

NASA SPACE APP CHALLENGE 2018

Team: *Interstellar Dolphin*

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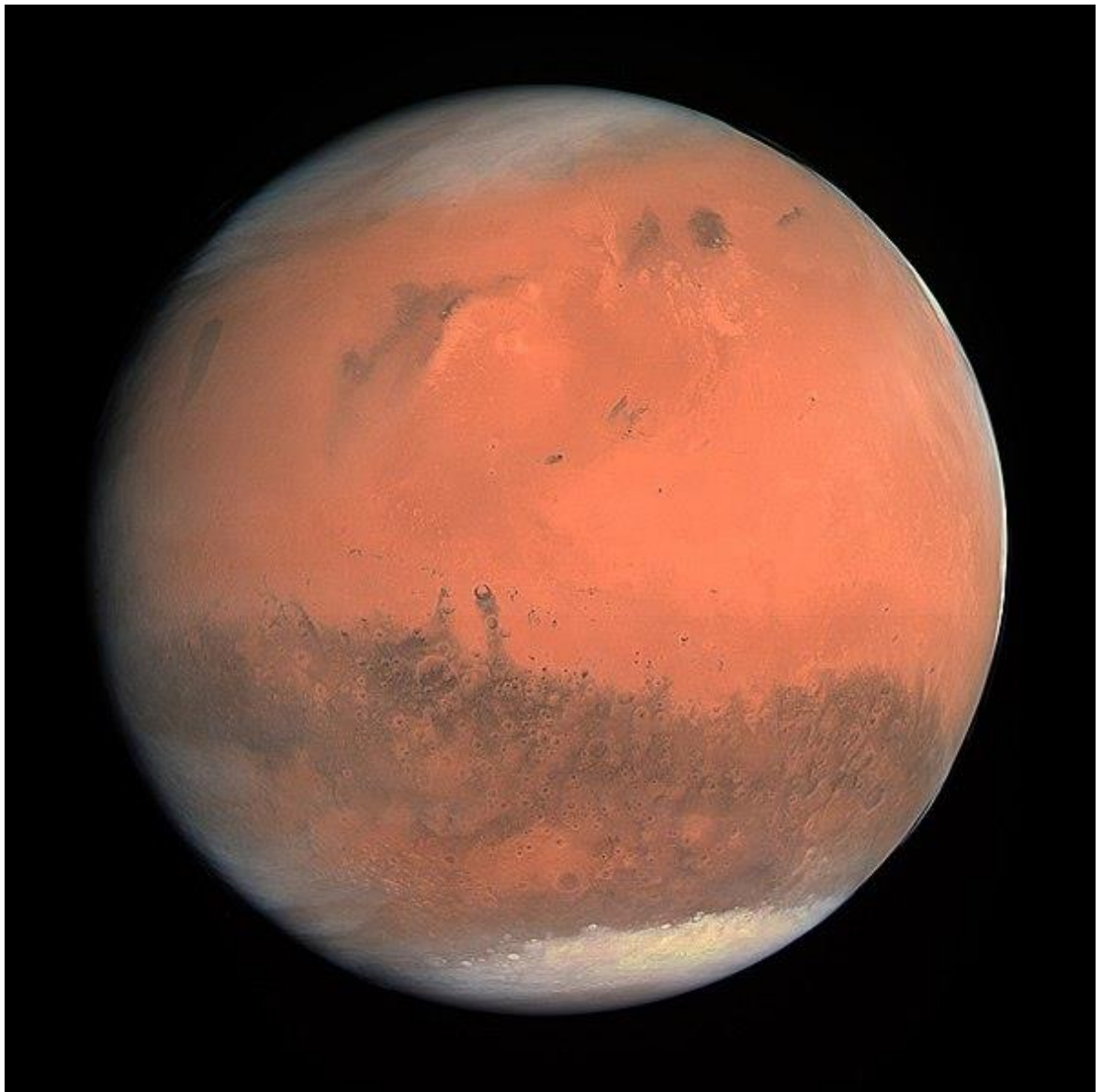
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Challenge: *Make out of sense from Mars*

SYSTEM FOR MANUFACTURING HUMAN BODY IMMOBILIZERS

Mars is the fourth planet from the Sun.



Picture 1 - Mars. [Wikipedia]

It is supposed that there are aluminum, titanium and other minerals on the Mars. The one of the main goals of human colony on the Mars is to be self-reliance and so mining of such minerals will be wide spread.



Picture 2 – Posters by NASA

One of the negative influences on the human body of long staying in the Mars low gravitation is osteoporosis. So exploration and mining on the Mars can be cause of different diseases and injures. At the Earth condition most of health issues now is not a problem. There are a lot of immobilizers that can help cure bone fractures. There are no such opportunities on the Mars.

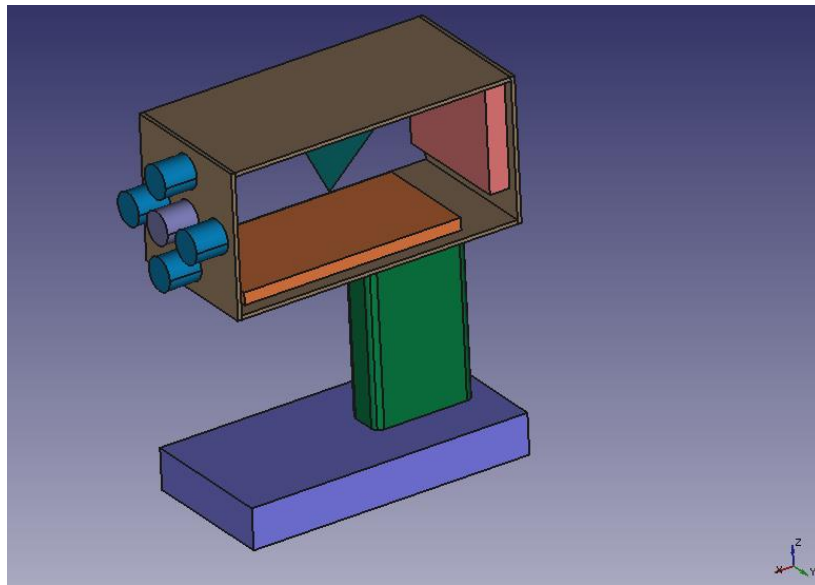
The solution may be found in field of 3D scanning and 3D printing. There are several projects of 3D building of houses on Mars for Settlers [1]. They can be printed from materials gathered from the surface of the Red Planet, including basalt and renewable bioplastic [2].

These technologies can be used not only for buliding houses but also for creating different useful things. Also the following tecnologies can be used in medicine especially in traumatology. 3D printed immobilizer can be considered as a solution for the problem of the future Martian exploration issues.

For producing 3D printed immobilizers it is necessary to scan the surface of human body. The building of ultrasonic 3D scanner is the main goal of our project.

Now there are a lot of technologies of 3D scanning. The leading position among them occupies 3D scanning based on lasers (lidars). The main disadvantage of 3D scanning based on lasers is their cost. Also it is used infrared sensors and ultrasonic sensors.

In our project we decided to use ultrasonic type of sensors. The advantage of the following sensors is cheapness, but not a high level of accuracy. We tried to increase their accuracy in the following way: we tried to compensate movement of 3D scanner using four ultrasonic receivers arranged as cross. Transducer is placed in the center. It can compensate the movement of 3D scanner with the help of evaluation of differences of time among receivers.



Picture 3 – Project of our 3D scanner

Secondly we tried to make beam of ultrasonic ray narrower with the help of cone and long narrow horn.



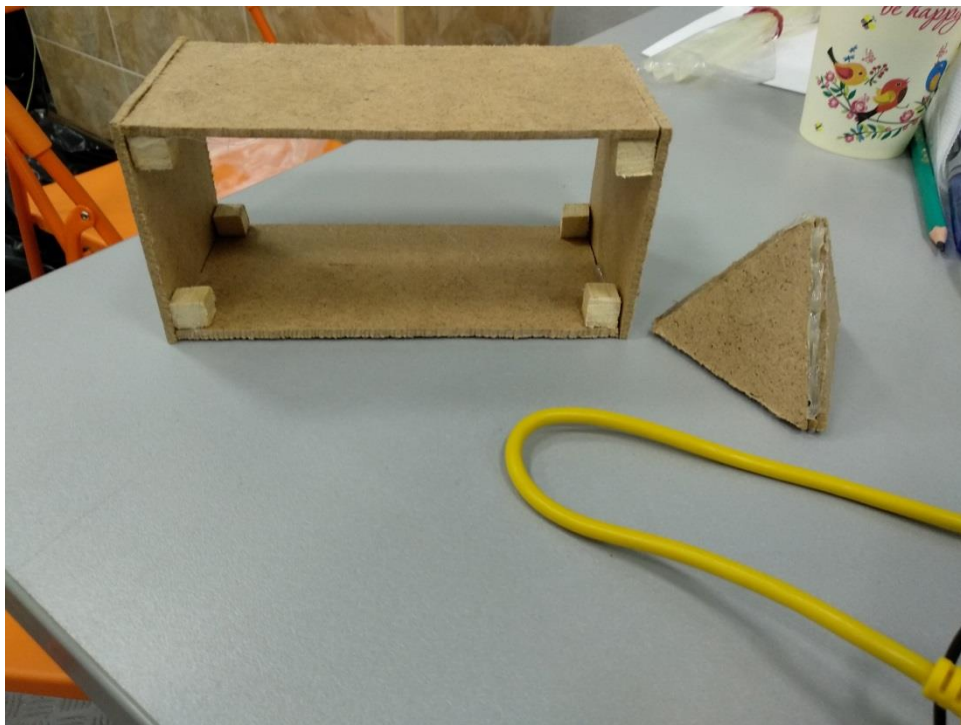
Picture 4 – Testing of cone and small horn on the transducer

We try to use three different tools with different length of horn. But using of such things needs further investigations.

In our project we use:

- Arduino Uno (2 pieces),
- Ultrasonic sensors HC-SR04 (4 pieces),
- Accelerometer and gyroscope GY-521 (4 pieces).

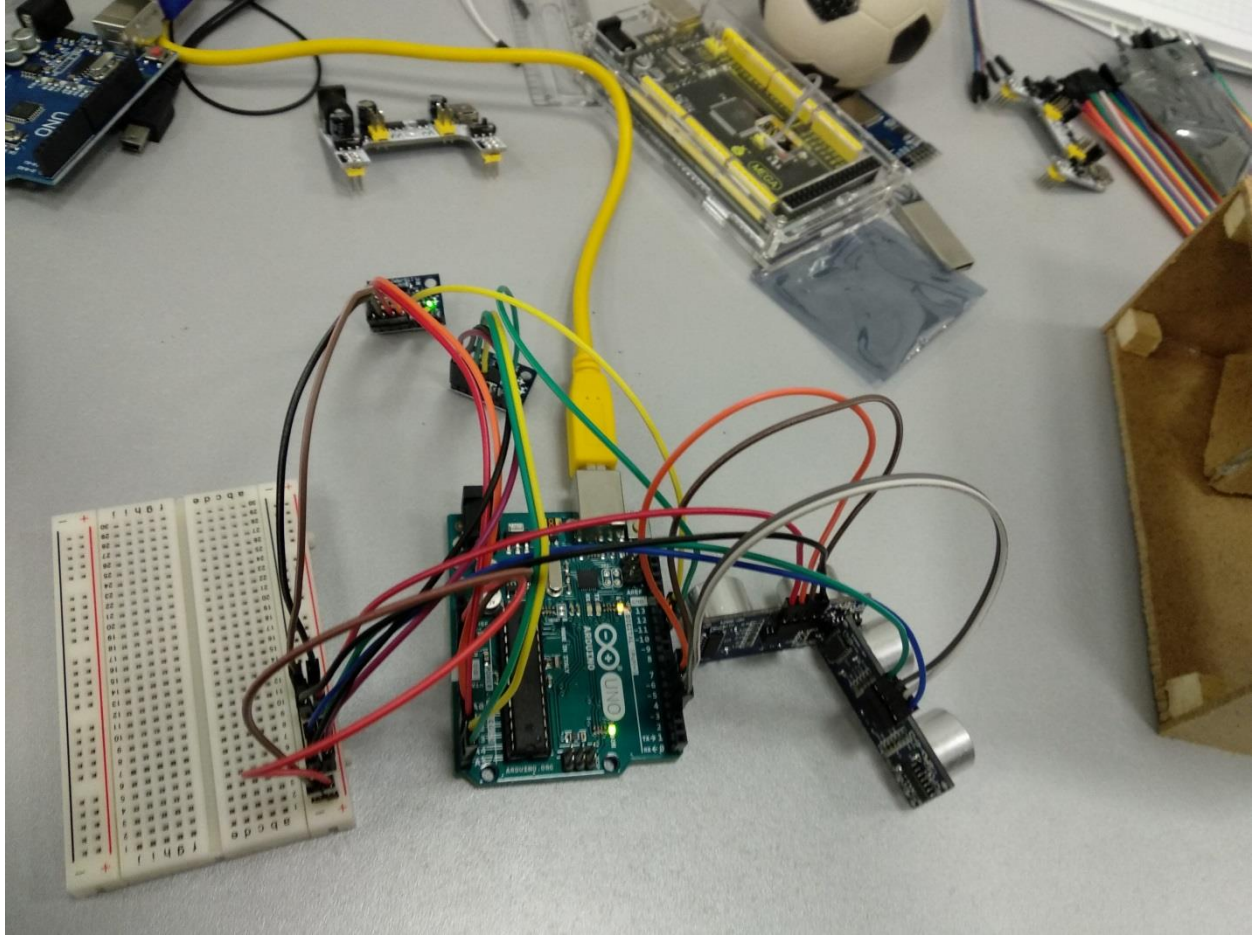
For our project we plan to build inertial navigational system with high accuracy. It will consist of 4 sensors that will be placed on non-orthogonal planes [3]. For constructive base form of our navigation system we use tetrahedron.



Picture 5 – Constructive frames of the prototype of 3D scanner.

The all system consist of two base units and main computer with software that analyzes data from sensors and compute position of 3D scanner and calculates point cloud of scanned body surface.

The main unit consists of one Arduino and two ultrasonic sensors and two position sensors.



Picture 6 – Main unit of 3D scanner.

Main unit collects data from sensors and transmits them to software that analyzes them and calculates necessary information for further calculation of position of 3D scanner and point cloud. We developed C code for Arduino that collects data and transmits them to Python script through Serial port [4].

In the Earth such technologies also can be used for producing immobilizers from different plastics.

We hope that 3D scanning and 3D printing can really help humans save their lives on the Mars.

1. <https://www.cnet.com/news/nasa-picks-3d-printed-houses-we-could-use-on-mars/>
2. <https://thespaces.com/ai-space-factory-designs-homes-for-planet-mars/>
3. <http://earchive.tpu.ru/bitstream/11683/45802/1/reprint-nw-20198.pdf>
4. <https://playground.arduino.cc/Main/MPU-6050>

Our GitHub repository:

<https://github.com/CleverRat/InterstellarDolphin>