# LED Swim Pacer

Group: 23

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# Presentation Outline

- Introduction
- Features
- Benefits
- Objective
- Original Design
- Final Design
- Project Build
- Functional Tests
- Software
- Successes
- Challenges
- Ethics
- Recommendations
- Closing

# Introduction

**Challenge**

- A variable speed pacer which will help swimmers to improve their performance
- Need to be waterproof in order to operate in the pool

# Features

- Strip of green LEDs with a 50cm separation between each LEDs
- Two ends of the strip will have red LEDs to alert the swimmer
- Beginning of LED programmed to be faster as the lap begins
- Waterproof LED strip and control box
- Batteries last at least 2 hours
- Timing increments at 0.5sec
- Maximum of 40 seconds and minimum of 10 seconds

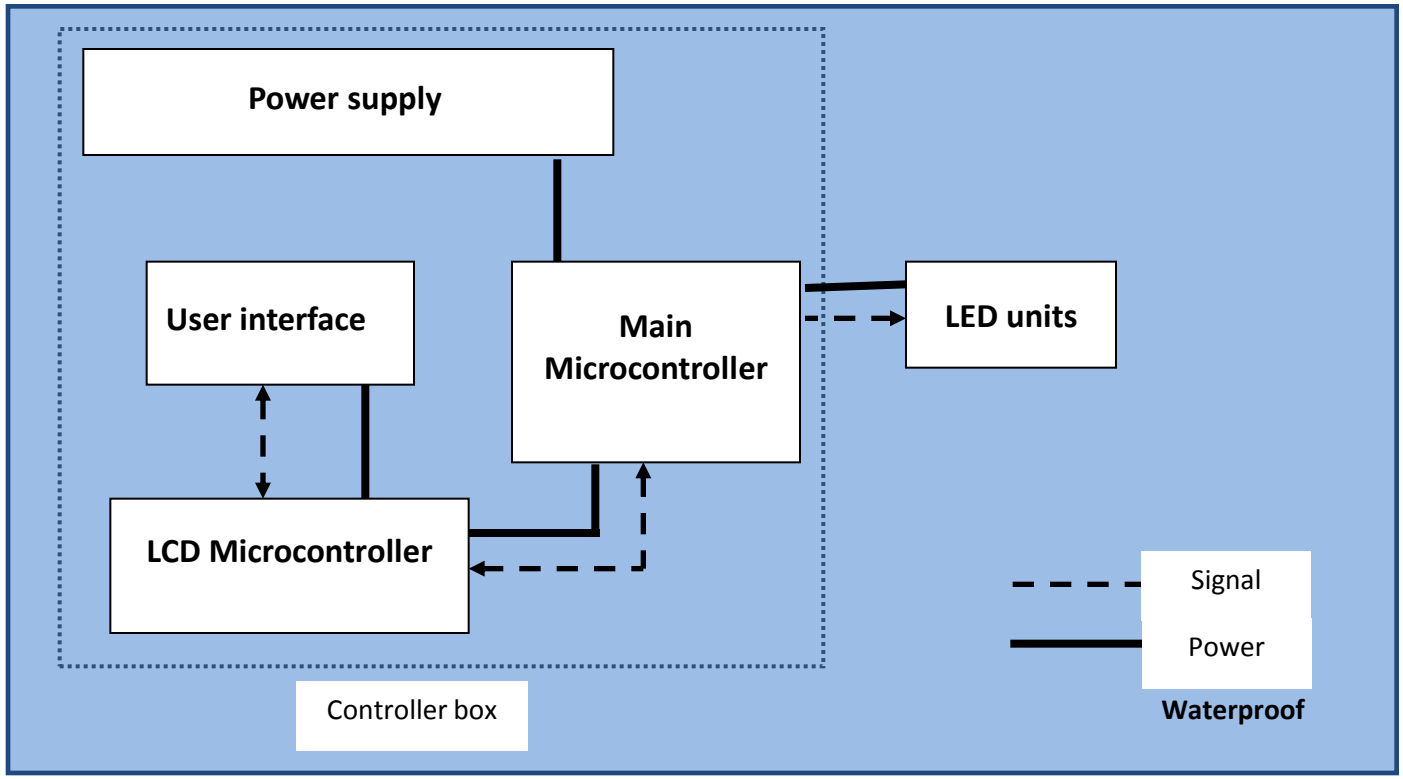
# Benefits

- Simple to deploy
- Display LED strip time for each lap
- Different colored LED to warn swimmers that end of pool is close

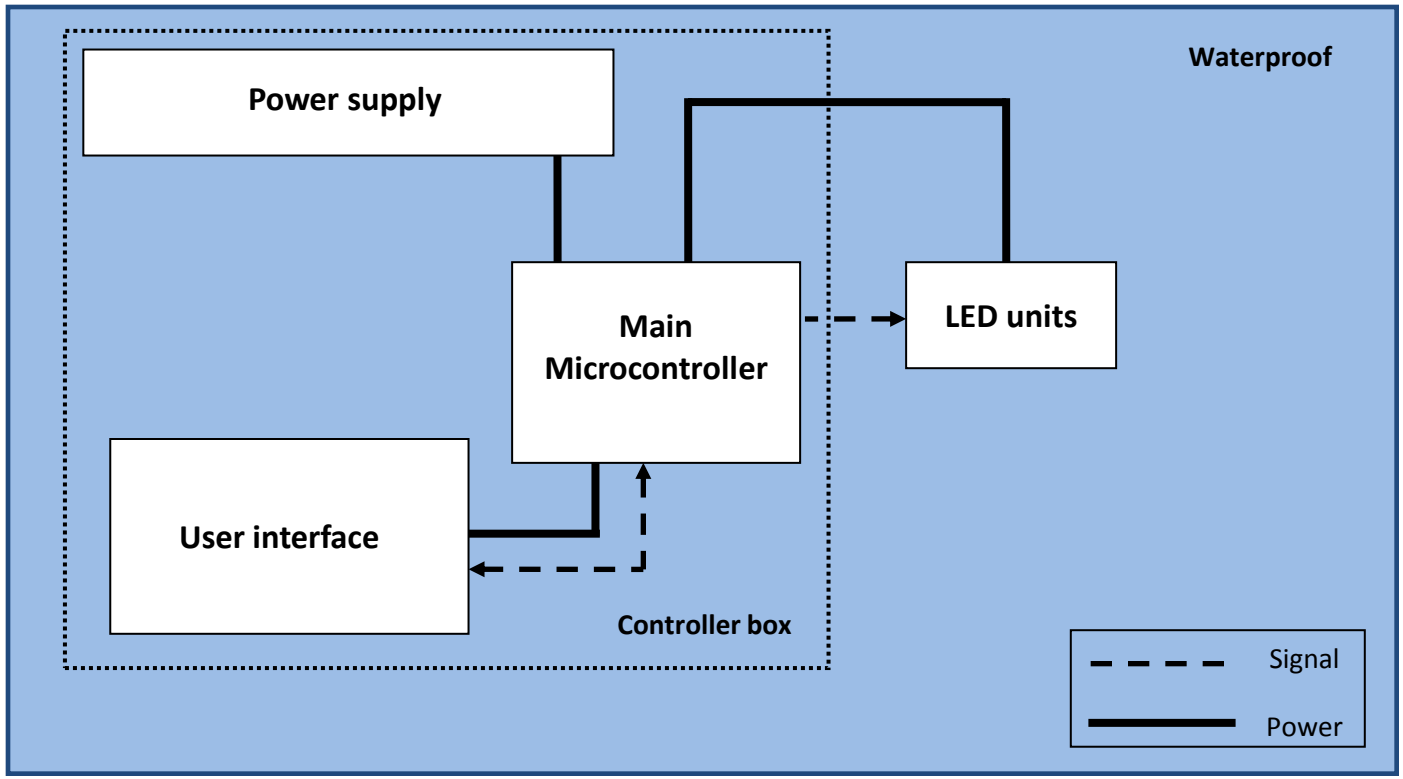
# Objective

- To make a strip of water proof LED under the pool to pace the swimmer
- Program the microcontroller to output the signal after certain delay according to user input
- Display timing on LCD monitor

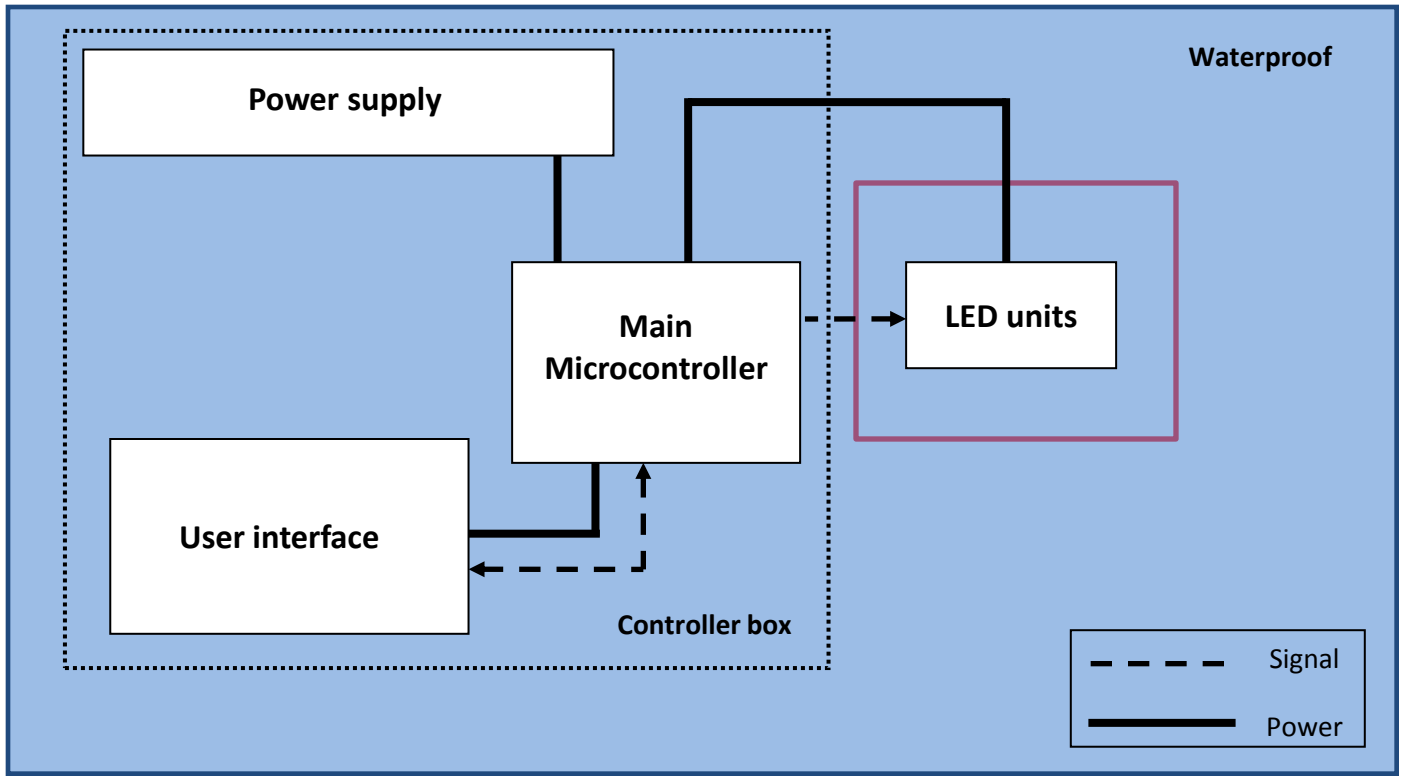
# Original Design



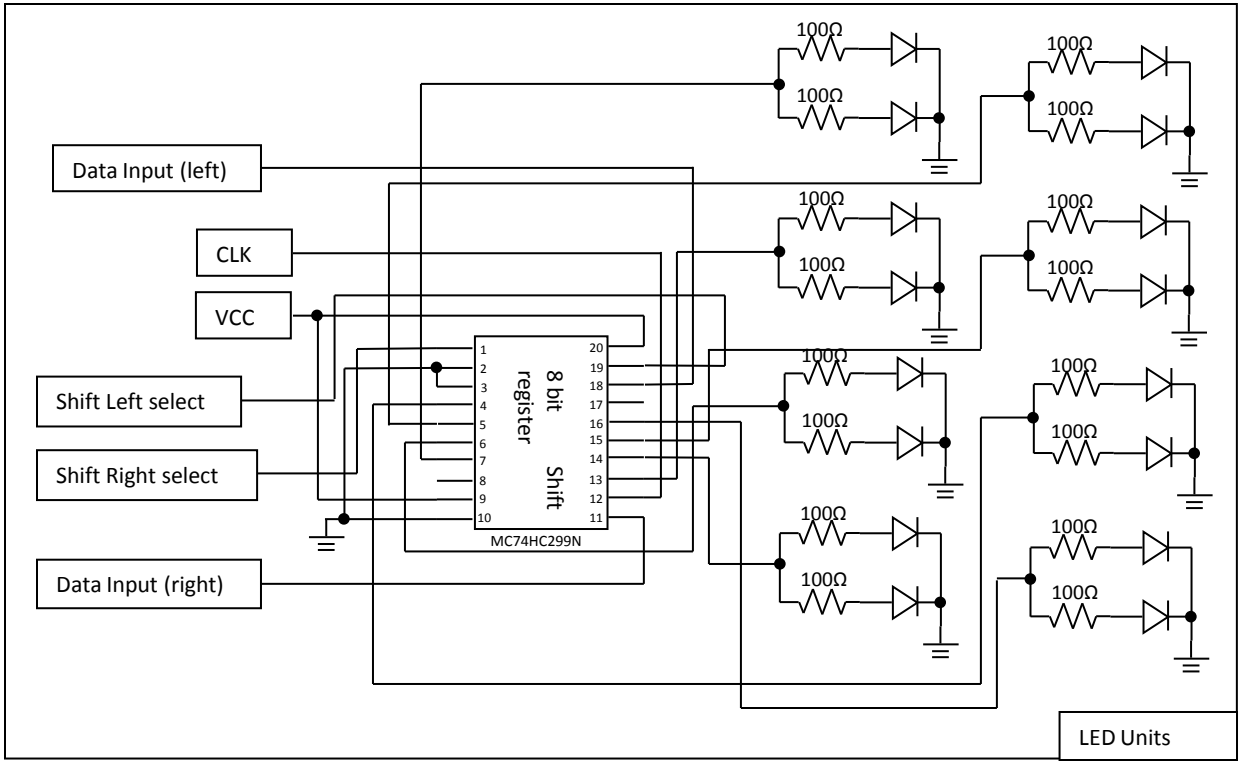
# Final Design



# LED units

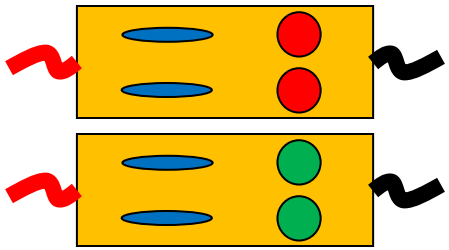

Waterproof
Power supply
Main Microcontroller
LED units
User interface
Controller box
Signal
Power

# LED unit Design

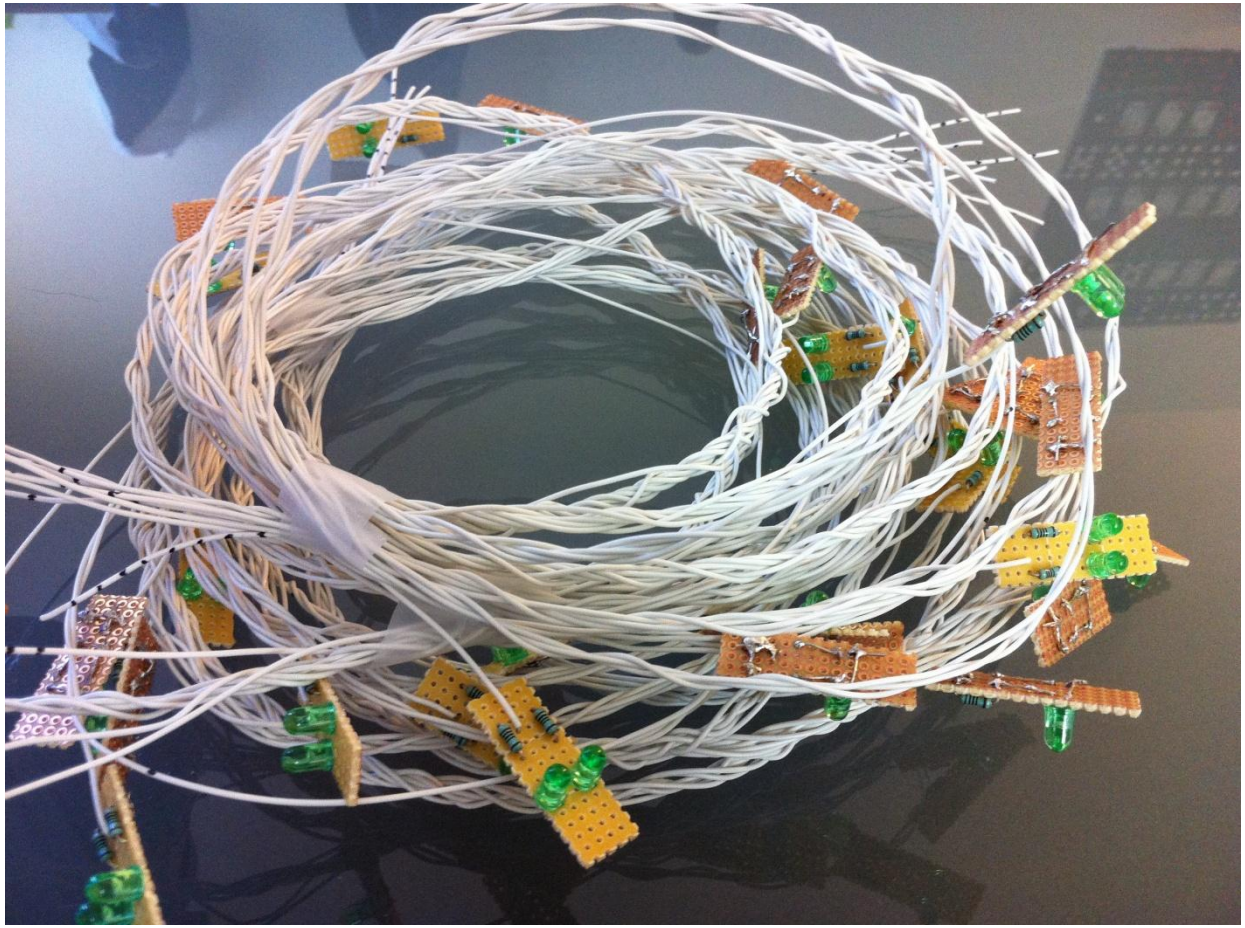


# LED unit Overview

- 60 Green LEDs
- 40 Red LEDs
- Maximum Continuous Current
  - Green: 120mA
  - Red: 120mA
- Forward Voltage
  - Green: 2.1V
  - Red: 2.0V



# LED Strip



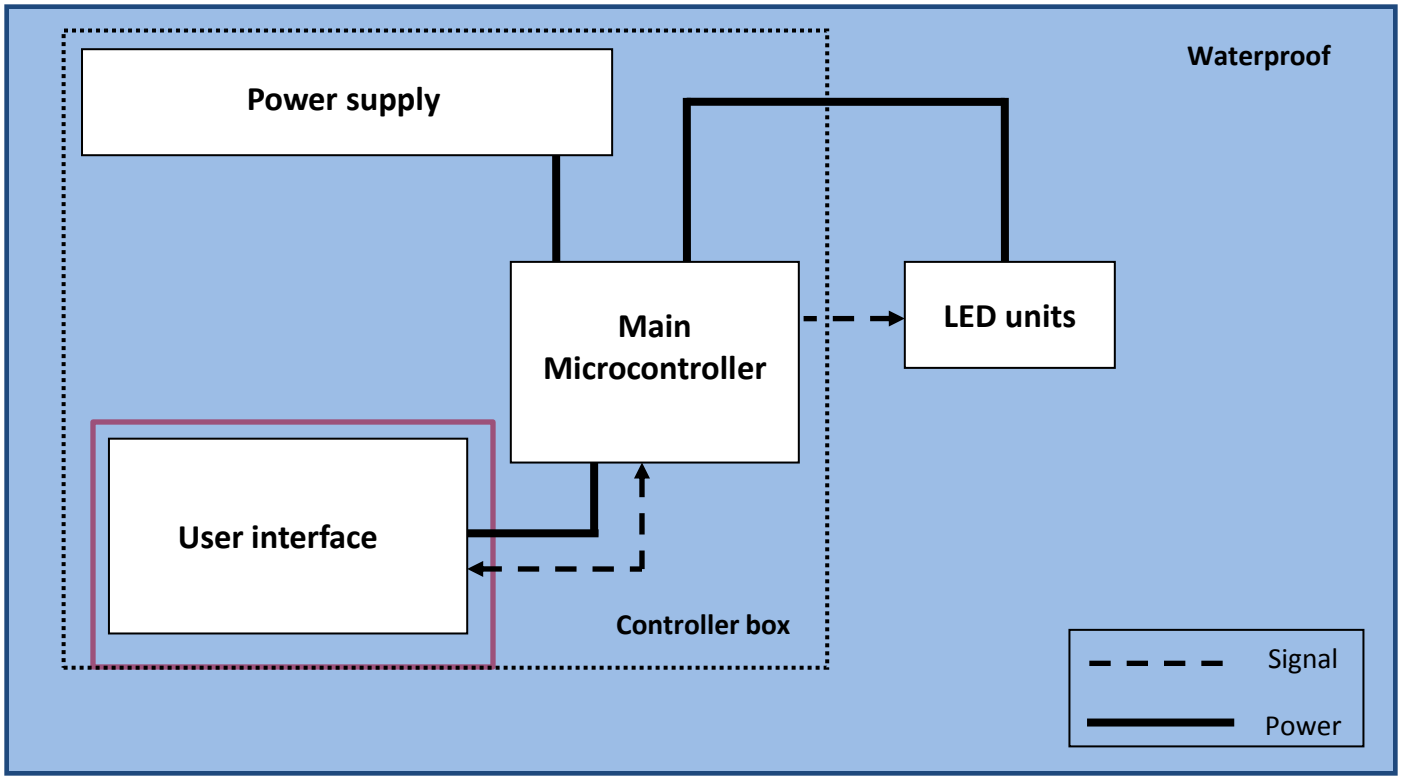
# Wire Resistance

Resistivity of 22 gauges wire: 0.01614 ohm per foot Diameter: 0.64516mm Area: 3.6167E-7 m2 Length: 79.74 feet (24m)

R= 0.01614*78.74 feet =1.271 ohms $R = \rho \frac{\ell}{A}$

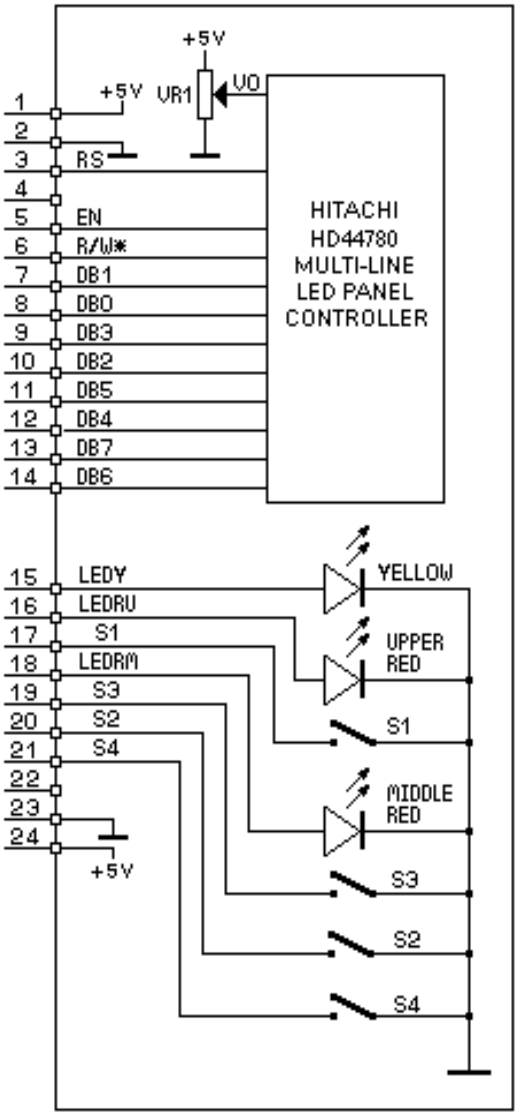
<u>Wire Resistance= 1.271 ohms</u>

# User Interface



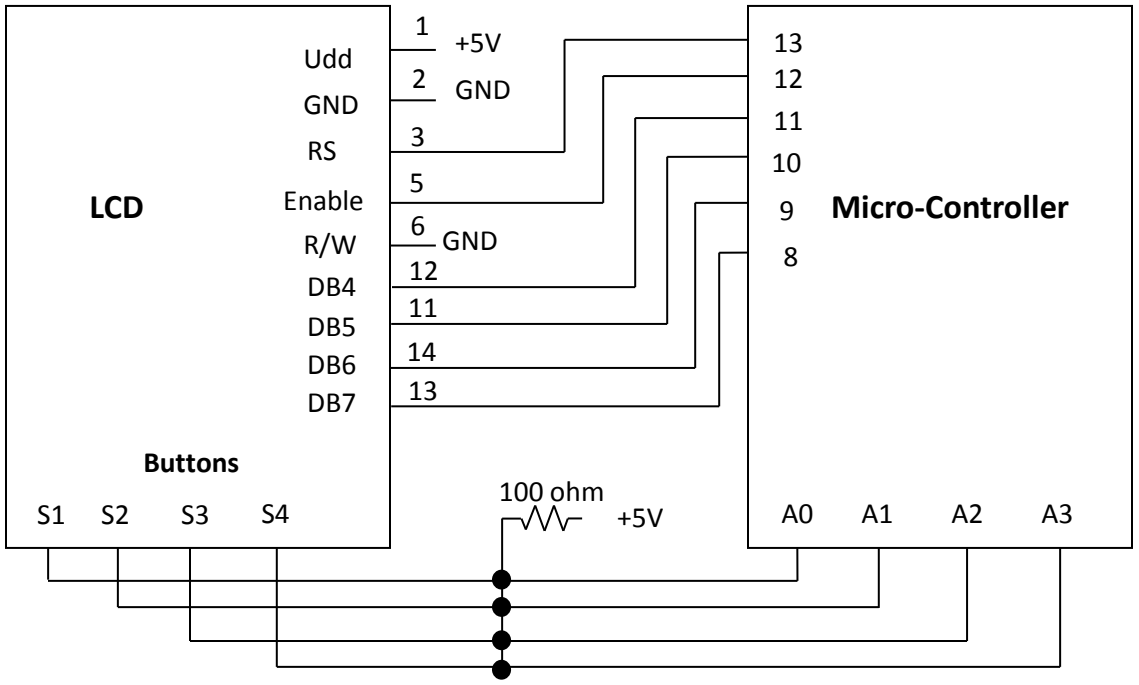
# User Interface

- LCD: 16 character X 2 line display
  - Displays menu
  - Prompts user input
- Push buttons: 4 buttons
  - User inputs

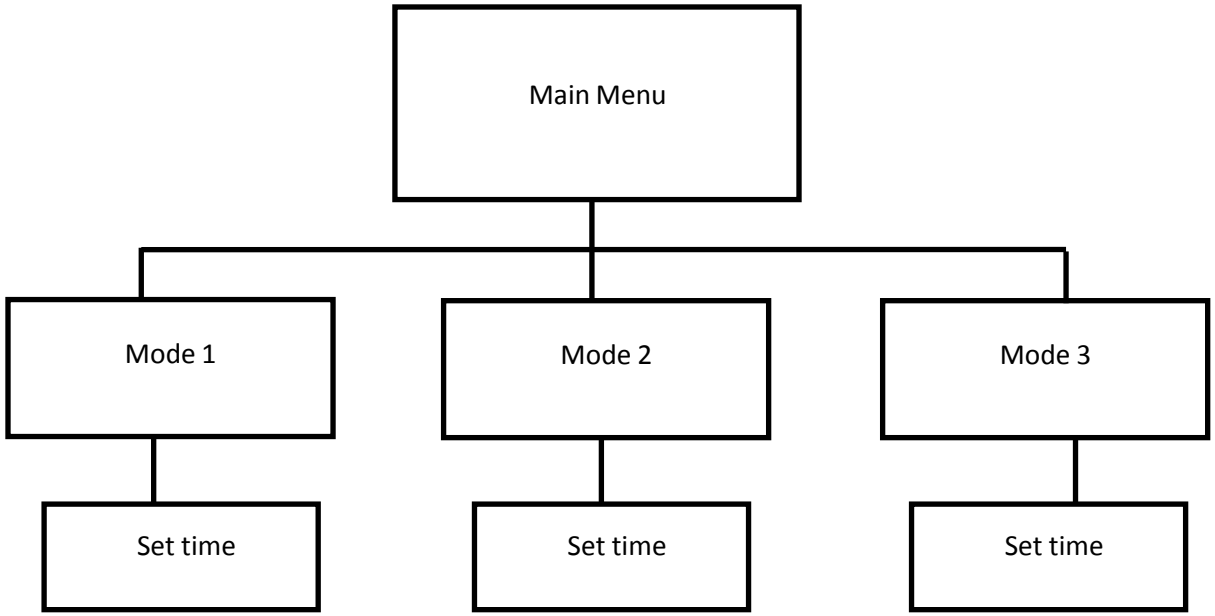



# LCD Design

- 4-bit Mode
  - Requires only DB4-DB7

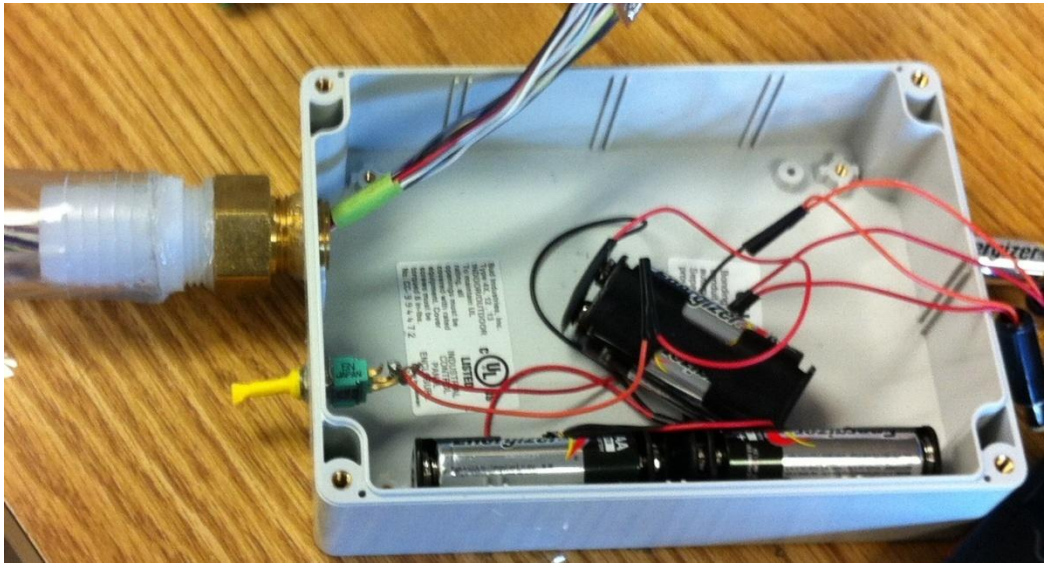


# User Interface Menu



# Power Supply

- 6 AA Batteries in series
  - 9 Volts



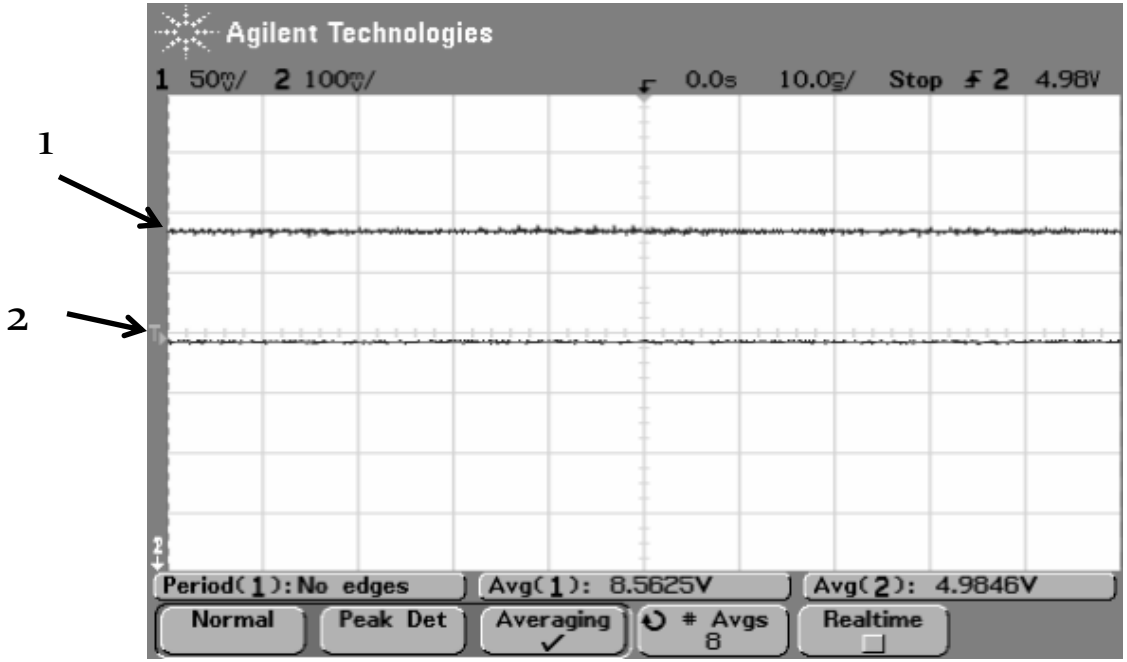
# Power Supply Overview

| Modules | Power usage (watts) |
|---|---|
| LED | 0.1362 watts(for a pair) |
| Microcontrollers | 0.21 watts |
| Shift registers | 1.50 watts |
| LCD | 1.5 watts |
| **Total** | 3.3462 watts |

6 AA batteries in series, 9V, and each which has a rating of 2amp-hour. Thus the battery will add up to 18 watt-hour

18watt-hour/3.3462 watts = 5.38 hours

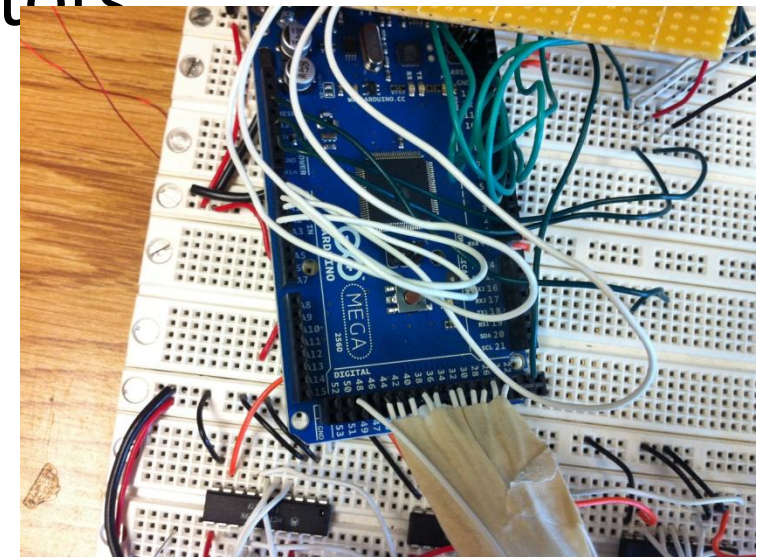
# Power Supply Testing

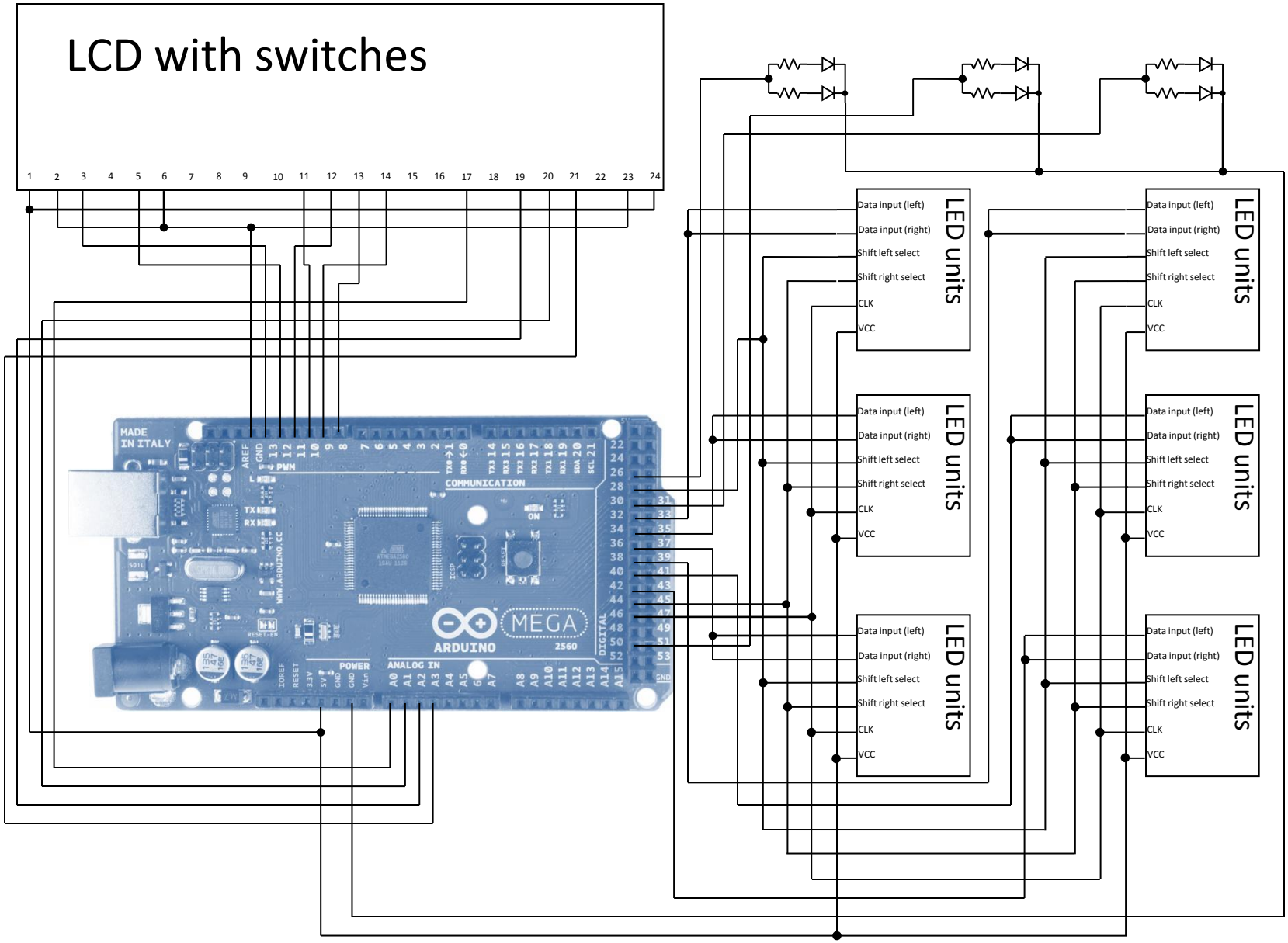



- 1 – input voltage from Battery: 8.56V
- 2- voltage regulator output: 4.98V

# Micro-Controller Overview

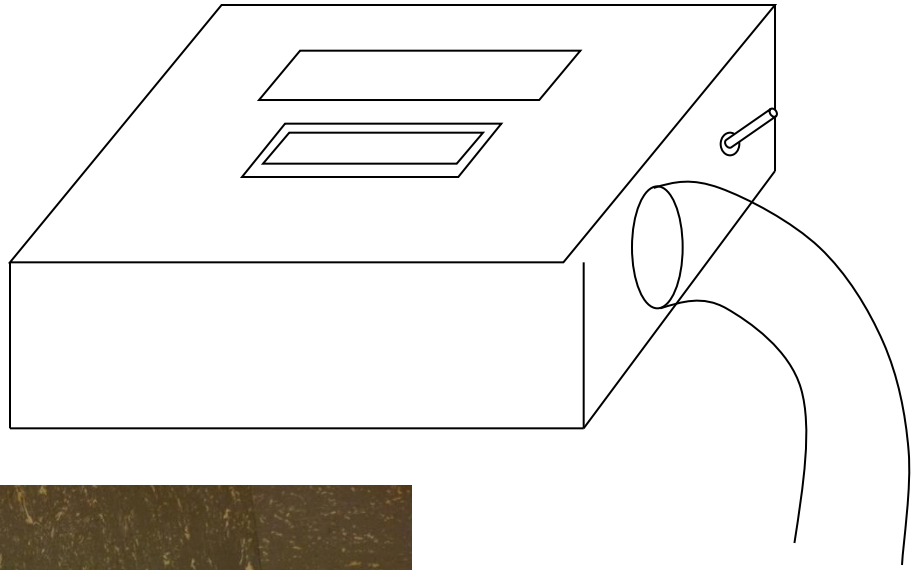
- Arduino Mega 2560
  - 16 MHz crystal oscillator
  - 54 Digital I/O
- Built-in Voltage Regulators
  - 5V-LCD, Buttons, LEDS

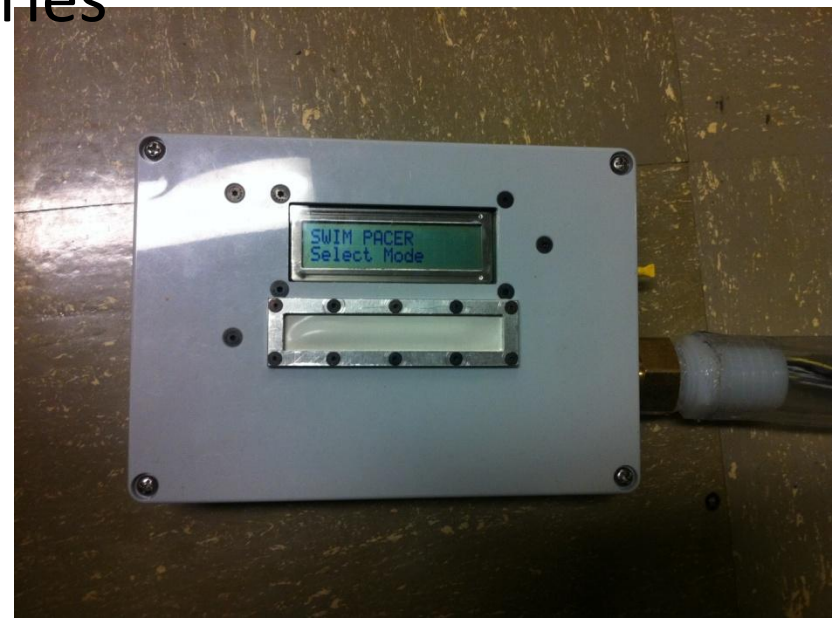



LCD with switches
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
LED units
Data input (left)
Data input (right)
Shift left select
Shift right select
CLK
VCC
MADE IN ITALY
COMMUNICATION
MEGA
ARDUINO
2560
POWER
ANALOG IN
DIGITAL

# Controller Box

- Waterproof
- Contains
  - Micro-Controller
  - Batteries
  - LCD

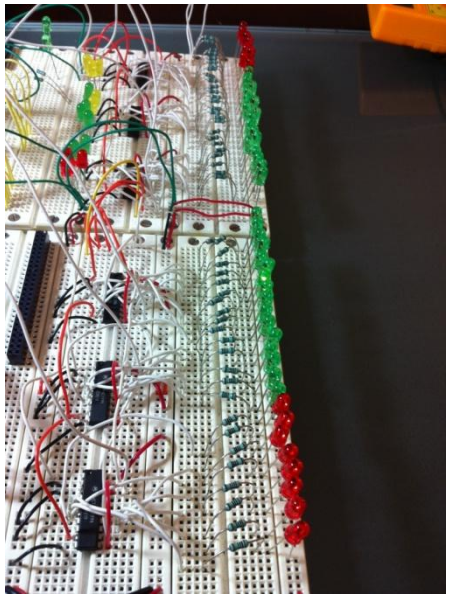




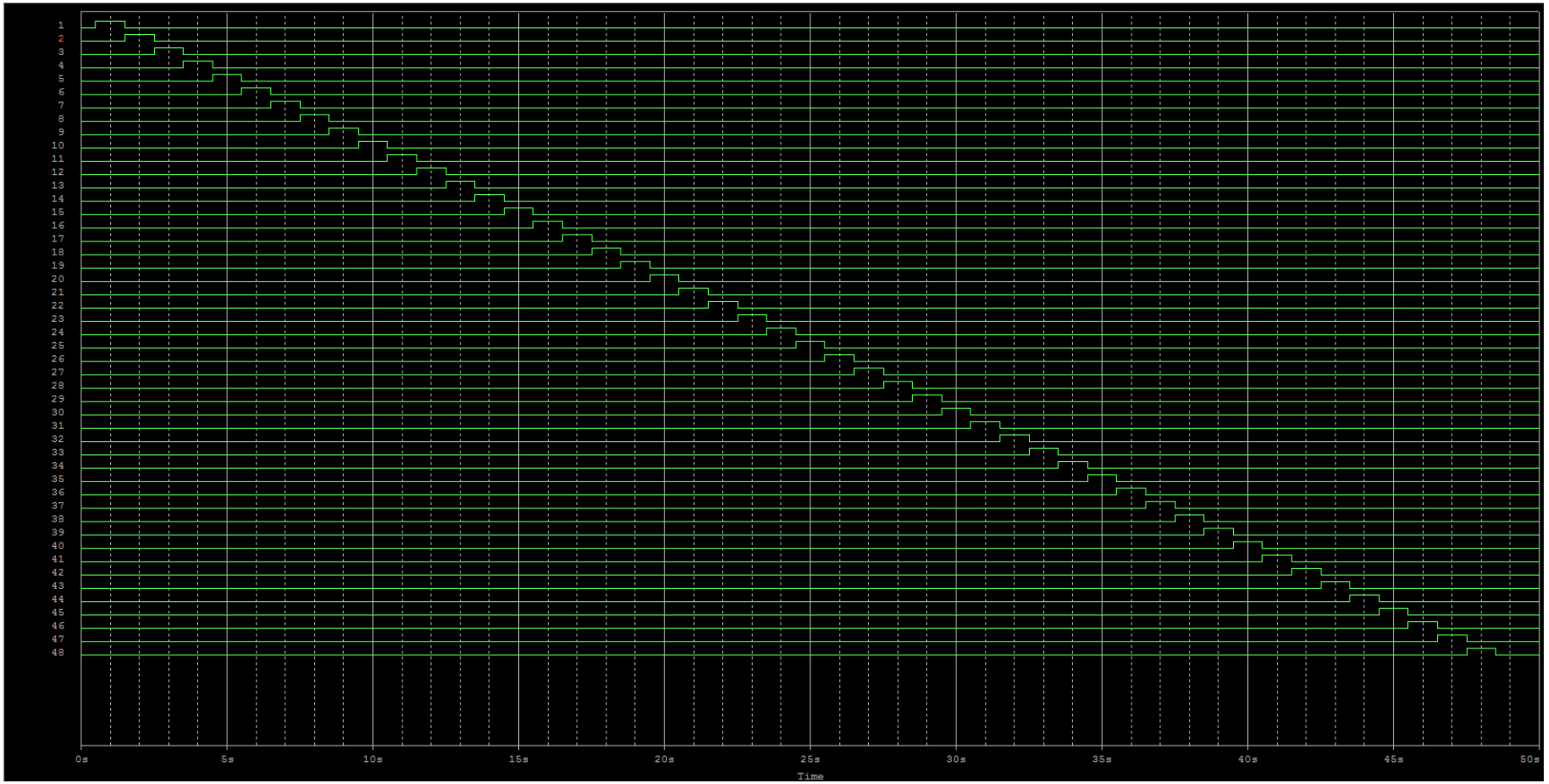
# Swim Pacer

# Functional Tests

- Test the LED unit's shift function using a prototype on a bread board
- Test the signal output and clock delay between each LED unit



# Simulation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35s
40s
45s
50s
Time

# Software

- Arduino 1.0
  - LCD
    - Displays main menu and prompts user input
  - Read timing from user
    - Stores and displays time
  - Clock calculation
    - Sends signals to shift registers

# Successes

- Shift register can shift the data in the direction according to the input signal
- LCD can display the message and change the menu after button has been pressed

# Challenges

- Calculate clock delay correctly
- Place LED inside the tube in same direction
- Battery life
- Placing LED strip inside tube

# Recommendations

- Brighter LED can be used to increasing the visibility
- Using AC outlet to improve operation time
- More pacer modes for user

# Ethics

- IEEE Code of Ethics issue #9 states, “to avoid injuring others, their property, reputation, or employment by false or malicious action”.
- Since the product will be submerged underwater, there might be a chance of causing electric shock to users. Therefore the product will be sealed tight and waterproofed.
- The power is supplied by batteries, not AC line input therefore it will reduce the potential danger of electric shock.

# Thank you

- Professor Paul Scott Carney
- TA, Ryan May
- Coach Howard
- ECE Machine Shop, Skee Aldrich
- ECE Parts Shop, Wally Smith