ELECOMP CAPSTONE SUMMIT
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THE UNIVERSITY OF RHODE ISLAND

THINK BIG WE DO℠

Wireless Poolside Multi-Sensor System

Project Falcon

Team Members: Daniel Williams (CPE), Elizabeth Stevens (ELE), Mark Sherman (ELE)

Technical Directors: Jamie Murdock '84, Joseph Gundel

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Project Motivation

Current pool automation technologies offer remote control and scheduling but require either wired sensing of remote parameters or an active pool filtration system. They also sense only a subset of what is needed to automate lighting and water levels. Existing aftermarket solutions are insufficient or are too costly to install, resulting in an unmet market need for a comprehensive solution.

A new wireless sensing system would provide a low cost upgrade to existing automation systems and provide an extended range of highly desirable features such as air and water temperature measurement, water level detection, automated lighting control, and pool cover detection.

Key Accomplishments

Sensor Selection: Possible sensors were researched. Sensors selected include ambient light and range detection for the pool cover, air and water temperature detection, and capacitive water level sensing

Radio and Microcontroller Selection: An integrated radio-microcontroller package (SAMR30G) was selected after substantial research.

Initial Sensor Testing: Sensor communication was achieved using an Arduino to explore I^2C connection with project specific sensors. Testing was also completed using the ambient light sensor near sunset to establish a baseline level at which outdoor lighting should be turned on.

Radio Communication: Initial radio communication has been achieved using two MCU development boards. A private MiWi Star network is set up between the two devices, where one is the determined transmitter (poolside sensor unit) and the other the dedicated receiver (OmniLogic Receiver), or PAN coordinator.

I^2C Protocol Communication: I^2C Protocol was selected in order to reduce the amount of GPIO pins used by our multiple sensors, as it only requires two pins to create a data bus. Communication is accomplished via device addressing, which means that each I^2C device is assigned an address that the MCU must use to communicate with it.

Thermistor Value Detection: Successfully capturing ADC value from thermistors in order to accurately determine temperature value, important for OmniLogic interfacing

Capacitive Sensing Layout Determined: Microchip contacts helped to determine the ideal sensing and PCB layout for our water level sensing application. The large ground-coupling of the pool water allows the system to employ a small, thin measuring strip paired with a rectangular, floating reference pad of the same area in order to accurately measure the water level.

Pool Cover Detection Method and Sensor Determination: After researching pool coping measurements, pool cover reflectivity, and ideal water levels, an IR ranging / ambient light sensor was chosen in order to measure both the distance detection and light level.

Initial Schematic and PCB Design: Significant progress on the poolside sensor unit schematic and board layout has been completed. The MCU, external crystal oscillators, sensing devices, and battery holders have be chosen, laid out in the schematic, and placed on the PCB layout. Finalizations for the antenna must be completed before final traces and ground planes can be completed. **See Figure 3.**

Initial Low Power Considerations Implemented: Our poolside sensor unit's processor has been programmed to go into a sleep mode between sensor reads which has significantly lowered the power consumption of the device. **See Figure 2.**

Initial Enclosure Design: A basic prototype of the enclosure for the poolside sensor unit has been drawn up and is currently being designed. **See Figure 4.**

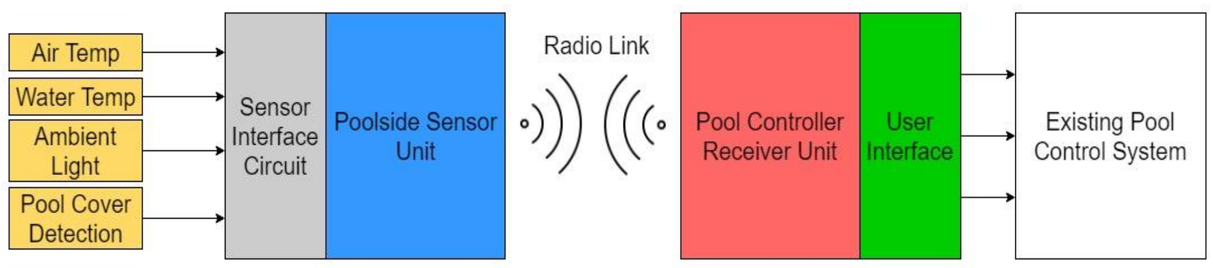

Figure 1: System Level Block Diagram showing the two devices connected via a wireless radio link.

Anticipated Best Outcome

An alpha level prototype of a two-unit system consisting of a poolside sensor hub unit and receiver unit which communicate via radio. The sensor unit should be battery operated and collect environmental data including air temperature, water temperature, pool cover position, water level, and ambient light level. This environmental data should be communicated to the receiver unit where it will be processed and sent to the existing automation units, which will control various pool features.

Project Outcome

The Best Anticipated Outcome was achieved.

Figures

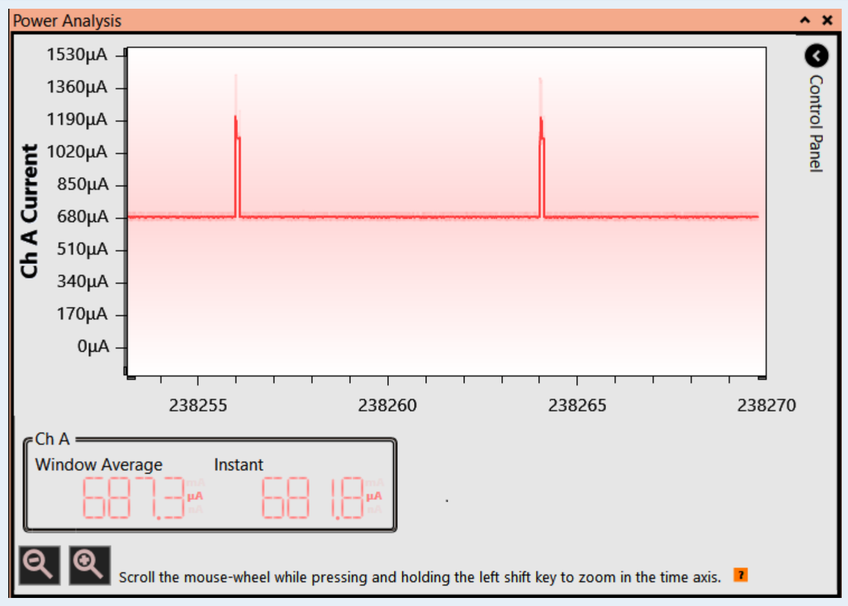

Figure 2: Power Consumption of the Poolside Sensor Unit in Awake Mode vs. Sleep Mode

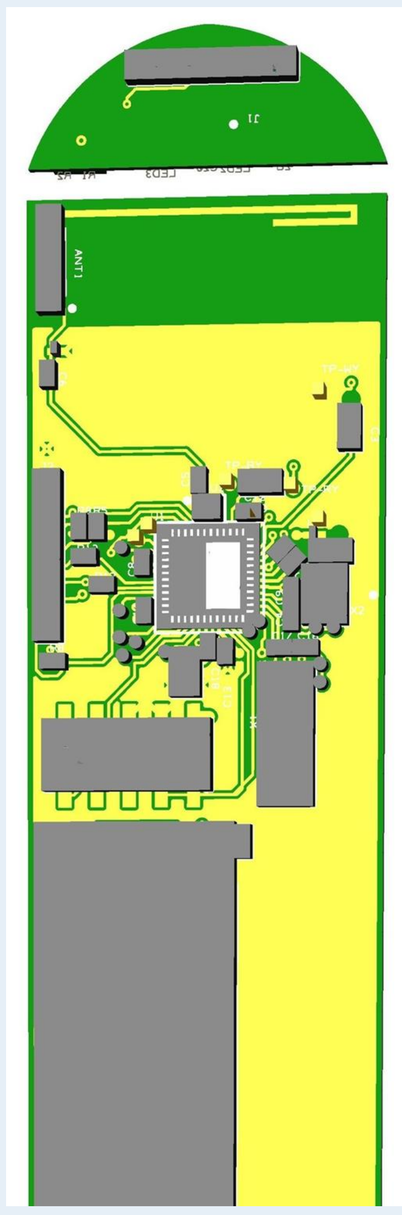

Figure 3: Detail of PCB Layout of Poolside Sensor Unit (left)
Figure 4: Prototype Enclosure of Poolside Sensor Unit (right)

ELECOMP Capstone Program Director: Professor Harish R D Sunak

email: sunak@ele.uri.edu telephone: 401-874-5859 ELECOMP Website: http://web.uri.edu/elecomp-capstone