User Specific Firearm Locking System

Group 12
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Outline

I. Introduction & Objectives
II. Features
III. Review of Original Design
IV. Final Design & Functional Tests
V. Challenges & Recommendations
VI. Ethical Issues
Introduction

- A portable and inexpensive system that allows firearm owners to have control over the firearm’s operators
- Utilizes a fingerprint recognition system that allows only authorized persons to operate the firearm
Objectives

• Simple and transportable system that increases firearm safety
• Increased security via fingerprint identification system
• Locking system that prevents trigger from being pulled and magazine from being removed
Features

• Simple user interface via keypad and LCD screen
• Fingerprint management system that accepts multiple fingerprints
• Automated locking for trigger and magazine
• Pressure sensitive or timed unlock options
• Wireless capabilities
Original Design

• Initial design including GPS tracking if firearm was stolen
• Locking mechanisms would move on tracks instead of rotating
Final Design

- Two separate systems, a control unit and a firearm unit
- Control unit – not attached to firearm
- Firearm unit – attached to firearm
Project Pictures

Control Unit

Firearm Unit
Control Unit

- Successful fingerprint scan allows authorized user to go through menu
- User interfaces with LCD screen and keypad
- Unlocked state options – timed or pressure sensitive
- Wireless signal with timer information sent to firearm unit
Control Unit Power Supply

- Using a 9V battery and voltage regulators:
  - Supplies +5 Vdc to LCD, microcontroller, and wireless transmitter and +3.3 Vdc to fingerprint scanner
  - Nominal current of 150 mA and 300 mA maximum (during fingerprint scan)
Control Unit Power Supply

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Peak-peak</th>
<th>Max</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5V supply</td>
<td>5V +/- 0.25V</td>
<td>250mV</td>
<td>5.00V</td>
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<tr>
<td>+3.3V Supply</td>
<td>3.3V +/- 0.3V</td>
<td>250mV</td>
<td>3.31V</td>
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</tbody>
</table>
User Interface

- **Keypad**: 16 key conductive rubber keypad
  - Accepts user inputs to allow control of fingerprint scanner and lock/unlock commands
- **LCD**: 16 character x 2 line display
  - Shows menu options and prompts user input
User Interface
User Interface Menu

- Authorized Scan
  - Manage Prints
    - New Print
    - Remove Print
  - Lock/Unlock
    - Lock
    - Timed Unlock

Images:
1. Manage Prints: 1: Manage Prints 2: Lock/Unlock
2. Lock/Unlock: Unlocking for 004 seconds
Fingerprint Scanner

- Optical scanner with control board
- Manages and stores several hundred fingerprints
- GPIO and serial interface capabilities

http://www.sparkfun.com/products/8839
Wireless Transmission

- Linx HP-3 transmitter, receiver, and antennas
- Transmits 8 data bits +1 start bit

![Graph showing transmitted and received signals]

Transmitted signal - 101
Received signal - 101
Fingerprint & Wireless
Firearm Unit

- Microcontroller interprets the received wireless signal from control unit
- Microcontroller provides control signals to locking mechanisms
- Locking mechanisms physically put firearm into proper state
Firearm Power Supply

- Supplies +5 Vdc to firearm’s subsystems
- Contains enough energy for approximately 12 hours of continuous usage
Firearm Power Supply

- Avg(1) – input voltage from battery
- Avg(2) – voltage regulator output
Firearm Power Supply Lifetime

- Current drawn from supply
  - Motors spinning: 70 mA (nominal)
    135 mA (maximum)
  - Motors off: 40 mA (nominal)

Pressure Sensor

- Pushbutton feeding into firearm’s microcontroller
- Sensor outputs +5V signal when firearm is held
Pressure Sensor Testing

Sensor unpressed: output voltage = 0 V

Sensor pressed: output voltage = +5 Vdc
Locking Mechanisms

- Receives multiple signals from microcontroller indicating the firearm’s state
- MOSFETs used to control voltage into motors
- Using microcontroller’s signals, the motors spin locking mechanisms into proper state
Locking Mechanisms

Magazine Lock

Trigger Lock
Locking Mechanisms Testing

<table>
<thead>
<tr>
<th>Enable</th>
<th>L/U</th>
<th>INV_L/U</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Movement</th>
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</thead>
<tbody>
<tr>
<td>0 V</td>
<td>0 V</td>
<td>5 V</td>
<td>5 V</td>
<td>5 V</td>
<td>5 V</td>
<td>0 V</td>
<td>Unlocking</td>
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<tr>
<td>0 V</td>
<td>5 V</td>
<td>0 V</td>
<td>5 V</td>
<td>5 V</td>
<td>0 V</td>
<td>5 V</td>
<td>Locking</td>
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<tr>
<td>5 V</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>0 V</td>
<td>0 V</td>
</tr>
</tbody>
</table>
Challenges & Recommendations

- Connector on fingerprint scanner
  - Solder connection directly

- Serial communication from fingerprint scanner
  - Use GPIO for control – serial determined to be unneeded
Challenges & Recommendations

• Limited wireless range
  • Better antennas

• Floating voltages on PIC inputs
  • Use pull down resistors

• Difficult to pack large components on firearm
  • Smaller components for marketability
Ethical Considerations

- Project designed to increase firearm safety; mirroring IEEE Codes 1, 5, and 9
- Code 1: “Making decisions consistent with the safety, health, and welfare of the public”
- Codes 5 & 9: Through the “appropriate application” of technology this project helps to “avoid injuring others”
Thank You!

- Professor Carney
- Jane Tu
- Wally Smith
- Mark Smart
- Skot Wiedmann