CS486C – Senior Capstone Design in Computer Science

Project Description

Project Title: Site Weather and Power Recorder (SWAPR) – Part 2	
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Project Overview:

Note that this project is restricted to U.S. Citizens only, due to govt. contractual requirements

Search and rescue (SAR) is one of the Coast Guard's oldest missions. Warding off the loss of life, personal injury, and property damage by helping boaters in distress has always been a top Coast Guard priority. Coast Guard SAR response involves multi-mission stations, cutters, aircraft, and boats linked by communications networks.

The Coast Guard is recognized as a leader in the field of search and rescue. To meet this responsibility, the Coast Guard maintains SAR facilities on the East, West and Gulf coasts, as well as in Alaska, Hawaii, Guam, and Puerto Rico, and on the Great Lakes and inland waterways

Rescue 21 is a nationwide command and control system used by the US Coast Guard to support their SAR and Law Enforcement missions. The system was created to better locate mariners in distress, save lives and property at sea and on navigable rivers. Our company, General Dynamics Missions Systems (GDMS) designed and deployed the Rescue 21 system, and is contracted by the Coast Guard to operate and maintain the system infrastructure. The system consists of manned command centers connected via IP to approximately 260 unmanned Remote Fixed Facilities (RFFs). Each RFF consists of an electronics shelter connected to Land Mobile Radio (LMR) base stations and Direction Finding (DF) antennas mounted on radio towers. Together, these facilities provide an overlapping mesh of radio communication coverage to create an extremely robust and seamless communications infrastructure in all targeted coastal areas.

This project is to develop a device that can measure/check parameters at the unmanned RFF and verify certain conditions remotely. If a problem occurs with one of the radios, it will take a few

hours for a technician to arrive and investigate. The two main parameters to check are transmitting power and outside weather conditions.

Knowing the current weather conditions at an RFF, mainly rain, can be valuable when trying to troubleshoot sites with RF noise present. Noise created from arcing power lines or small shorts in transmissions lines can go away when rain is present. Online weather databases record this information, but are not accurate for every site because it depends on how close the RFF is to the physical weather station.

Measuring the radio's output power verifies that the radio is transmitting correctly. A technician would need to travel to the site locally to verify this. Testing can also be done remotely, but not accurately or quickly. This information is critical to operators during SAR missions and could allow the Coast Guard operators to understand any impacting RF performance at an RFF site.

Part 1 of this Capstone was completed in Spring 2021 by Northern Arizona University (NAU) engineering students. These students created a Site Weather and Power Recorder (SWAPR) device that could be placed in an RFF and measures the outside weather conditions as well as the transmitted power from the LMR VHF base stations. These devices have been successful, but their information is currently not remotely accessible to operators. This need is the basis for the project proposed here.

Envisioned Solution: A secure web application for registering, configuring, and managing the SWAPR network, and displaying output in a clear graphical interface.

Part 2 of this Capstone is to take the output from the SWAPR device and create a web status page that will display the site's weather information. The web status page can display the current temperature, humidity, wind speed, wind direction and if rain is present across all RFFs. A user can also see additional details or historical graphs/weather over time from any RFF they choose. Some of the key features of the proposed remote SWAPR monitoring and management tool will include:

- A secure web application architecture, including secure authentication, user account management, and role-based permissions.
- A dashboard with both map-based and list views of the monitoring network; provides summary indication (e.g. red/orange/green) of recent status of each SWAPR in the network.
- An automatic alarm or notification that will notify the user of critical events or loss of functionality from a specific SWAPR device.
- Ability to drill down to examine each SWAPR in detail. Gives detailed status and a variety of other functions including graphical summaries of historical data, and ability to export selected data ranges.
- A method for simulating multiple SWAPR devices to connect to the prototype web status page. This simulation method will be incorporated in a lab environment and used to stress test or verify any software or equipment updates before deploying to the 'live' environment.

As the original developer and current sustainer of the system, GDMS would like to provide the USCG operators and our Customer Care Center (CCC) operators with the ability to view data from the SWAPR device using a GUI rather than having to manually review log files. The SWAPR web status page could provide the operators with historical/current weather information from the weather sensors located at each RFF.

This prototype will be demonstrated to our customer, the U.S. Coast Guard, to show them the additional features that can be available for the Rescue21 system.

Knowledge, skills, and expertise required for this project:

- Software development in C# or C++
- Familiarity with Microsoft Office tools (PowerPoint, Word, Excel)
- Familiarity with Microsoft Windows OS development environment
- Familiarity with Blazor Server Web API

Equipment Requirements:

- Visual Studio License ($15/month per license, may be free for students)
- Desktop/Laptop (Student's computer, no cost)
- Other costs dependent on student design but not expected to exceed $1000 (to be paid by GDMS)

Software and other Deliverables:

Project deliverables are phased through the two-semester sequence and include:

- Weekly verbal or written progress reports on work completed and problems encountered
- Use cases in student's choice of tool and derived requirements
- Report containing trade study and final recommendation
- Demonstration of how the recommended solution could be configured/used
- Deliver final solution to GDMS including user and design documentation, code and/or configuration scripts
- Phase End Reviews:
    - Requirements Review: after Use Cases and Derived Requirements
    - Design Review: after trade study and final recommendation
    - Demonstration: final solution