



# Product Requirements Document Version 1.0



Project Wall-E

May 17<sup>th</sup>, 2022

## Product Requirements Document

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### 1. Objective

Vision	Project Wall-E is intended to be a land rover to operate on Mars as well as throughout the United States in hard-to-reach areas where humans cannot sustain life or travel. The vision of Project Wall-E is to provide better and smarter control over today's robotics utilizing the latest and most advanced software. The original intention is to provide stronger and more controlled space aviation given large distance. Applications for Project Wall-E public sector is endless and can provide many applications to everyday citizens involving rapid-transportation, remote engineering, and access to uninhabitable environments.
Goals	The goal of the project is to emulate a rover and real-life teleportation using virtual reality. If the control system for the rover is through VR the system will work optimally. Additionally, we can highlight objects and improve functionality by using neuro networks to perform human tasks more precisely.
Initiatives	<ul style="list-style-type: none"><li>- Implementation of neuro network to spot walls and objects to obtain</li><li>- Virtual Reality control system to emulate robotic teleportation</li><li>- Long-distance high-speed connectivity for control through satellite</li><li>- Fully controllable and environment viewing specs attached to robot</li></ul>
Persona(s)	The project is initially designed to help people on earth or space connect with each other over long distances through a physical controllable system.

## 2. Release

Release	Prototype version 1.0
Date	The projected release data of prototype 1 is due June 5 <sup>th</sup> , 2022
Initiative	The initiative of the first release of the prototype is to include: <ul style="list-style-type: none"> <li>- Functioning rover with implemented motors</li> <li>- Input and output from computer to Arduino/RaspberryPi wirelessly</li> <li>- Connectivity to components through two networks</li> </ul>
Milestones	<ul style="list-style-type: none"> <li>- Control RaspberryPi remotely using RPI GPIO (5/20/2022)</li> <li>- Implement motor control (5//22/ 2022)</li> <li>- Mount setup to rover (5/ 23/ 2022)</li> <li>- Implement camera through RPI GPIO to remote device (5/23/2022)</li> </ul>
Features	<u>Prototype 1 Features</u> <ul style="list-style-type: none"> <li>- Remote control of output through Arduino/RaspberryPi</li> <li>- Components mounted inside prototype</li> <li>- Remote camera output to operating device</li> </ul>
Dependencies	<u>Dependencies of release</u> <ul style="list-style-type: none"> <li>- Raspberry Pi 4</li> <li>- Video camera</li> <li>- Arduino Uno R3</li> <li>- Arduino/ Raspberry Pi rover base</li> <li>- Motor connected to circuits</li> <li>- Servo motor connected to circuit</li> </ul>

## 3. Features

Feature	Assisted autonomy
Description	Assisted autonomy through neuro networks is to sense both walls and objects which the rover will place inside the payload.
Purpose	The purpose of assisted autonomy is to provide a greater level of precision as opposed to human controlled movements
User problem	The problem with a rover is that once it runs into a blockage there is no way to retrieve the rover and objects are hard to precisely identify. When assisted autonomy is included the robot will be able to travel by waypoint without any blockage. Additionally, object will be obtained through more consistent and unguided control/
User value	The deep learning network will allow the craft to avoid blockage and help the user retrieve objects through object recognition.
Assumptions	- Cameras are attached to rover and are loaded in Python.

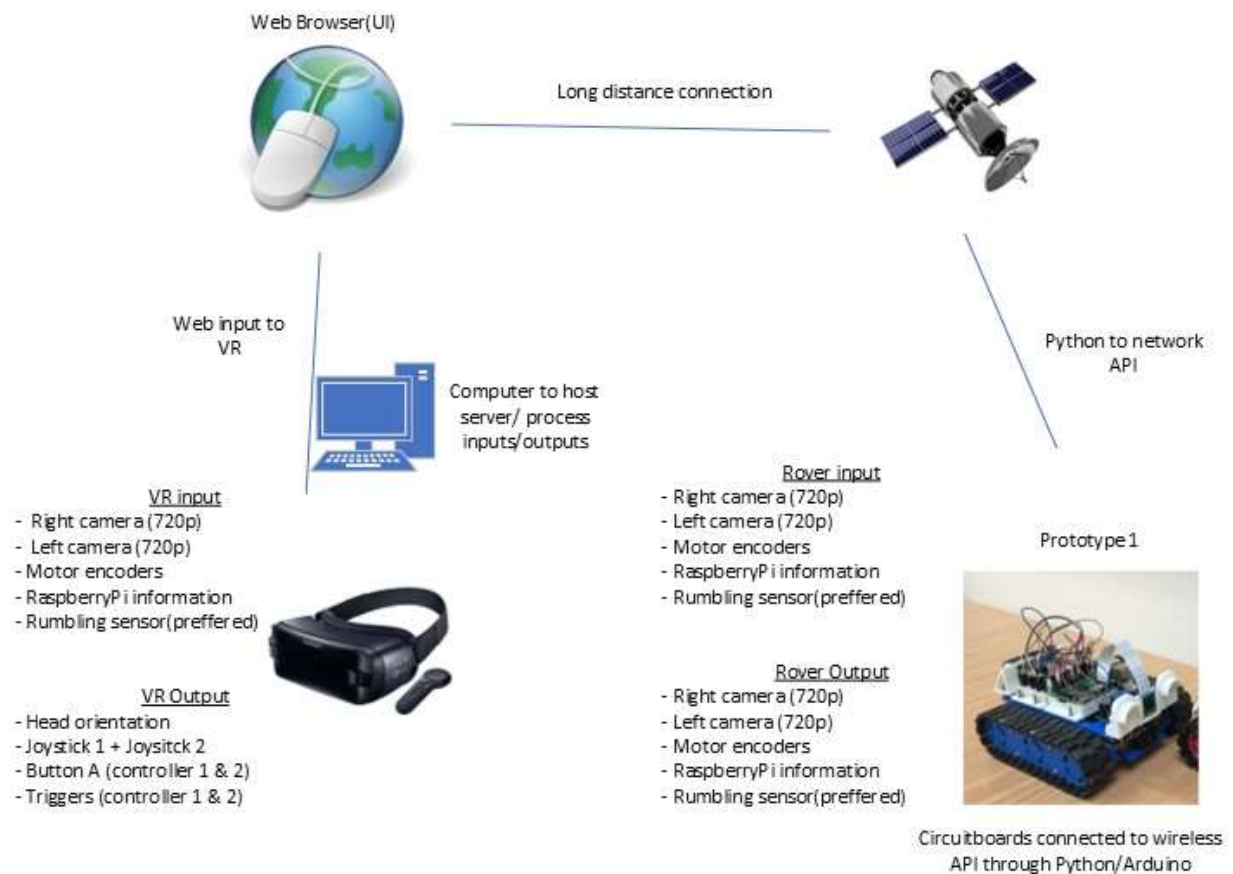
Not doing	Not fully implementing entire autonomous functions (can also control).
Acceptance criteria	To test the autonomy from our rover we will have an object placed 20 ft away from the rover in any direction and it will be able to retrieve the object and drop the item off at the starting location. Vr will be able to run.

Feature	Virtual reality control
Description	Due to virtual reality being the latest technology there will be an option to control the rover using virtual reality. Virtual reality will include two cameras being fed into our virtual reality helmet and the rovers and components of the craft will be able to be controlled through the controls.
Purpose	The purpose of the virtual reality implementation is to spectate the rover during operations and to guide assisted control.
User problem	The problem is that the rover shall be controlled to ensure that operations are working under correct standards. In the case these operations are interrupted the user will be able to control the rover and fix any problems.
User value	Virtual reality control will allow the user to intervene in operations in the case of a mission interruption.
Assumptions	<ul style="list-style-type: none"> <li>– The satellites are functioning with our rover</li> <li>– Cameras are online and working</li> <li>– The server for our system is up and running</li> <li>– The operator is an admin and is authorized to control the rover</li> </ul>
Not doing	Users will be able to spectate instantaneously. Multiple administrators will be incapable of sending commands to the rover during the same time.
Acceptance criteria	For the virtual reality to be correctly implemented the user shall: <ul style="list-style-type: none"> <li>- View through the cameras (right camera to right eye, left to left eye).</li> <li>- Move the location of the rover 10m forward using the right trigger.</li> <li>- Move the location of the rover 10m backward using the left trigger.</li> <li>- Collect an object without using autonomy.</li> </ul>

Feature	Long distance control
Description	Long distance operation will allow the robotic to be accessed around the globe and anywhere a satellite will be able to reach at a sustained signal.
Purpose	The purpose of long distance is so the rover can operate at long distances over a 10-mile range.

User problem	This will allow people to travel into far away and unsustainable areas.
User value	The value achieved by using wireless API will be that the rover has no long-distance connectivity issues.
Assumptions	<ul style="list-style-type: none"> <li>- Connection with RaspberryPI GPIO</li> <li>- Power source running in correct condition</li> <li>- Satellites online</li> <li>- Receiving computer online</li> </ul>
Not doing	Not using local connection/ using RaspberryPI GPIO
Acceptance criteria	<u>Led connection to Arduino powered from separate network</u>

#### 4. User flow and design



#### 5. Analytics

*Hypothesis: Using two cameras will help translate to Virtual Reality to increase control of rover.*

Key performance indicator	Baseline	Target	Timeframe
1280x720 cameras must operate at latency of 0.046ms(30 fps per camera)	The baseline of operations involves a minimum of 30fps/ 0.023 ms latency.	The preferred latency for operations per camera will be 0.023 ms/60 fps.	6/10/2022

## 6. Future work

Future features	Purpose	Priority	Timeframe
Implementation to web browser/ react 360	Use of	Must Have	6/10/2022