Team 58: Posture Guidance Chair RV Table

Component/Module	Requirement	Verification	Points
Voltage Regulators	The 3.3V voltage regulator must consistently output voltages between 3.0V - 3.6V given an input of 5.5-6V.	1. Provide a 5.5-6V input signal into the 3.3V regulator. 2. Check the output voltage to make sure it's within 3.0-3.6V.	/1
	The 5V voltage regulator must consistently output voltages between 4.5V - 5.5V given an input of 5.5-6V.	1. Provide a 5.5-6V input signal into the 5V regulator. 2. Check the output voltage to make sure it's within 5.5-6V.	/1
Pressure Sensors	A neutral balanced sitting position with two sensors on both sides of the body should output voltages within 0.1V of each other.	1. Place two sensors directly under the subject. 2. Use a leveler to ensure the user is balanced. 3. Measure the voltages to make sure the difference is within 0.1V (~20 difference in readings).	/3
	A position with an upright or slight lordosis should register readings of over 150 higher than a slouching position. The readings under the thigh and ischial tuberosity should be distributed accordingly (ischial tuberosity should increase as the user applies more pressure to the back).	1. Start with a slouching position such as the slump posture in figure 1 of the design document. 2. Record the readings for the lumbar, ischial tuberosity, and under the thigh. 3. Recline to a flat, long lordosis, or short lordosis position and take the same measurements. 4. The lumbar should register over 150 points higher and the ischial tuberosity should increase while the thigh decreases linearly.	/5

Distance Sensor	Distance readings where the user is leaning as far back as possible in the chair should hold valid values of at least 2 cm.	1. The user should sit on the chair with the distance sensor mounted on the back. 2. Lean back by applying as much pressure as is comfortable on the back. 3. Record the readings of the sensor and confirm the readings are valid	/2
Microcontroller	The microcontroller should be able to decode received bytes that have the form [3:0] one-hot encoded motor ID [7:4] Motor intensity mapping onto the voltage range of 2.3V – 3.3V The intensity should be used to activate the indicated motors.	1. Create a program that sends bytes to all combinations of motor IDs from 0x0 to 0xF 2. Each ID combination should be sent with varying intensities. 3. Verify that the motors are identified in the lower 4 bits and the intensity/voltage changes as the higher 4 bits change.	/4
	Readings from each sensor should be successfully polled by the microcontroller and sent as a CSV row ending with a newline.	1. Have the microcontroller collect sensor data and send them to the computer over Bluetooth. 2. Confirm the CSV format ending in a newline.	/4
Analog Multiplexer	Power dissipation per input must be less than 100 mW.	1. Apply the pressure sensor inputs into the mux. 2. Measure the voltage and resistance to calculate the power as V^2/R.	/2
Bluetooth Module	Between 10 and 25 readings of all sensors should be sent in roughly 1 second.	1. From the computer, have a thread sleep for 1 second. 2. When the thread wakes up, verify that the number of readings in the queue is between 10 and 25.	/3

Vibration Motors	Must be noticeable when sitting on the chair when operating on 3.0V+/-0.3V.	1. Provide a ~3.3V power input to the vibration motor circuit. 2. A user sitting on the motor should be able to identify which motor is active.	/3
	The current draw of each motor must not exceed 120 mA when applying a ramped PWM signal.	1. Supply power to the vibration motors starting from ~2.3V to ~3.3V via PWM. 2. As the intensity/voltage increases, check the current draw and confirm that a single motor does not draw more than 120 mA.	/1
	Must be spaced at least 1.5-2 inches away from the nearest pressure sensor to avoid interference.	1. Obtain a ruler to measure the distance from each vibration motor to the nearest FSR. 2. Verify that the distances from the motors to the nearest pressure sensor is greater than 1.5-2 inches.	/1
Posture Analysis GUI (Software)	Should be able to receive user-inputted calibration information and send it to the posture processing program.	1. The user should be able to enter a “learning rate” number between 0 and 1.0. 2. Check that the posture processing program receives the learning rate.	/4
	Must update the visualizations and posture indications from the posture processor in real-time (around less than 2 seconds of latency).	1. Send posture data to the GUI from the posture processing program. 2. The GUI should update in less than 2 seconds after receiving the new posture data and decisions.	/4

Software	The supervised learning model should be trained with at least 100 samples of bad posture and at least 50 samples of good posture.	1. A poorly trained model cannot accurately classify data that are slightly unusual, so provide various, distinct poses. 2. Record the posture data with the pressure sensors and distance sensor. 3. Check that the positions were correctly classified as good/bad.	/3
	The classification accuracy should be at least 85%.	1. Create a test set of posture data that is separate from the training set. 2. Score the binary posture classifier and verify that at least 85% of the data is correctly classified.	/3
	Calibration should be able to learn various positions indicated by the user (possible to learn “bad” posture as “good”).	1. The user should lean forward until the classifier consistently labels the position as bad. 2. Input a learning rate above 0.5. 3. Check that the new bad posture is now classified as “good.”	/4
	The vibration algorithm should identify the correct motors to activate with 70% accuracy.	1. Apply various biased positions in different directions (left, right, front, back) in a test set. 2. Observe which motors are activated and score the accuracy.	/2
		Total:	/50