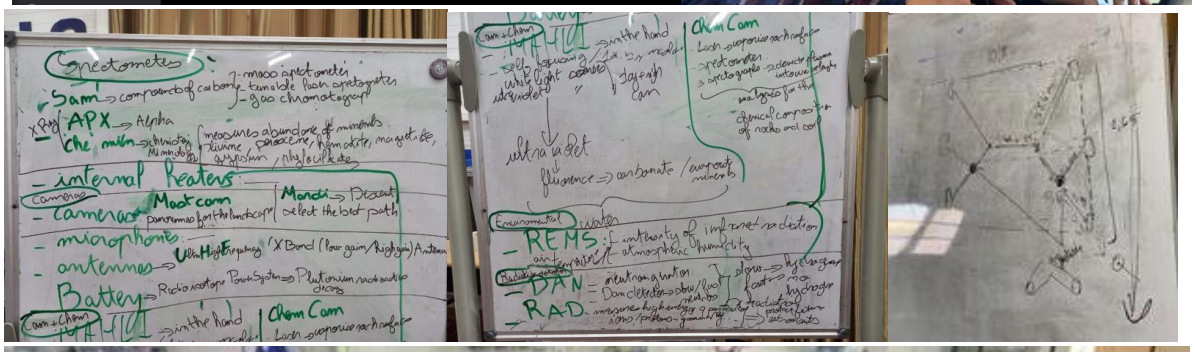
To accomplish the mission properly, our rover will take advantage of high quality mechanisms built precisely throughout the building phase.
These structures are; the intake arm, the drivetrain and the laboratory.
3ellissa will first have a tour around the campus exploring its land, estimating its age by its geological structure after collecting data and ground samples using the intake arm.
Later on, the rover will store the data into the laboratory pipes of 10ml each that will be measured in detail and put on the land to mark where it's been taken from.

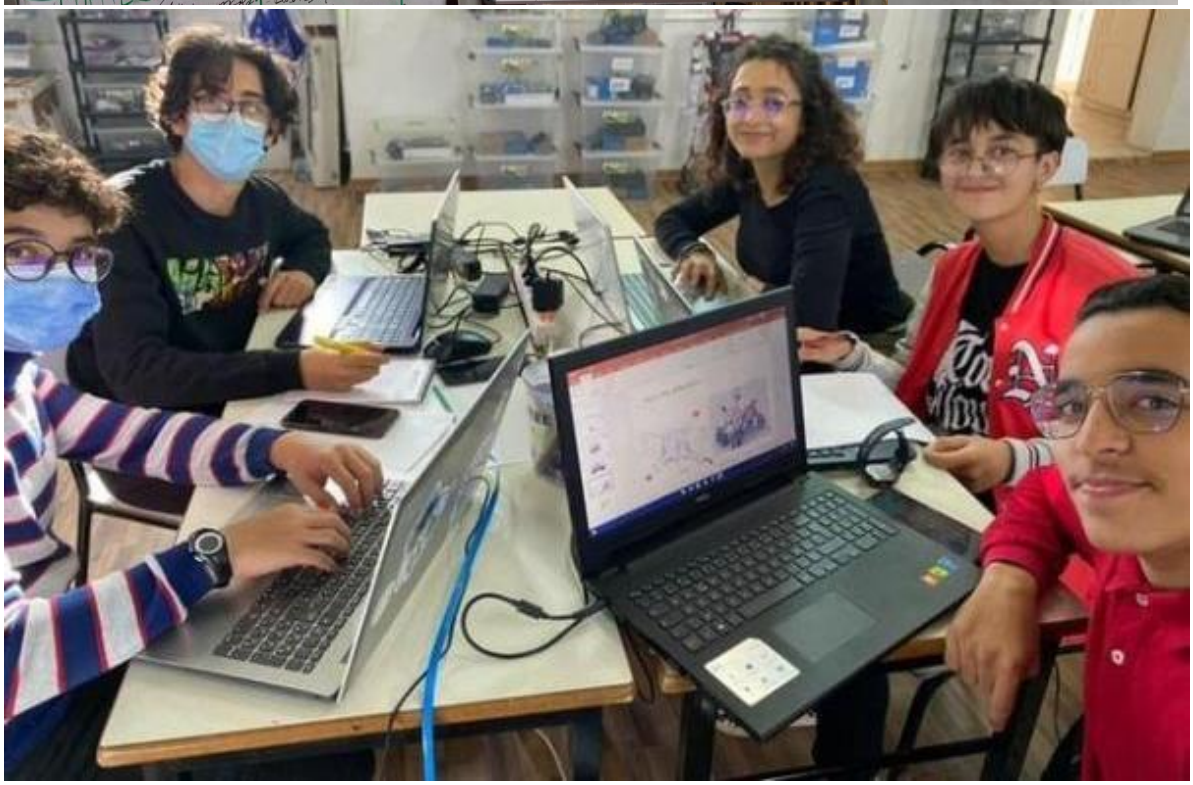
3. Design Process:

- **3.1. Our Meeting-Gallery:**

If you want more of our content check out our videos:
https://drive.google.com/drive/folders/1W2YHpcREFb1Gq8Y1hkTugdY0UC9kFS8H?usp=sharing


Engineering Community
intake
lab
eng-nb
pics-n-vids
sr-meeting-plans
saturn-titan-planetary-m...
saturn-resources
MS COMMUNITY
DRONES COMMUNITY
VOICE CHANNELS
Lounge
Meeting Room 1
Ahmed Abdenadher
Eya Lahiani
Video connected
Video
Screen


Spectrometer
Sam
APX
Alpha
Internal Heaters
Camera
Mastcam
Mardi
microphone
antennas
Battery
ChemCam
REMS
DAN
RAD

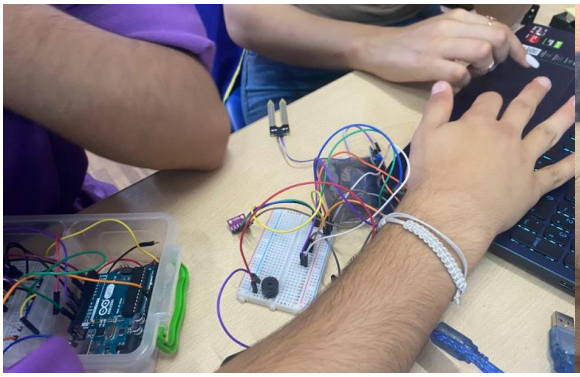


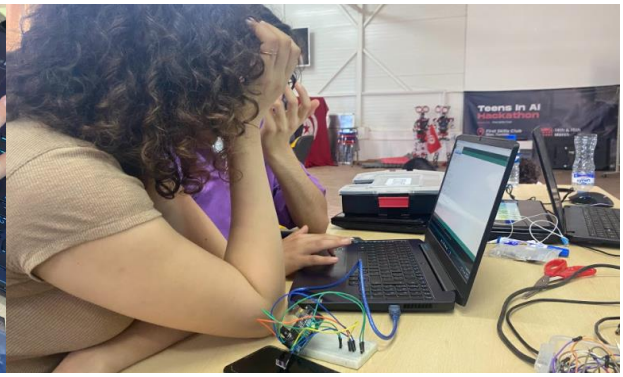

Teens in AI
Hackatho
First Skills Club
Sfax, Tunisia


REV
EXPANSION HUB
REV
CONTROL HUB


SKILLS

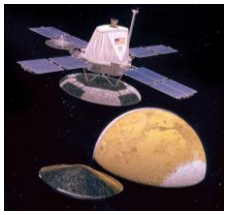
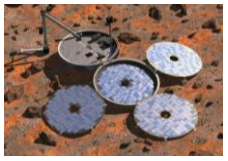

ETERNAL DYNAMICS





- **3.2. Prototyping:**

Choosing the rover's design:
Here we decided to single out the best of each rover over the years:

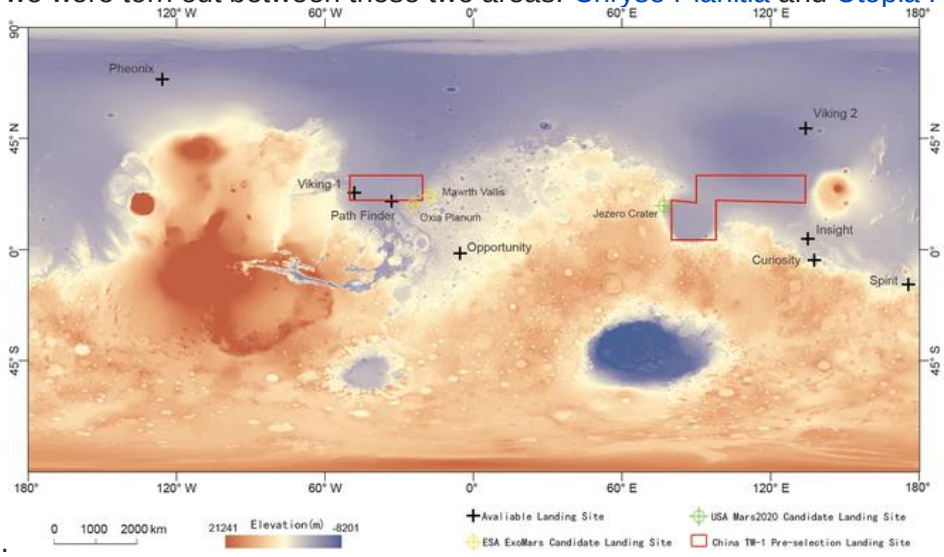
Rovers:	Mission description:	Benefits:	Disadvantages:	Mark
 Viking 1 and 2, 20 July 1976	Viking 1 and 2 landed on Mars in 1976. Composed of two main parts: an orbiter designed to photograph the surface from orbit, and a lander designed to study the surface.	- It was the very first SpaceCraft to reach the surface of the red planet. - Made it to the media (somehow) - Popularised the space-rover field	- Heavy - Old technology - So much energy, time and money was put into this thing - not even that good	3/10
 Beagle2,	It was intended to conduct an astrobiology mission that would have looked for evidence of past life on Mars.	No added value.	Failed to operate as it reached the surface of the planet due to technical issues with the powering.	2/10

25 Dec 2003				
 Insight, 5 May 2018	Operated by NASA, The mission of the InSight lander is to study the deep interior of the planet Mars.	Design change + circular solar panels.	Design-change fails.	5/10
 Curiosity, 26 Nov 2011	Curiosity Rover is designed to study the chemical and isotopic composition of the martian atmosphere.	Curiosity carries the most advanced payload of scientific equipment ever used on the surface of Mars.	It has limited autonomy on-board so most of its decisions are made by the ground control team, so the speed it reacts to its environment decreases due to delay.	7/10
 Zhurong, 23 July 2020	The spacecraft was launched on 23 July 2020 and it was made so that China could get a better understanding of the red planet.	A Chinese copy of perseverance.	Didn't include or bring added value to what has been already discovered. Only made to cause drama and deepen political issues.	8/10
 Perseverance, 30 July 2020	Seek signs of ancient life and collect samples of rock and regolith (broken rock and soil) for possible return to Earth.	It's very modern they used the latest technology It's more updated than the other rover They applied more safety The scientifics have used new sensors that can get a better output (results) in their goal	- A chance of failure, due to landing and other risks. - It is limited to the area of the landing site which itself is only approximately anticipated. - The camera had a very low resolution. - There was a technical problem but it was fixed later.	9/10

Choosing the ground testing prototype:
The prototype of our testing area is based on a certain coordinate on Mars and is was determined because of two main criterias:

- **Engineering feasibility**, including latitude, altitude, slope, surface condition, rock distribution, local wind speed, visibility requirements during the EDL process.
- **Scientific objectives**, including geology, soil structure and water ice distribution, surface elements, mineral, and rock distribution, magnetic field detection.

And we were torn out between these two areas: Chryse Planitia and Utopia Planitia



However, Utopia Planitia was favoured due to higher chances of finding proofs about whether an ancient ocean ever existed on the northern part of Mars.

It was eventually selected as the final testing prototype for our mission.

4. Final Research Paper for Space Rover Prototype Design:

- **4.1. Drivetrain:**

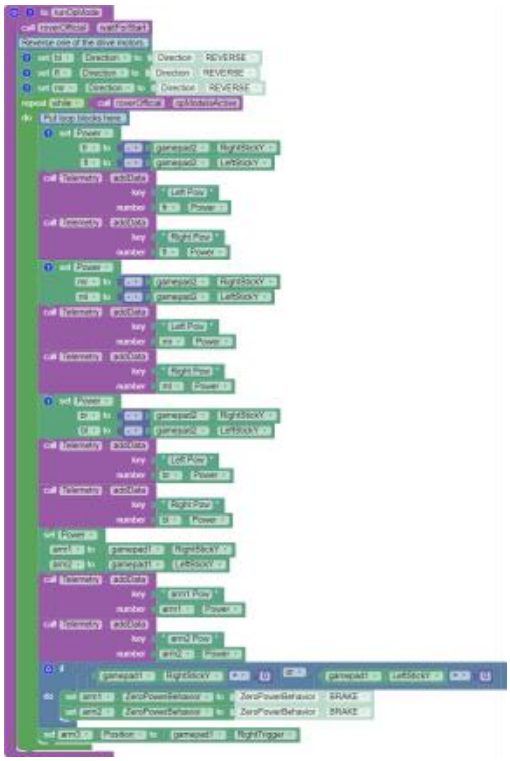
Design:

Drivetrain Research Paper: Drivetrain Research Paper.docx

Materials:

1 x Control Hub.
1 x Expansion Hub.
1 x Slim Robot Battery.
6 x Core Hex Motor.
20 x Aluminium bars.

Code: (to the right)



- **4.2. Lab and Intake Arm:**

Design:

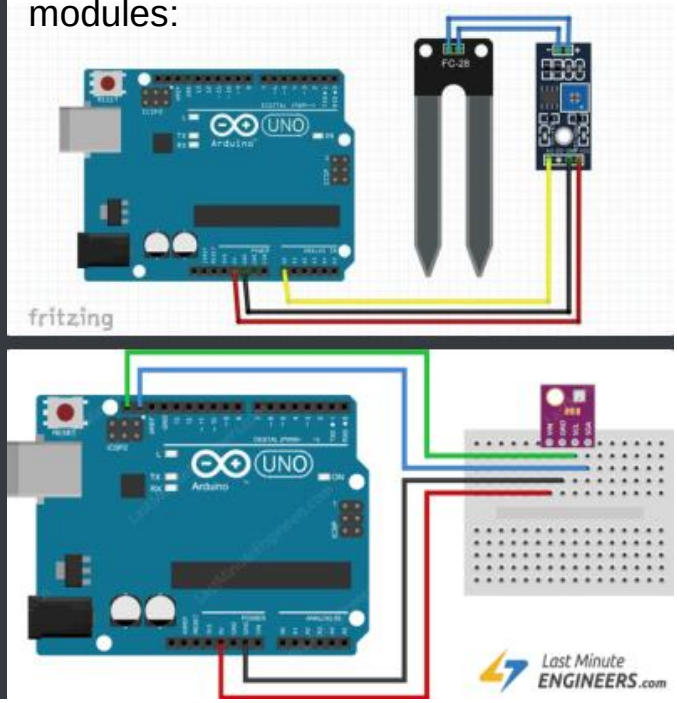
The laboratory can measure: the acceleration and gyroscopy of the rover, the pressure, altitude, humidity and temperature of the environment as well as the humidity of the soil.

Intake & Lab Research Papers: Intake Arm Research Paper & mass spectrometery

Code:

```
#include <Wire.h>
#include <Adafruit_Sensor.h>
#include <Adafruit_BME280.h>

#define SEALEVELPRESSURE_HPA (1013.25)

Adafruit_BME280 bme;

const int hygrometer = A0;  //Hygrometer sensor analog pin output at pin A0 of Arduino
//Variables
int value;

void setup() {
  Serial.begin(9600);

  if (!bme.begin(0x76)) {
    Serial.println("Could not find a valid BME280 sensor, check wiring!");
    while (1);
  }
}

void loop() {
  // When the plant is watered well the sensor will read a value 380-400, I will keep the 400
  // value but if you want you can change it below.

  value = analogRead(hygrometer);  //Read analog value
  value = constrain(value,400,1023);  //Keep the ranges!
  value = map(value,400,1023,100,0);  //Map value : 400 will be 100 and 1023 will be 0
  Serial.print("Soil humidity = ");
  Serial.print(value);
  Serial.println("%");
  Serial.print("Temperature = ");
  Serial.print(bme.readTemperature());
  Serial.println("°C");

  Serial.print("Pressure = ");
  Serial.print(bme.readPressure() / 100.0F);
  Serial.println("hPa");

  Serial.print("Approx. Altitude = ");
  Serial.print(bme.readAltitude(SEALEVELPRESSURE_HPA));
  Serial.println("m");

  Serial.print("Humidity = ");
  Serial.print(bme.readHumidity());
  Serial.println("%");

  Serial.println();
  delay(2000);
}
```

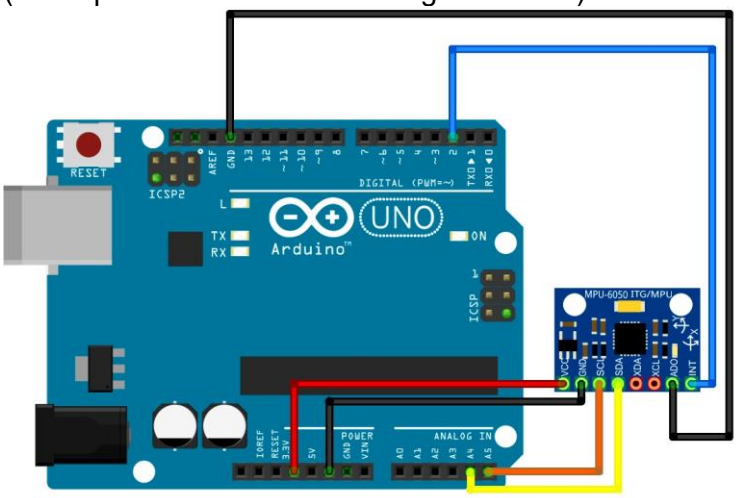
This is the code for the BME280 (Pressure, Altitude, Humidity & Temperature) and the Soil Hygrometer modules:



The picture to the right is the code for the MPU6050-GY 521 – an accelerometer and gyroscope.

```
#include<Wire.h>
const int MPU=0x68;
int16_t AcX,AcY,AcZ,Tmp,GyX,GyY,GyZ;

void setup(){
  Wire.begin();
  Wire.beginTransmission(MPU);
  Wire.write(0x6B);
  Wire.write(0);
  Wire.endTransmission(true);
  Serial.begin(9600);
}
void loop(){
  Wire.beginTransmission(MPU);
  Wire.write(0x3B);
  Wire.endTransmission(false);
  Wire.requestFrom(MPU,12,true);
  AcX=Wire.read()<<8|Wire.read();
  AcY=Wire.read()<<8|Wire.read();
  AcZ=Wire.read()<<8|Wire.read();
  GyX=Wire.read()<<8|Wire.read();
  GyY=Wire.read()<<8|Wire.read();
  GyZ=Wire.read()<<8|Wire.read();

  Serial.print("Accelerometer: ");
  Serial.print("X = "); Serial.print(AcX);
  Serial.print(" | Y = "); Serial.print(AcY);
  Serial.print(" | Z = "); Serial.println(AcZ);

  Serial.print("Gyroscope: ");
  Serial.print("X = "); Serial.print(GyX);
  Serial.print(" | Y = "); Serial.print(GyY);
  Serial.print(" | Z = "); Serial.println(GyZ);
  Serial.println(" ");
  delay(333);
}
```

This is the wiring for the MPU-6050-GY 521: (some pins' locations were changed later on)



5. Results:

- **5.1. Results:**

Describe how the SR Prototype performed and if the mission was accomplished.
❗ Must include photos of the team with the final product finally realised.

- **5.2. Lessons Learned:**

Describe the social and communicative challenges your team faced and how they overcame them. Explain what your team learned from this experience and what they would do differently if they had the chance to redo such an experience.

- **5.3. Future:**

Explain how your team could take this mission further, especially if they had access to a real Space Rover launched into space.

6. References:

- Design-related:

https://spaceplace.nasa.gov/mars-rovers/en/
- Rover updates from NASA: https://mars.nasa.gov/mer/
- Opportunity & Spirit updates: https://mars.nasa.gov/mer/mission/rover-status/#recent
- Curiosity: https://mars.nasa.gov/msl/home/
- Perseverance: https://mars.nasa.gov/mars2020/
- “China chooses landing site for its Tianwen-1 Mars rover”: https://www.space.com/china-mars-rover-tianwen-1-landing-site*
- “On its first try, China's Zhurong rover hit a Mars milestone that took NASA decades”: https://www.space.com/china-mars-rover-zhurong-milestone-took-nasa-decades
-Mars: https://mars.nasa.gov/explore/mars-now/

- Drivetrain-related:

- Mars 3D Model: https://solarsystem.nasa.gov/resources/2372/mars-3d-model/
- This interesting website: https://trek.nasa.gov/mars/#v=0.1&x=0&y=0&z=1&p=urn%3Aogc%3Adef%3Acrs%3AEPSG%3A%3A104905&d=&locale=&b=mars&e=-233.08593315211596%2C-122.34374771785271%2C233.08593315211596%2C122.34374771785271&sfz=&w=

- Rovers:

- Zhurong: https://en.wikipedia.org/wiki/Zhurong_(rover)
- InSight: https://en.wikipedia.org/wiki/InSight
- Perceverence: https://mars.nasa.gov/mars2020/
- Viking 1 and Viking 2: https://mars.nasa.gov/mars-exploration/missions/viking-1-2/
- Beagle 2: https://www.space.com/28302-beagle-2-lost-mars-lander-found-infographic.html
- Curiosity: https://en.wikipedia.org/wiki/Curiosity_(rover)

- Spectrometer:

- https://www.youtube.com/watch?v=rw2zsNbMHvE
- https://mars.nasa.gov/msl/spacecraft/instruments/sam/