UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Swimming Data Tracker

ECE445 - Project Proposal

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1.0 Introduction

1.1 Title

This project was selected because there is a need for easier swim time tracking during practice. We have been given specifications by Illini swim coach Howard Schein who we will work with throughout our project. We are convinced that this product will be marketable since it is easy to set up for swim training in public pools. We are looking forward to improving the process of swim training by giving the coach "hands-free" lap timing, minimizing set-up time, and gathering data easier.

1.2 Objectives

1.2.1Goals

- Help coaches record and adjust lap times during training.
- Coaches can view trends in lap times (improving, etc…)
- Store data acquired and make it easier for the coaches to read.

1.2.2 Functions

- Acquire lap time from the swimmers triggering a RFID sensor.
- Transmit data via Bluetooth to coach's laptop for easy viewing.
- Allow coaches to adjust rest times between sets on their laptop.

1.2.3 Benefits

- Faster, easier, and accurate lap time recording.
- Data is easily acquired without coach's involvement.
- Coaches can view lap times in excel format without hassle.

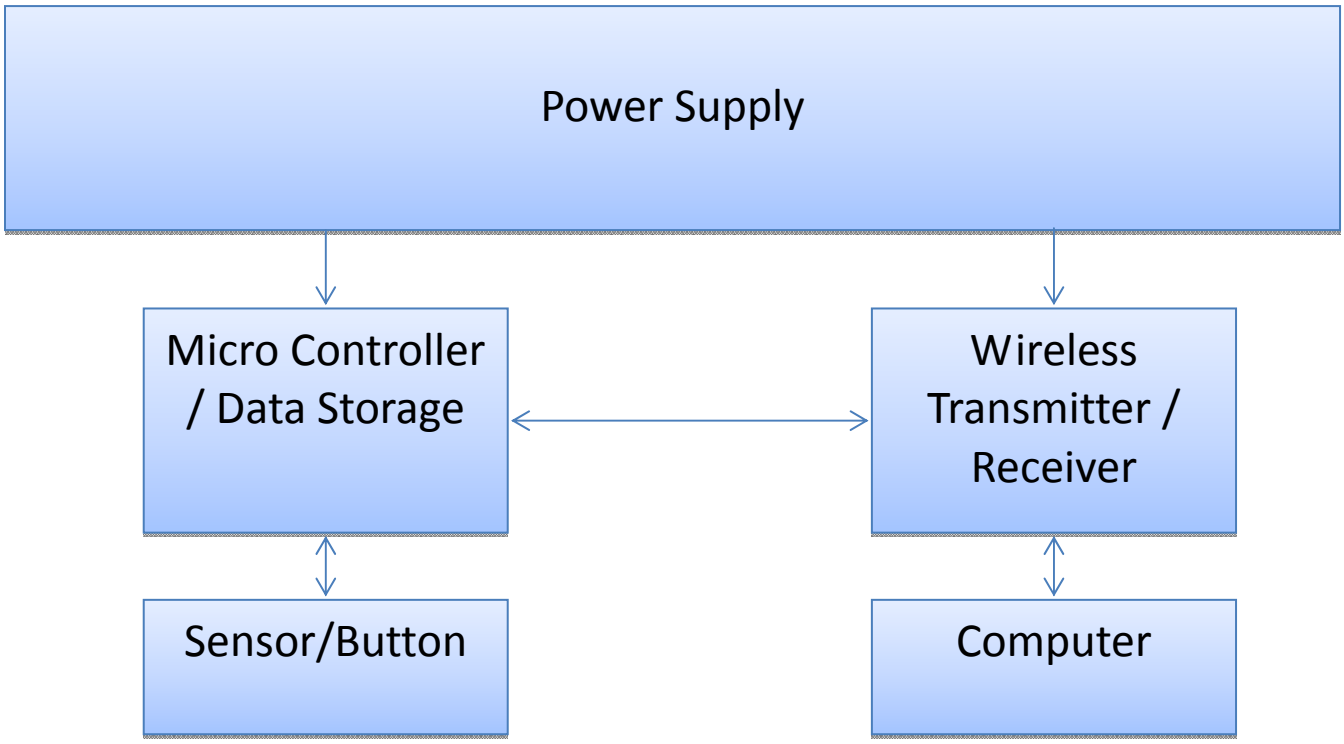
1.2.4 Features

- RFID sensor located on swimmer to trigger timer to start/stop.
- Time tracker to adjust coach's desired rest times between lap sets for desired swimmers.
- Wireless transmitter/Receiver (Bluetooth) to transfer data between a laptop and the timing box.
- Software to decode data into an excel format.

- Waterproof enclosure to protect electrical components and batteries.

2.0 Design

2.1 Block Diagram



2.2 Block Descriptions

1. Power Supply

   The power supply will be a bank of removable batteries installed inside the waterproof enclosure. We will need 7 - 12V to power a Bluetooth transmitter and microcontroller. Therefore we will use a 12V battery to power the electronics in the waterproof enclosure. We will have a rechargeable battery that you can plug into the wall while you are not using it. It will be only able to charge when the power switch is off.

2. Sensor/Button

   The sensor for this device will be 4 waterproof buttons that will sit along the poolside for the swimmers to press to start/stop the timing of their laps. We will connect the buttons to the microcontroller to trigger the timer. Our other sensor option is to use an RFID tag located on a waterproof bracelet to trigger an RFID receiver inside the waterproof enclosure. Our focus

is to finish out the project using 4 buttons and making sure our timers work. If they do work and there is enough time, we will work on including our bracelet RFID idea.

3. Microcontroller/Data Storage

   The microcontroller will receive digital signals from the sensors to start/stop timing. When the button has been hit, the timer will start and then stop once the button has been hit again. The microcontroller will store this time and will transmit it via Bluetooth to the coach's computer.

4. Transmitter/Receiver

   We will be sending data from our waterproof enclosure to the coach's computer via Bluetooth. Our laptop connection will be a USB Bluetooth device. Our waterproof enclosure Bluetooth device will be soldered onto our PCB board that we will design and produce personally.

5. Computer

   The computer will be the user interface of our device. It will have a program that will receive data and decode into an excel form for the user to easily read. It will also have the option of changing rest times between sets for the swimmers.

3.0 Requirements and Verification

3.1 Requirements

1. Power Supply

   - This unit should supply a voltage of 12V +/- 5%. The battery should be able to be rechargeable through a wall outlet when not in use.

2. Sensor/button

   - The buttons must detect the start/stop of the lap when the swimmers press them.

3. Microcontroller/Data Storage

   - The microcontroller must record the time of each swimmer's lap.
   - The micro controller must tell the Bluetooth transmitter to send data to the computer.
   - The data storage system must have the capacity to store up to 8 different lap times.

4. Transmitter/Receiver

- The transmitter in the waterproof enclosure must transmit lap times to the computer up to 50ft.
- The receiver on the computer must receive data from the waterproof enclosure transmitter.
- The receiver in the waterproof enclosure must receive adjustable rest times set by the coach on the laptop.
- The transmitter on the computer must transmit adjusted rest times that the coach sets on the computer.

5. Computer
    - The computer must receive lap data from the waterproof enclosure and decode it into an excel form.
    - The computer must let the coach adjust the rest time between each set.

3.2 Verification

1. Power Supply
    - The power supply will be probed with an oscilloscope while the device is in operation to verify the voltage thresholds are met.
2. Sensor/button
    - The output of the buttons will be probed with an oscilloscope to verify that a signal is generated when it is pushed.
3. Microcontroller/Data Storage
    - The microcontroller will be probed
    - The memory unit will be directly accessed to verify data acquisition.
    - The output of the microcontroller will be probed with an oscilloscope to verify that a signal is being sent to the Bluetooth to send data.
4. Transmitter/Receiver
    - The transmitter and receiver will be probed with an oscilloscope to verify data is being sent between the computer and waterproof enclosure.

- The computer will directly be accessed to verify data being sent from the waterproof enclosure is correct.
- The bluetooth device in the waterproof enclosure will directly be accessed to verify data sent from the computer is correct.

5. Computer

- The computer will be directly accessed to verify correct information is being received.
- The output of our computer program will be assessed to verify correct use of information and correct formatting is shown.

3.3 Tolerance Analysis

The most critical aspect of this project is the network's ability to communicate as whole. The poolside devices must be able to accurately send their recorded data to a computer in order for it to be recorded and logged. Due to Bluetooth technologies being simpler than WiFi, we have selected the former as our form of communication. However, Bluetooth may have some drawbacks. Unlike WiFi, it is most often used for a single path, connecting two devices. We are looking to connect the main device, a computer, with multiple poolside timers. At most, a pool will have eight lanes, therefore our project should be able to manage and retrieve data from eight different modules. Also, a computer near the pool is not a desirable so we need to be sure that the network communicates from a safe distance. Ten meters is a reasonable and feasible interval. With a pool about 20 meters wide, if the computer were to sit near the middle lanes ten meters from the water, the farthest device that it would have to be communicating with is about 15 meters away (~50 feet). In order to test these tolerances we will continuously increase distance the wireless signal must cover and measure the frequency of connections lost and inaccurate data. We will also increase the frequency of data transmission from the devices to see at what point it becomes inaccurate, giving a measurement as to how well the computer can manage multiple devices.

4.0 Cost and Schedule

4.1 Cost Analysis

4.1.0 Labor

Name	Hourly Rate	Total Hours Worked	Total = Hourly Rate x 2.5 x Total Hours Worked
Phil Niemerg	$35.00	200	$17500.00
Lin Stacey	$35.00	200	$17500.00
Ryan Turner	$35.00	200	$17500.00
Total	$105.00	600	$52500.00

4.1.1 Parts

Item	Part Number	Quantity	Total Cost ($)
Button’s		4	15.00
Bluetooth USB module Mini	WRL-09434	1	10.95
Microcontroller	ATMEGA328P-PU	1	3.50
Bluetooth SMD Module	WRL-10253	1	15.95
Waterproof Wire Connectors		4	5.00
PCB		1	0.00

12V Battery		1	25.00
Waterproof Enclosure		1	15.00
Memory	SST25VF020B	1	3.00
TOTAL COST			93.4

4.1.2 Grand Total

Labor ($)	Parts ($)	Grand Total ($)
52500	93.4	52593.4

4.2 Schedule

Week	Task	Responsibility
2/11	Get buttons and waterproof case and 12 V battery	Phil
	Research excel file management over Bluetooth	Lin
	Order Microcontroller and Bluetooth Module	Ryan
2/18	Construct case with power outlet and cord connections	Phil
	Begin programming code for Microcontroller	Lin
	Create Circuit on bread board	Ryan

2/25	Establish communication between swimmer and computer Prepare for Design Reviews	ALL
3/4	Set up buttons for each swimmer	Phil
	Finish microcontroller program	Lin
	Design PCB on Eagle / PCB build from Electronic Shop	Ryan
3/11	Test button communication	Phil
	Begin work on computer program	Lin
	Populate and test PCB and test Bluetooth communication to computer	Ryan
3/18	SPRING BREAK	ALL
3/25	Finalize outward appearance	Phil
	Finish Computer program	Lin
	Second Revision of PCB	Ryan
2/11	Get buttons and waterproof case and 12 V battery	Phil
	Research excel file management over Bluetooth	Lin
	Order Microcontroller and Bluetooth Module	Ryan
2/18	Construct case with power outlet and cord connections	Phil
	Begin programming code for Microcontroller	Lin
	Create Circuit on bread board	Ryan
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	Finish microcontroller program	Lin
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