RV table

Microcontroller

Requirements	Verification
1. Must must be able to measure voltage signals between 0 to 3.3 volts within an accuracy of 0.1 volts.	1. Install a program onto the microcontroller that would output the voltage it reads from an input.
2. Must be able to send signals between 0 to 3.3 volts to the H-Bridge with an accuracy of 0.1 volts.	2. Send voltages from 0 to 3.3 in 0.1 volt increments from the microcontroller and measure the output with a voltmeter.
3. Must be able to operate on a power source of 3-3.6 volts.	3. Power the microcontroller from a power supply at 3 volts and 3.6 volts and test a program on it.
4. Must not draw more than 20 mA.	4. While testing the microcontroller, read the current being drawn with an Amp meter to ensure it doesn't exceed 20 mA.
5. Must be able to understand I2C signals from the RGB sensor.	5. Connect the microcontroller to a working RGB sensor that communicates via I2C and load a program that will display the different colors the microcontroller reads, and compare the output with the input color that the RGB sensors are detecting.
6. Must have a PWM resolution of at most 50ns	6. Connect the output of the PWM I/O pin to an oscilloscope and configure the microcontroller to send pulses of less than 50ns through and measure the the width of the pulses on the oscilloscope.

Power Button

Requirements	Verification
1. Must be able to withstand current up to 500mA.	1. Send a steady flow of 500mA current through the button over 30 minutes and ensure that afterwards the button hasn't broken the connection or overheated.

Batteries

Requirements	Verification
1. Batteries must be rechargeable batteries that supply between 1.15 to 1.25 volts each. 2. Each battery must have a capacity of 1500mAh, and able to supply 500mA to a load before dropping to 1.15V. 3. Must be manually rechargeable	1. Measure the voltage across a single battery and unsure it is within 1.15 to 1.25 volts. Then deplete the battery and repeat the test after attempting to recharge. 2. Setup up the battery to an Ammeter and a variable resistor in series. Vary the resistance on the resistor till the Ammeter reads 500mA and measure the voltage across the batteries with a voltmeter over 3 hours of use to see if it drops below 1.15 volts. 3. Deplete a battery and test recharging it on an eneloop battery charger.

3.3 Voltage Regulators

Requirements	Verification
1. Must be able to withstand current up to 500mA. 2. Must be able to take in between 4.6 to 5 volts as an input from the battery power supply and output 3.3 volts with a tolerance of 5%	1. Setup the voltage regulator to an Ammeter and a variable resistor in series such that the draw is 500mA and measure that it is still outputting a steady 3.3 volts 2. Input the battery power supply and measure the output voltage with an oscilloscope to ensure it is outputting a steady 3.3 volts within the tolerance.

Transistors

Requirements	Verification
1. Must be able to handle current from 100mA to 300mA to power the motors. 2. Must maintain a temperature below 50 degrees Celsius. 3. Must also be able to act as switches when provided a voltage to the base of 0 to 1.5 volts and 2 to 3.3 volts	1. Setup the transistors in the H bridge configuration connect the outputs, MOTOROUT1 and MOTOROUT2, to an Ammeter and a variable resistor in series. Vary the potential across the resistor such that the Ammeter reads a draw of 300mA. 2. Setup the transistors in the H bridge configuration and measure their temperatures while powering a motor. 3. Setup the transistors in the H bridge configuration and ensure the motors spin can be controlled by the values of the bases to the input transistors, IN-1 and IN-2, as shown in the truth table below. High values are voltages between 2 and 3.3 volts and low voltages are between 0 and 1.5 volts.

Diodes

Requirements	Verification
1. Must be able to catch back current flow when a motor changes direction.	1. Setup the diodes in a working H bridge configuration and measure the current across them for any spikes, as the motors are controlled to change directions.

RGB Sensor

Requirements	Verification
1. The RGB sensor must be able to detect the color of a 1cm by 1cm area being illuminated by a white LED that is between 0.5 cm to 4cm from the sensor. 2. Must be able to send I^2C signals to the microcontroller to accurately detect colors that to the naked eye look red, blue, green, black, gray, and	1. Read the values from the RGB sensor while it is placed at 0.5 and 4cm away from the surface of a 1cm by 1 cm square of various colors. 2. Draw squares that are 1cm by 1cm of the colors red, blue, green, black, gray, and brown and ensure that sensor can differentiate between

brown.	them.

LED

Requirements	Verification
1. The LED should provide a broadband white light across 400nm to 700nm. 2. The LED should be able to illuminate an area of 1cm by 1 cm between 0.5cm to 4cm.	1. This can be tested by focusing the light into an optical spectrum analyzer and reading the spectral response. 2. Draw a 1cm by 1cm square on a piece of paper and see that it is illuminated by the LED when places at 0.5cm away and 4cm away.

Allocation of Points

Module Name	High Level Requirement	Points
Microcontroller	● The microcontroller must be able to appropriately differentiate between red, blue, green, black, gray, and brown from an I2C signal sent by the Color Sensors. ● The microcontroller must be able to interpret color codes of up to four colors long and make decisions on how to control the motors as a result. ● The microcontroller should be able to control a servo motor with a PWM signal. ● The microcontroller must be able to control DC motors by sending signals to the DC motor control module	20
Color Sensor	● The Color sensor module will be composed of color sensors that must be able to differentiate between red, blue, green, black, gray, and brown colors and send an appropriate I2C signal to the microcontroller.	15
DC Motor Control	● The DC motor control module must be able to direct sufficient current to two DC motors individually and be able to control their rotation direction.	10
Power Module	● The power module must provide sufficient power to the microcontroller, sensors, servo motor, and DC motor control.	5
	Total	50