User Specific Firearm Locking System

Group 12

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ECE 445 – Senior Design

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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

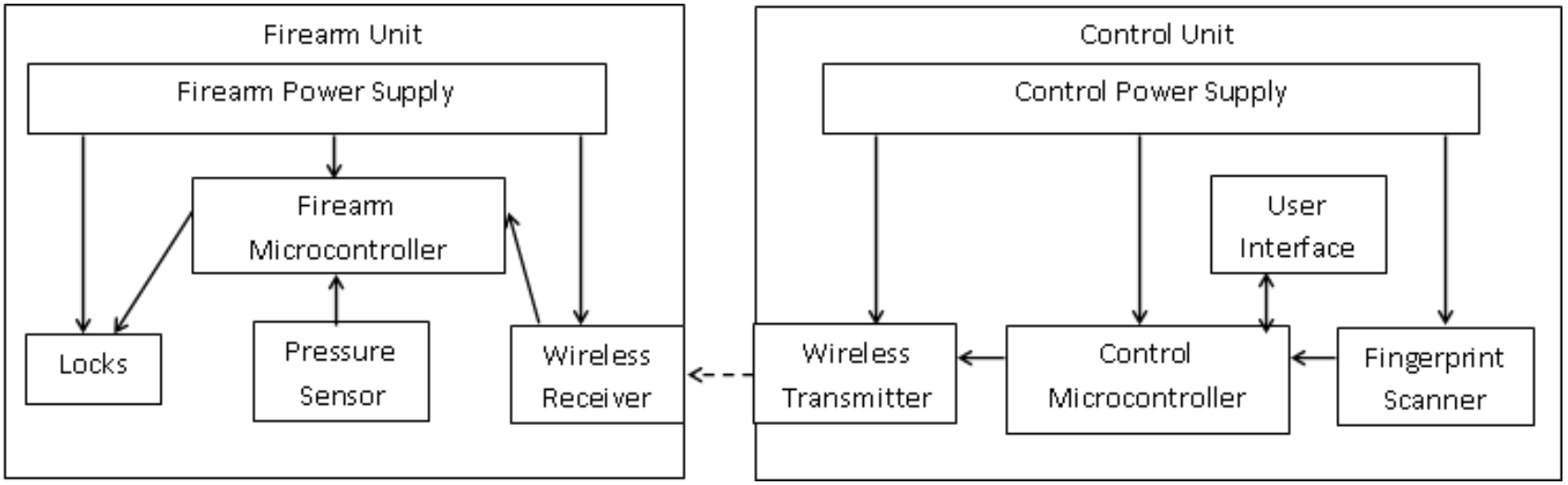
- Simple user interface via keypad and LCD screen
- Fingerprint management system that accepts multiple fingerprints
- Automated locking for trigger and magazine
- Pressure sensitive or timed unlock options
- Wireless capabilities

Original Design

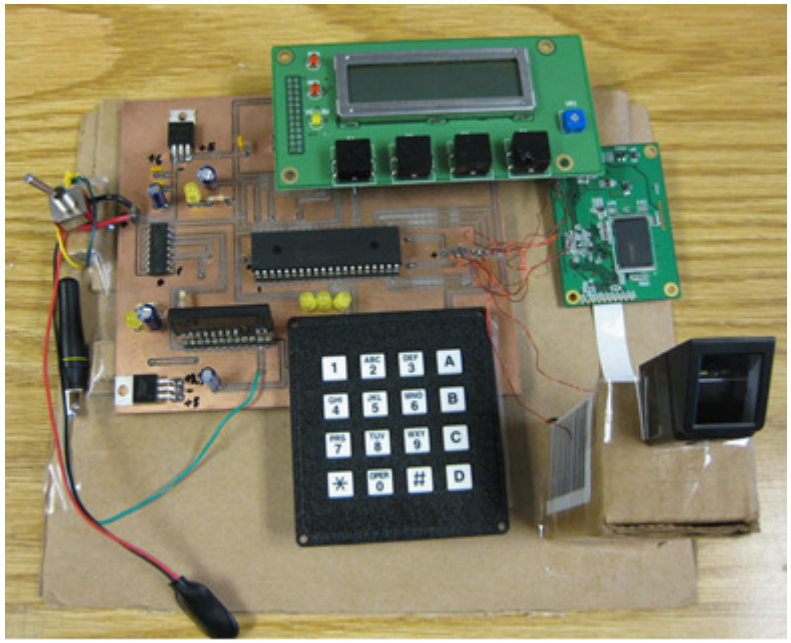
- Initial design including GPS tracking if firearm was stolen
- Locking mechanisms would move on tracks instead of rotating

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

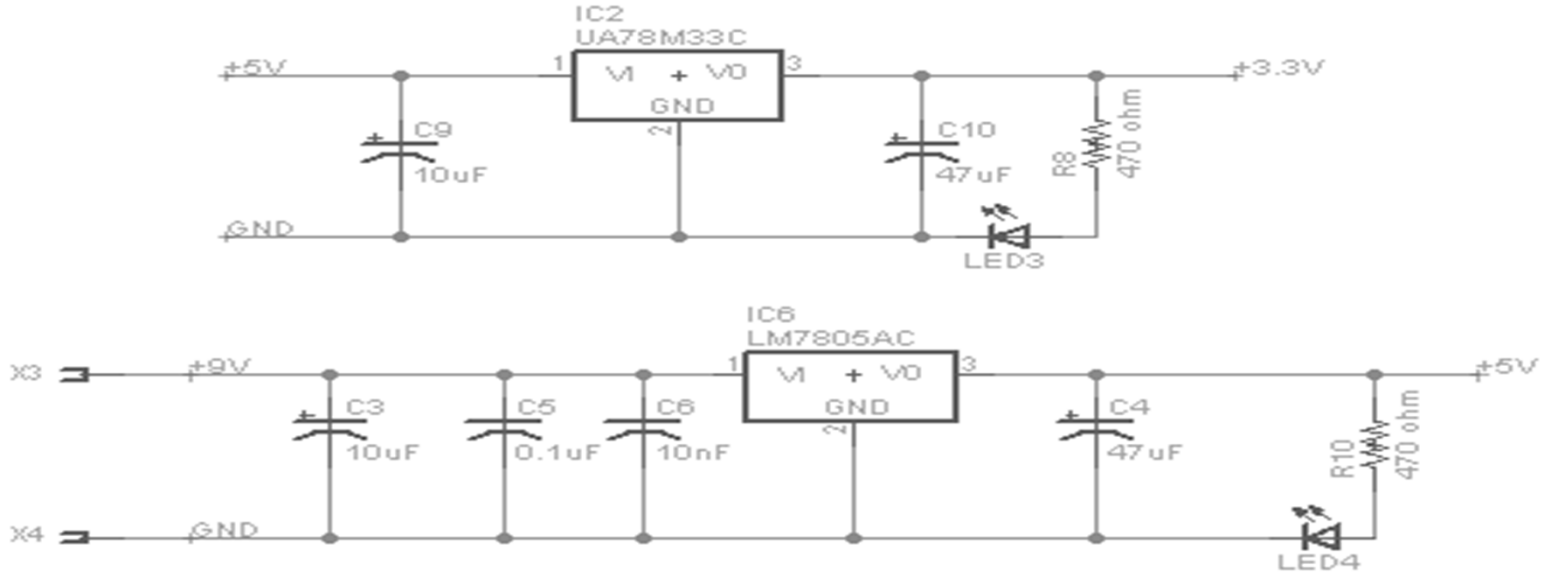
Firearm Unit

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

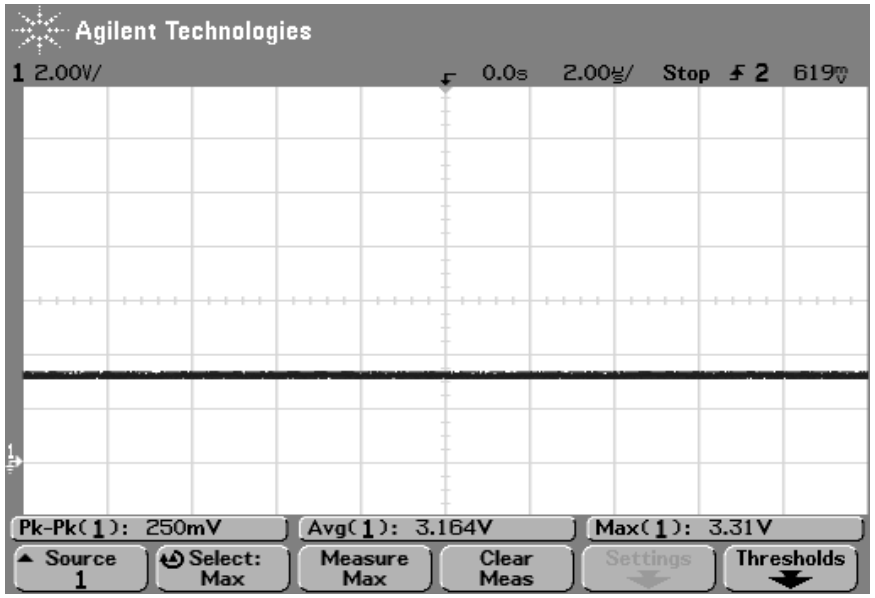
Control Unit Power Supply

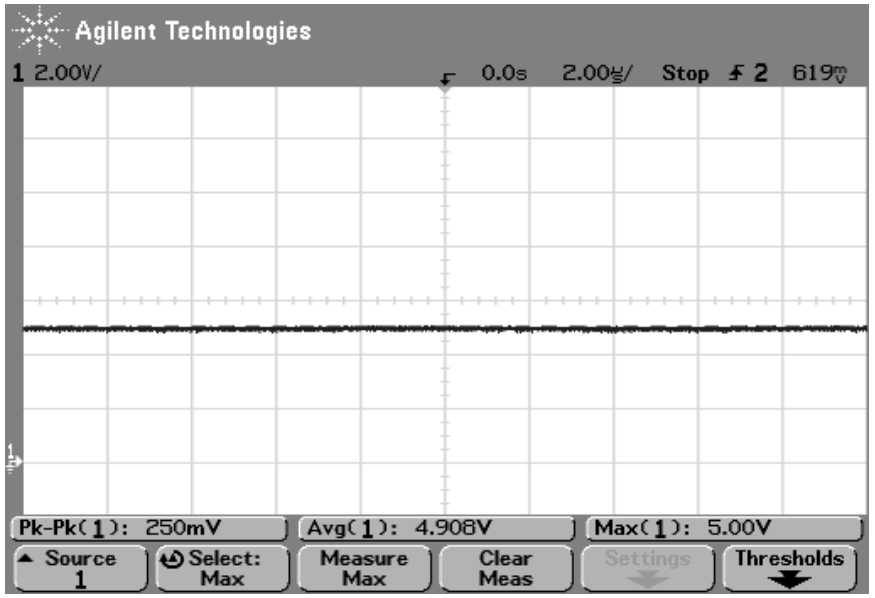
- Using a 9V battery and voltage regulators:
  - Supplies +5 Vdc to LCD, microcontroller, and wireless transmitter and +3.3Vdc to fingerprint scanner
  - Nominal current of 150 mA and 300mA maximum (during fingerprint scan)



Control Unit Power Supply

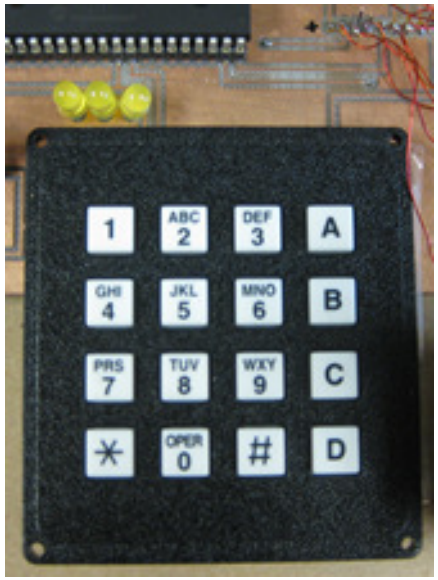
	Requirement	Peak-peak	Max	Average
+5V supply	5V +/- 0.25V	250mV	5.00V	4.908V
+3.3V Supply	3.3V +/- 0.3V	250mV	3.31V	3.164V

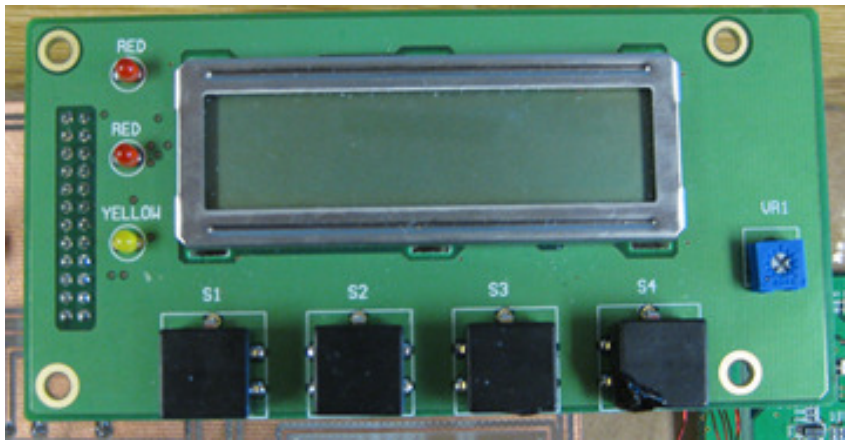




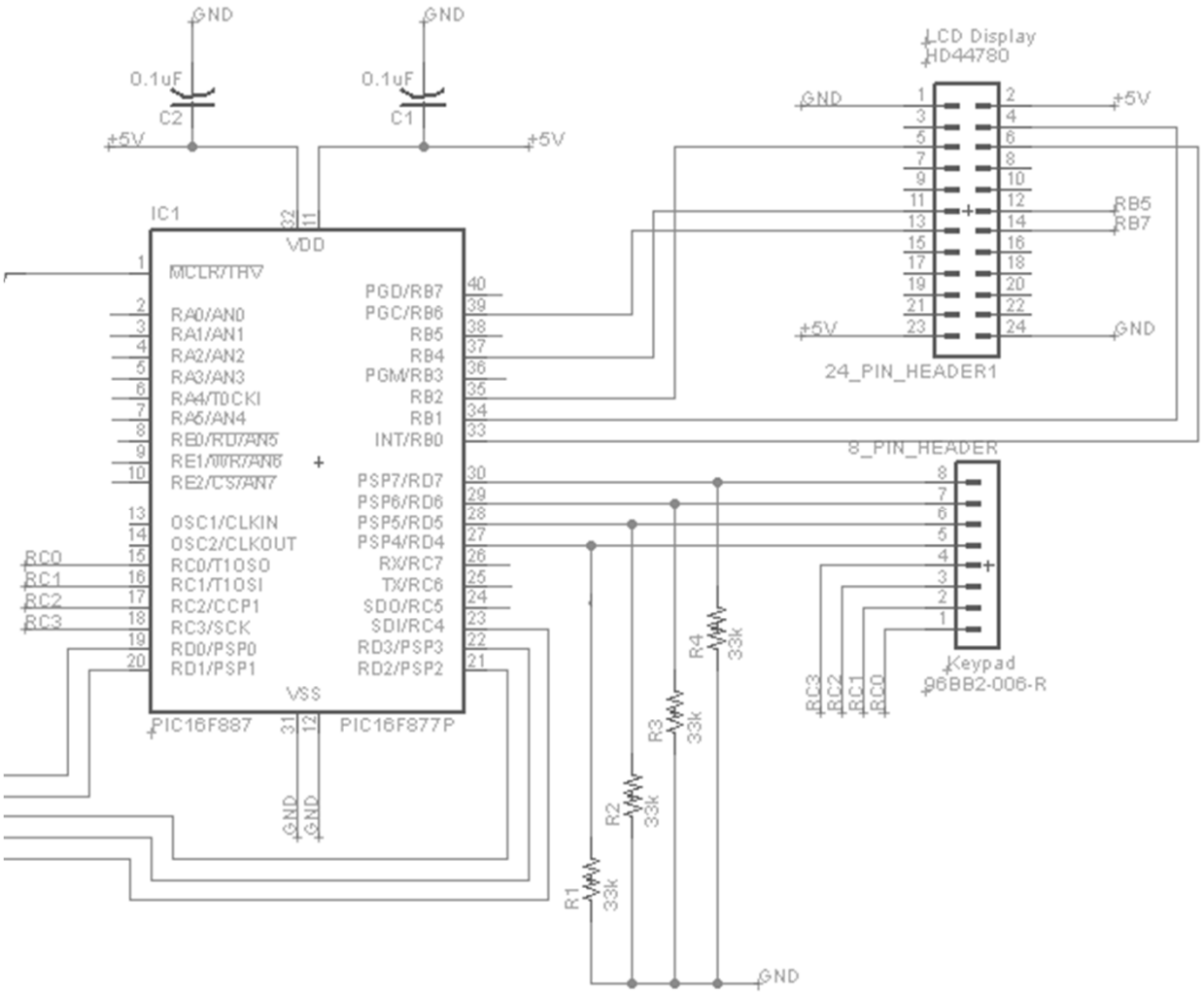
User Interface

- 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

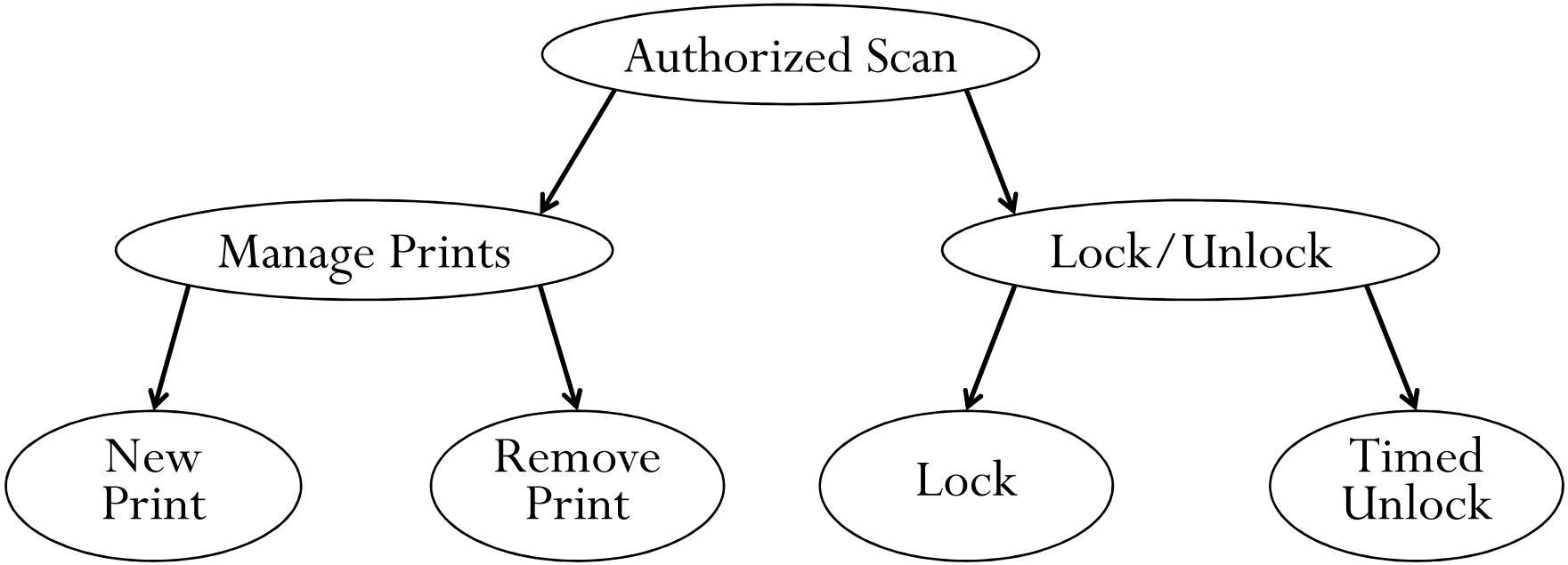




User Interface



User Interface Menu



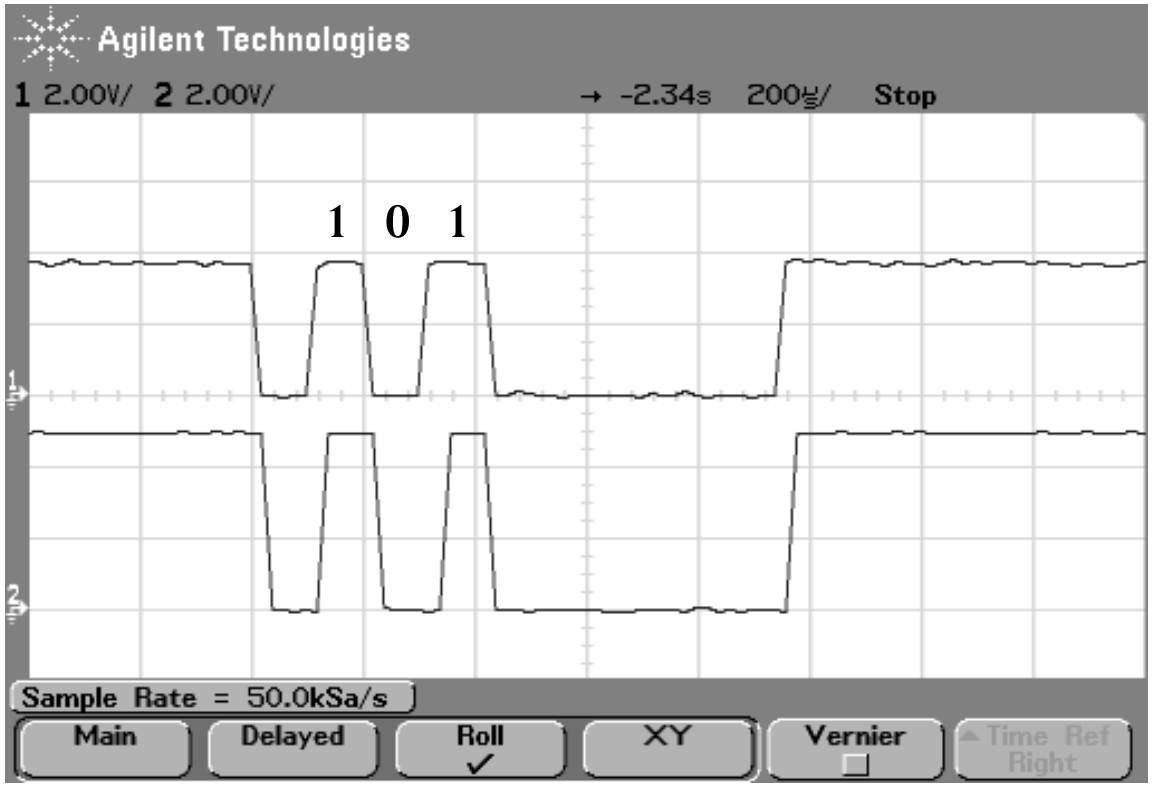
Fingerprint Scanner

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

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

Wireless Transmission

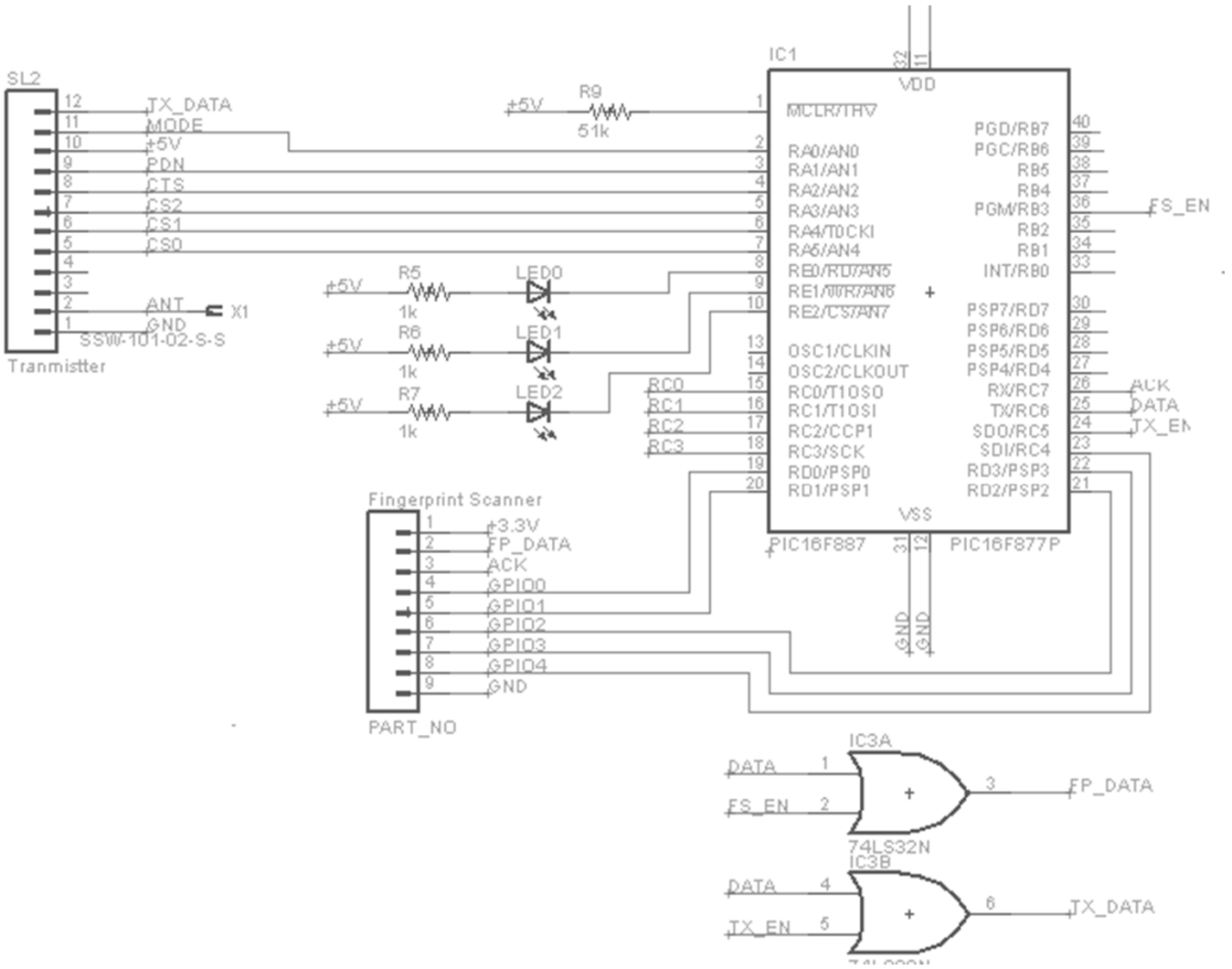
- Linx HP-3 transmitter, receiver, and antennas
- Transmits 8 data bits +1 start bit



Transmitted signal - 101

Received signal - 101

Fingerprint & Wireless

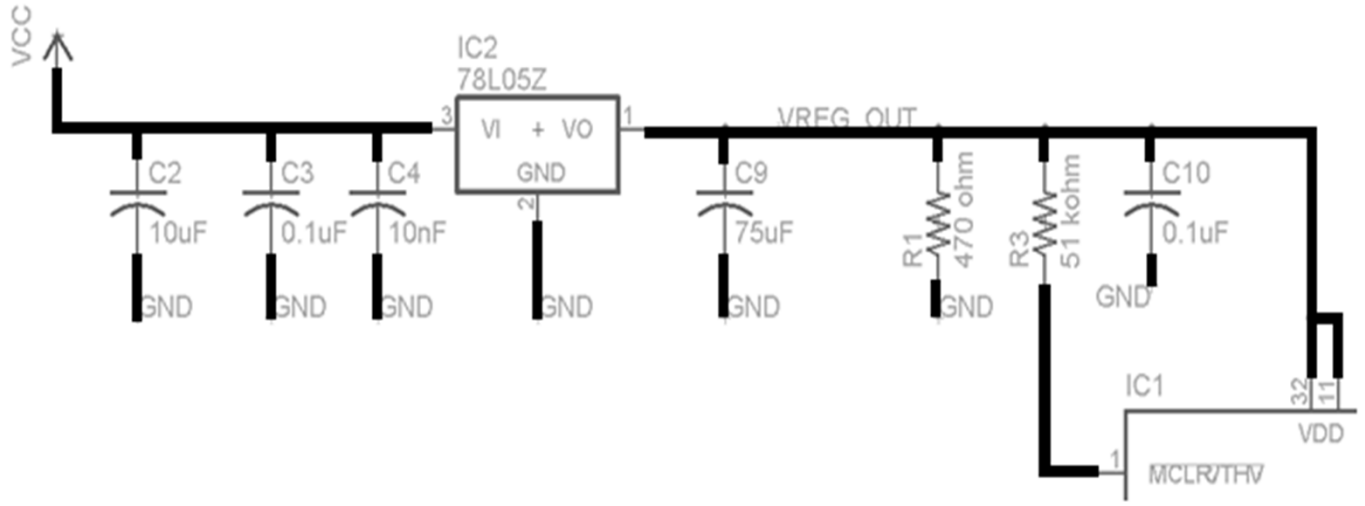


Firearm Unit

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

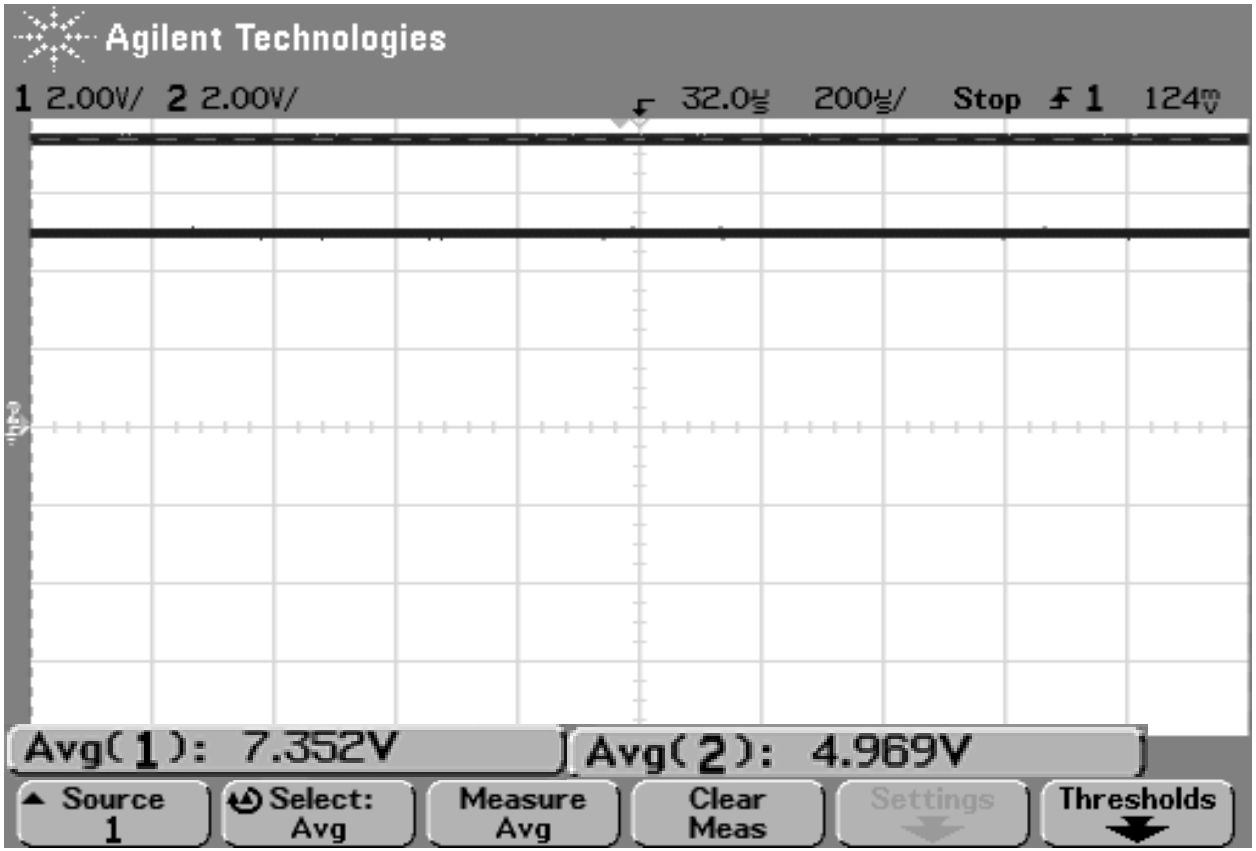
Firearm Power Supply

- Supplies +5 Vdc to firearm's subsystems
- Contains enough energy for approximately 12 hours of continuous usage



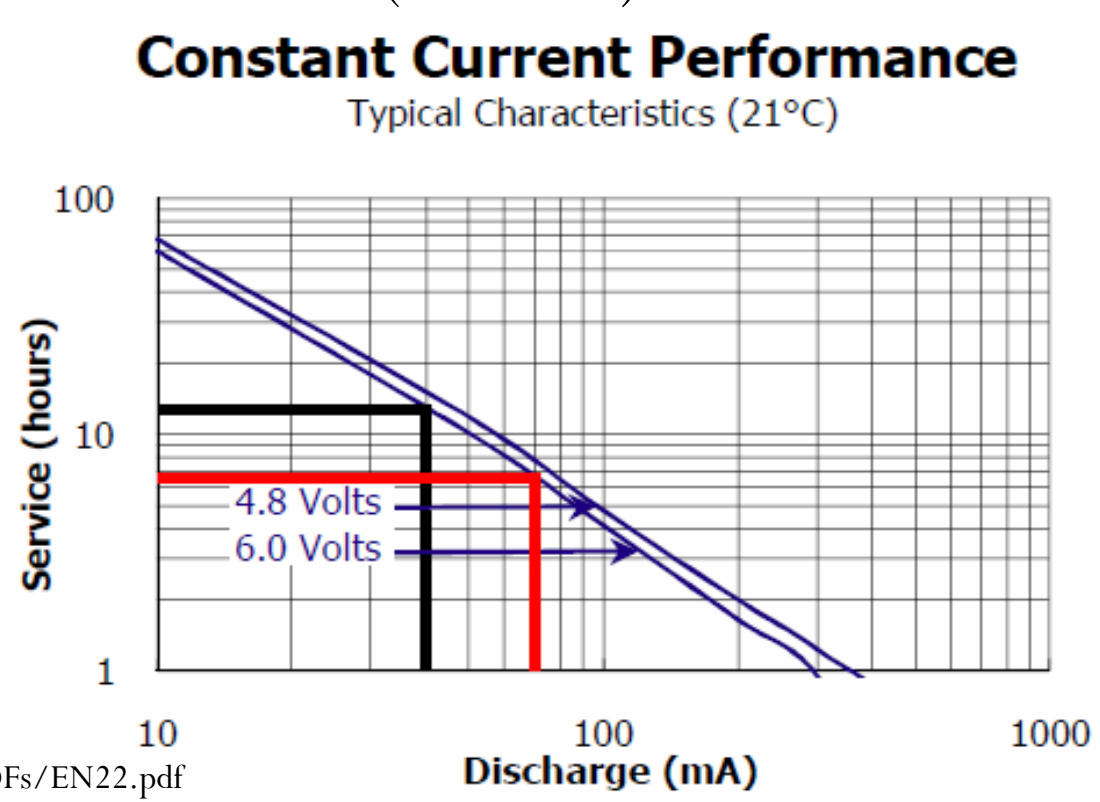
Firearm Power Supply

- Avg(1) – input voltage from battery
- Avg(2) –voltage regulator output



Firearm Power Supply Lifetime

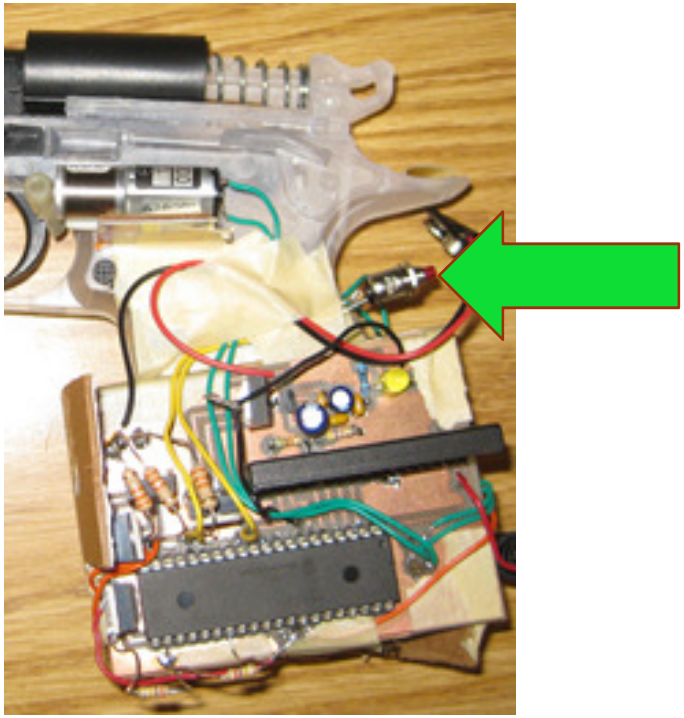
- Current drawn from supply
  - Motors spinning: 70 mA (nominal)
    135 mA (maximum)
  - Motors off: 40 mA (nominal)



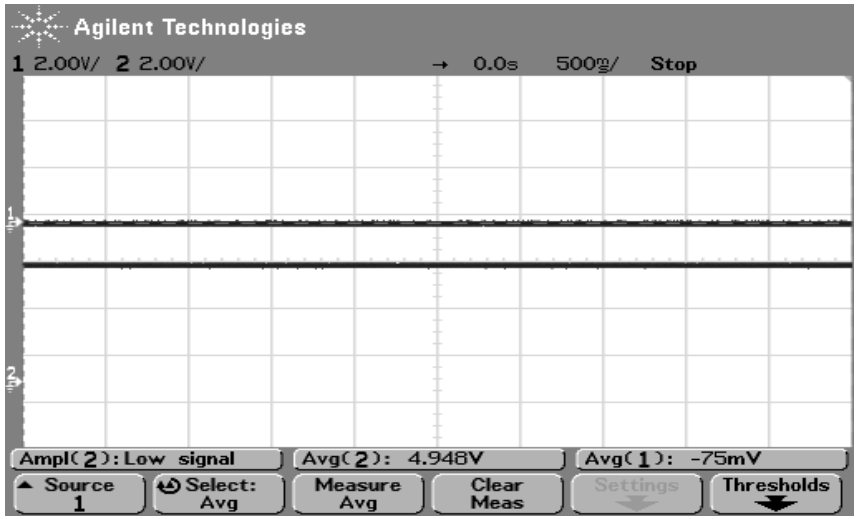
http://data.energizer.com/PDFs/EN22.pdf

Pressure Sensor

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

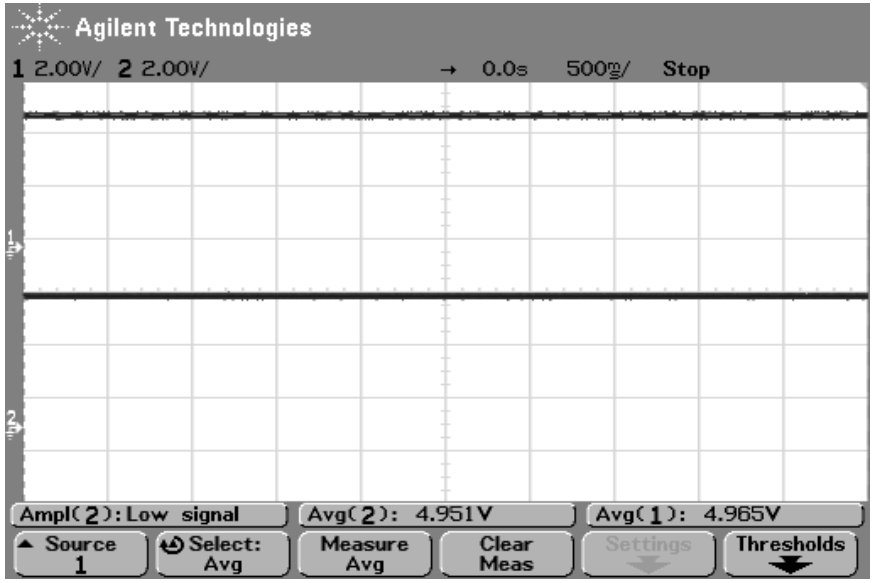


Pressure Sensor Testing



Sensor unpressed:

output voltage = 0 V



Sensor pressed:

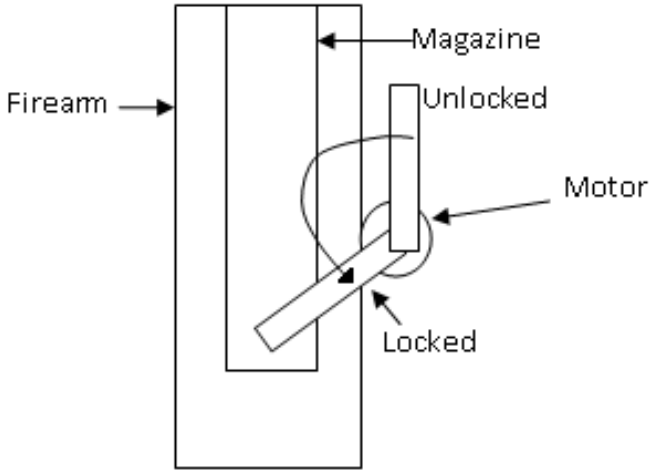
output voltage = +5 Vdc

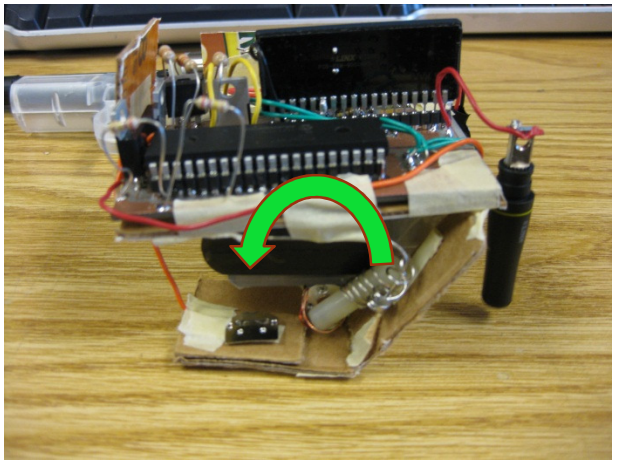
Locking Mechanisms

- 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

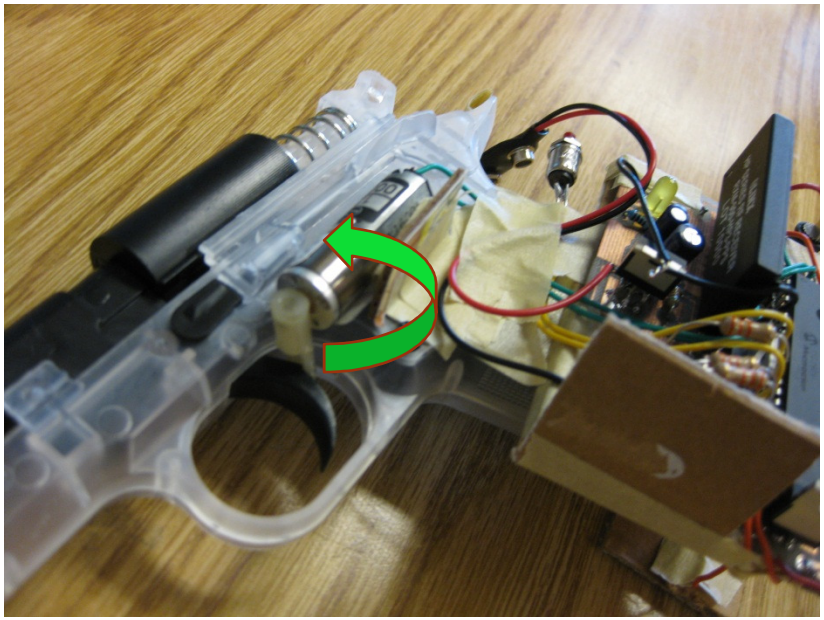
Locking Mechanisms

Magazine Lock



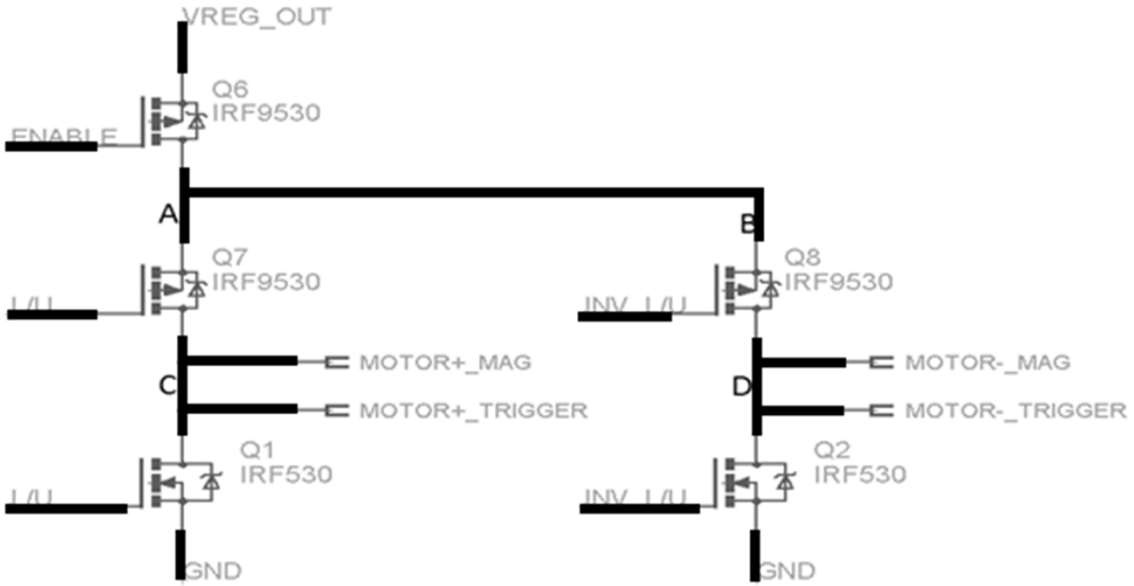


Trigger Lock



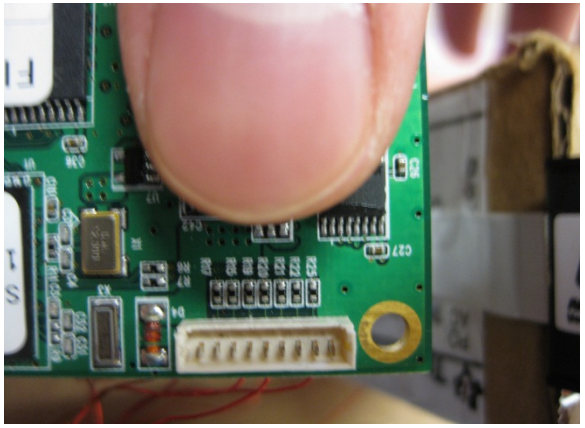
Locking Mechanisms Testing

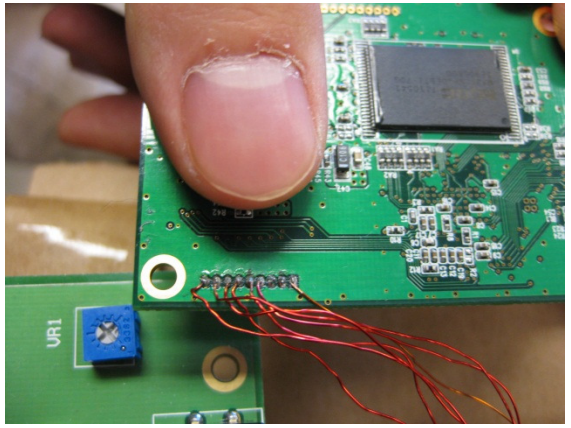
Enable	L/U	INV_L/U	A	B	C	D	Movement
0 V	0 V	5 V	5 V	5 V	5 V	0 V	Unlocking
0 V	5 V	0 V	5 V	5 V	0 V	5 V	Locking
5 V	X	X	X	X	0 V	0 V	None



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