Home Fitness Aid

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ECE 445 Point Distribution of R&V - Fall 2020
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The following are the proposed points distribution among the systems in each Requirement and Verification table:

System	Points
Lithium Ion Polymer Batteries	3
Voltage Regulator	6
Battery Charger	4
Microcontroller	13
Inertial Measurement Unit	8
User Interface	12
Wearable	4

Lithium Ion Polymer Batteries

Points: -/3

Requirements	Verification
- Provides a minimum of 350 mAh for wearable unit and sensor unit. - Provides a minimum of 2000 mAh for the computation unit.	1. Connect the 350 mAh charged battery to a power unit mock-up circuit for the wristband microcontroller and sensor unit. 2. Discharge the battery at a rate of 100 mAh. 3. Use a voltmeter to ensure the voltage remains above 3.7 V until the battery is discharged. 4. Repeat steps 1-3 with the 2000 mAh charged battery for the central microcontroller and user interface.

Table 1: Requirement and Verification of Lithium Ion Batteries

Voltage Regulator

Points: -/6

Requirements	Verification
- Provides 1.8 V ± 10% from a 3.7 V - 4.2 V source. - Can operate at a current of ± 10% 0.45 mA. - Operates at an efficiency of 43% at max voltage and 49% at minimum voltage.	1. Using a power unit mock-up circuit connect a 4.2 V source and draw 0.45 mA for the sensor section. 2. Measure output voltage using an oscilloscope and ensure that voltage remains ± 10% of 1.8 V. 3. Verify efficiency by measuring power consumption of voltage regulator and sensor at 4.2 V and 3.7 V and comparing the consumption of regulator and sensor.

Table 2: Requirement and Verification of Voltage Regulator

Battery Charger
Points: -/4

Requirements	Verification
● Charges Li-ion battery to 4.2-4.16 V when a continuous voltage of 4.4-7.0 V is applied.	1. Discharge a Li-ion battery to 3.7 V. 2. Charge battery from the output of the charger from an input of 7.0 V. 3. Using a voltmeter, verify that when the battery is fully charged when at 4.16-4.2 V and does not go beyond this level.

Table 3: Requirement and Verification of Battery Charger

Microcontroller
Points: -/12

Requirements	Verification
● Must successfully transmit and receive 90% of Bluetooth low-energy (BLE) packets over a distance of 5 meters.	1. Run a program that sends BLE heartbeats (1 packet per second) from one microcontroller to another at a distance of 5 meters apart. The program will be run for 1 minute and 40 seconds. 2. Use IO pins from the receiving microcontroller to display the number of packets received on the screen. 3. Divide number by 100. See if the result receives at least 90-100% of packets.

Table 4: Requirement and Verification of Microcontroller

Inertial Measurement Unit

Points: -/13

Requirements	Verification

- The inertial measurement unit must sample data at a rate of at least 50 measurements a second. - Accelerometer must have a precision of at least ± 1.0 m/s^2.	1. Test sampling rate:
	   a. Test sensor by connecting it to a development board and run it at a high frequency mode (should be greater than 100 measurements per second).
	   b. Count the number of measurements every second through the development board. Display that number through a computer screen.
	2. To test the precision of the accelerometer, drop the sensor onto a soft surface at a height of less than 1 meter. Check if the measurement matches 9.8 m/s^2 with a margin of error of ± 1.0 m/s^2.

Table 5: Requirement and Verification of Accelerometer and Gyroscope

LCD Display(UI)

Points: -/9

Requirements	Verification

● Active screen area must be at least 40 x 50 mm large.
● The pixels per inch (PPI) must at least be 100 for readability.
● Touchscreen must be functional and accurate within an error of ± 8 pixels.
	1. Measure the dimensions of the active screen area with a ruler
	2. To test readability:
	   a. Try to display 3mm tall ASCII characters on the screen. Check if the font is clear and readable.
	   b. To find PPI, take the pixels of the length of the display and divide by the measured length in inches.
	3. To test the accuracy of the touchscreen:
	   a. Have the microcontroller load a single chosen pixel and note the coordinate
	   b. Use a stylus to pinpoint and touch the pixel on the screen
	   c. Read coordinates from the microcontroller and ensure it is within 8 pixels radius of the original pixel within a margin of error of ± 10%.

Table 6: Requirement and Verification of LCD Display

Processing Unit Case(UI)

Points: -/3

Requirements	Verification
● Must weigh less than 3 pounds for portability.	1. Place the finished case with electronics on a scale to measure weight. Ensure the weight is less than 3 pounds within a margin of error of ± 10%.

Table 7: Requirement and Verification of Processing Unit Case

Wearable

Points: -/4

Requirements	Verification
● Band must comfortably fit a person's arm or ankle from a circumference of 6 inches and 10 inches. ● Case must weigh less than 1.5 pounds.	1. Measure the circumference of the band at its smallest form, and once again at its largest stretched. Ensure the values of 6 inches and 10 inches are within this bound. 2. Place the finished wearable with electronics on a scale to measure weight. Ensure it is less than 1.5 pounds within a margin of error of ± 10%.

Table 8: Requirement and Verification of the Wearable