TRAFFIC CONTROL SMART SYSTEM

Team 16
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Project Idea

We worked with the Siebel Center for Design to bring their project idea to life. This project idea in particular was in collaboration with the University Police.

Background

- Modern day traffic control uses large, cumbersome traffic wands.
- One-dimensional communication, limited options.
- Vague hand signals that are not always clear.
- Heavy wands limit motion for officers which is potentially dangerous.

Objective

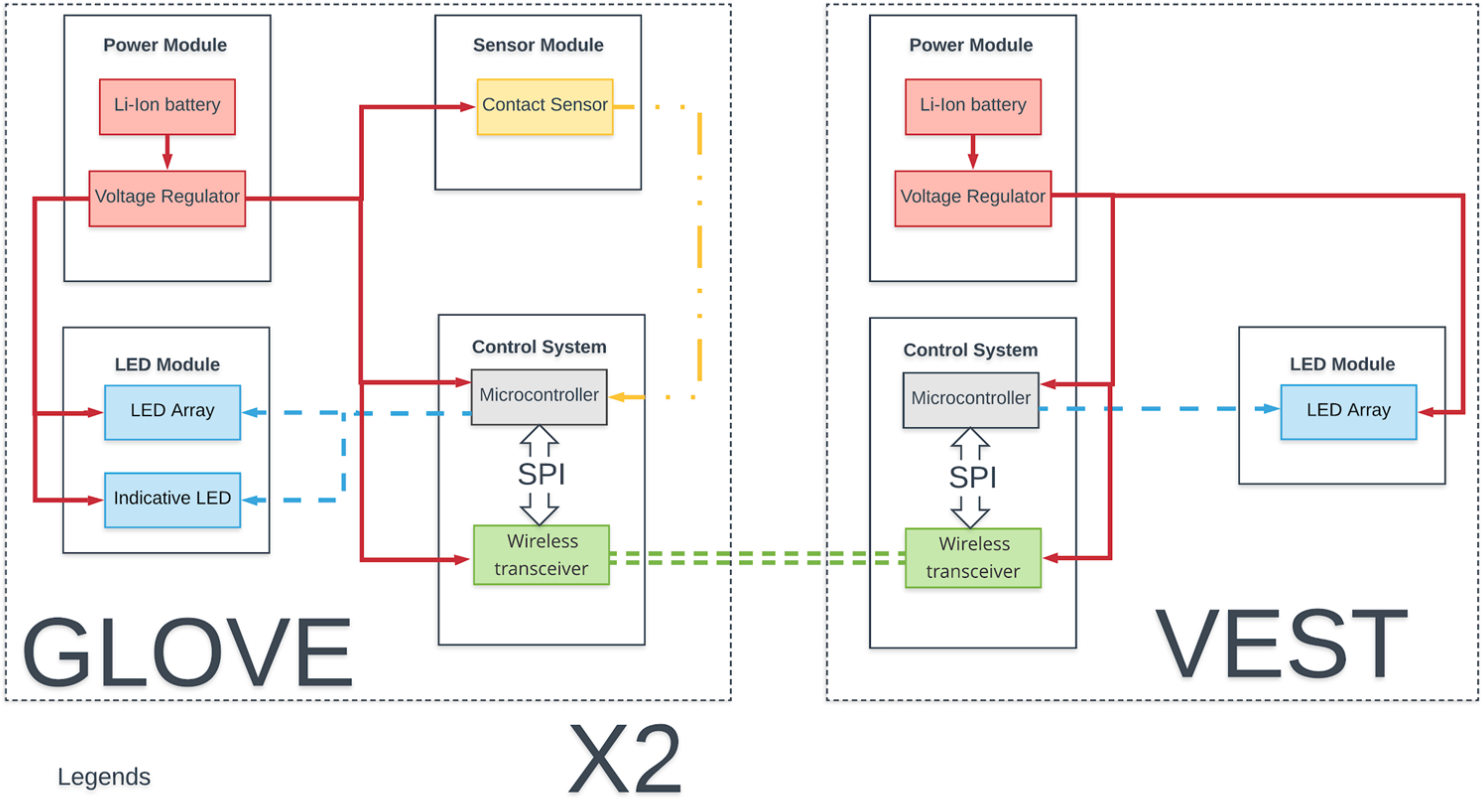
- Replace heavy wands with lightweight gloves and LED chest panels.
- Multiple, programmable options for colors and message displays.
- Do not need to use vague hand signals if we use clear colors and words.
- Gloves and vest are small and flexible enough so that they do not restrict officer’s movement.

High Level Requirements

- Gloves and Vest should be able to communicate wirelessly.
- LEDs need to be able to be programmed to exhibit a full range of colors with brightness control. They also should be bright and be comfortably viewable for both Day and night conditions.
- The system must be entirely powered by rechargeable batteries that can sustain power for elongated duration (at least two hours).

System Overview

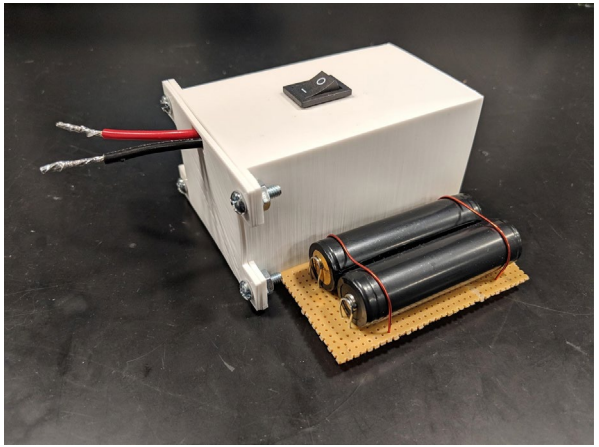
- Left/Right Glove - Three Sensors
- Sensor functions
  - Glove LED Color Control
  - Glove LED Brightness Control
  - Vest Panel Control
- Left Glove Controls Front Panel
- Front Panel Sequence : ‘GO’-> ‘ STOP’-> Turn Off
- Right Glove Controls Back Panel
- Back Panel Sequence : ‘STOP’-> Turn Off


Power Module
Li-Ion battery
Voltage Regulator
Sensor Module
Contact Sensor
LED Module
LED Array
Indicative LED
Control System
Microcontroller
SPI
Wireless transceiver
GLOVE
Power Module
Li-Ion battery
Voltage Regulator
Control System
Microcontroller
SPI
Wireless transceiver
LED Module
LED Array
VEST
X2
Legends
Power
Input Signal
Output Signal
Data Bus
Wireless Connection

Power Module

Power Source

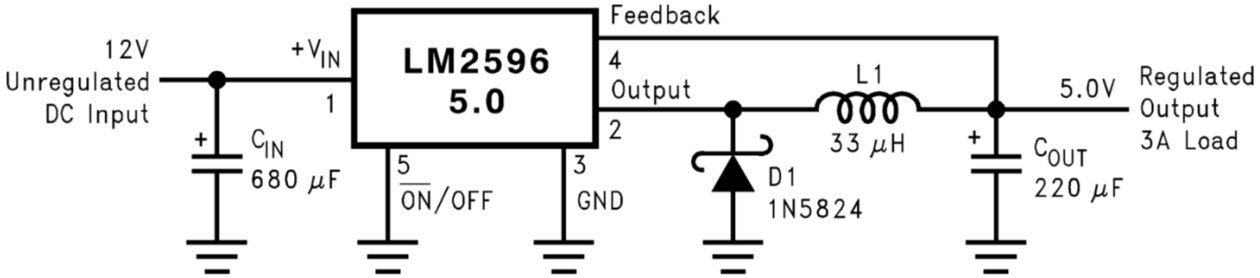
- Two Li-ion Cells for each Glove/Vest.
- 3.7 V (~ 3400 mAh) per Cell
- 7.4 V (~ 6800 mAh) for each Glove/Vest.
- Protected cells.



Voltage Regulators

- Power supply - 5V: LED strips and microcontroller

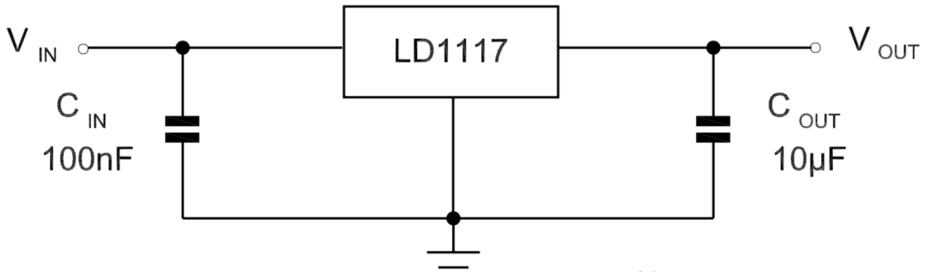
Component	Output Load Current	Input Voltage	Output Voltage
LM2596	Up to 3 A	Up to 40 V	5V



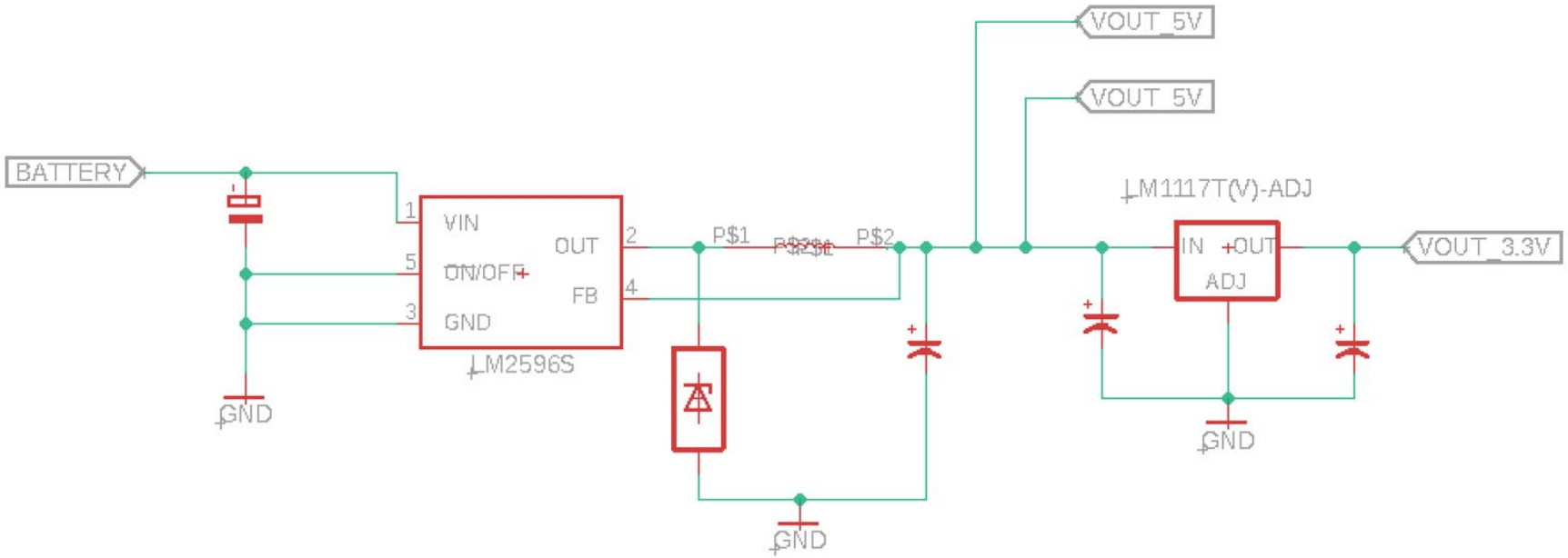
Voltage Regulators

- 3.3V: Wireless transceivers

Component	Load current	Voltage
LD1117	Up to 800mA	Vin: Up to 15V Vout: 3.3V
nRF24L0	9.0mA - 12.3mA	Vin: 3.3V



Schematic


VOUT_5V
VOUT_5V
BATTERY
1
VIN
OUT
2
5
ON/OFF
FB
4
3
GND
LM2596S
GND
P$1
P$2
LM1117T(V)-ADJ
IN
OUT
ADJ
VOUT_3.3V
GND
GND

Battery Life

Left Glove / Right Glove

- 31 LEDS
- Total Current Draw ~ 0.62 Amps
- Battery Life ~ 11 hrs

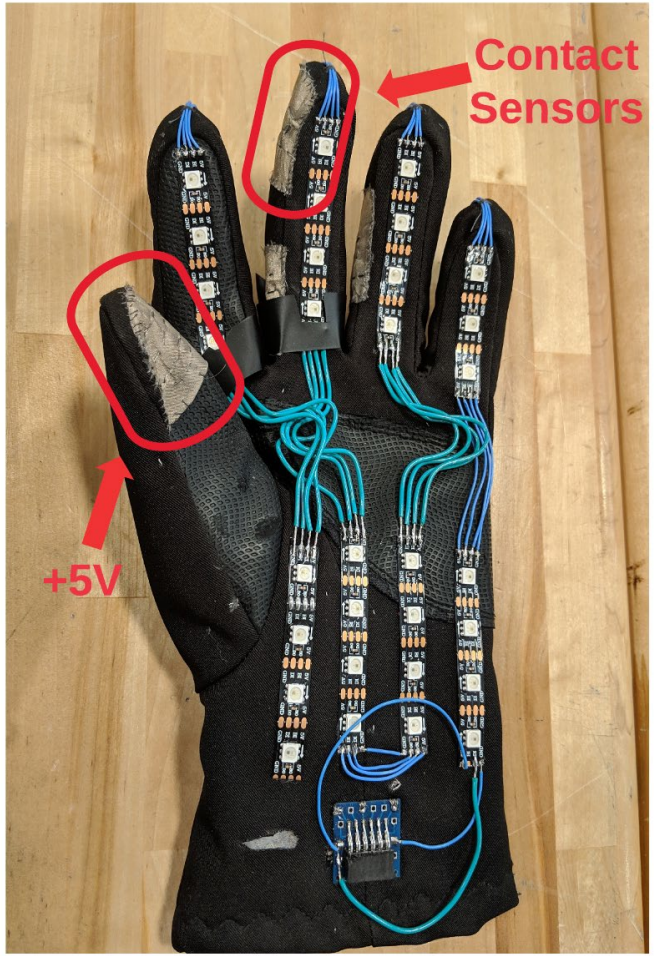
Vest

- 48 LEDS
- Total Current Draw ~ 0.96 Amps
- Battery Life ~ 7 hrs

- *Per LED current Draw ~ 20 mA*
- *Total Battery Capacity ~ 6800 mAh*

Contact Sensor

- Conductive fabric is sewed onto Gloves.
- Must hold for ~ 1 second to prevent accidental touches triggering events.



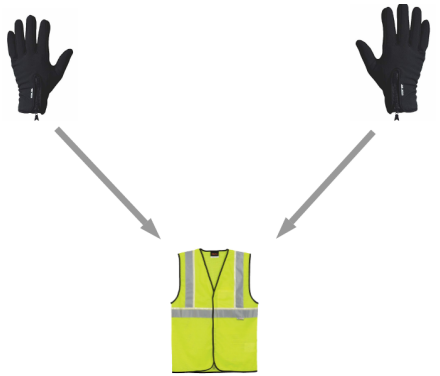
Wireless Transceiver

- 3 nRF24L01 modules, 1 for each glove and vest.
- Easily interfaced with our ATmega328P using RF24 library.

Network Topology

```
//On trigger
radio.openWritingPipe(left_pipe);
radio.write(&button_code, sizeof(button_code));
```

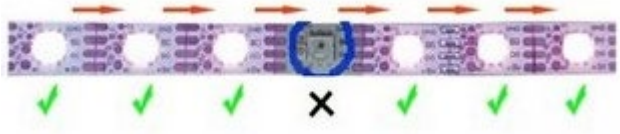
```
//On trigger
radio.openWritingPipe(right_pipe);
radio.write(&button_code, sizeof(button_code));
```



```
radio.openReadingPipe(1, left__pipe);
radio.openReadingPipe(2, right_pipe);
radio.startListening();
```

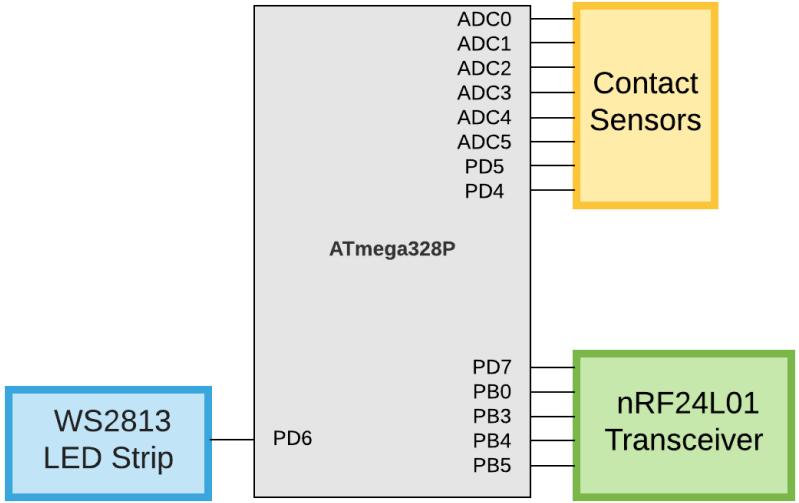
LEDs

- WS2813 (double data line Feature).
- All LEDs in Serial.
- Need to Send N*24 bits to modify the LEDs serially.

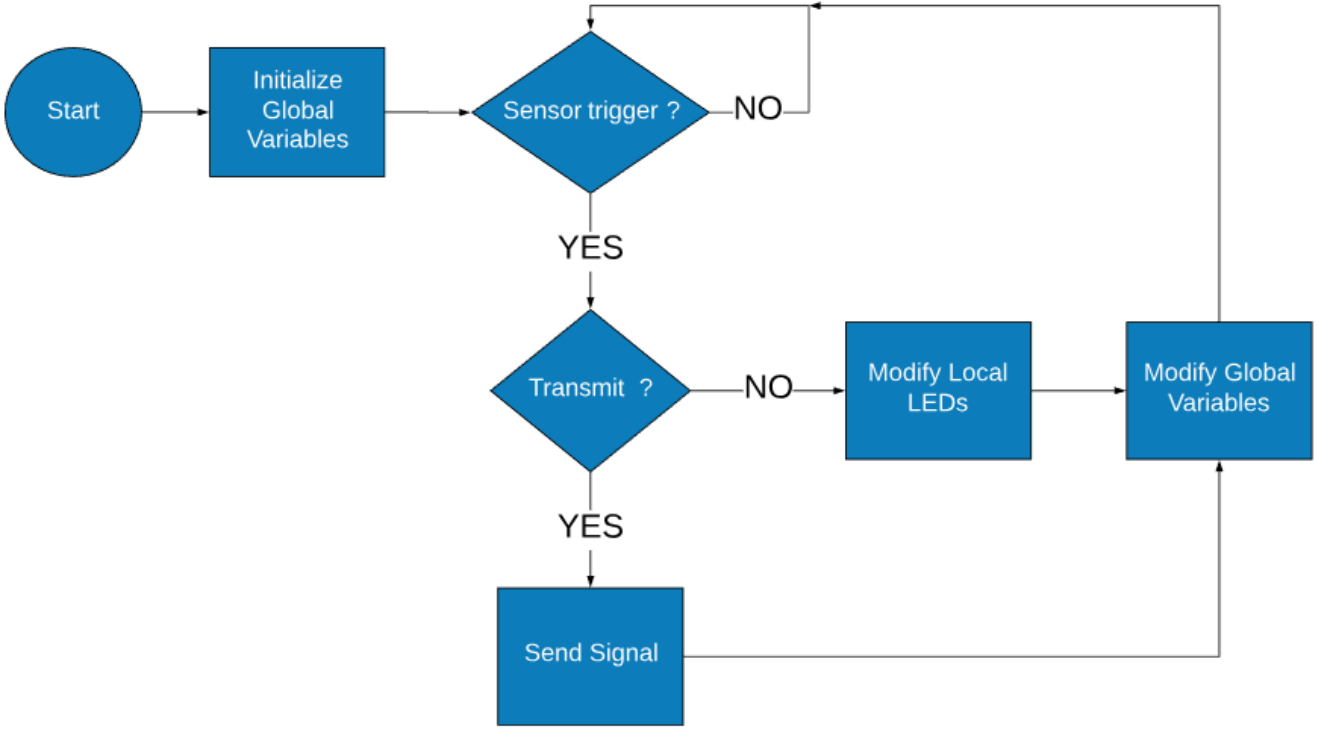


Microcontroller

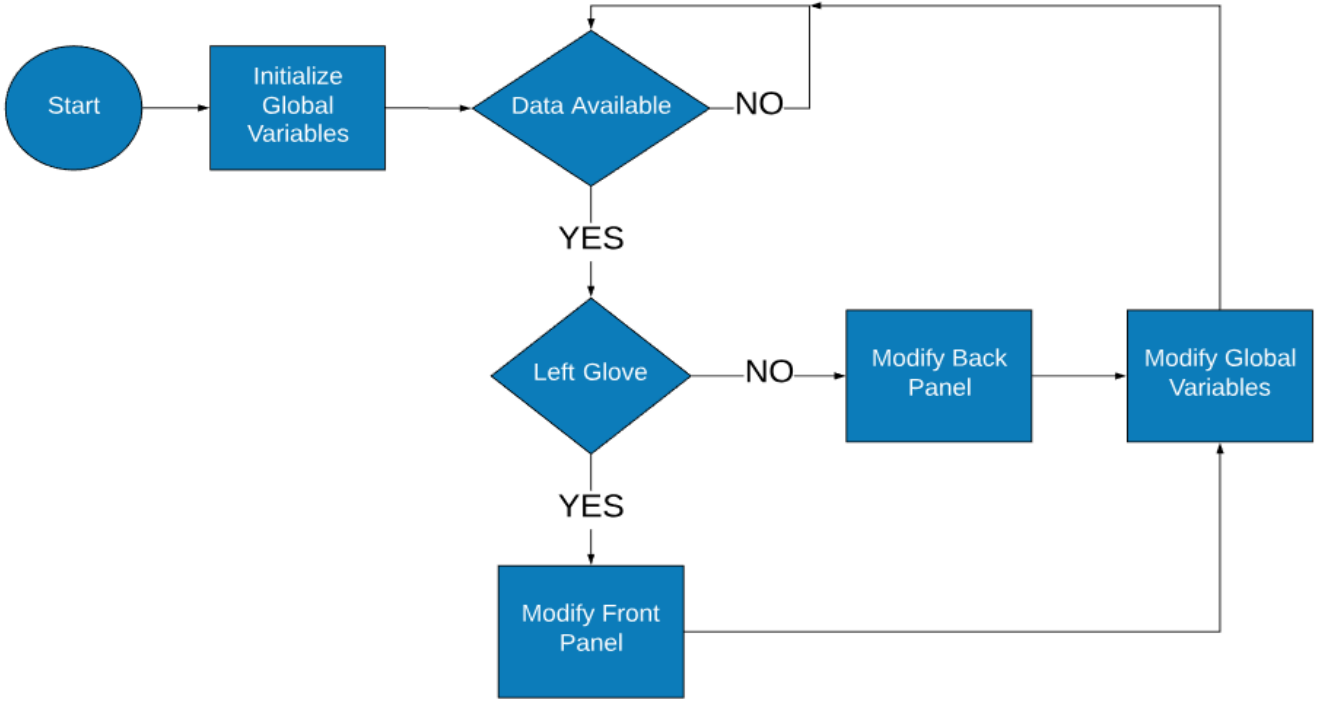
- 3 ATmega328P microcontrollers, 1 for each glove and 1 for the vest.
- Interfaces Sensors, LEDs and Transceiver



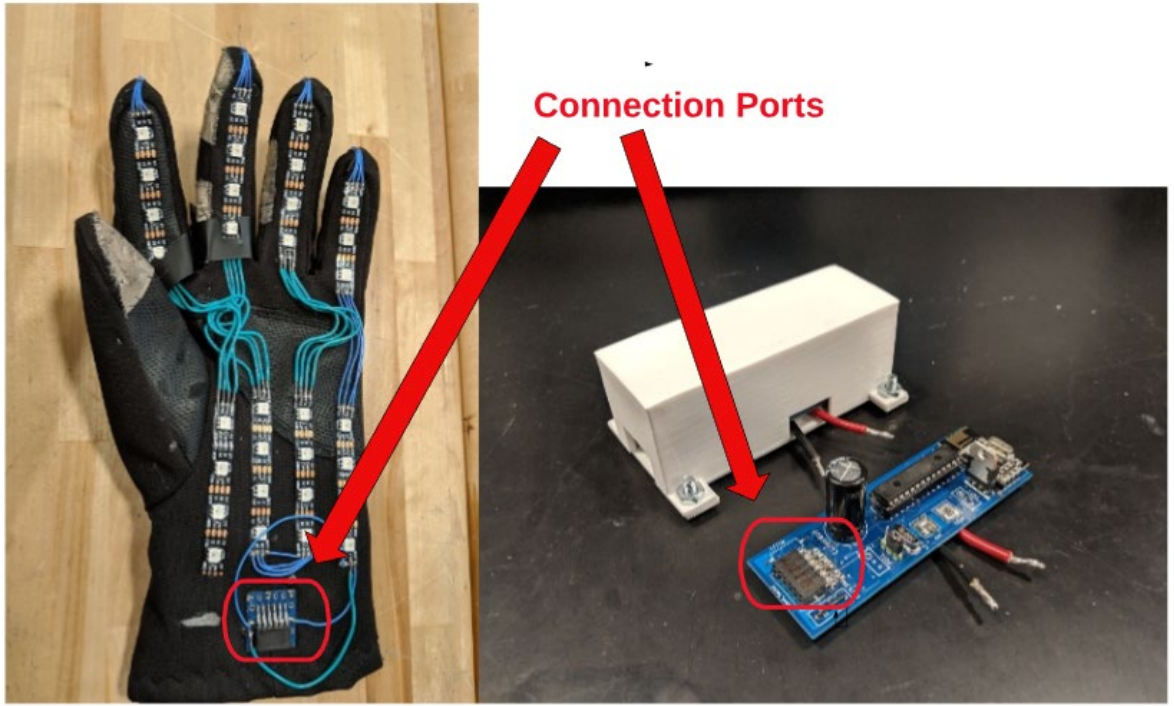
Algorithm (Gloves)



Algorithm (Vest)



Physical View (Gloves)



Physical View (Vest)

Front Panel

Back Panel

Future Improvements

- Redesign with flexible PCB to avoid rigidity .
- Redesign PCB for lesser space consumption (eg. Custom ICs).
- Use Single Li-ion Cell (3.7 V) and Design step-up regulator (to 5 V). Two Cells are bulky (~220 gm , 55% of Glove Weight).

Any Questions?

Thank You