Generator Monitoring for Air Compliance (GMAC)

Forward deployed portable generators require tracking and monitoring of routine maintenance, operating time and time-in-location. (U.S. Navy photo by Lt. Cmdr. Mike Billips)

OBJECTIVE

To develop an automated method for capturing operating time and location for Department of Navy generators, and transmitting data wirelessly to a centralized historian for compliance tracking and monitoring.

PROBLEM STATEMENT

Emergency and non-road generators are utilized in various manners at Navy facilities. In order to remain compliant with air regulations set forth by the US Environmental Protection Agency (EPA), there is an ongoing need to record operational data related to operating time and time-in-location. Current practice is based on manual tracking and recording of information. While the information is not complex, this can pose a challenge for facilities with large generator inventories and a large footprint of possible use locations.

DESCRIPTION

This solution will leverage commercial off the shelf components to create a secure, wireless sensor system capable of transmitting location and generator operation information to a remote server for central data processing and logging. The system would be built as an open architecture leveraging commercial microcontrollers, WiFi, Global Positioning System (GPS), and vibration modules, to collect and transmit data.

The unique aspect of this project is the use of machine learning (ML) for data collection. Due to the distinct vibration patterns of generator start, stop, operation, and movement, these characteristics can be measured by an accelerometer and a machine learning model can be trained to distinguish and classify these modes of operation.

First, the project team will conduct a review of potential sensor components, followed by procurement of the selected components and benchtop testing. Then, work will proceed to firmware/software development, collection of generator vibration data for generator operation identification and logging, and training of the ML model. A one-year operational experiment of the system will then proceed at Pearl Harbor Naval Shipyard (PHSNY), where the new solution will be compared to the manual process. As well during operational testing, the sensor modules will be monitored monthly for their operating conditions (temperature and humidity levels) to conduct system reliability analysis and calculate failure rates.

RETURN ON INVESTMENT

Estimates from the PHNSY Occupational Safety, Health & Environment Department(Code 106) indicate finding, tracking, and maintaining this data could range from 10-20 percent of a man-year. This does not include the shop labor tasked with visiting each generator to gather required information on a regular (monthly or more frequently as needed) basis. Especially for facilities with numerous generators, the man-hour requirements can quickly grow. The information gained from this project would help refine specific hardware/software costs required for this capability in addition to any other sustainment costs.

NAVY BENEFITS

This technology is innovative in being flexible and dynamic enough to operate on any generator make, model, and manufacturer with minimal work to train and update the ML model. The proposed solution would apply to any facility with emergency and non-road generators. While this describes nearly all Navy facilities, the facilities that stand to benefit the most from the technology would be those with large inventories and large footprints, such as major maintenance depots, support/logistics hubs, or those with large training ranges.

TRANSITION DESCRIPTION

The combination and development of the sensor module in an open architecture that integrates with the existing PHNSY Sensor Interface and Infrastructure for Monitoring (SIIM) system would provide a seamless transition path for environmental program managers. Because the team is leveraging the PHNSY SIIM system, transition will be targeted to the PHNSY Clean Air Program Manager initially. Other shipyard environmental program managers would be targeted for follow-on transition since cyber security issues, especially within Controlled Industrial Areas, are similar.

CONTACT

For more specific information about this project, contact the Principal Investigator at 808-221-7180.

ABOUT THE NESDI PROGRAM

The Navy Environmental Sustainability Development to Integration (NESDI) program is the Navy's environmental research and development demonstration and validation program, sponsored by OPNAV N4I Installations Division and managed by the Naval Facilities Engineering Systems Command from the Engineering and Expeditionary Warfare Center in Port Hueneme, CA. The mission of the program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes and materials and by filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Navy readiness and lethality.

For more information, visit the program's web site at www.navfac.navy.mil/nesdi or contact Ken Kaempffe, the NESDI Program Manager at 805-982-4893, DSN: 551-4893 or kenneth.c.kaempffe.civ@us.navy.mil.