Active Windows MDR - Presentation

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HELLO AGAIN!

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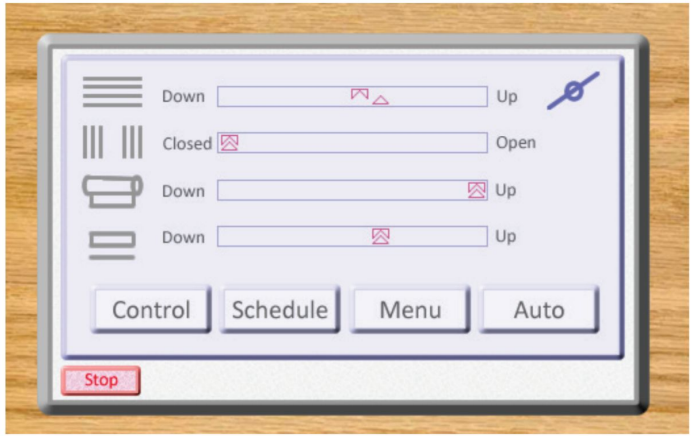
Faculty Advisor &
Enormous Help

Our Problem Statement

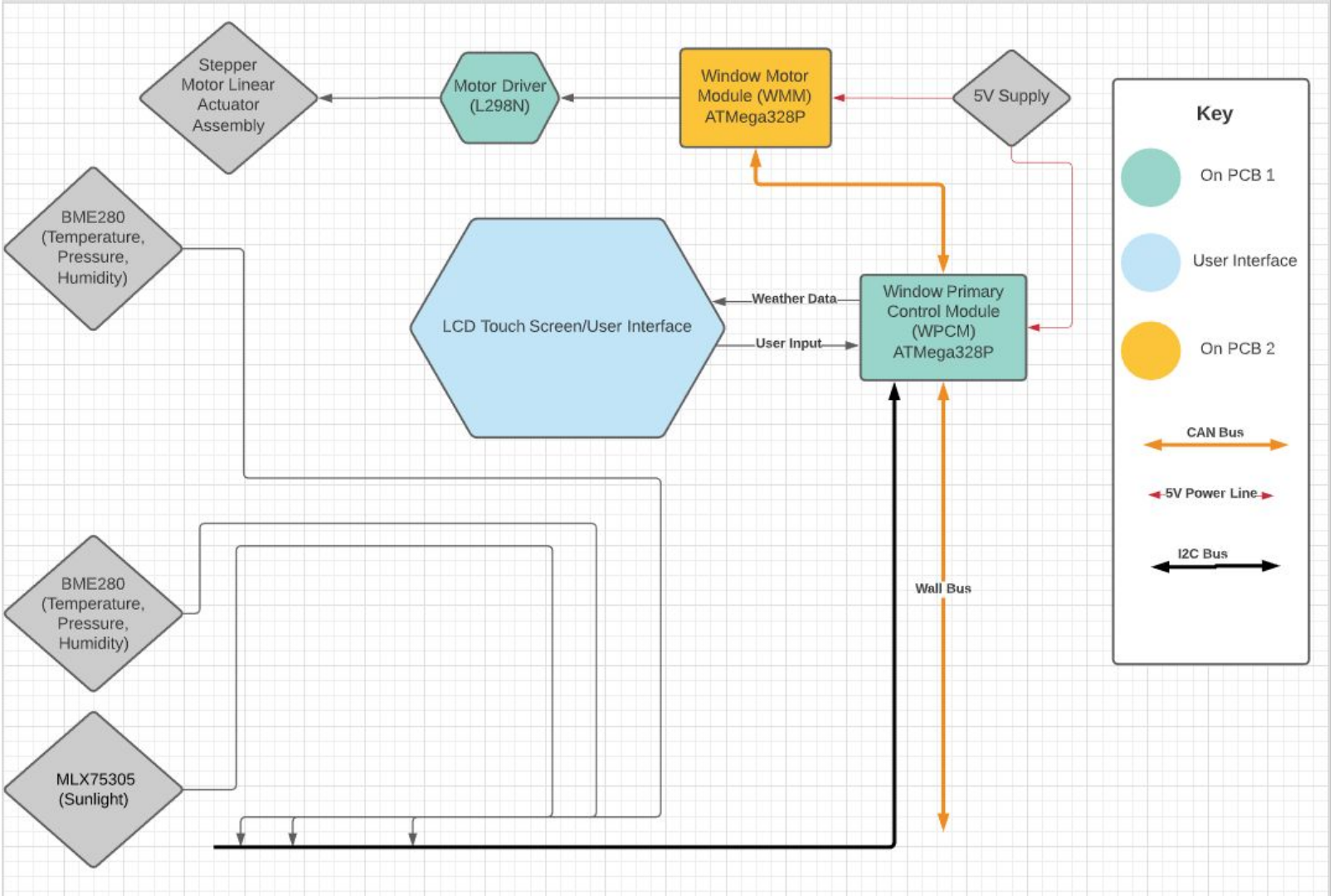
Goal: Design a user interface that utilizes environmental data from sensors to allow a user to receive scheduling information that controls windows in their house.



Updated System Specifications

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

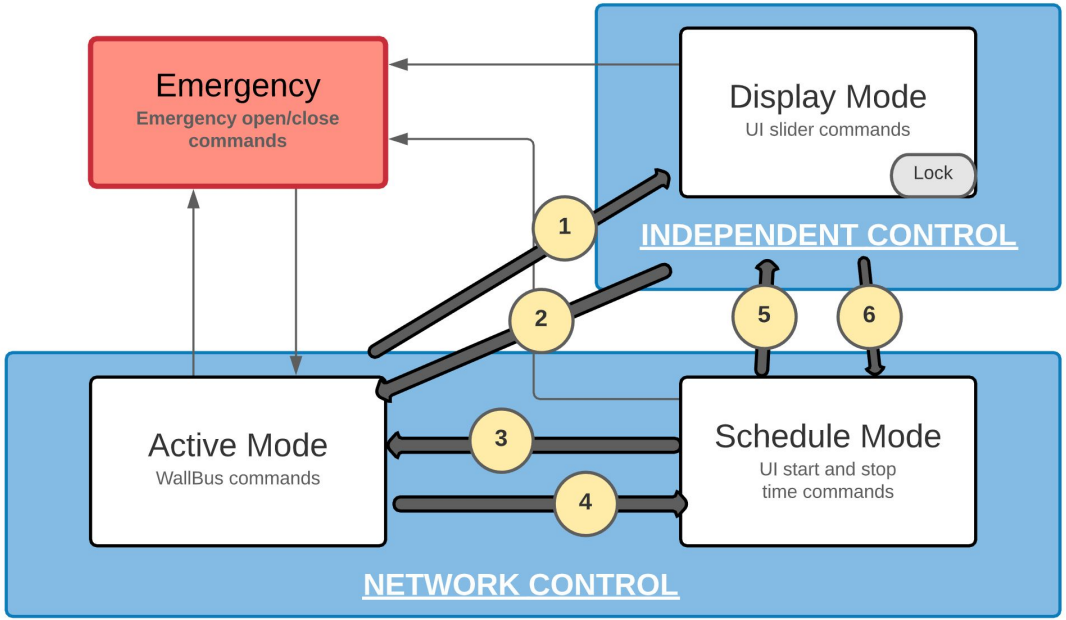
1. Supports communication with network via WallBus (CAN Bus)
2. Supports communication with inter-window motors via WindowBus (CAN Bus)
3. Allow the user to set the height at which the window, thermal cover, and blinds are opened/drawn
4. Allow the user to create a time schedule to open/close parts of 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 height at which the window, thermal cover, and blinds are opened/drawn
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))
10. ~~Last more than 50 years before needing replacement~~


Stepper Motor Linear Actuator Assembly
Motor Driver (L298N)
Window Motor Module (WMM) ATMega328P
5V Supply
BME280 (Temperature, Pressure, Humidity)
LCD Touch Screen/User Interface
Weather Data
User Input
Window Primary Control Module (WPCM) ATMega328P
BME280 (Temperature, Pressure, Humidity)
MLX75305 (Sunlight)
Wall Bus
Key
On PCB 1
User Interface
On PCB 2
CAN Bus
5V Power Line
I2C Bus

Active Window Command Hierarchy

4 Modes:

- **Active:** WallBus commands determine window height
- **Display:** User sets height via touch screen
- **Schedule:** User sets schedule to open/close window to
- **Emergency:** Activated via network, waits to receive “All clear”



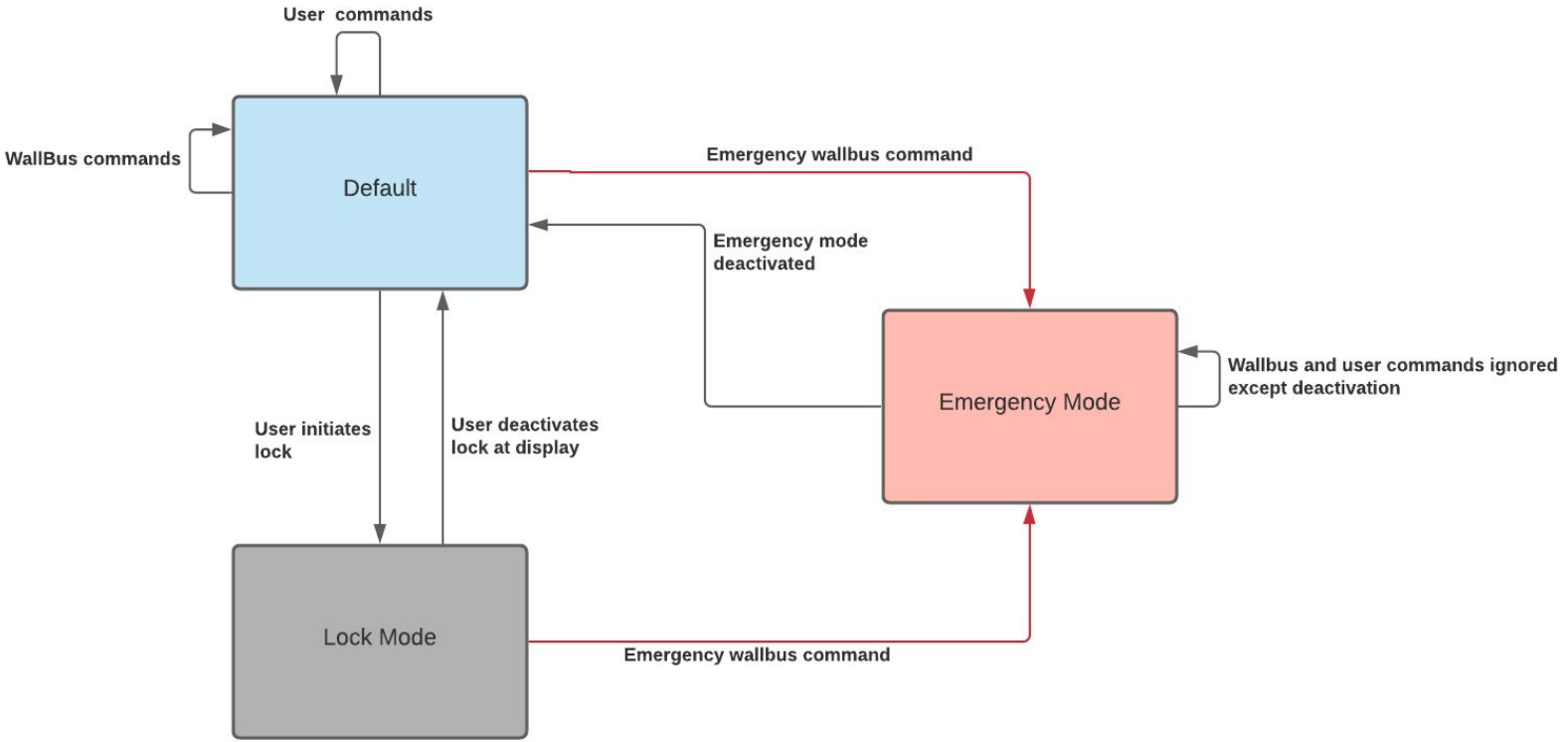
Emergency commands will always have priority, while selected mode commands will come second:

1&2. User can switch between Active and Display mode at the touch screen at any time. ***Lock*** function will prevent anything (WallBus, sliders, or schedule) except **Emergency** commands from changing the window height. ***Lock*** can only be set/unset from the touch screen.

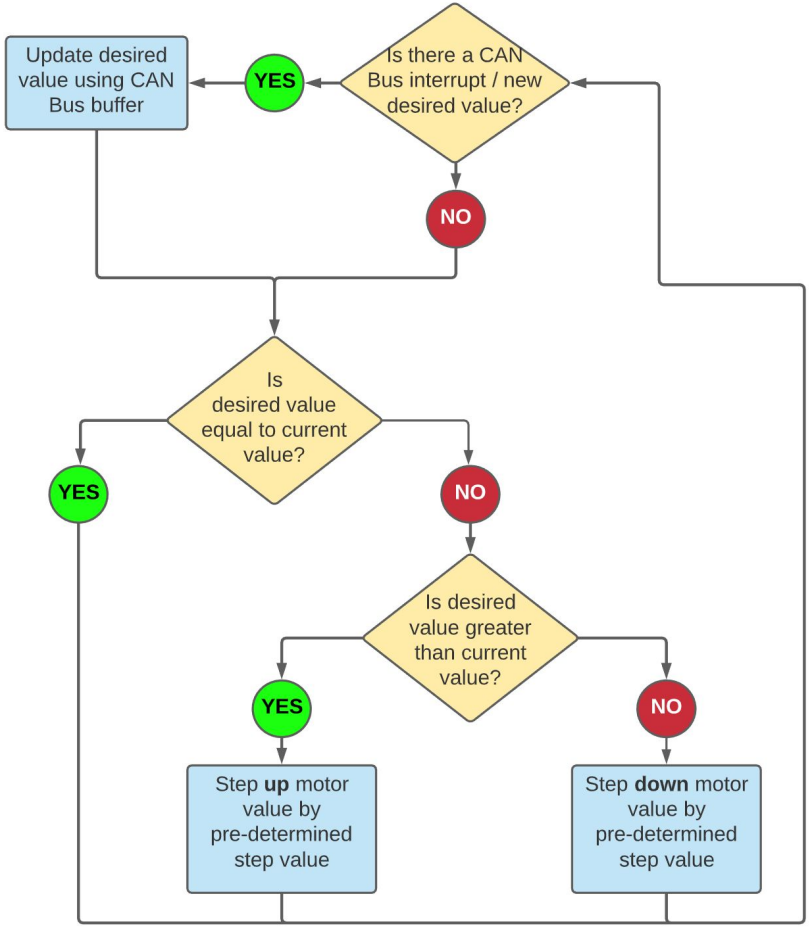
3&5. User can decide to switch into Active or Display mode once their schedule command finishes (or switch to Display by interrupting the schedule).

4&6. Schedule Mode will be automatically entered when a scheduled start time is reached.

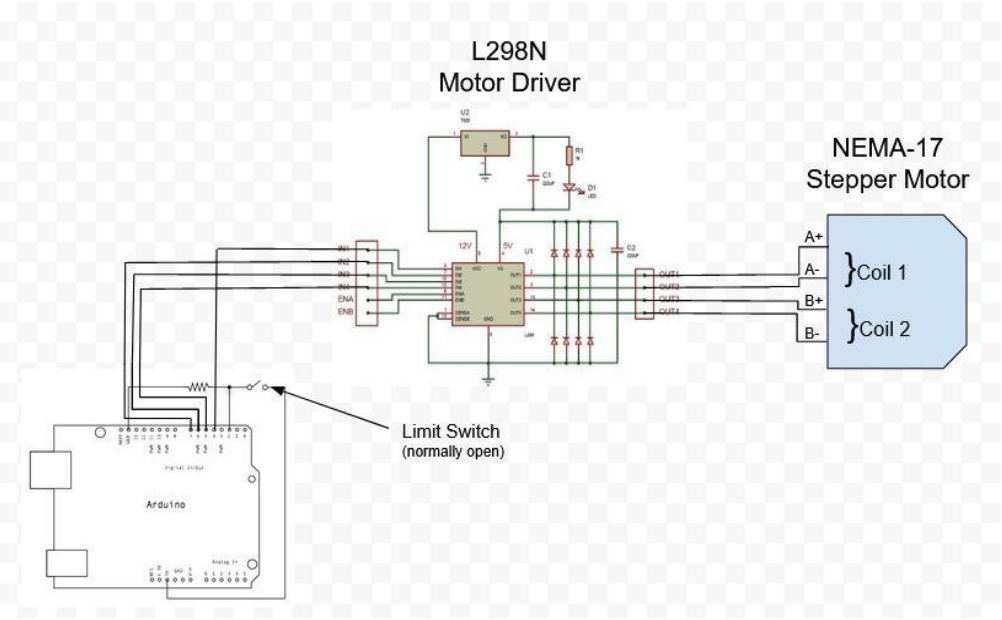
Updated Software Diagram (WPCM)



Updated Software Diagram (WMM)



Deliverables - Motor Control



Installed Features

- Homing position upon system initialization
- Specific distance control via user input
- Directional control via user input
- Integration with CanBus: able to receive and execute CanBus communications
- Directional Control
- Can Demo

https://www.arduino.cc/en/Tutorial/BuiltInExamples/Button
https://components101.com/modules/l293n-motor-driver-module

Deliverable - User Interface [Display Demo]

What We Have Done:

- **Transferring data to / from Touch Screen (MDR GOAL)
- Main Menu
  - Allows user access between different window toggles (Network and Manual)
- Slider Menu
  - Allows user to set values for window height, thermal cover, and blinds
  - Displays slider percentage to user

What We Plan to Design:

- A CAN bus communication line between the Touch Screen and motors
- Communication between the sensors and display (to show current temperature in the room, override Manual mode)
- Allow user to input automatic schedule through Schedule Menu

CAN Bus

- 2-Wire Interface - Uses only two wires to communicate
- Asynchronous - There is no clock signal
- Multi-Master - Any device in the network can be either a master or a target device
- Bitwise Arbitration - Device that sends first zero gains control of the bus

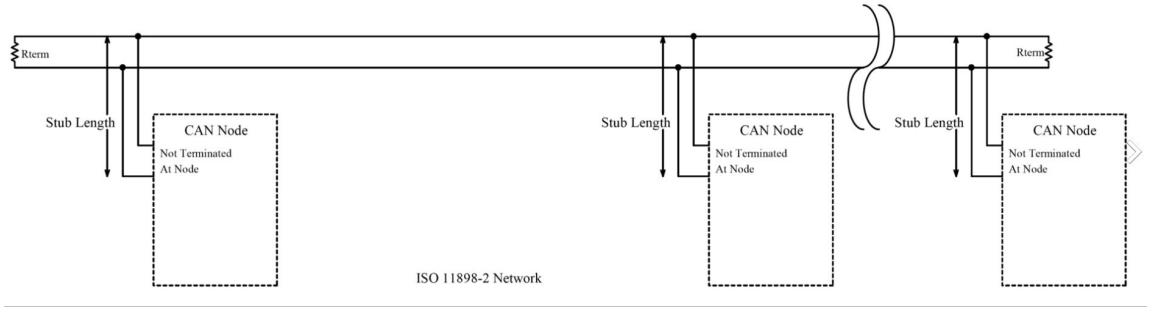


Figure 1: Example of CAN Bus Network https://tekeye.uk/automotive/can-bus-cable-wiring

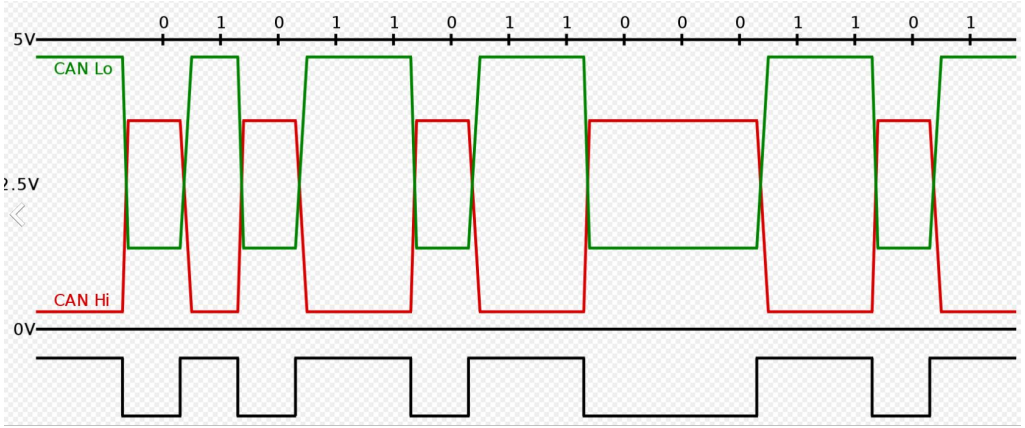


Figure 2: CAN Bus 2-Wire Output https://support.squarell.com/index.php?/Knowledgebase/Article/View/94/7/can-high--can-low

CAN Bus Message Structure

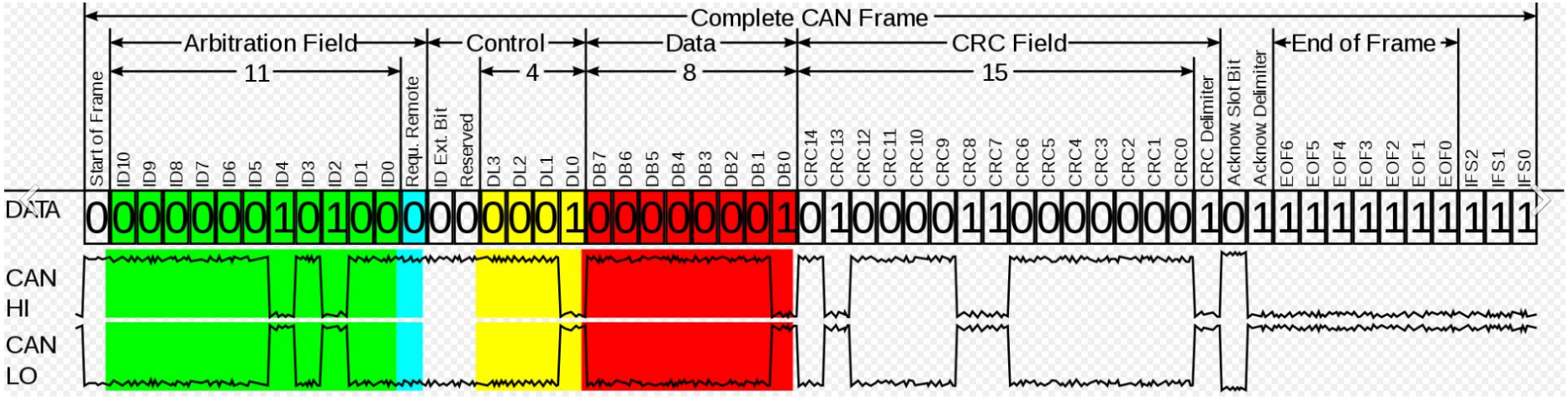


Figure 3: Example CAN Bus Message https://www.electronicsweekly.com/news/high-speed-can-fd-bus-is-coming-to-cars-says-microchip-2015-10/

Our Current CAN Board

- Made of two chips - Can controller (MCP 2515) and Can transceiver (TJA 1050)
- Arduino communicates to controller via SPI
- Controller controls what message transceiver outputs and interprets what the transceiver inputs
- Transceiver delivers/receives actual Can bus message

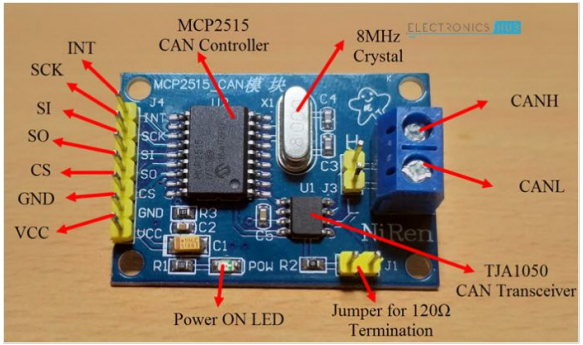


Figure 4: CAN Board we are currently using, XSOURCE CAN Board
https://www.electronicshub.org/arduino-mcp2515-can-bus-tutorial/

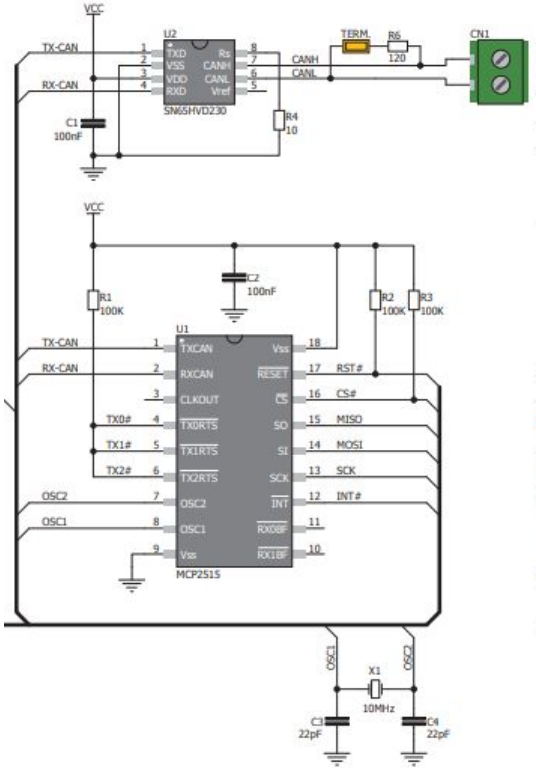


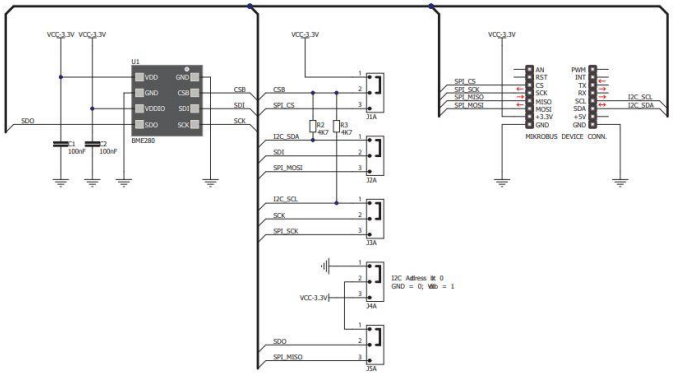
Figure 5: Example of board wiring
https://www.mikroe.com/can-spi-33v-click

CAN Bus Demo

Deliverable - Weather Data (Damian)

What We Have Done

- Enabled communication via I2C with the Weather Click and Microcontroller
    - Obtained readings for humidity (%), temperature(C), and pressure (hPa)
- Collected ambient light readings via analog connection
    - Readings obtained as illuminance (lux)
- All data is logged into a spreadsheet where we can take averages and plot data
- Researched usage of filtering modes, resolution of data, and active/sleep modes of the sensors



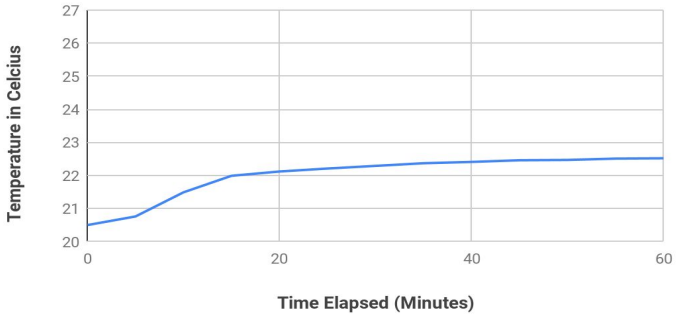
https://www.mikroe.com/weather-click

What We Plan to Design

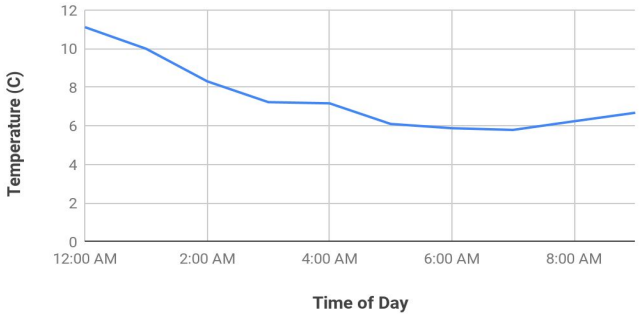
- Design system (sensors) without click boards using chips on the boards
- Full integration of weather sensors and data so data can be read by microcontroller and create responses via motor
- Send sensor data to Display

Weather Data

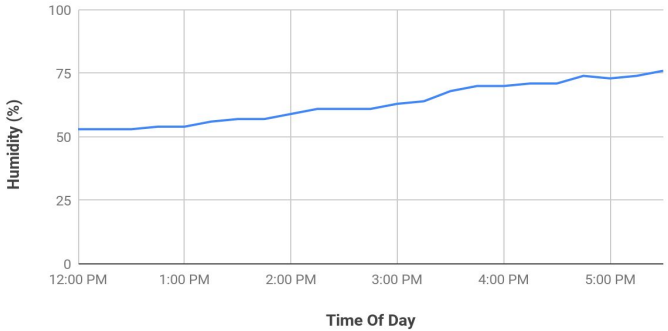
Temperature In My Room With a Heater On



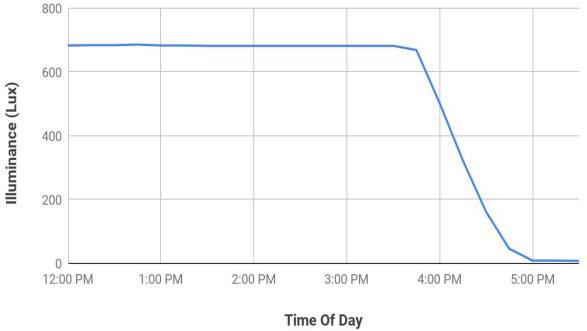
Temperature Overnight



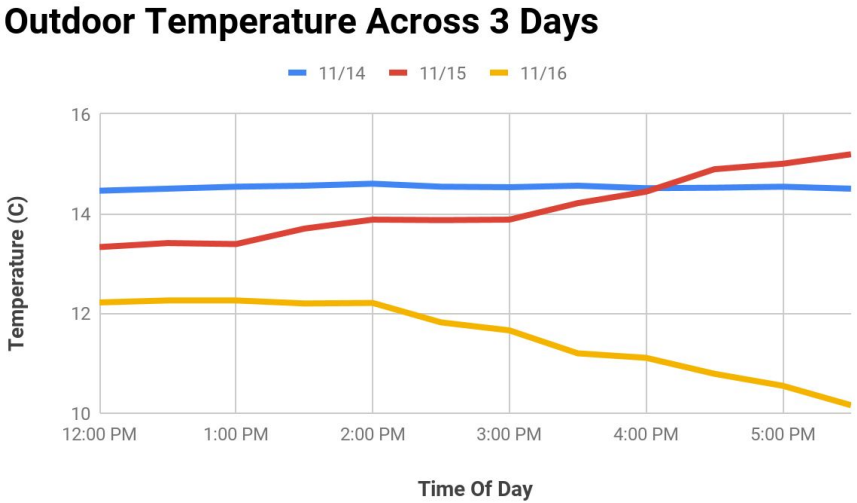
Humidity During A Cloudy Day

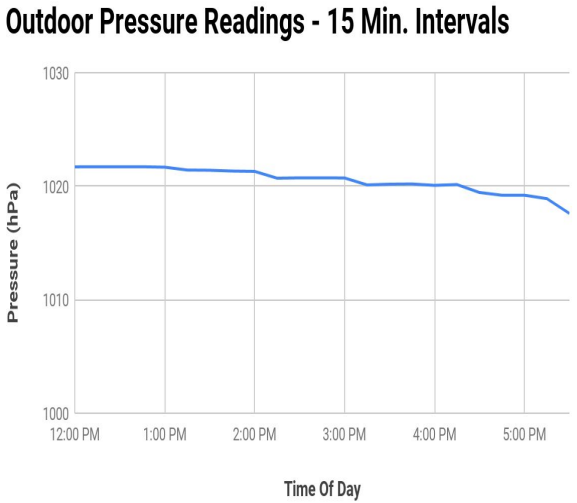


Outdoor Light In the Afternoon and Evening



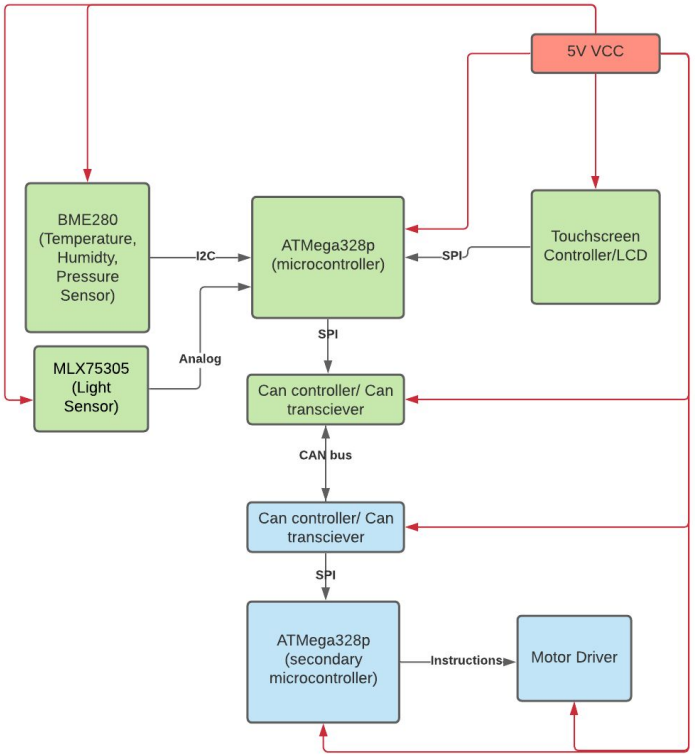
More Weather Data



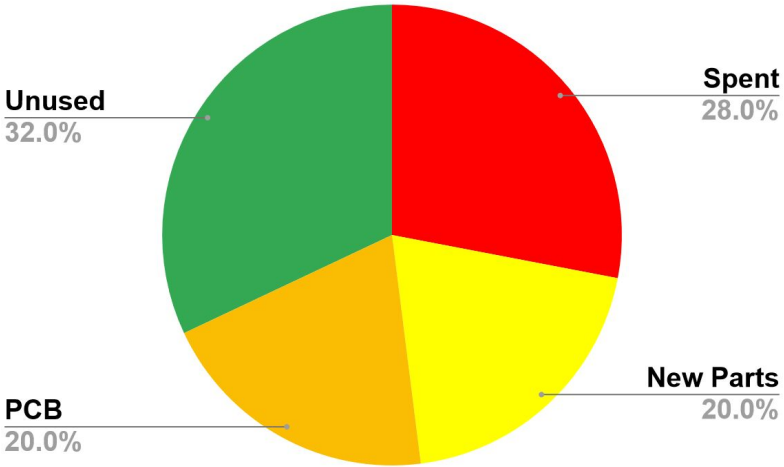


Custom Hardware Plan

- Microcontroller x2
  - ATMega328p
- Chips from the Click Boards
  - Weather Click- **BME280**
  - Ambient Click- **MLX75305**
  - CAN SPI Click - **MCP2515** and **TJA1050**
- Motor Driver and Motor
- RTC
- Will keep the breakout board for LCD
  - 3.5" TFT 320x480 + Touchscreen
- Will test and use Altium



Budget Update



Fall Parts Purchase

Part	Part Number	Quantity	Cost	Totals
2.8" Touch LCD Display Shield	1528-1027-ND	1	$34.95	$34.95
Weather click by Mikroe	MIKROE-1978	1	$22.88	$22.88
Ambient Click by Mikroe	MIKROE-1890	1	$9.36	$9.36
Arduino UNO Click Shield	MIKROE-1581	2	$7.80	$15.60
Can SPI Click	MIKROE-986	2	$21.84	$43.68
IC MCU	ATMEGA328P-PU-ND	1	$2.08	$2.08
				$128.55

Spent = **$140**

Spring Cost Estimate = **$200**

Unused = **$160**

Budget Update: Proposed Parts Purchase (SP21)

Part	Part Number	Segment of Project	Quantity	Cost	Totals
Can Controller	MCP 2515	Can Bus	3	$2.52	$7.56
Receiver	TJA1050	Can Bus	3	$1.09	$3.27
Microcontroller	ATMega 328P	Can Bus, Sensing, Motor, Display	3	$1.72	$5.16
IC Bridge Driver	L298N	Motor Control	1	$4.86	$4.86
Voltage Regulator	78M05	Motor Control	1	$0.48	$0.48
Temp/Humidity/Pressure Sensor	BME280	Sensing	1	$5.95	$5.95
Optical Light Sensor	MLX75305	Sensing	1	$2.33	$2.33
3.5" TFT 320x480 + Touchscreen	HXD8357D	User Interface	1	$39.95	$39.95
Resistive Touch Screen Controller	STMPE610	User Interface	1	$9.95	$9.95
					$79.51

List of Software and Hardware

Component	Software/Hardware	Part Number
Dual H-Bridge Motor Driver	Hardware	L298N
Bipolar Stepper-Motor	Hardware	Nema-17
mcp2515 Library	Software	
Arduino Uno	Hardware	A000066
Stepper Motor	Hardware	28BYJ-48
Motor Driver	Hardware	ULN2003
XSOURCE CAN Board	Hardware	MCP2515
2.8" TFT Touch Shield for Arduino with Resistive Touch Screen	Hardware	1651
Adafruit GFX Library	Software	
Adafruit ILI9341 Arduino Library	Software	
SPI Library	Software	
Weather Click	Hardware	BME280
Ambient Click	Hardware	MLX75305
SparkFun_BME280_Arduino_Library	Software	

Task	Team Member	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13
Motor Behavior	Jon										Debug / Integration			
Simulating WallBus Setup	Max										Debug / Integration			
Improving User Interface	Andrew										Debug / Integration			
Altium	Damian						Test PCB	Test PCB		Test PCB	Debug / Integration			
PCB	All			Design PCB	Order PCB		PCB Arrives	Possibly Re-Order PCB		New PCB Arrives				
CDR	All													
FPR	All													
Demo Day	All													

Thanks!

Q&A