

ISTITUTO di ISTRUZIONE SECONDARIA SUPERIORE EINAUDI-CASAREGIS-GALILEI



**ERASMUS PLUS PROGRAMME KA 2
STRATEGIC PARTNERSHIP 2017-2020
EUROPEAN SCHOOLS GO GREEN!
A PROJECT ON SUSTAINABILITY:
THINK GLOBAL, ACT LOCAL!**



GOOD VIBES...

The second phase of the Erasmus Plus project was based on science.

This is the reason why the students of Galileo Galilei Technical High School, together with their teachers Mr. Andrea Boccalero and Mr. Piero Belmonte, have analysed the technical aspects linked to renewable energy sources. Their main concern was the implementation of the dual axis solar tracker with the building of a new prototype, driven by Arduino, and able to improve efficiency up to 40% thanks to photo-sensors connected to a solar panel mounted on the top of it. Some experiments on the fuel cell have also been carried out, thanks to the contribution of Mrs. Barbara Bosio, Professor at the Chemical Engineering Faculty of the University of Genoa, who dealt with the risks of pollution and the impact of greenhouse gases.

The students of Galileo Galilei Technical High School have studied the working principles of the solar cell too, thanks to an amazing lesson by Mr. Giuseppe Canepa, Professor at the Faculty of Mathematics at the University of Genoa, and electronics teacher. The students have also made some experiments on solar energy during their visit to the Astronomical Observatory in the uphill of Genoa Righi, whose Director, Mr. Walter Riva, was kind enough to show the mysteries of the universe to the students, who enjoyed the experiments on the solar cooker. Finally, led by Mrs. Giovanna Rosso, drawing teacher and architect, and her assistant Mr. Gerolamo Biosà, some students have designed and built a model of the school, analysing the thermal exchanges shown by the pictures with infrared radiations taken by a thermo-graphic camera.

But the most amazing experience made during the second project year has been the preparation of the Eratosthenes experiment, led in collaboration with the 2nd Junior High School of Amaliada. The students of the two schools have worked together, by measuring the circumference of the Earth and exchanging their data, making their connection stronger and nicer.



Friendship among everyone has been consolidated during the second transnational mobility to Genoa, that took place from the 7th to the 13th April 2019. The activities have been done both at school (from the presentation of the delegations' works to the experiences at the chemistry lab, guided by

Mrs. Marzia Pinna, the chemistry teacher; from the workshops on Arduino and robotics to coding with Scratch thanks to Mrs. Roberta Repetto, mathematics teacher and statistics analyser) and outside school (from the visit to the Aquarium to the Paper Museum led by Mr. Giuseppe Traverso, from the PESEA Park managed by Mr. Sandro Ottonello to the Italian Institute of Technology with the supervision of Mrs. Irene Rivara).

The cooperation with our partners, the Italian Institute of Welding represented by Mrs. Elisabetta Sciaccaluga, and ABB Information Systems by Mr. Paolo Scalera, has been fruitful and valuable, as well as the relationship with the local authorities, in particular the Vice Mayor Mr. Stefano Balleari and the Assessor Mrs. Barbara Grosso. The German and Greek delegations have been welcomed at Palazzo Tursi, the head office of the Municipality of Genoa, by Mrs. Graziella Sperindio, Mr. Stefano Piroli, Mrs. Francesca Arba, on the behalf of the Department of Youth Policies.

All the students have enjoyed the spirit of Genoa, visiting its main museums and cultural sites, thanks to the wonderful guide and expert in art and history of our city, Mrs. Simonetta Maione, who has led the delegations to Palazzo Bianco, Palazzo Rosso, Nervi Park and its Museum at Villa Serra, not to mention the visit to the historical centre of Genoa with a stop at the Museum of Saint Augustine.

We really enjoyed our Erasmus Plus experience with the Germans and Greeks and we hope our guests have appreciated our hospitality. But good vibes are still coming...

Franca Monzeglio

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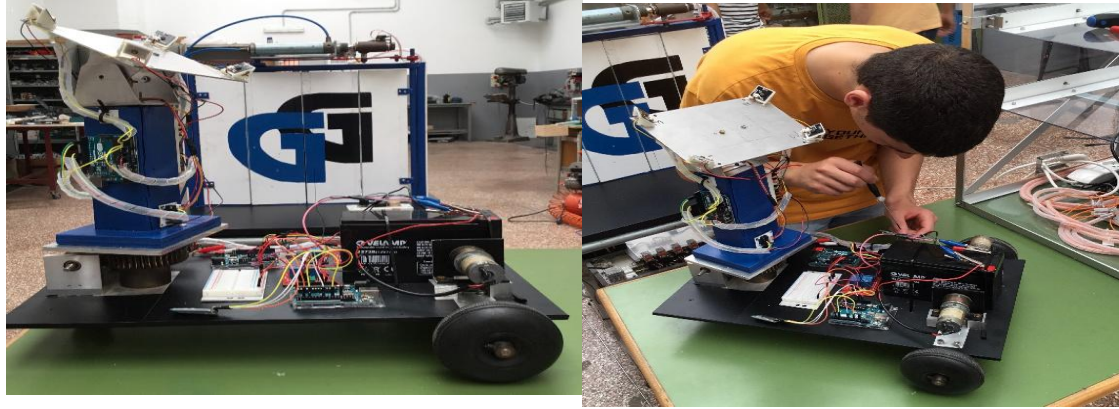


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**PROJECTS DESIGNED BY THE STUDENTS OF GALILEO
GALILEI TECHNICAL HIGH SCHOOL
USING ARDUINO**

**DUAL AXIS
SOLAR TRACKER**



What is it?

The solar tracker is a device made up of a solar panel able to follow the movement of the sun. Its main structure consists of a tower with a solar panel on the top, which can rotate around two axis.

How does it work?

There are four photo sensors, positioned on the corners of the solar panel that read the value of light and send data to Arduino. Then, Arduino processes the information and drives the motors in order to move and rotate the solar panel. Furthermore, the dual axis solar tracker may move like a car if driven by a smart phone or any other electronic device connected to Bluetooth.

SAFETY VAULT



What is it?

The safety vault is a space created to store values and documents of considerable importance or secrecy frequently found in banks.

How does it work?

The project consists in the simulation and testing of the security system in a safety vault, also said *caveau* from the French word. Inside it there are sensors of various types connected to the same alarm powered by Arduino.

There is also a keypad outside the safety vault that gives the correct input to open or close the main gate. If the sensors inside the safety vault reboot, a signal to Arduino system is sent, asking to boot off the security system and trigger the alarm.



BUS DOORS SYSTEM

What is it?

This system can be operated in two ways: via PLC or relay.

How does it work?

After choosing whether to make it work by PLC (Programmable Logic Controller) or by a relay via a selector, you need to press the green button to activate the doors.

For this project a PLC of the *MOELLER KLOCKNER* has been used, programmed using the AWL language, with six relays, one of which with three switches, four with four switches and one bi-stable relay.

There is also an anti-crushing system that reopens the doors if an obstacle is detected between them.

GREENHOUSE WITH TEMPERATURE CONTROL



What is it?

This is the prototype of a greenhouse with an automatic switch to control the temperature inside it.

How does it work?

The greenhouse works in such a way that by pressing a switch the light turns on. Under the light bulb, there is a heat sensor that is used to detect the temperature and by the electro-pneumatic connections it moves a piston

with three limit switches which are used to decide the opening of the part above the greenhouse that contributes to the cooling of the environment together with a fan.

When the temperature is restored to the standards imposed by the program or if the greenhouse lid is lowered, the cover is reduced by one level or completely closed.

In addition to the autonomous system, there are three buttons that are used to send the piston back and forth manually if necessary. There is also a stopping key in case the piston must be held in position for a given period of time.

COCKTAIL MACHINE



What is it?

This machine can prepare four types of cocktails.

How does it work?

First you must enter the code corresponding to the beverage that you want to drink and you must press the confirmation button that is located on the keyboard.

After the engine starts working, thanks to a sliding trolley, you must place the glass under the container with the desired beverage. The limit switches will control the quantity of liquid and a solenoid valve will accordingly release the right quantity of drink chosen by the programmer.

After the machine has finished its preparation cycle, it is possible to withdraw the beverage produced.

The memory chip stores four codes that are used to empty all the liquid tanks, thus allowing a maintenance of the system.

ROBOTIC ARM



What is it?

It is a robotic arm that uses five electric engines able to do different movements.

How does it work?

The arm can store the movements that you memorize manually and reproduce them by itself. The arm uses a set of pliers that have been 3D printed to grab objects. The base of the robotic arm is made of metal and is equipped with four adjustable legs to keep its stability. To control the engines' movements Arduino Mega has been used. It can also be controlled by a mobile phone thanks to Arduino's App. To remember the movements it uses tracking sensors that drive Arduino. Pressing a button the information stored can recreate the movements previously made.

SNACK AUTOMATIC MACHINE



the end of the operation.

What is it?

This machine is an automatic distributor of snacks.

How does it work?

By inserting a specific code, you can get the snack you wish, thanks to Arduino micro controller.

It consists of a mechanical spiral which is powered by a small motor, letting the food drop. An ultrasonic sensor, placed on one side of the structure, sends a signal that blocks the motor making the spiral stop at

METAL SEPARATOR



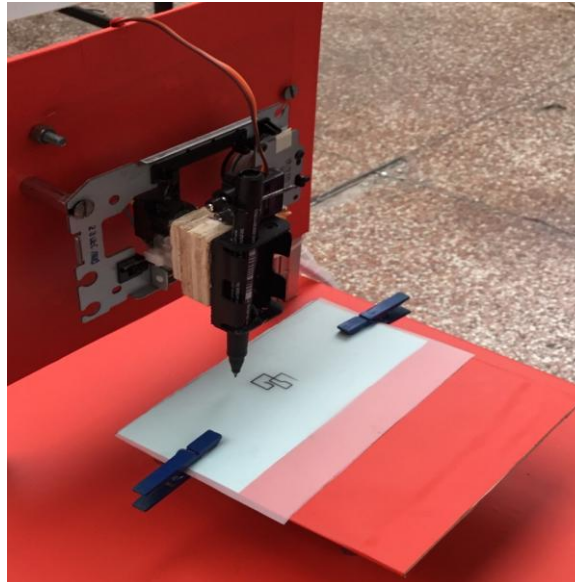
What is it?

The metal separator is an automatic machine controlled by PLC (Programmable Logic Controller) and it is able to divide metals from non-metals.

How does it work?

It consists of a conveyor belt which can change its direction of rotation in order to separate the two different types of material in different containers, placed at two opposite sides.

PLOTTER



What is it?

It is a machine that can reproduce very precise drawings.

How does it work?

It works with Arduino and it is driven by electric motors. A pen follows the precise movements stored as lists of coded instructions sent by Arduino.

OFF-ROAD WHEELCHAIR



What is it?

It is a different wheelchair because it is capable of climbing up and down any stairs and slopes up to 30°, overcoming obstacles and crossing dirty paths.

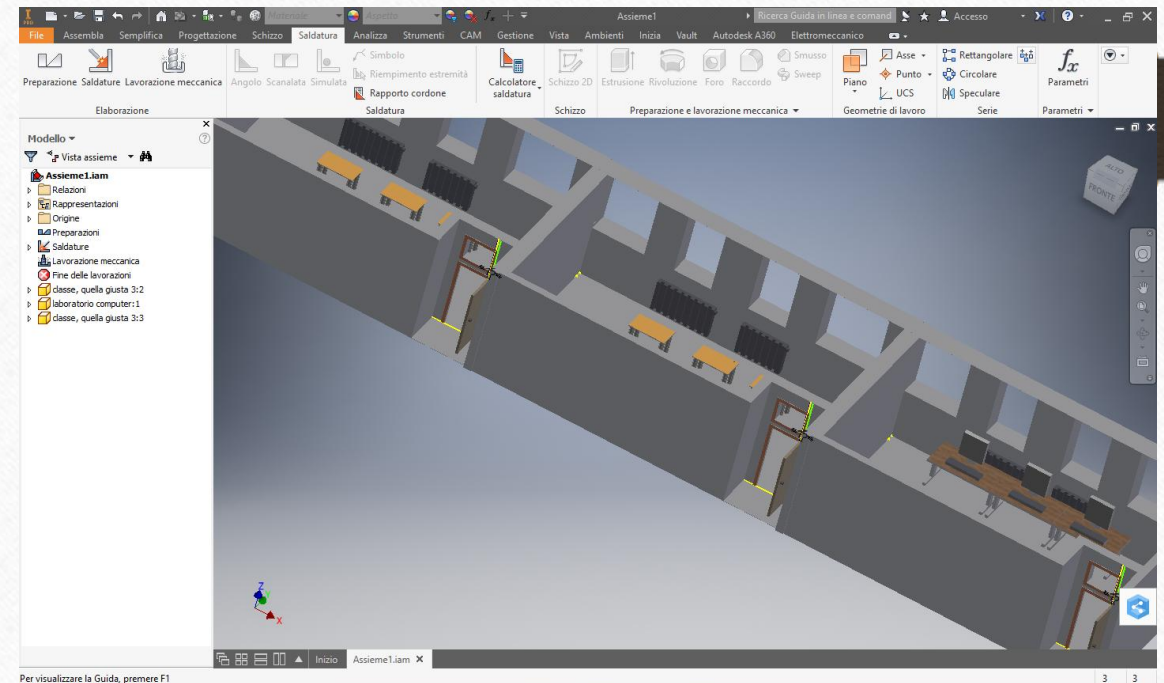
How does it work?

A system of wheels and tracks are combined with two electric motors. The frame is made of wood, and at the top of it there are some front LEDs, so that they can light the road. Some rear LEDs are also present in order to detect one's presence. The padding of the seat is made of foam rubber, the lining of fabric to offer a greater comfort to the passenger. The Perspex mudguards provide protection and the rear anti-tip wheel prevents the chair from tipping over.

The School Model in Polystyrene



This is our polystyrene school model. We have used the 3D map of the school ground floor to build it. After measuring the rooms' sizes, we have built the model draft by using the 1:60 scale.



The School Model in Wood

The polystyrene model was just a prototype necessary to build the final one using a stronger and more resistant material: plywood. The measurements and the scale are the same of the draft, of course.

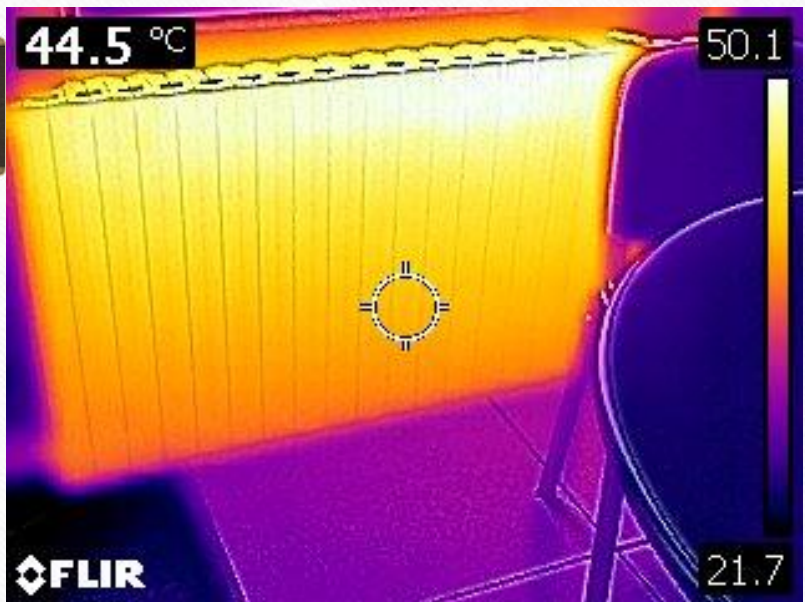


The Thermographic camera

A thermographic camera is a device that forms a heat zone image by using infrared radiation, similar to a common camera that can create an image with visible light.



Thermographic photos



Here is an example of a picture taken with the thermographic camera.



THE SOLAR TRACKER

WHAT IS IT?

- ▶ The solar tracker is a device which consists in a rotating solar panel driven by electric motors that move the panel so that it is always opposite the sun.



WHAT ABOUT EFFICIENCY?

- ▶ It is able to improve efficiency up to 40%.

HOW DOES IT WORK?

- ▶ The main parts of a solar tracker are:

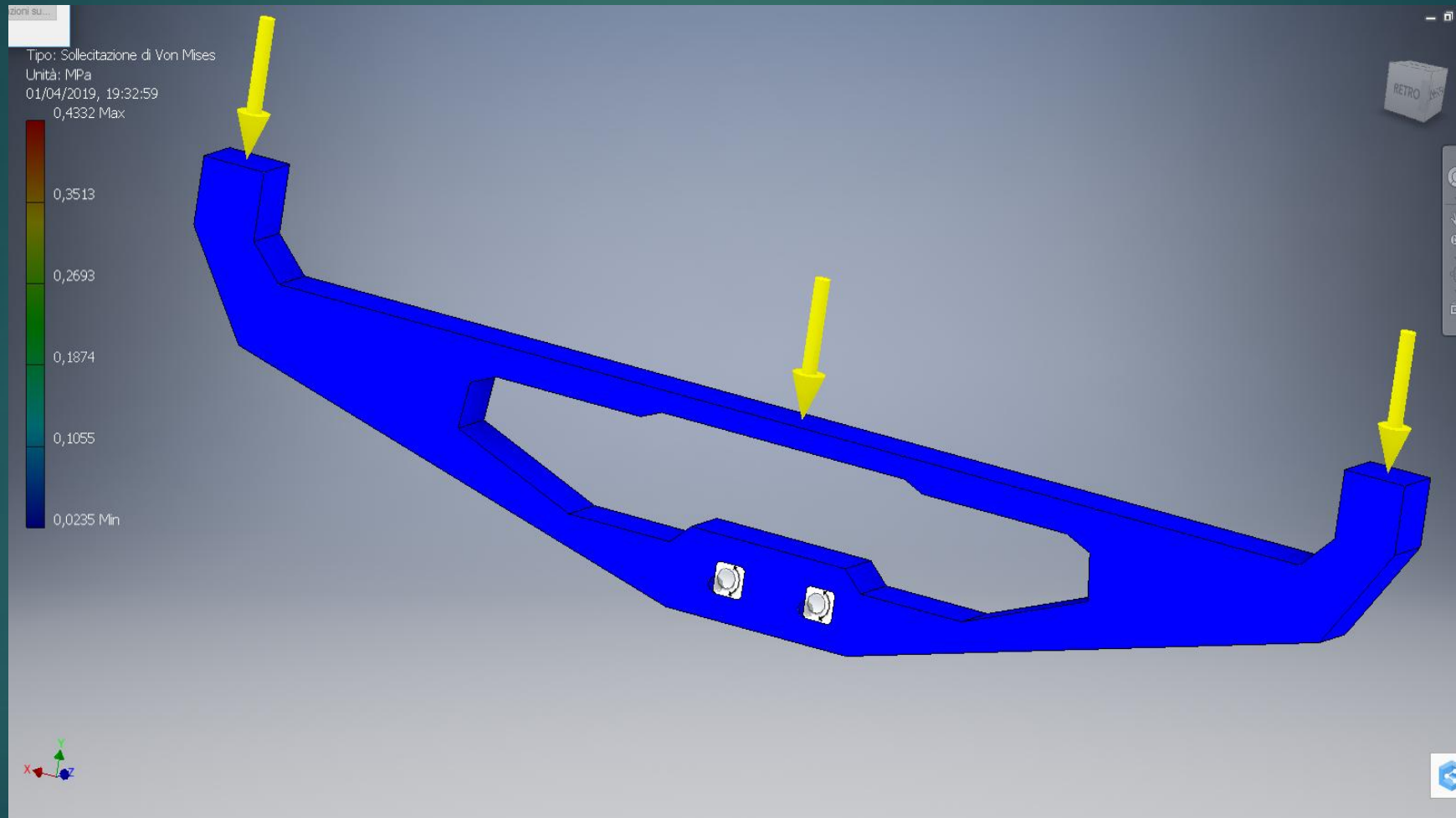


HOW DID WE MAKE IT?

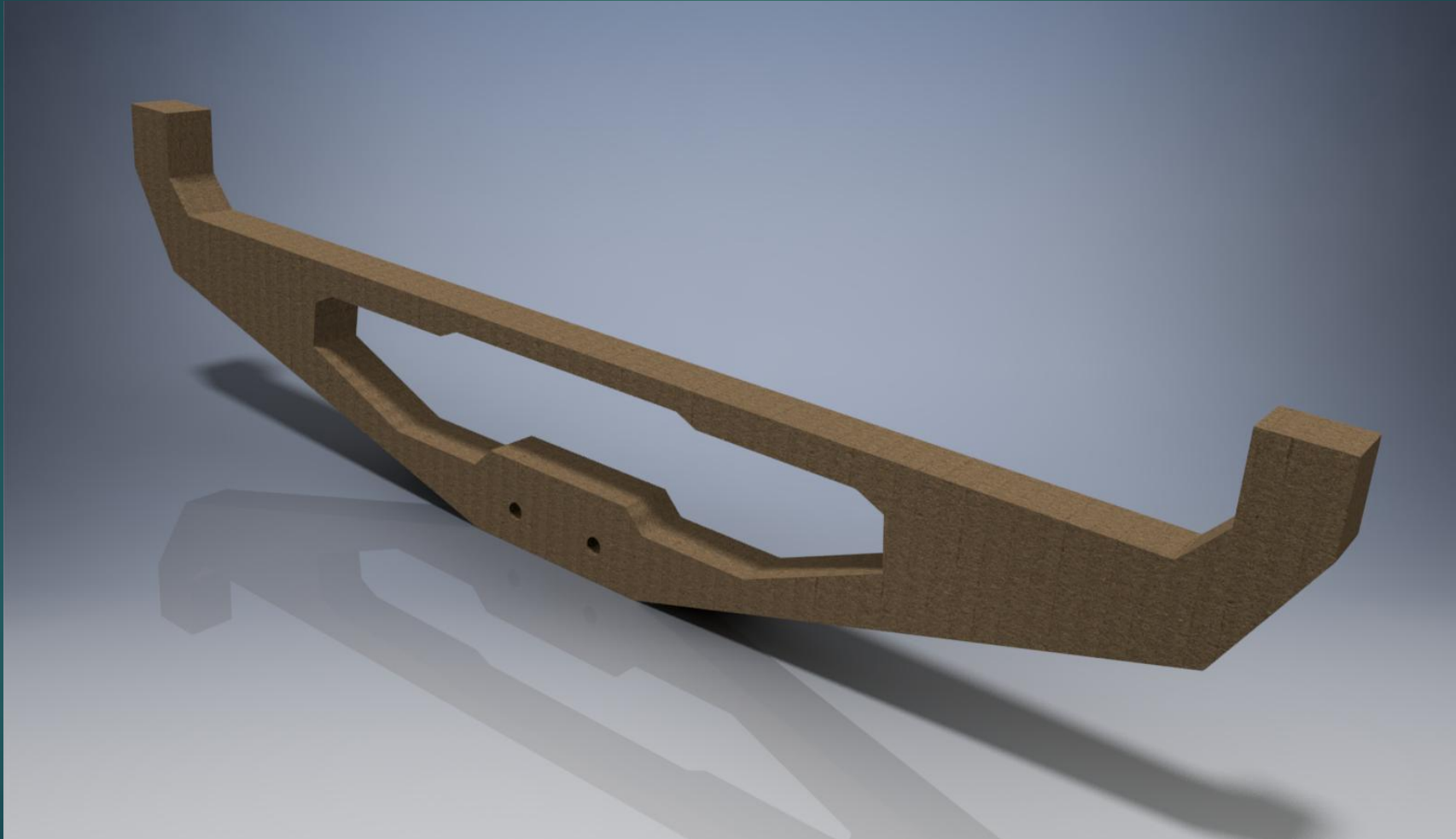
- ▶ First we have analysed the main advantages of its use;
- ▶ Then we have designed different prototypes by using CAD (Computer Aided Design);
- ▶ The best prototypes have been printed by a 3D printer;
- ▶ Finally we have tested them all and we have kept the one with the desired features.



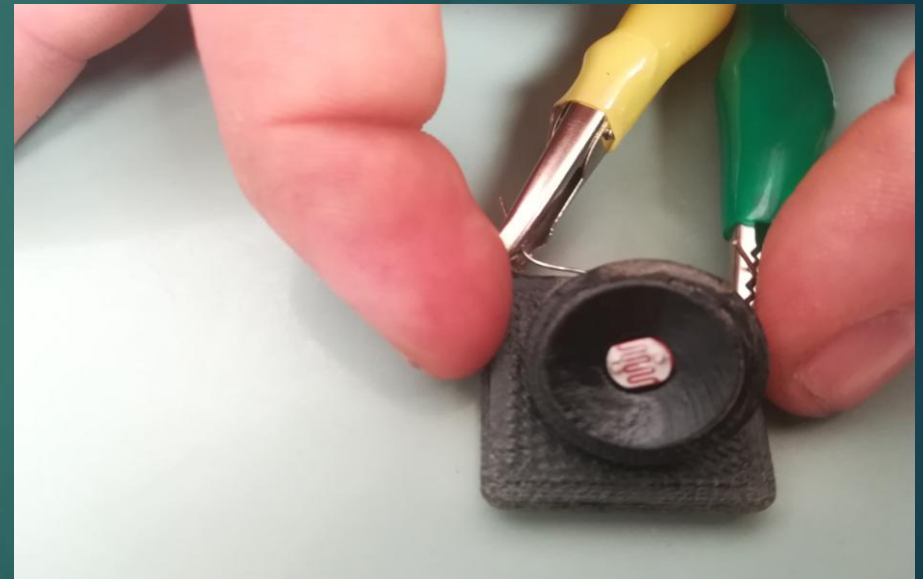
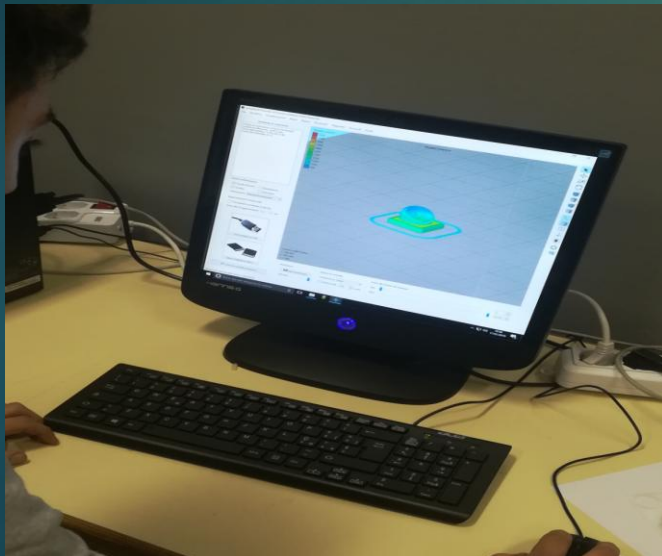
TESTING



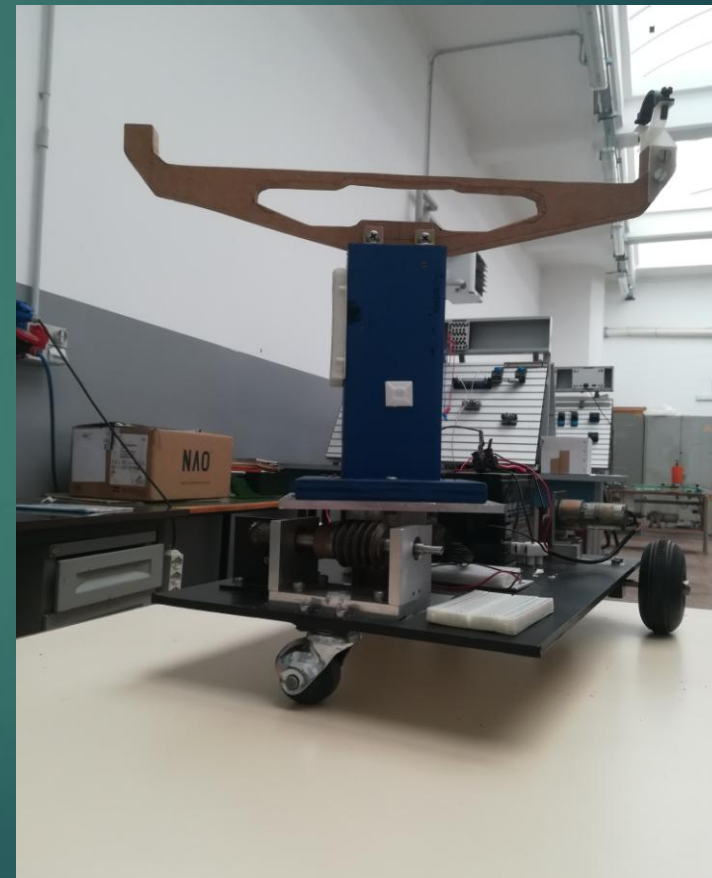
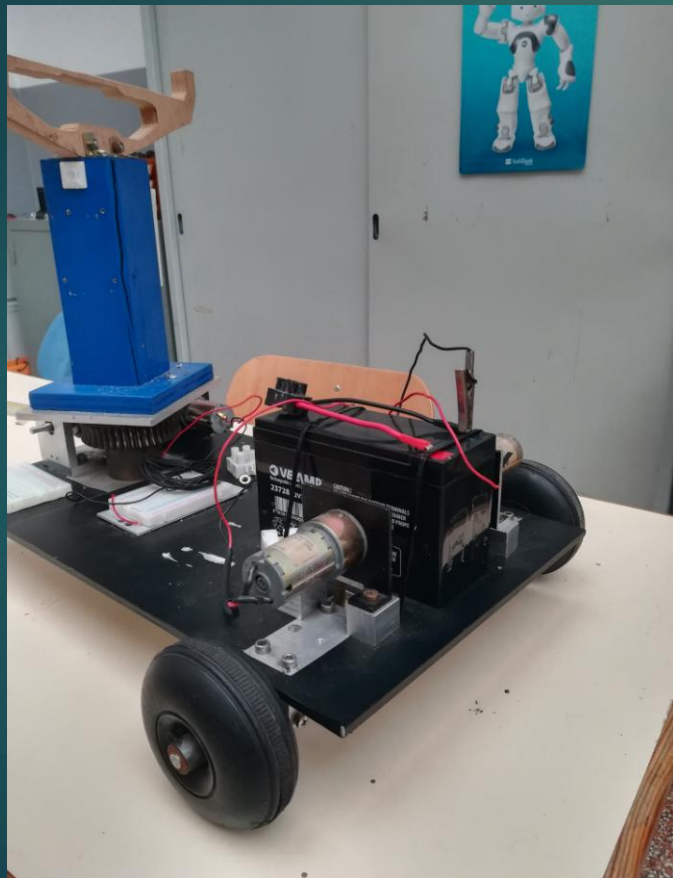
RENDERING



PRINTING



BUILDING



THE ASTRONOMICAL OBSERVATORY OF RIGHI



THE SOLAR COOKER





A *solar cooker* is a device which uses the energy of direct sunlight to heat, cook or pasteurize drink and other food materials.



The *Spectroscope* is an instrument used to measure properties of light over a specific portion of the electromagnetic spectrum, typically used in spectroscopic analysis to identify materials.

source

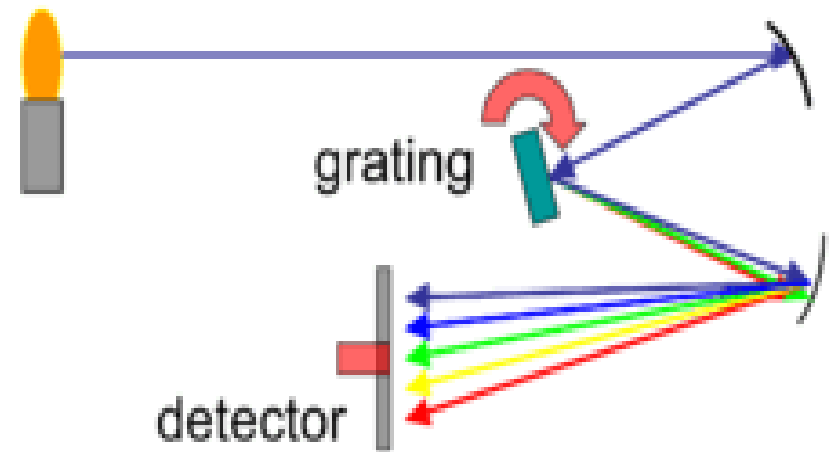


grating



mirrors

detector



TELESCOPES



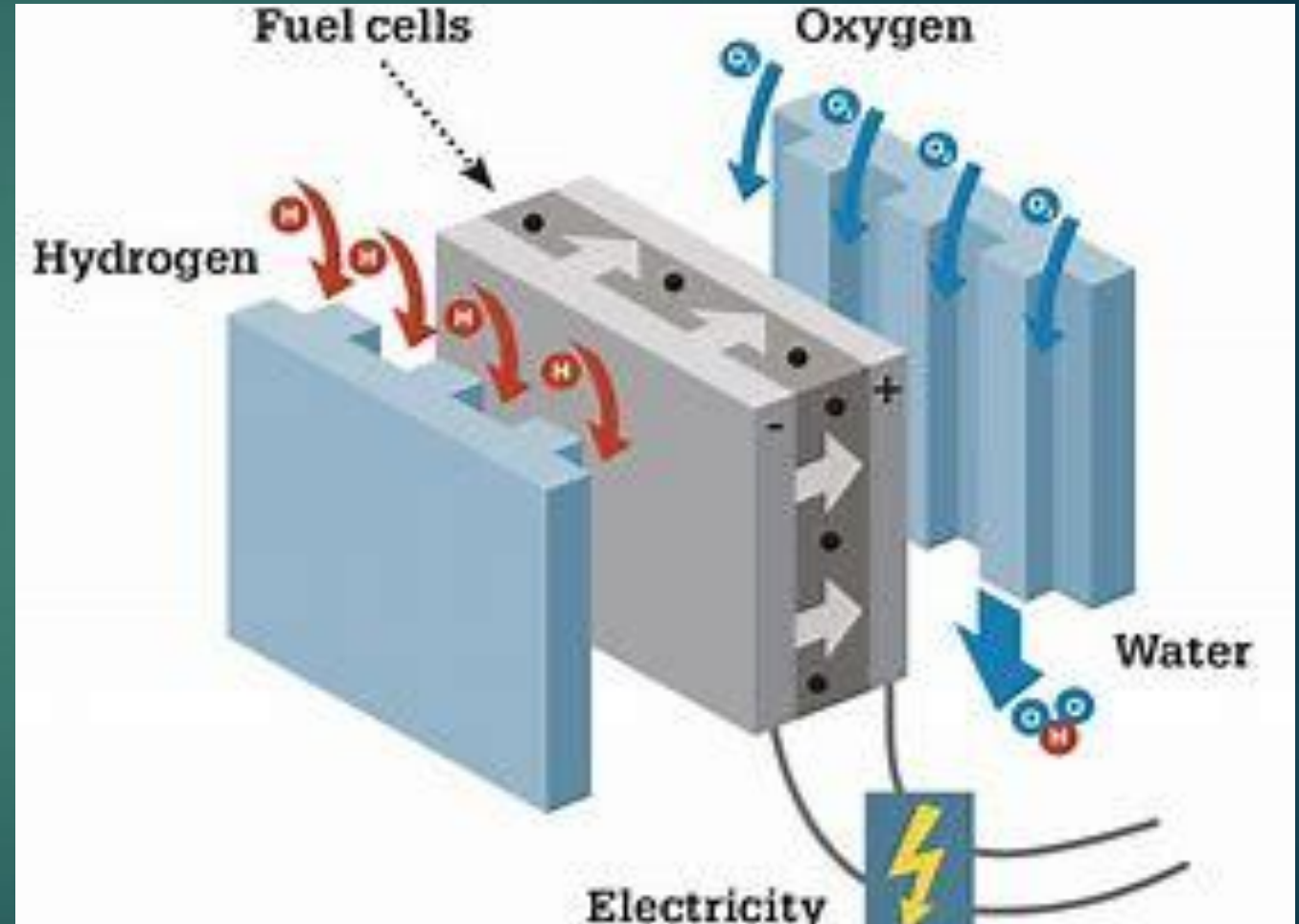
Telescopes are optical instruments that make distant objects appear magnified by using an arrangement of lenses or curved mirrors and lenses, or various devices used to observe distant objects by their emission, absorption, or reflection of electromagnetic radiation.

THANKS FOR WATCHING!



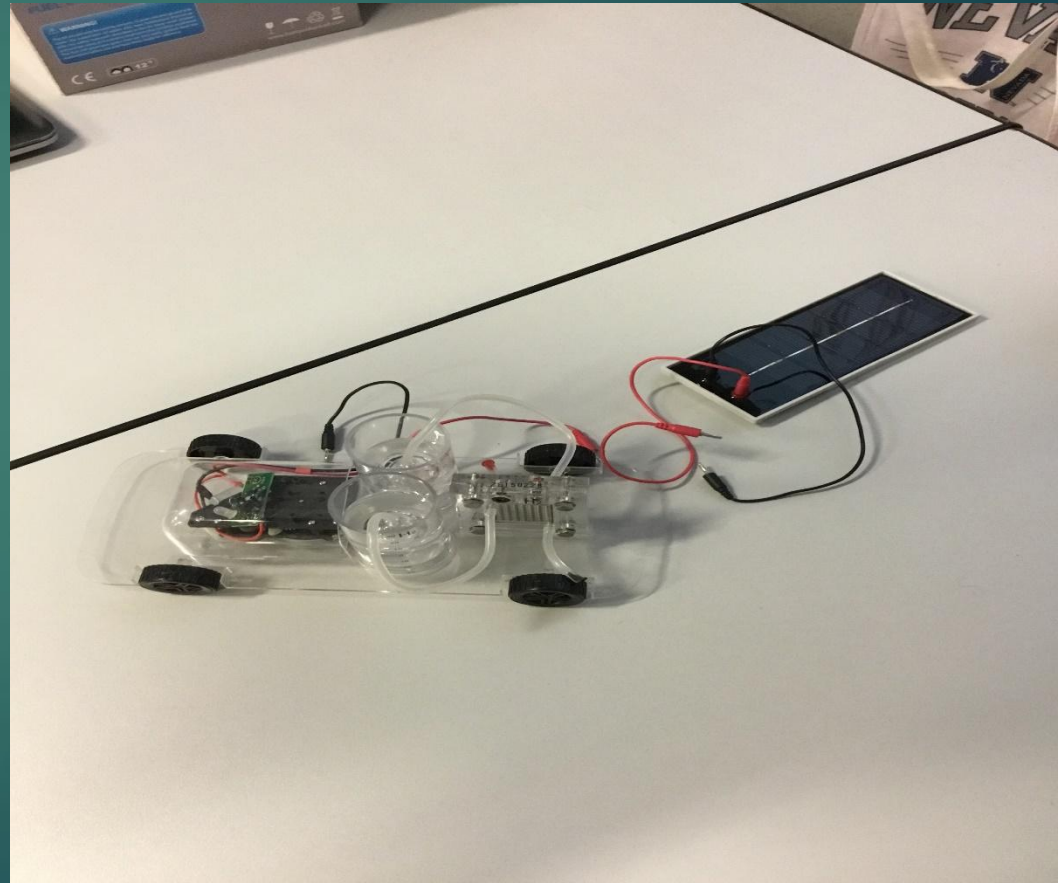
FUTURE TECHNOLOGY

The fuel cell has enormous potential as a future source of electric power. The technology has already been used successfully in electric cars.



The technology works by dividing protons from electrons in hydrogen atoms. While the protons pass through a special membrane in the centre of the fuel cell, the electrons are channelled along a different route thus creating an electric current. The fuel cell creates no noise and no pollution or greenhouse gases.

▶ THE FUEL CELL



Professor Barbara Bosio, faculty of Chemical Engineering at the University of Genoa, has shown us the risks of pollution and the impact of greenhouse gases.



She has also dealt with sustainable energy sources and she has explained the working principles of the fuel cell with a nice workshop.

