Active Windows FPR

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Good afternoon!

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User Interface
Website Czar

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Budget Manager

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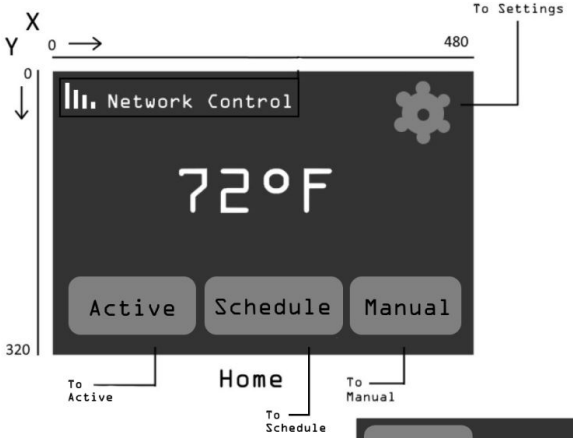
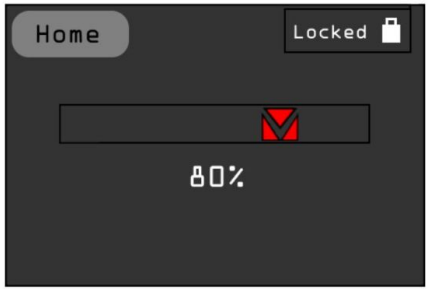
Sensors
Altium Lead

Shira Epstein
Faculty Advisor &
Enormous Help

Our Problem Statement

Goal: Design a user interface that forwards environmental data from sensors to a server and allows a user to input scheduling information that controls windows in their house.

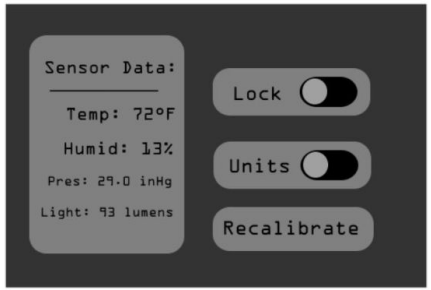




Sliders (MANUAL)

Active

Schedule



Settings

Updated System Specifications

The Active Window - Window Primary Control Module will meet or exceed the following system specifications:

1. Supports communication with network via WallBus (CAN Bus)
2. Supports communication with inter-window motors via WindowBus (CAN Bus)
3. Allow the user to set the height of the window
4. Allow the user to create a time schedule to open/close parts of the window
5. Allow the user to stop smart capabilities of the window, returning it to a simple mechanical device
6. Measure temperature, humidity, air pressure, and light inside and outside the room
7. Display the position of the window
8. Ability to enter Sleep mode when not being used, can enter Active mode upon user touching screen
9. Volume (LxWxH): 1,536 cubic cm. (12 x 16 x 8 cm) (93.7 cubic in. (4.72 x 6.30 x 3.15 in))

Decision to not use Custom PCB

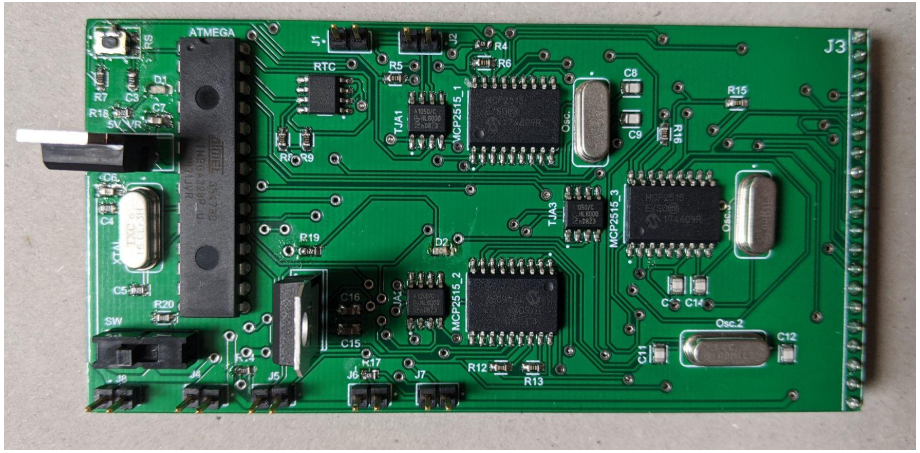
- Custom PCB Testing/Debugging Issues
  - PCB did not power Up
    - Trace continuity checks
    - Resoldering of parts sequentially
  - Improper Outputs from Voltage Regulators
    - Debugged 5V regulator and 3.3V regulators
    - Power to LCD
  - Time constraints with further testing and reordering of PCB
  - Certain parts like the BME280 were out of stock

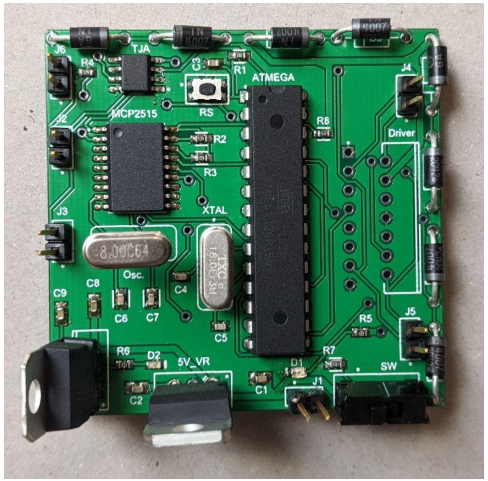
- Used soldered protoboards
  - All chips are properly soldered and connected using schematics
  - System functions as intended
    - User can interact with the LCD to control the motor
    - Motor responds effectively to CAN commands
    - Sensors read accurate data

Final Demo

Populated PCBs

- **4 separate PCBs**
  - WPCM
  - WMM
  - Indoor Sensor
  - Outdoor Sensor
- **Main Components**
  - Atmega328p in each board
  - Canbus modules in each board
    - 3 in the WPCM board
    - 1 in the other boards
  - RTC in WPCM
  - BME280 in indoor sensor board
  - BME280+Light sensor in outdoor sensor board
  - Motor module in the WMM board
- **Power Supply**
  - 9V supply for each board
  - 3.3V and 5V voltage regulator on each board





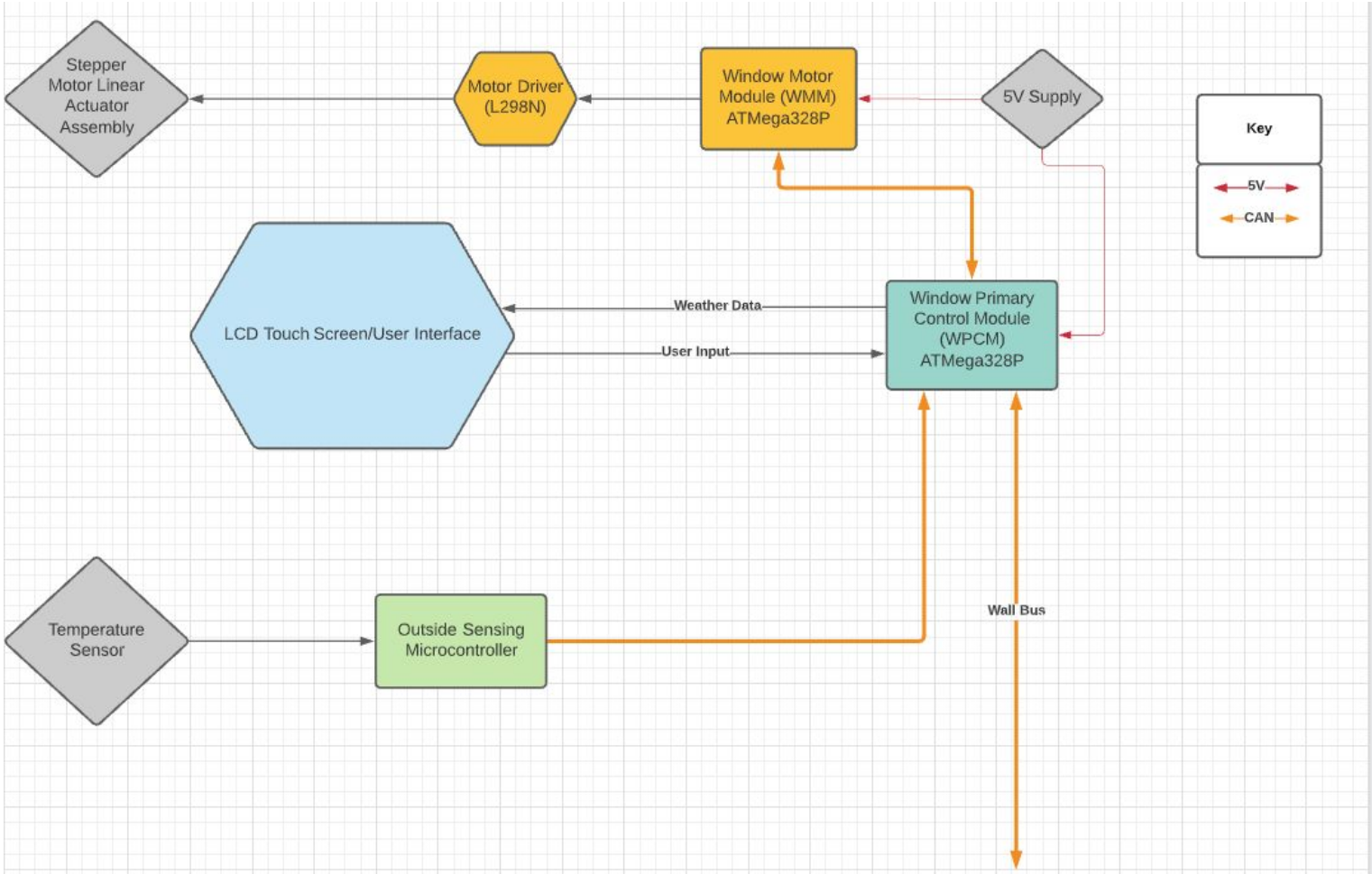
Summary of System

- System uses three MCP2515 CAN controllers to receive and send information about motor position and sensor data across the network

- LCD screen allows user to switch between modes, adjust the motor’s position via a slider, and displays the temperature

- Communication to the CAN controllers occurs over a prototyping board.

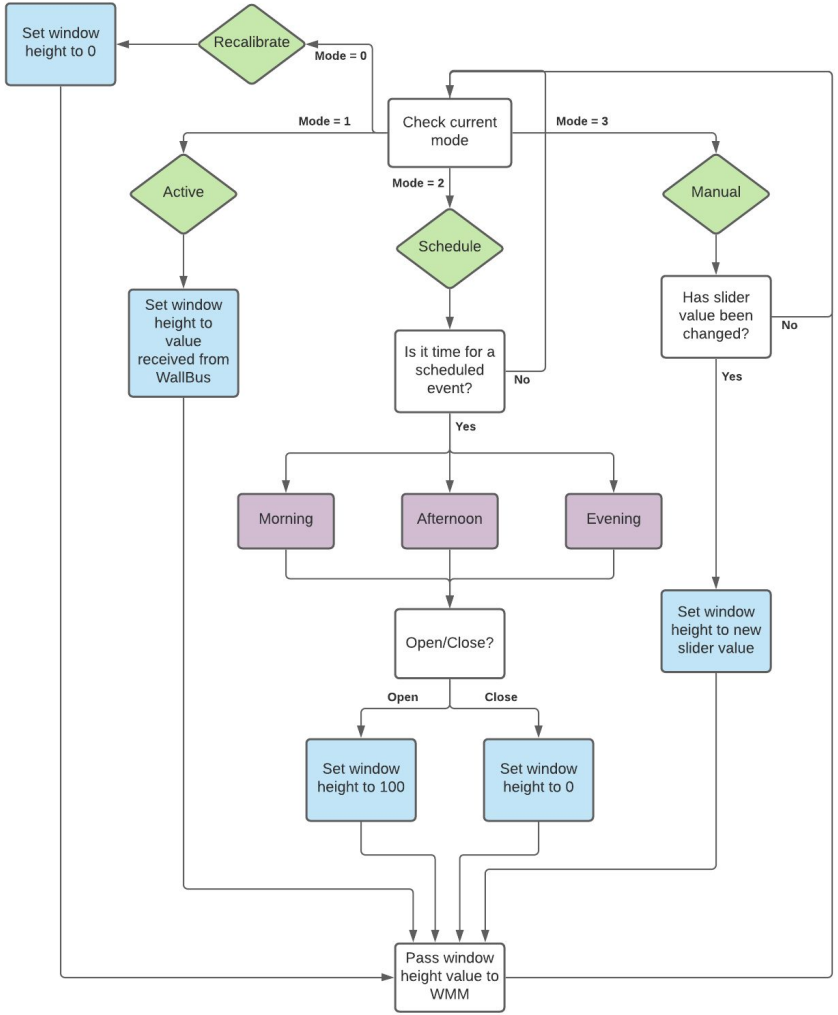
Hardware Overview



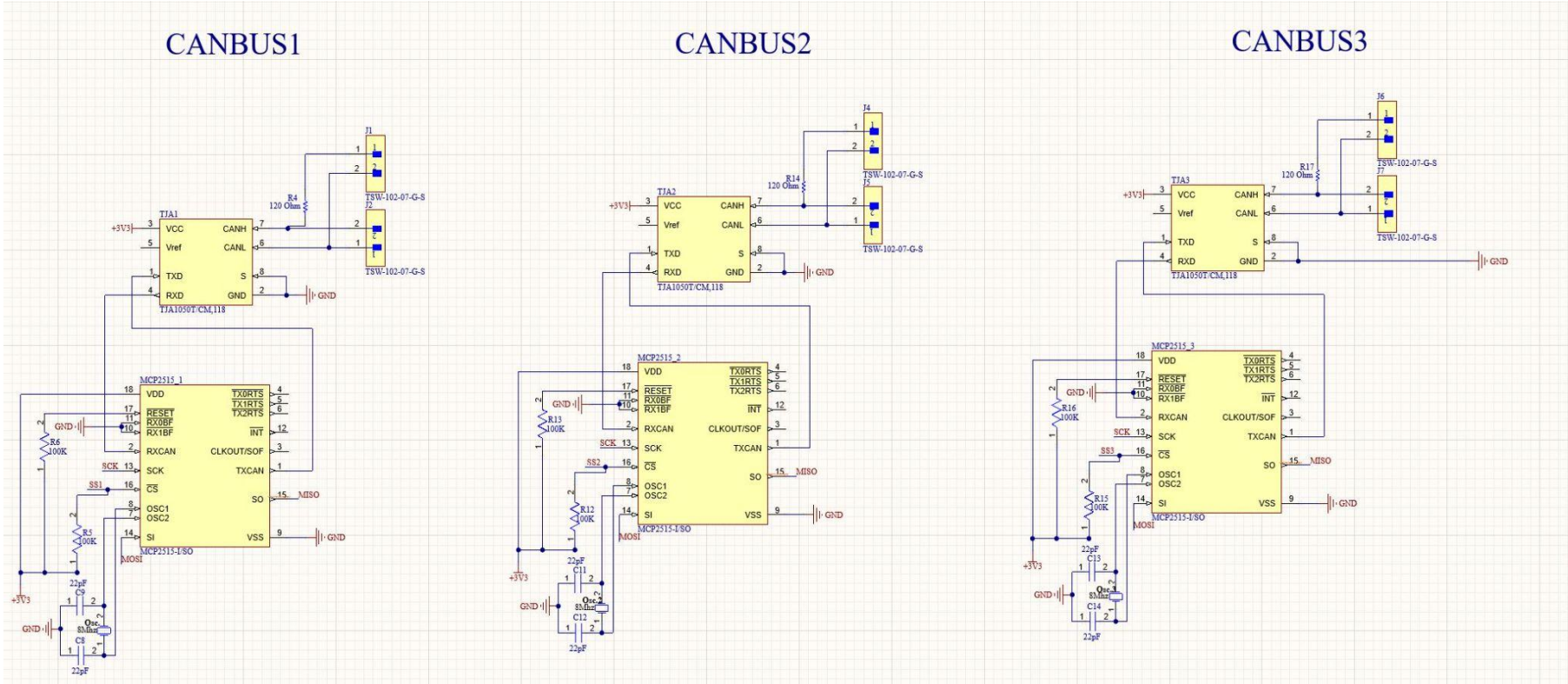
Software Overview

Window works in 3 modes *(and 1 function)*:

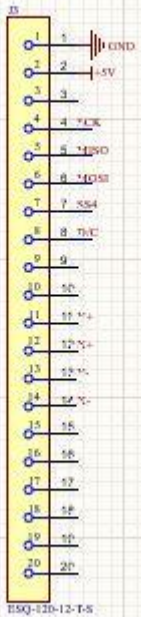
- **Active Mode** - WPCM forwards sensor data from MCP2515 to WallBus, which then returns the desired height of the window
- **Schedule Mode** - User enters preset commands based on 3 popular times of the day. When time of day is reached, the height command is set for the window
- **Manual Mode** - User adjusts the window height in real-time via a slider on the LCD display
- ***Recalibrate*** - Forces the window to close until limit switch is hit. Useful due to drift in our linear actuator



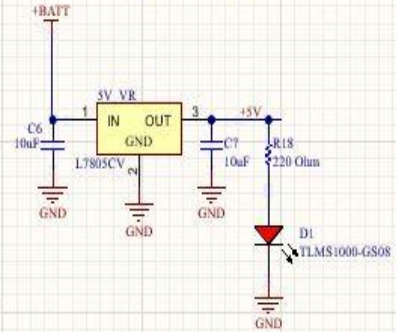
WPCM Schematics



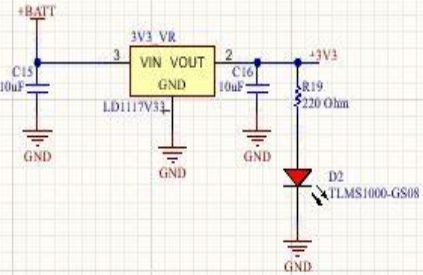
LCD HEADER



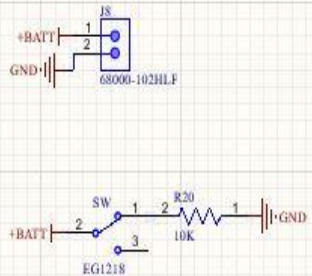
5V Voltage Regulator



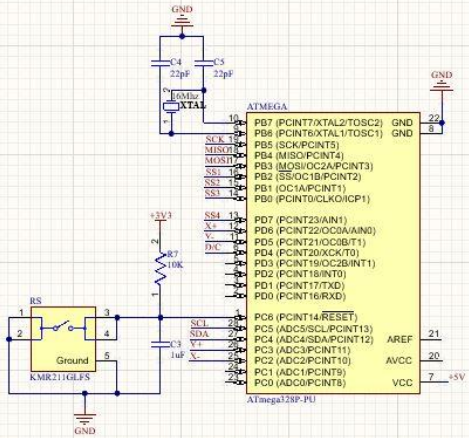
3V3 Voltage Regulator



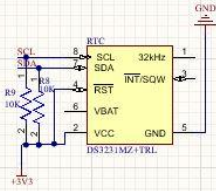
BATTERY HEADER



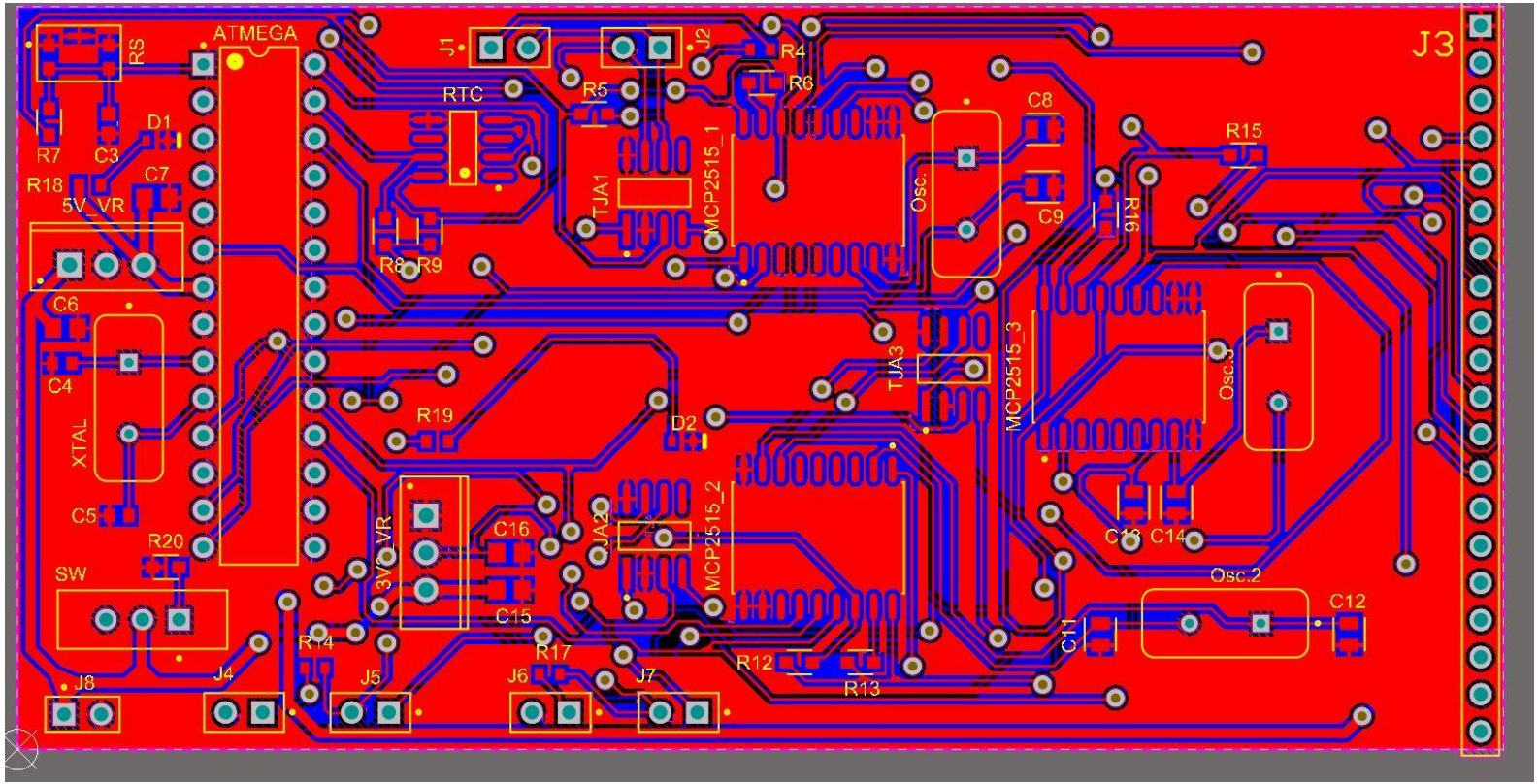
MICROCONTROLLER



RTC

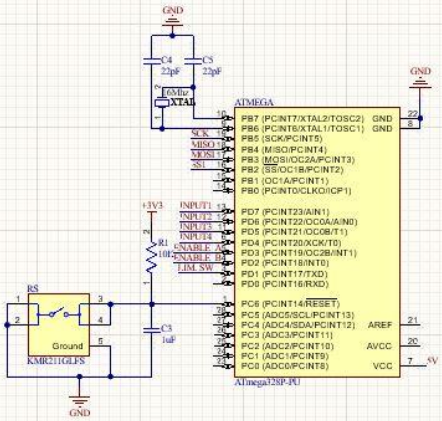


WPCM Layout

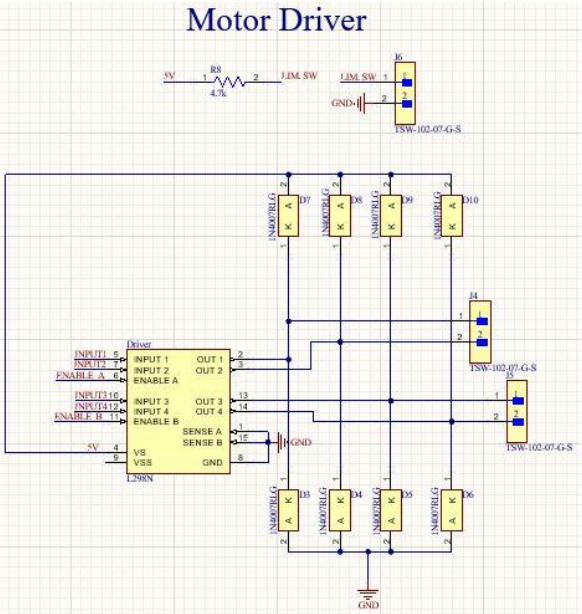

ATMEGA
RS
J1
J2
J3
RTC
R4
R5
R6
C8
R15
D1
R7
C3
R18
C7
5V_VR
TJA1
MCP2515_1
Osc.
C9
R16
R8
R9
C6
C4
XTAL
C5
R19
D2
TJA3
MCP2515_3
Osc.3
R20
SW
3V3_VR
C16
C15
TJA2
MCP2515_2
C13
C14
Osc.2
C12
C11
R14
R17
R12
R13
J8
J4
J5
J6
J7

WMM Schematics

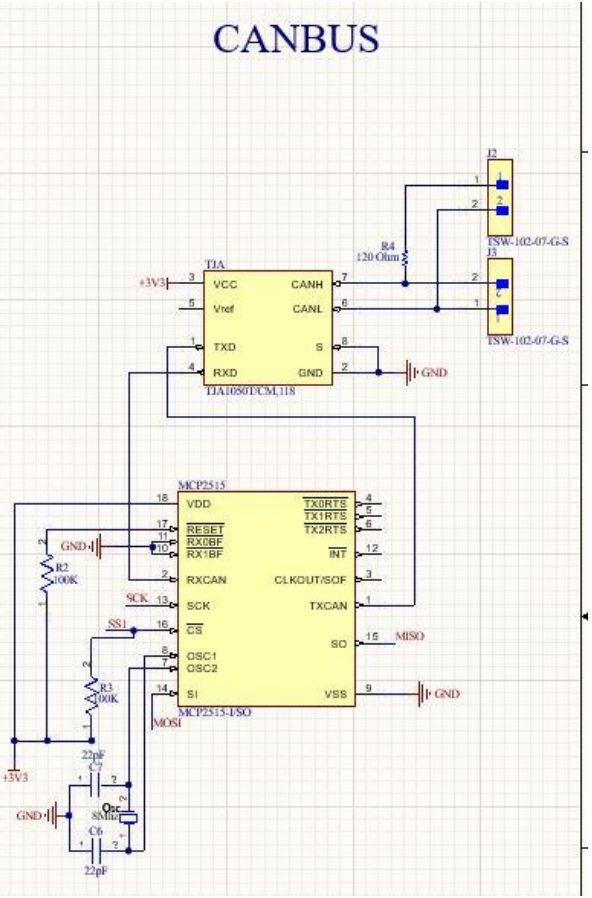
MICROCONTROLLER



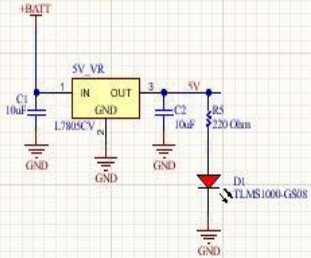
Motor Driver



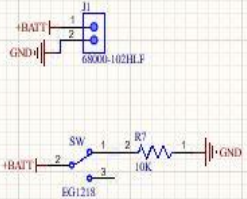
CANBUS



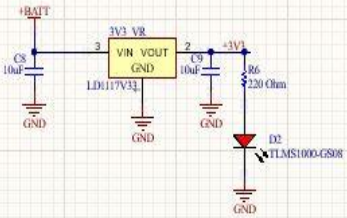
5V Voltage Regulator



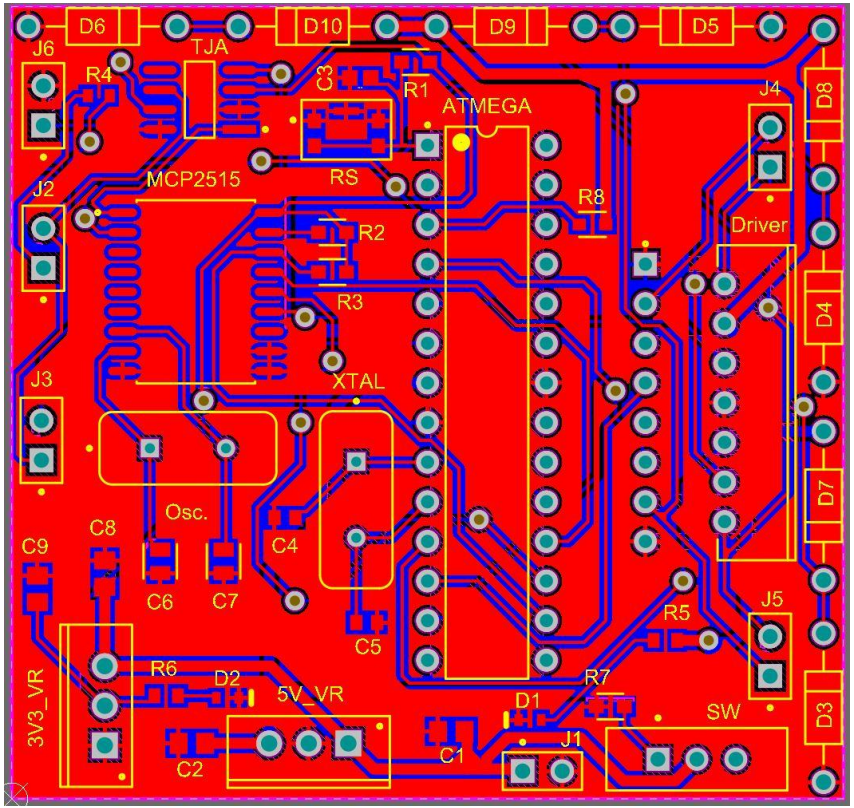
BATTERY HEADER



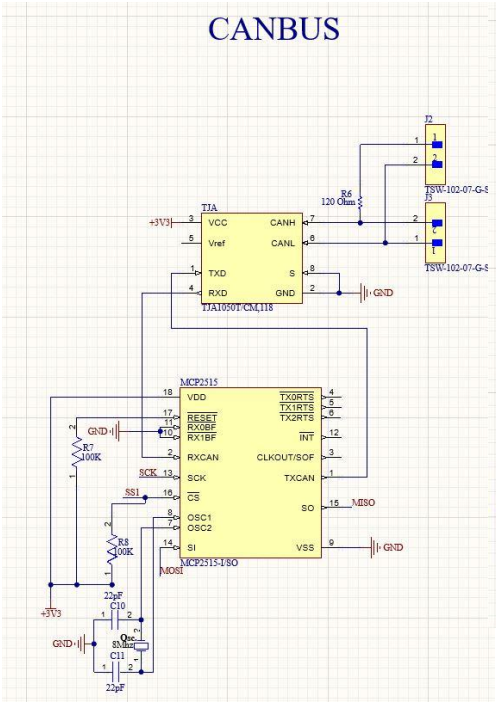
3V3 Voltage Regulator

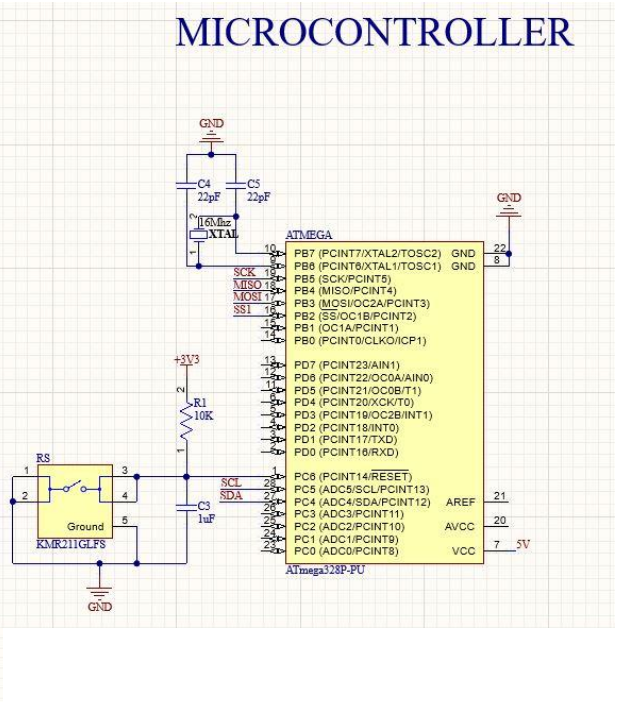


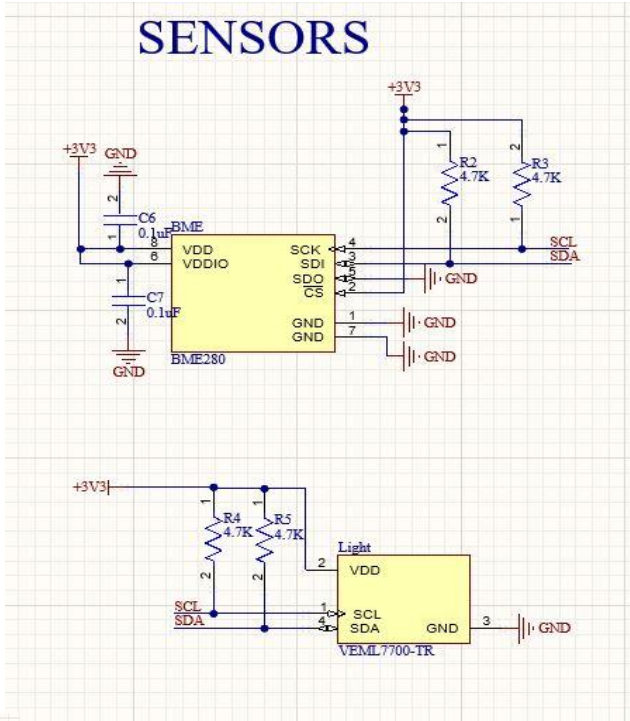
WMM Layout

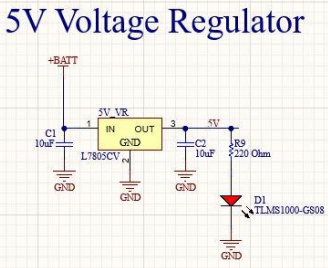

D6
D10
D9
D5
J6
TJA
R4
R1
ATMEGA
J4
D8
J2
MCP2515
RS
R8
R2
Driver
R3
D4
J3
XTAL
Osc.
C8
C9
C4
C6
C7
J5
R5
C5
R6
D2
5V_VR
R7
D1
SW
D3
3V3_VR
C2
C1
J1
D7

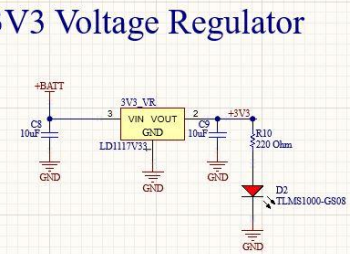
Sensor Board Schematics

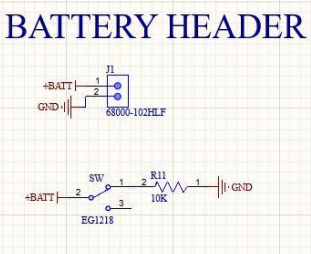




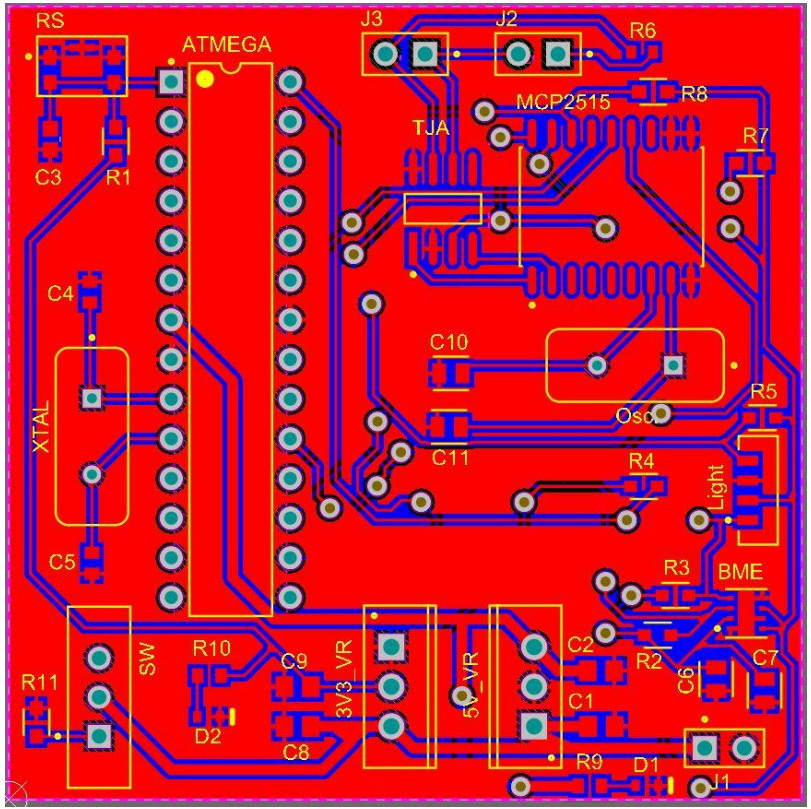








Sensor Board Layout



Thank You!