Heart Attack Remote Alarm System for Swimmer in Triathlon

Senior Design Project Proposal

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I. Introduction

1. Statement

This project is intended to be used by swimmers in triathlon or open water swimming competitions. The project will provide a remote alarm system connecting the athletes and rescuers so that the rescuers can quickly find the athletes that need help.

2. Objectives

Some people died in the swimming portion of the game because of heart attack or some other reasons. However, since there are many athletes in water at the same time, it is hard for the rescuers to notice that someone needs help. We design this project to solve this problem and save lives.

This project includes two parts: wireless emitter and receiver. The emitter part should be carried by each player and the receiver is used by rescuers traveling with the players on motorized water scooters. The emitter includes a heart rate monitor. Once it detects an abnormal heart rate, the buzzer will sound and LED will flash. At the same time, the emitter will send out a signal to the rescuer. When the wireless receiver catches the signal, it will trigger the alarm and LED to notice the rescuer that someone needs help. This will bring help to the athletes in a shorter time. Our system also includes a manual switch that can be controlled by the swimmer to manually call for help by turning on the switch. It will also trigger the alarm system and send signals to rescuers.

Benefits:

- Easier for rescuers to know someone needs help.
- Able to get notice from surrounding swimmers when emergency happens.
- Automatic alarm when abnormal heart rate appears.
- Able to manually call for help if feeling uncomfortable.
- Waterproof.
- Wearable.

Features:

- Bright LED and buzzer alarm to get notice for help.
- Wireless signal emitter and receiver transmit signal underwater.
- Heart rate monitor detect abnormal heart rate behavior.
- Manual switch for option to control the system.

II. Design

1. Block Diagram

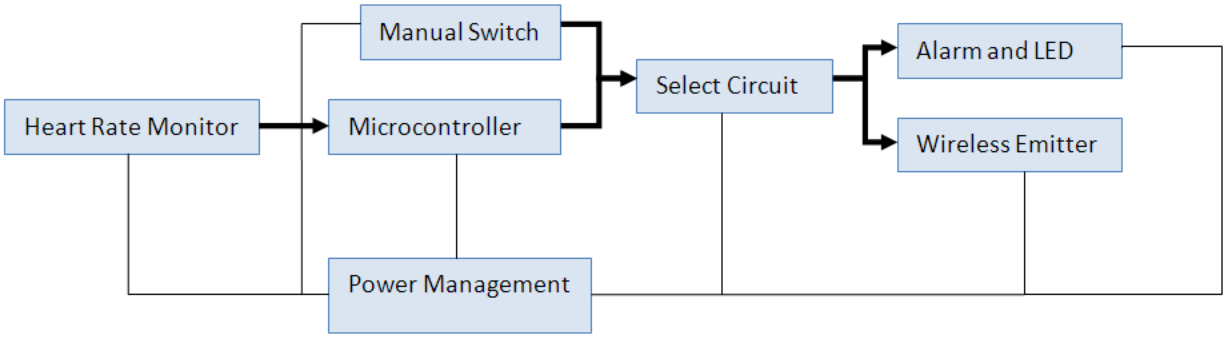

Figure 1. Wireless Emitter Part

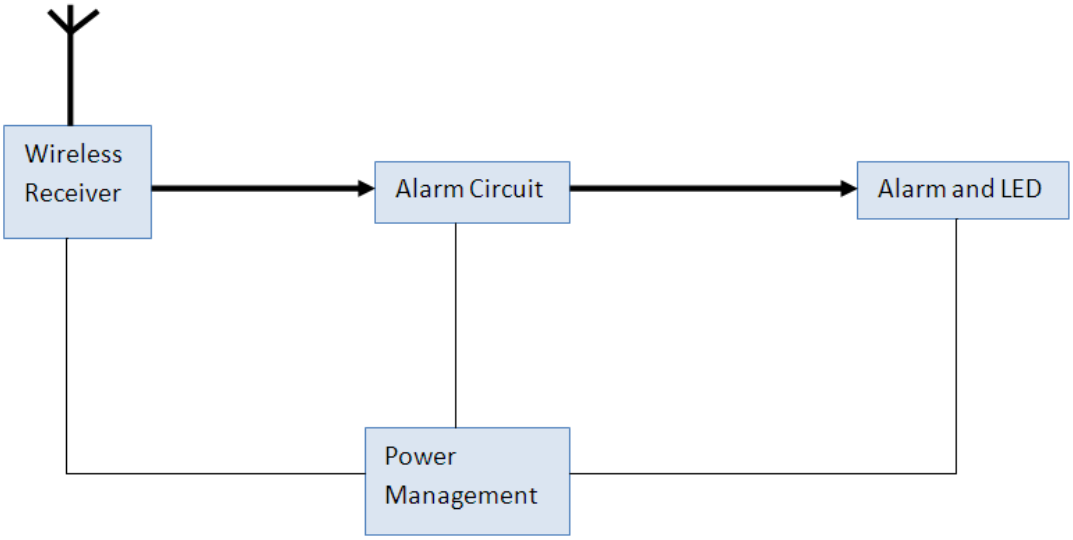

Figure 2. Wireless Receiver Part

2. Block Description

- Heart Rate Monitor:

An Ear Heart Rate Monitor will be used to detect the heart rate of swimmers, which will comfortably fit the athletes and have a minimum impact on their performance in the competition. It will constantly send data collected to the Microcontroller be to processed, so as to detect whether the specific swimmer is encountering some health issue.

- Microcontroller:

We will be using a microcontroller that is capable of collecting data from the Heart Rate Monitor, deciding whether the heart rate is within a certain range, and sending the corresponding information to the Select Circuit. The range will be programmed into the

microcontroller beforehand according to the maximum and minimum heart rate possible for human beings. If the monitored heart rate of the athlete is outside that range, the microcontroller will detect it and trigger the alarm system calling for help through the select circuit.

- Manual Switch:

A manual switch will be added to our device to allow the swimmer manually trigger the alarm system and send rescuing signal through the wireless emitter. This function enables the athlete to call for help when he or she feels uncomfortable but when the heart rate is still within the normal range.

- Select Circuit:

This circuit collects information from the microcontroller and the manual switch. When either the microcontroller or the switch indicates the need to call for help, this select circuit will trigger the wireless emitter, alarm and LED.

- Alarm and LED:

When the select circuit is indicating a need to call for help, it will trigger the alarm and LED at the swimmers' side. Similarly, the alarm circuit will trigger the alarm and LED at the rescuers' side. At the swimmers' side, the alarm will sound and the LED will light up to notify surrounding. At the rescuers' side, the alarm and LED will call for the rescuers' attention to help the athletes.

- Wireless Emitter:

When the select circuit is indicating a need to call for help, it will trigger the wireless emitter to send a signal to the wireless receiver located at the rescuers to notify them.

- Wireless Receiver:

The wireless receiver could receive signal from the wireless emitter located on each swimmer. It would then send the information to the alarm circuit to indicate whether alarming is necessary.

- Alarm Circuit:

It takes data from the wireless receiver. If it is indicating the need for help, this circuit will trigger the alarm and LED to call for the attention of rescuers.

- Power Management:

This system manages the power of all the circuits.

III. Requirements and Verification

1. Requirements

All portions of the wireless emitter part should be able to work normally underwater.

- Heart Rate Monitor:

The data provided by the monitor should be continuous and reliable despite dramatic motion of the swimmers and be safely and stably sent to the microcontroller.

- Microcontroller:

The microcontroller should compare the data sent from the heart rate monitor with a certain pre-programmed range and correspondingly decide whether to trigger the select circuit.

- Manual Switch:

The switch should be easily controlled by the swimmer. And it should not be accidentally turned on due to the force of water or other outside force.

- Select Circuit:

The select circuit should make sure to trigger the alarm system when either the switch or microcontroller indicates such a need.

- Alarm and LED:

The alarm should have enough sound volume and the LED should have enough luminance to be able to call for attention of people, when they received positive trigger signal from select circuit.

- Wireless Emitter:

It should be able to send out a signal to the receiver only when the select circuit triggers it. The signal should be strong enough to reach the rescuer.

- Wireless Receiver:

It should be able to receive the signal from emitter and deliver the information to alarm circuit.

- Alarm Circuit:

It should trigger the buzzer alarm and LED at rescuer’s place based on the signal from the receiver.

- Power Management:

It should deliver appropriate power to each circuit and block.

2. Verification

Block	Verification Procedures	Acceptable Quantitative Results
Heart Rate Monitor	Turn on the heart rate monitor when it is installed properly on person, and present its output signal on oscilloscope.	1. Consistent and clear signal corresponds to human heart rate should be observed.
Microcontroller	Test microcontroller program with series of test inputs to simulate heart rate and observe the output to see if the microcontroller reacts right as expected.	1. Output low when test inputs corresponding to heart rate within range between set thresholds. 2. Output high when input goes beyond set range or changes dramatically corresponding to abnormal heart behaviors.
Select Circuit	Accept inputs from manual switch and microcontroller and the see the select output. Manually control the switch and use test code for microcontroller.	1. Output low when switch is turned off and microcontroller outputs low. 2. Output high when manual switch is turned on. 3. Output high when microcontroller output high.
Alarm and LED	Input a logical high and see if both of them work.	1. Alarm sounds 2. LED lights
Wireless Emitter	Input logic high and low separately and see if the emitter works right. Test transmission when emitter part of circuit is placed underwater.	1. Emitter doesn't send out any signal when input low. 2. Emitter sends out a signal when input high. 3. The emitter works right when put underwater.
Wireless Receiver	When wireless emitter sends out a signal, the receiver is able to catch the signal.	1. Receiver is at rest when emitter doesn't sends out signal. 2. Receiver catches signal when emitter sends out one.
Alarm Circuit	After the wireless receiver gets a signal, see if alarm circuit will pass the information to alarm and LED.	1. When receiver is at rest, alarm circuit output low. 2. When receiver catches a signal from the emitter, the circuit output high.

3. Tolerance Analysis

Tolerance analysis will be performed on the wireless signal transmission system, since the success of this project greatly depends on the efficient transmission of the alarm signal from swimmers underwater to the rescuers. Suppose the rescuers are on the boat following swimmers in the competition, we set the minimum distance for transmission at50m±5m. Specifically, the behavior of the wireless emitter and receiver will be tested when the emitter is placed underwater and the receiver is placed 50maway. The signal should be able to travel through water and be detectable for the receiver over such distance.

IV. Cost and Schedule

1. Cost Analysis

▪ LABOR

Name	**Rate**	**Hours**	$\boldsymbol{Total = Rate \times 2.5 \times Hours}$
Zilin Dou	$40/hr	160	$16,000
Yunye Gong	$40/hr	160	$16,000
		Total	$32,000

▪ PARTS

Part	**Unit Cost**	**Quantity**	**Total**
Heart Rate Monitor	$5	1	$5
315 MHz Wireless Emitter and Receiver kit	$9.55	1 (5 pics inside)	$9.55
Microcontroller (PIC16F877)	$5.704	1	$5.704
Alarm	$1	3	$3
LEDs	$0.25	20	$5
Resistor, capacitor, switch, logic gates			$10
PCB	$33	2	$66
		Total	$104.254

▪ GRAND TOTAL

Labor	$32,000
Parts	$104.254
Grand Total	$32104.254

2. Schedule

Week	**Zilin Dou**	**Yunye Gong**
8/26	Initial post	Initial post
9/2	Brain storm	Brain storm
9/9	Post RFA	Update project page

9/16	Proposal: Introduction, verification and compile Research heart rate monitor information Design circuit	Proposal: Cost and requirements Research and learn about MCU Design circuit
9/23	Detail schematics Sign up DR Order parts	Programming MCU Implement and test heart rate monitor
9/30	PCB design	Implement and test wireless emitter and receiver
10/7	Implement and test LED and alarm	Implement and test select circuit
10/14	Integrate emitter circuit	Integrate emitter circuit
10/21	Integrate receiver circuit	Integrate receiver circuit
10/28	Test the whole circuit	Test the whole circuit
11/4	Sign up and prepare Mock-up presentations	Test circuit underwater
11/11	Debug circuit	Debug circuit
11/18	Thanksgiving	Thanksgiving
11/25	Prepare demos and presentation	
12/2	Demos	Demos
12/9	Presentation	Presentation