ELECOMP CAPSTONE SUMMIT
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THE UNIVERSITY OF RHODE ISLAND

THINK BIG WE DO℠

Chlorine Generator Cell Tester

"A portable tester to quickly and accurately determine the cell's health"

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Project Motivation

Currently, Hayward approved servicers of the AquaRite Salt Chlorine generation system use a storefront diagnostic tool to determine if the T-Cell chlorine generator has worn out. This involves connecting the warranty T-Cell to the tester's plumbing and generating measurable chlorine, the parts-per-million of which depend on the cell's age, as well as how dirty it is. The current tool is too expensive, too bulky, too easy to misinterpret, and thus is only used by a fraction of the servicers that diagnose and make warranty claims. As such, many cells are approved for warranty claims when they are in fact fully functional, or simply dirty.

Our capstone team will use water conductivity sensing, test signal generating circuits, impedance measurement, and software to produce a new testing method that is simple for any technician to comprehend, portable and less expensive. This innovation will allow Hayward to widely deploy thousands of T-Cell testers, saving possibly 15% of total warranty claims.

Key Accomplishments

New Fast and Accurate Test Algorithm - Hayward came to us with an idea for a new test algorithm which would be much faster and more efficient than the current method. We were able to take this idea and verify by testing around 15 T-Cells of varying health. We were able to show that good cells had a high current and low voltage, while a bad cell behaved opposite and had a low current and high voltage. Essentially, T-Cells act like resistors: the older/more damaged the cell, the higher the resistance

Custom Hardware to Read from T-Cell - Once the test algorithm was verified, we then developed a custom circuit which would read the necessary values from the connected T-Cell so that our microcontroller would be able to determine the health of the T-Cell. The main drive and sensing circuits consist of driver MOSFETs that control the signals being sent to the T-Cell, such as our main 1 KHz square wave drive signal. The resulting output of the T-Cell is then sent to the MCU and read with the on-board ADC. **Figure 1** shows the final result of our PCB.

Firmware Designed for All Hardware in Project - In addition to developing custom hardware to interface with the various T-Cell models, we also developed firmware to provide a way for Users to use the T-Cell Tester. The goal for the software was to interface with the hardware we designed as well as provide the User with a step-by-step guide to conduct the test. We decided on using the MSP430 family of microcontrollers for this project and were able to develop firmware to work with the sensing circuit, the LCD character display, buttons and LEDs, and the power supply (in order to get the battery level). **Figure 2** shows an overview of our project including the key peripherals involved.

Scheduler Executes Tasks only when Needed - In order to make use of the firmware we developed, we also implemented a scheduler which would execute tasks based on both a time interval and a finite state machine. We also have two tasks running continuously to handle the user interface and the finite state machine. **Figures 3 and 4** show the user interface which these tasks read from and write to.

FIG. 3 Tester hooked up to a chlorine cell

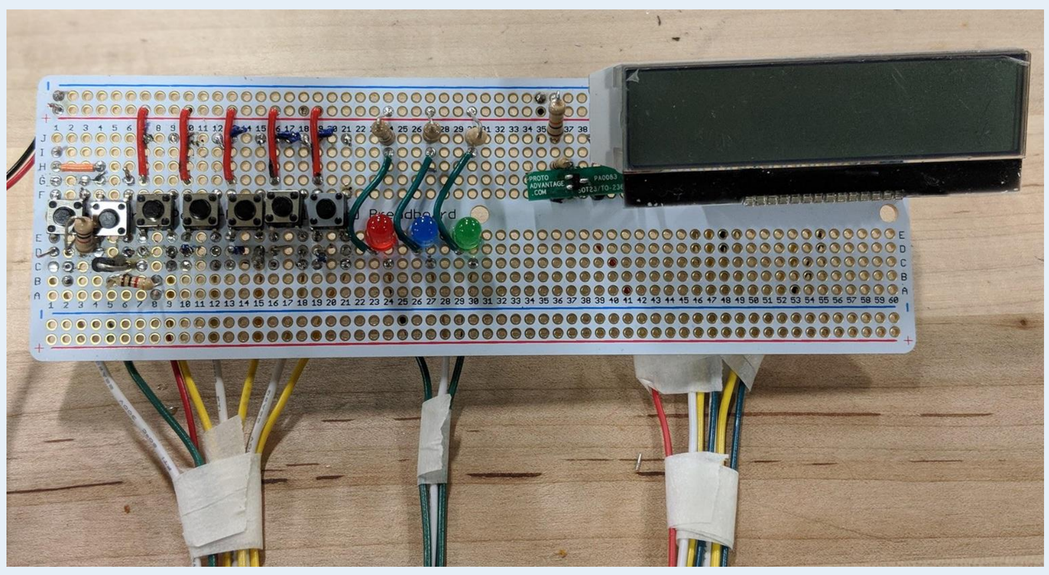

FIG. 4 Current UI prototype

Anticipated Best Outcome

Ideally, by the Spring our team will have developed a test algorithm, as well as testing circuits with a fully breadboarded tester. This would include the cell drive circuit as well as the user interface. The ideal test unit should be battery operated for portability, function at a wide range of temperatures and be compatible with all Hayward T-Cell models. The tester's interface will be simple and allow the user to initialize the test and clearly see if the cell passes or fails, as well as the cell's chlorine output and other parameters. Previous test results will be stored for ease of access, and be sent to a bluetooth-enabled app for simple warranty claims. Ideally, the total cost of the tester will be $30.

Project Outcome

The Anticipated Best Outcome was not achieved. The product schematic was successfully completed; the prototype remains to be produced.

Figures

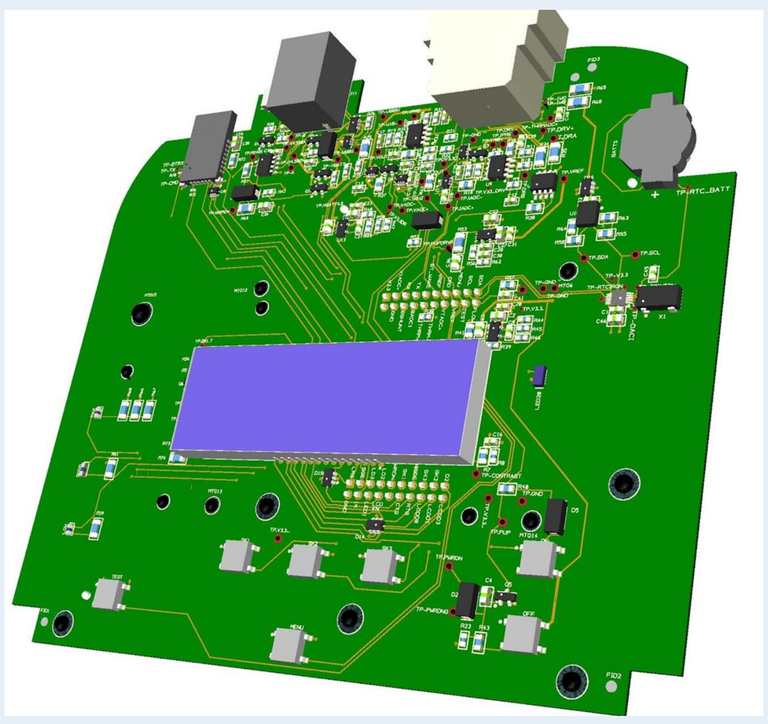

FIG. 1 3D-Model of our custom PCB design

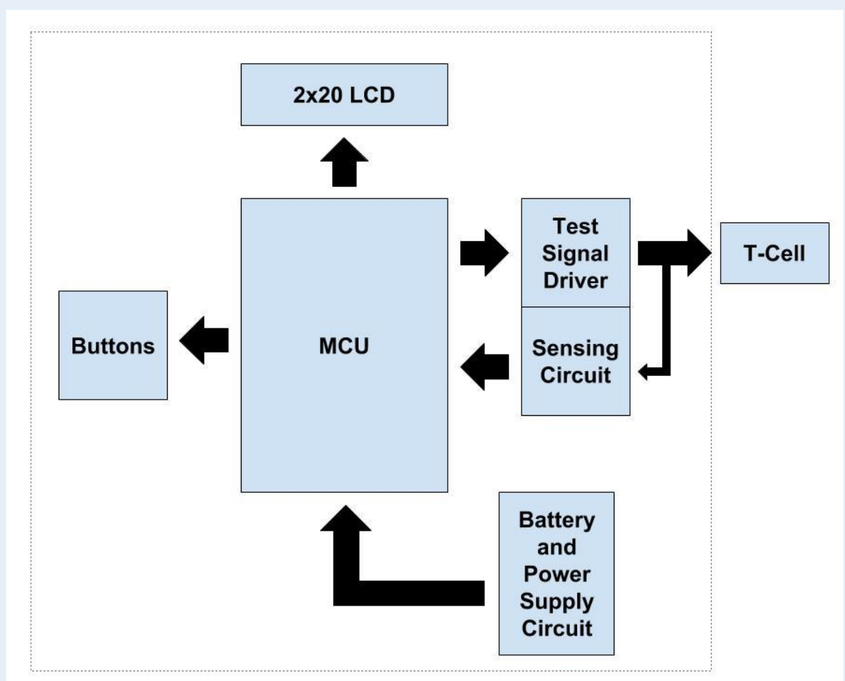

FIG. 2 Block Diagram of our project