Robotically Motioned Rover for Extraterrestrial Exploration & Construction

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Science has improved life, and one of the main events that scientists are trying to achieve is to expand life beyond earth. The very next planet that may have resources to make it habitable is Mars. Through the years, NASA has explored Mars intending to find life and resources. NASA sent rover vehicles like the perseverance in 2020, inspiring us to build one. Considering global warming and the scarcity of resources on earth, it is important to view other options to preserve human life.

We know that the new Mars settlers will need equipment to colonize the Martian terrain. Explorers will need heavy-duty equipment to move rocks or the shell modules where they will live. Also, they will need precise equipment to do planetary surface construction. In this 2021 Nasa Internship project we wanted to create a rover with a robotic arm that can move heavy object, but at the same time is capable of being precise and consistent where it could screw in a bolt. The rover and the robotic hand would be controlled via Bluetooth through an app. We thought of this rover as the perfect equipment the new Martian settlers will need for planetary surface construction, mobilization, and exploration.

Motivation

Interplanetary colonization is not too far ahead of our time. With the latest rover sent to mars (the perseverance), we will soon have some samples of the Martian terrain and know if life exists. Since this mission is being a success so far, we wanted to build something similar, but with the purpose of helping humans to settle on the Martian surface.

Current status

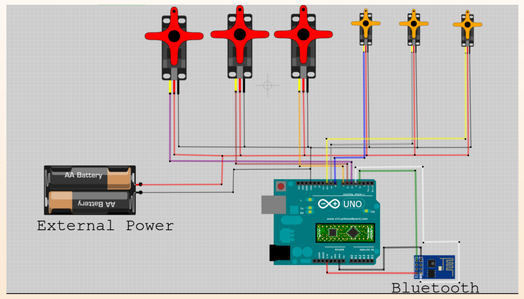
The last Rover was sent to Mars in 2020, which included a hand that can collect rock samples to study, communicate, and an efficient mobility system. The surface of Mars is mostly covered by dust, iron, basalt, and scoria rocks. Therefore, being aware of unexpected situations is essential. Hence, an enormous percentage of the surface of Mars has been mapped by high-resolution stereo cameras, which facilitates the routes for the Rover

Approach

Our team aims to build a rover with a robot arm capable of lifting objects controlled via Bluetooth. We were planning on building a small car that can be self-controlled with an app and a robotic arm. Our main idea is to make the car with four wheels that can go in any direction and travel over different terrains.
Moreover, the app will send a signal via Bluetooth to a Module installed in the car. The app will instruct the car to move in different directions and move the robot arm, which will be on top of the car. The robotic hand was entirely 3D printed using PLA material.
Our rover consists of six 180 degrees servos and 4 DC motors. The car's frame is plastic, with wooden cylinders going horizontally in the upper part of the car to make the structure more rigid. The rover will face different terrains, so we added shocks to our wheels, and to stabilize our 4 DC motors, we added metal rods to act as a dead Axle.

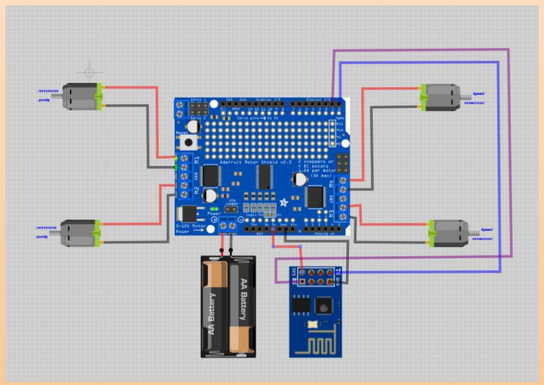
The car is attached with omnidirectional wheels for efficient movement. The wheels allow the car to move to any direction on the a 2D plane. The car also includes 70mm Metal Shock Absorber Damper

Arm circuit



The Arm consists of three MG996R Servo Motors and three A20CLS digital servos, that are connected to an Arduino uno board that is powered by 5V source and controlled via a HC-08 Bluetooth device.

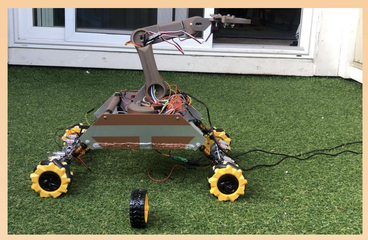
Wheels circuit

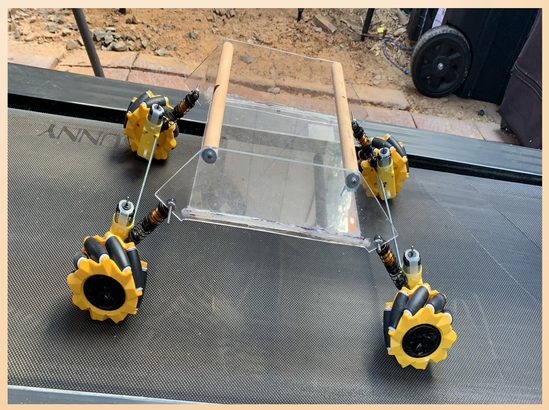


The DC Motors are connected to the motor shield V1, that is on top of the Arduino uno, along with an HC-08 Bluetooth module and powered by a 5 volts source.

Outcome

The car can move from one position to another and lift objects that weigh 13kg value. Furthermore, the car receives signals from a phone app that gives instructions to the vehicle to move the wheels and the hand. The robotic hand can also perform a series of steps and repeat those steps as many times as possible. We can also adjust the speed of each servo as well as the speed of the car.
The Rover's omnidirectional wheels and shock absorbers keep the robotic hand stable on rough terrains and allow for the hand's smoother mobility. The hand can lift 13kg, and that number can increase if we increase the tension created by the rubber bands helping servo number 2, which is on the waist of a robotic hand.





Conclusion

The purpose of this project was to create a prototype rover. We integrated a mechanical arm controlled via Bluetooth signal to simulate the exploration on Mars. Minimal actions, such as lifting objects and removing obstacles from an astronaut's path, might cause deadly injuries when exploring new terrains. A robotic hand will help prevent accidents by doing heavy work. Additionally, the Rover and the hand can be used here on earth to rescue people that are trapped under concrete rubble after an earthquake.
With this project, we wanted our Rover to be multipurpose, meaning that it could be used for exploration, construction, and navigation through the Martian terrain. As it is right now, our Rover can lift 13kg of weight and travel at approximately 3 m/h. The Rover still needs some code adjustments and app enhancement for better manipulation. There is space for a lot of improvement. We think that we got far on building the project and learned a lot from it.

Next Steps

After finished our car, we considered:
- Adding layer protection made of aluminum
-Attach solar panels to the car so it can be powered solely by light photons
-Instead of using Bluetooth, the car can receive signal via Wi-Fi
-Include temperature and photon sensors to determine an area of greatest exposure to sunlight
-Get a better power supply to stop twitching of servos (robotic hand)

Long Term

Adjust the robot arm to move with more flexibility and manipulate objects as a regular human hand may do. This way, it can build stationary solar stations where the Rover could get power from the sun. Moreover, analyze at a deeper level the type of material that can be more resistant than aluminum for the car's outer layer. Create an algorithm so that the Rover can drive itself. Furthermore, the Rover can serve as a prelaunch and start to crate settlements ready for humans to habit.