LED Swim Pacer

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Presentation Outline

- Introduction
- Features
- Benefits
- Objective
- Original Design
- Final Design
- Project Build
- Functional Tests
- Software
- Successes
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- 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
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)

\[ R = \frac{\rho \ell}{A} \]

\[ R = 0.01614 \times 78.74 \text{ feet} = 1.271 \text{ ohms} \]

Wire Resistance = 1.271 ohms
User Interface

- User interface
- Power supply
- Main Microcontroller
- LED units
- Controller box

Waterproof

Signal

Power
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

Main Menu

- Mode 1
  - Set time

- Mode 2
  - Set time

- Mode 3
  - Set time
Power Supply

- 6 AA Batteries in series
  - 9 Volts
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

\[ \frac{18 \text{ watt-hour}}{3.3462 \text{ watts}} = 5.38 \text{ hours} \]
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
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
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

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