Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Team 60: Solar Lighting System
Bi-Weekly Update 2

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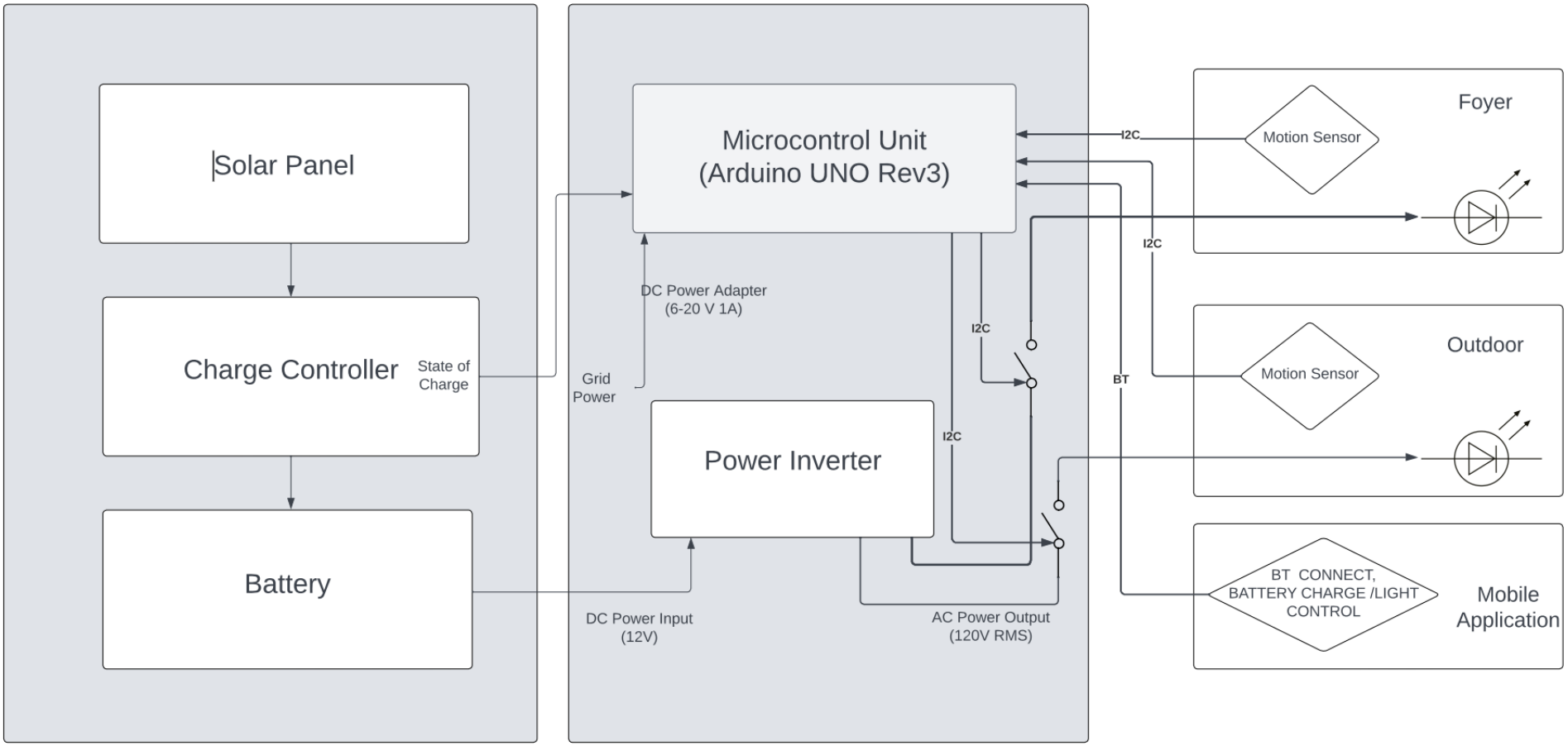
TA: Rhett Guthrie

Project Summary

- A need for clean, renewable sources becomes more apparent than ever.
- Our home indoor and outdoor lighting system is the first step towards this, using **solar power.**
- Design an indoor/outdoor home lighting system that operates with a battery, power conversion, mobile application functionality, BT microcontroller for switch automation from motion sensors.

Project/Subsystem Overview



Project Timeline

Subsystem Designs (completed 01/16)	Subsystems ordered and soldered (2/14)	Integration of Bluetooth and Arduino (to complete by 2/21)	Integration of Solar Charge Controller and MCU (3/1)	Final Integration (to complete by 3/15)	System Test (to complete by 3/21)	Validation (to complete by 3/25)	Demo and Report (to complete by 4/1)

Solar Charge Controller

Lyric Haylow

Accomplishments since last update 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Parts for PCB arrived a week ago - PCB board ordered, expected to arrive within 3 days	- Solder board when arrives, immediately start testing - Working on 3D model for sensor holder and microcontroller enclosure - Design board/system for reading battery percentage to Arduino for Bluetooth

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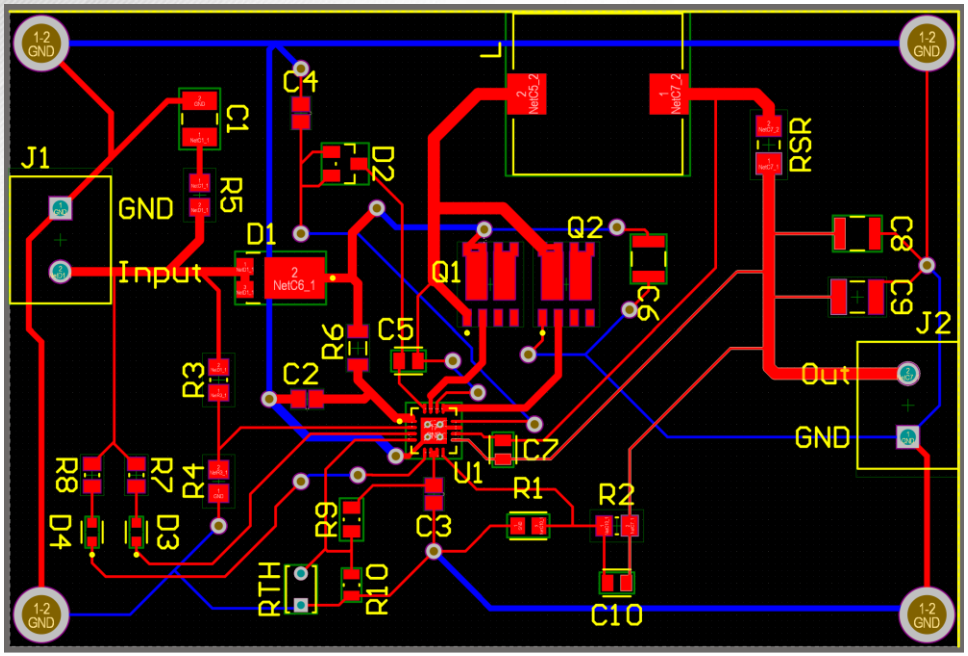
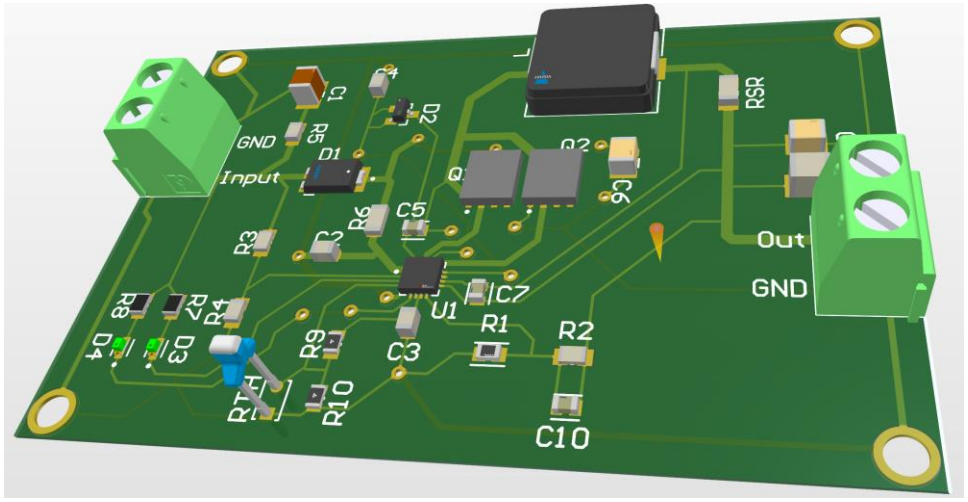
Solar Charge Controller

Lyric Haylow





Inverter Subsystem

Jeb Malek

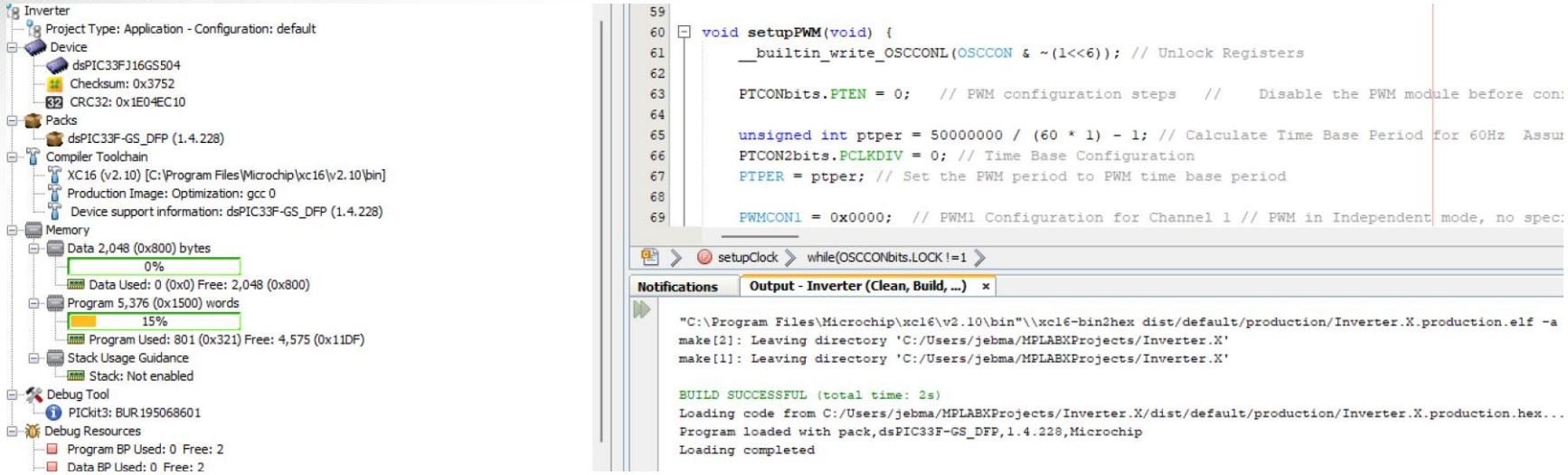
Accomplishments since 403 25 hrs of effort	Ongoing progress/problems and plans until the next presentation
PCB Assembled dsPIC in-circuit programming Gate drive signal validated Power transformer voltage validated	Testing & Validation of Signal to Switches and Transformer Drivers Apply Battery Power and Check Transformer Voltage Levels Check Output from Full Bridge

- Evaluated PWM Timing configuration to avoid shoot through to protect MOSFETs.

  Validation of In-Circuit Programming

Inverter Subsytem

Jeb Malek



Verification of MCU Programing

<u>DSPIC33FJ16504 Specifications</u>

Maximum Duty Cycle Resolution 1.04ns

System Clock 50 MHz

Normalized Sine Wave Lookup Table b/t 0 – 1 for Unipolar Switching Function

Timing mechanism: True Independent Mode

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Microcontroller Subsystem

Jeb Malek & Josh George

Accomplishments since 403 25 hrs of effort	Ongoing progress/problems and plans until the next presentation
Relays Ordered Passive Infared (PIR) Sensors Ordered Light Cord & Socket Ordered Verified connection for Arduino MCU Programming	Testing of Sensor proximity & distance Testing of Relay Communication with Arduino Testing of Relay with Light Load

- Evaluated Sensor Communication of requirements for Arduino
  Body Sensor Signal High at 150uA
- Future Test Light Bulbs with Socket and begin design of demonstration structuring

Microcontroller Subsytem

Jeb Malek & Josh George

PIR Motion Sensor
HC--SR501
Operating Voltage: 4.5 – 20V
Delay time: 5-18S
Block time: 2.5S

Microcontrolled Solid State Relay
Rated: 10 Amps

Light Socket
Rated: 375 W
E26 E27 Bulbs
Switch for Manual Testing

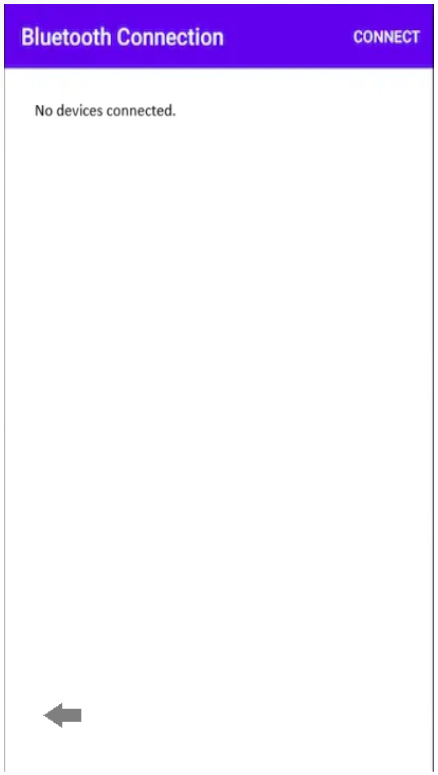
Mobile Application

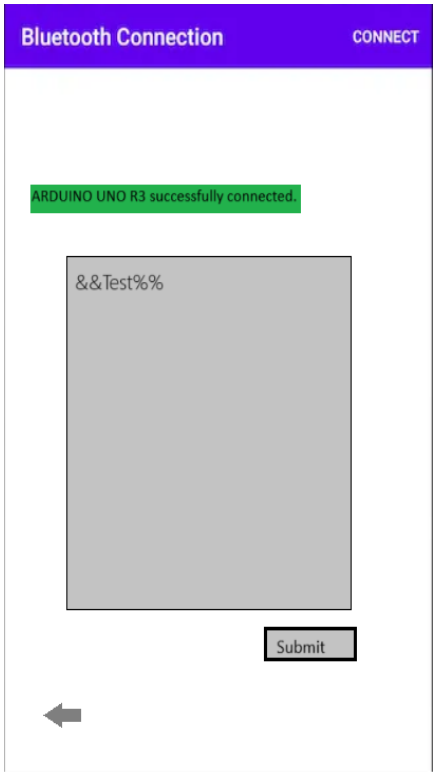
Josh George

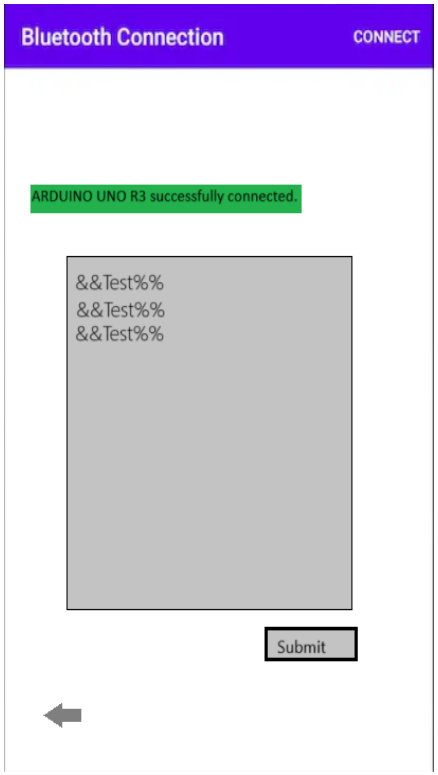
Accomplishments since last update 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
-Added Bluetooth screen listing available devices -Finalized Bluetooth connection to Arduino R3 -Implemented rotation of app	-Begin coding microcontroller -Decide pin inputs and outputs

Mobile Application

Josh George







Parts Ordering Status

- Full Part Shipment for Inverter expected : Week of 2/5
- Parts for new Charge Controller PCB arrived.
- Final Parts for preliminary version Inverter
- Sensors need to be ordered.
- Sensors, relays, and sockets are ordered, ETA roughly one week.

Execution Plan

TASK	21-Jan-24	28-Jan-24	4-Feb-24	11-Feb-24	18-Feb-24	25-Feb-24
Application						
Bluetooth Widget						
Bluetooth Screen						
Working Connection to Arduino						
Data input to MCU						
Data output to MCU						
Battery Preferences						
Complete Interface						

Execution Plan

TASK	21-Jan-24	28-Jan-24	4-Feb-24	11-Feb-24	18-Feb-24	25-Feb-24	3-Mar-24	10-Mar-24	17-Mar-24	24-Mar-24
Solar Charge Controller (SCM)										
Solar Panel Testing										
Order Parts										
MK2 PCB Designing & Ordering										
Soldering Solar-PCB-Battery										
Design 3D print enclosure										
Solar-to-MPPT Testing and Verification										
Implement System										
Test Battery Charging over time										
Integrate with System										

TASK	21-Jan-24	28-Jan-24	4-Feb-24	11-Feb-24	18-Feb-24	25-Feb-24	3-Mar-24	10-Mar-24	17-Mar-24	24-Mar-24
Power Inverter										
Load Measurements, Operating Conditions										
Topology Selection for DC/AC Inverter										
Pulse Width Modulation Switching Part Select										
PWM Pure Sine Wave Schematic Verification										
Inverter PCB Design										
Inverter PCB Soldering										
MCU Programming										
Battery Input Verification										
Transformer/Voltage Verification										
Power Regulation Verification/System Integration										
Switching Verification										
Full Load Support Testing										
Full Load Solar Light System Demo										

Validation

App Requirements				
3.2.5.1	App Connection to phone Via USB	Android studio establishes a connection with Android phone when connected via micro USB	Beginner code in android studio	
3.2.5.2	App Connection to phone Via APK F	Android studio establishes a connection with the Android phone when the app is downloaded on the phon	Beginner code in android studio, uploaded through Bluetooth	
3.2.5.3	Establish Bluetooth Connection wit	Able to connect to a bluetooth capable device and detect the serial number	Work with microcontroller Bluetooth package to connect to android studio	
3.2.5.4	Bluetooth Communication via App	App displays screen with good connection.	Make sure code runs successfully on Android device	
3.2.5.5	Main Screen	App is able to display a home screen	Code home screen in Android studio, make sure it runs, debug errors.	
3.2.5.6	Data from Charge Controllor	App is able to connect to charge controller and accurately display readings.	Understand how charge controller connects to MCU, adapt code accordingly.	
Solar Panel Battery Charge				
3.2.1.1	Solar Panel Mount	Stays in space mounted for several days time	Verifying Hardware is properly mounted	
3.2.1.2	MPPT Functionality	MPPT is working as expected within the IC	Set higher voltage than MPPT, check whether IC brings voltage down to set MPPT voltage level.	
3.2.1.3	Charge Controller Verification	Voltage levels are modulated along with Current Levels	Steadily increasing current will be applied to charge controller, to point of max expected	
3.2.1.4	Overvoltage Solar Panel Protection	Supply voltage levels do not exceed IC limits	Sending a increasingly higher voltage through the charge controller, eventually checking it functions as predicted	
3.2.1.5	Overcurrent Battery Protection	Charging current levels do not exceed expected input values	When charging battery, consistently measuring charging current upon increasing supply voltage using DC power supply	
3.2.1.6	PWM EMI Interference	Interference does not significantly alter design guidelines	Use a Broadband RF meter if one available, if not then the Oscilloscope to identify interference points.	
3.2.1.7	Battery Charging to Capacity	Battery stops being charged once it has a full charge	Feeback voltage will be applied back to IC as shown in documentation	
3.2.1.8	State of Charge (SOC)	Measurement for current State of Charge coincides with expected values	Measure the voltage with a multimeter and convert measured voltage to approximate power percentage expected	
3.2.1.9	Depth of Discharge (DOD)	Measurement for current State of Charge coincides with expected values after discharge	Measure the voltage with a multimeter and convert measured voltage to approximate power percentage expected	
Power Inverter Characteristics				
3.2.2.3	PWM EMI Interference	Amplitude modulation ration falls in desired values for correct switching frequency EMI	In a unipolar switching topology the pulse width modulated signal should be a desired value to obtain suit	
3.2.2.5	Output Voltage	Inverter will supply a steady 120 VAC RMS value	With an attached load a benchmark of current drawing configurations to satisify stable pure sine wave voltage of 120 RMS	
3.2.2.6	Output Frequency	Inverter will supply a steady output sinusoid at a frequency of 60 Hz	Proper inverted sine waves shall operate at normal operating constraint of 60 Hz	
3.2.2.7	DC/DC Conversion	Inverter will supply 3.3 V / 1 A USB-C regulated output	Attaching E-Load to Inverter USB-C Receptacle provides 3.3 V load at varying currents	
3.2.2.8	Output Stability	Output Voltage Ripple demonstrates acceptable output harmonic components below certain THD	Measurement with Oscilloscope and E-Load with charging and discharging states can cause voltage flucuation	
3.2.2.9	Varying Loads	Inverter will supply light loads of varying configurations	Measurement with Oscilloscope and E-Load with benchmark loads attached while charging, discharging, in all modes of operati	
Microcontroller and Sensor Characteristics				
3.2.3.1	Sensor Detection Rate	The indoor sensor miss rate does not exceed 5% and outdoor sensor miss rate does not exceed 10%	Move an object within detection ranges over a 30 min duration. Monitor for detected objects using its output.	
3.2.3.2	Response Time	The time from sensor detection to a I/O signal heading to the relay must be less than 2 seconds	Measure time between output of sensor detection and output from microcontroller to relays.	
3.2.3.3	Bluetooth Connectivity	Microcontroller is able to connect to a mobile device via Bluetooth	Use multiple devices and connect to the microcontroller via bluetooth.	
3.2.3.4	Peripheral Input Voltages	The input voltages of the microcontroller and peripherals shall be 3V-3.6V	Use a multimeter to validate.	
3.2.3.5	Application Communication			
3.2.3.6	System Integration	Arduino receives communication from motion sensors, Verified mobile application instruction	Check Logs of Arduino Bluetooth Communcations with Debugging circuit / application logs for sensor data continuity	
3.2.3.7	Response Time			
3.2.3.8	Response Time			

Thank you , 404 Classmates