TRAFFIC CONTROL
SMART SYSTEM

Team 16
María Pilar Galainena Marín
Mohit Rawat
William Wang
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.
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**

**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

<table>
<thead>
<tr>
<th>Component</th>
<th>Output Load Current</th>
<th>Input Voltage</th>
<th>Output Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM2596</td>
<td>Up to 3 A</td>
<td>Up to 40 V</td>
<td>5 V</td>
</tr>
</tbody>
</table>

![LM2596 Circuit Diagram](image-url)
Voltage Regulators

◆ 3.3V: Wireless transceivers

<table>
<thead>
<tr>
<th>Component</th>
<th>Load current</th>
<th>Voltage</th>
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</table>
| LD1117        | Up to 800 mA      | Vin: Up to 15 V
                     |                   | Vout: 3.3 V          |
| nRF24L0       | 9.0 mA - 12.3 mA  | Vin: 3.3 V            |

![Diagram of LD1117 voltage regulator circuit](image)
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.
//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 (e.g., 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