**Test Cases:**

***3.3.1 Final Run***

**Description: The Pathfinder will follow a course That is 0.9 miles in length.The course will includes going up a set of 3 stairs at a 45 degree incline and another set of 3 stairs with a decline of 45 degrees. The robot will start the course in a cocoon state and will deploy solar panels.**

**Test Environment: Outside the classroom**

***3.3.2* *Proportional Controller***

**Description: The Pathfinder will adjust solar cells using proportional controller.**

**Test Environment: Inside a classroom**

***3.3.3 Cocoon***

**Description: User will use the Arexterra App to enter and exit cocoon moder.**

**Test Environment: Inside a classroom**

***3.3.4 Articulate Mode***

**Description: The user will use the arexterra App to activate ‘articulate mode’, and receive feedback from the Arxterra App.**

**Test Environment: Outside the classroom**

***3.3.6 Scale***

**Description: Pathfinder should resemble the ‘Spirit Mars Rovers’**

**Test Environment: Inside a classroom**

***3.3.7 Obstacle Avoidance***

**Description: The Pathfinder will avoid obstacles while running the final course.**

**Test Environment: Outside the classroom**

***3.3.8 Solar panels***

**Description: The Pathfinder solar Panels will be made out of metal and use a stepper motor**

**Test Environment: Inside a classroom**

***3.3.9 Feedback***

**Description: The Pathfinder will relay information charging panel angles, GPS location, battery level and charge current through the Arexterra App**

**Test Environment: Outside the classroom**

***3.3.10 Diff Gearbox***

**Description: The Pathfinder box will be made out of three miter gears, three machined shafts, six mounted bearings and shaft collars, and enclosed in an aluminum box.**

**Test Environment: Inside a classroom**

***3.3.12 Assembly***

**Description: The Pathfinder is will demonstrate that it is designed for easy disassembly, and will allow easy access to the electronic components.**

**Test Environment: Inside a classroom**

***3.3.13 RPM***

**Description: Use current source to measure the RPM of each wheel at different loads.**

**Test Environment: Inside a classroom**

***3.3.14 Mods***

**Description: The add modifications on the Pathfinder will hinder its ability to function on hard terrain.**

**Test Environment: Inside a classroom**

# **Test Procedures**

This section contains details of every Test Case utilized for V&V of project requirements. Each Test Case subsection within this section will contain the following: Test Case number and name, detailed scenario description, Test Case Traceability Matrix, detailed success criteria, detailed Test Environment description, Test Assumptions/Preconditions, Detailed Test Procedure Steps, and a Pass/Fail Matrix of success criteria per Test Case.

## **TC-01:**

### **Detailed Description**

This test case provides the steps needed to move the Pathfinder in the forward direction. These steps are similar across a multitude of requirements. The point of this test case is to prevent repetition of the basic steps needed for movement.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
|  | The Pathfinder will be able to drive on flat surfaces | Pathfinder travels whole length of 0.9 continuously | Verification | Inspection |  |
|  | The Pathfinder will climb over an 45 degree incline | Pathfinder climes a stair at 45 degree angle. | Verification | Test |  |
|  | The Pathfinder should be told to move remotely using Arxterra | Pathfinder reaches 0.9 mile mark | Verification | Test |  |
|  | The Pathfinder will traverse the course on a single charge. | Pathfinder climes a stair at 45 degree angle. | Verification | Test |  |
|  | The Pathfinder will travel over an 45 degree incline with no weight issue | Pathfinder climes a stair at 45 degree angle. | Verification | Test |  |

### **Detailed Success Criteria**

For this test case to be successful, the Pathfinder must be able to continuously move for a distance of 0.9mile.

### **Test Environment**

The test will be conducted in the upper campus.

### **Assumptions and Preconditions**

* Battery is fully charged
* Pathfinder is fully assembled
* Custom commands on mobile app are already configured

### 

### **TC-02:**

### **Detailed Description**

This test case provides the steps needed to display that the Pathfinder will adjust solar cells using proportional controller.

**Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
|  | The Pathfinder will display the articulate mode | The Pathfinder shows the solar panels adjusting using the current sensors. | Verification | Test |  |

### **Detailed Success Criteria**

For this test case to be successful, the Pathfinder will adjust solar cells using proportional controller.

### **Test Environment**

The test will be conducted in the Engineering and Computer Science building on the 3rd floor in room 316.

### **Assumptions and Preconditions**

* Battery is fully charged
* Pathfinder is fully assembled
* Custom commands on mobile app are already configured

### 

## **TC-12: Assembly**

### **Detailed Description**

This test case provides the steps needed to assemble and disassemble the Pathfinder with relative ease.

### **Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
| L1-3 | The Pathfinder will behave like a toy | Pathfinder is disassembled and reassembled within 20 minutes | Validation | Inspection |  |
| L2-8 | The wires in Pathfinder should be clean so no interference during disassembly | Customer sees Pathfinder has clean arrangement of wires inside | Validation | Inspection |  |

### **Detailed Success Criteria**

For this test case to be successful, the Pathfinder must be able to be assembled and disassembled with ease A completely assembled Pathfinder is one that is fully operational and responds to commands given by the Arxterra mobile app.

### **Test Environment**

The test will be conducted in the Engineering and Computer Science building on the 3rd floor in room 316.

### **Assumptions and Preconditions**

* Battery is fully charged
* Custom commands on mobile app are already configured

## **TC-06: Scale**

### **Detailed Description**

This test case provides the steps needed to measure the dimensions of the newly moded Pathfinder.

### **Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
|  |  |
|  | The Pathfinder should appear in scale to the real Mars Rover | Newly modded Pathfinder is in scale to Mars Rover | Verification | inspection |  |

### **Detailed Success Criteria**

For this test case to be successful, the overall shape is compared to the real Mars Rover.

### **Test Environment**

The test will be conducted in the Engineering and Computer Science building on the 3rd floor in room 316.

### **Assumptions and Preconditions**

* Pathfinder is fully assembled

## **TC-07: obstacle avoidance**

### **Detailed Description**

This test case provides the steps needed to show the ability to avoid obstacles.

### **Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
|  |  |
| L1-9 | The rover should not make any attempt to climb an  object that it is unable to clear. | The pathfinder will not attempt to climb a wall | Verification | demonstration |  |

### **Detailed Success Criteria**

For this test case to be successful, the Pathfinder will not attempt to climb over a wall and will either come to a stop or move around it.

### **Test Environment**

The test will be conducted in the upper campus.

### **Assumptions and Preconditions**

* Pathfinder is fully assembled

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## **TC-08: solar panels**

### **Detailed Description**

This test case provides the steps needed to show that the solar panels are made of aluminum.

### **Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
|  |  |
| L1-9 | The that the solar panels on the Pathfinder are made of aluminum. | The pathfinder solar panels are made aluminum | Verification | inspection |  |

### **Detailed Success Criteria**

For this test case to be successful, the Pathfinder solar panels are made of aluminum

### **Test Environment**

The test will be conducted in the Engineering and Computer Science building on the 3rd floor in room 316.

### **Assumptions and Preconditions**

* Pathfinder is fully assembled

## **TC-09: solar panels**

### **Detailed Description**

This test case provides the steps needed to show that the solar panels are made of aluminum.

### **Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
|  |  |
|  | The Pathfinder will relay information charging panel angles, GPS location, battery level and charge current through the Arexterra App | The pathfinder will update information into the Arexterra App | Verification | inspection |  |

### **Detailed Success Criteria**

The Pathfinder will relay information charging panel angles, GPS location, battery level and charge current through the Arexterra App

### **Test Environment**

The test will be conducted in the Engineering and Computer Science building on the 3rd floor in room 316.

### **Assumptions and Preconditions**

* Pathfinder is fully assembled

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## **TC-10: Gearbox**

### **Detailed Description**

This test case provides the steps needed to show that the solar panels are made of aluminum.

### **Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Procedure Step(s) where Requirement is tested** | **Pass/Fail?** |
|  |  |
|  | The Pathfinder will disassemble to show the diff gearbox | The Pathfinder box will be made out of three miter gears, three machined shafts, six mounted bearings and shaft collars. | Verification | inspection |  |  |

### **Detailed Success Criteria**

**The professor will see that the Pathfinder gearbox will be made out of three miter gears, three machined shafts, six mounted bearings and shaft collars.**

### **Test Environment**

The test will be conducted in the Engineering and Computer Science building on the 3rd floor in room 316.

### **Assumptions and Preconditions**

* Pathfinder is fully assembled

## **TC-10: Gearbox**

### **Detailed Description**

This test case provides the steps needed to show that the solar panels are made of aluminum.

### **Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
|  |  |
| L1-9 | The Pathfinder will disassemble to show the diff gearbox | The Pathfinder box will be made out of three miter gears, three machined shafts, six mounted bearings and shaft collars. | Verification | inspection |  |
|  | The Pathfinder diff gearbox is enclosed in aluminum | The diff gearbox will be housed in an aluminum gearbox | Verification | inspection |  |

### **Detailed Success Criteria**

**The professor will see that the Pathfinder gearbox will be made out of three miter gears, three machined shafts, six mounted bearings and shaft collars.**

### **Test Environment**

The test will be conducted in the Engineering and Computer Science building on the 3rd floor in room 316.

### **Assumptions and Preconditions**

* Pathfinder is fully assembled

## **TC-13: RPM**

### **Detailed Description**

This test case will show the robot se the current sensors measure the RPM at every wheel, and cut the power at the wheel and disconnect the wheels under no load

### **Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
|  |  |
| L8-1,2,3,4 | **The Pathfinder will use high-side detection and correction.**  **Consequently, wheels undera no-load condition shall**  **be considered and power to that motor shall be decreased.** | **Measure the RPM of each wheel to ensure that inside**  **wheels are turning at a different speed than the outside.** | Verification | Test |  |
| L9-1 | **A 6-wheel electronic slip differential shall be implemented.** | **Measure the RPM of each wheel to ensure that inside**  **wheels are turning at a different speed than the outside.** | Verification | Test |  |
| L9-2 | **The software program shall be used to make**  **the appropriate turns of the Pathfinder..** | **The code will be presented.** | Verification | Analysis |  |

### **Detailed Success Criteria**

The professor will see that the Pathfinder Measure the RPM of each wheel to ensure that inside wheels are turning at a different speed than the outside.when the value is below the threshold,it'll interrupt the motor and shut off power

### **Test Environment**

The test will be conducted in the Engineering and Computer Science building on the 3rd floor in room 316.

### **Assumptions and Preconditions**

* Pathfinder is fully assembled

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## **TC-14: Mods**

### **Detailed Description**

**This test case will show that there is no design decision shall preclude operations in a high desert environment. (Amboy,California)**

### **Test Case Traceability and Pass/Fail Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Requirement Number** | **Requirement Text** | **V&V Success Criteria** | **V&V Designation** | **V&V Method** | **Pass/Fail?** |
|  |  |
|  | **The Pathfinder will be inspected to show that there is no modifications that will hinder operations in a high desert environment** | **The professor will inspect the Pathfinder** | Verification | Inspection |  |

### **Detailed Success Criteria**

The professor will see that the Pathfinder has no modifications that hinders the operations in a high desert environment.

### **Test Environment**

The test will be conducted in the Engineering and Computer Science building on the 3rd floor in room 316.

### **Assumptions and Preconditions**

* Pathfinder is fully assembled