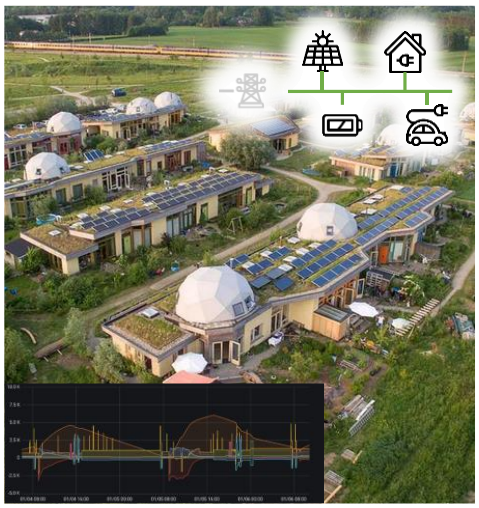
INDUSTRIAL IOT OPEN-SOURCE ARDUINO LIBRARY FOR SUSTAINABLE ENERGY COMMUNICATIONS

PROJECT INTRODUCTION



To accelerate the transition of the European electricity supply to a more decentralized structure with local renewable production and sustainable consumption, the recently founded Horizon 2020 SUSTENANCE European project aim to demonstrate cost-effective and customer-centric solutions for effectively integrating different energy system carriers (electricity, heat, water) for the sustainable development of local communities to meet their energy needs from local renewable energy sources. Some of the overarching goals are to research all relevant technical and non-technical challenges in establishing the best combinations of local renewable energy production (solar PV, wind), energy storages (battery and thermal), flexible demand and demand-response based technologies and solutions forming an integrated user-centred and community-based sustainable energy solutions for smaller cities, villages, and local communities. The overall project objective is to investigate how citizen involvement can be improved to promote as much as possible renewable energy sources to solve grid problems and to stimulate self-consumption of local renewable energy, thus minimizing the CO2 generation.

The current project demonstrator in the Netherlands involves the local community of Vriendenerf (https://www.vriendenerf.nl/) in the village of Olst, active around sustainability, renewable energy and self-sustainable communities. Within Saxion, the research group of Ambient Intelligence (AmI) is contributing to the project by providing technical solutions for secure IoT monitoring (sensing, storage, and management), energy management system (EMS), user dashboards and applications, to provide the best solutions for the inhabitants in the self-management of power and energy resources to promote sustainable energy behaviors.

As part of SUSTENANCE project, Ambient Intelligence is developing an IoT data collection infrastructure (named as IECON "*IoT Edge Computing for carbon neutral communities*"), as well as the interfaces for the end users (dashboards, mobile apps and generic interfaces). The IoT IECON framework is developed and optimized to run on low performance computing platforms, such as Single Board Computers, with secured and lightweight IoT communication interfaces.

ASSIGNMENT TASKS

Within the scope of microgrid communications and embedded IoT systems (sensors, devices, and actuators), we would like to research and developed an **open-source modular software library** to provide **standardized Industrial IoT (IIoT) communications** for fast and efficient communications between embedded platforms (edge and cloud solutions) and IoT embedded devices (smart meters, thermostats, sensors) with restricted performance (ie. power consumption, computation power or storage capacity among others), like in microcontrollers systems or single board computers.

Specifically, we are looking at the latest Industrial IoT (IIoT) protocol based on the Eclipse Sparkplug B specifications (https://sparkplug.eclipse.org) that it is implemented on top of MQTT communications. The goal is to develop a C/C++ software modular library that can be used generically for embedded platforms to provide optimized microgrid communications following this Sparkplug B specification. As for hardware platform, we are also interested to develop this library at the widely used and powerful Espressif ESP32-based platforms, as all the derived commercially available ESP-based devices (i.e. Shelly, BlitzWolf, LSC Smart Connect) for the integration of the open-source custom IECON Microgrid MQTT Sparkplug B communication interface.

The envisioned assignment tasks will include, but are not limited to:

- Research, understand and analyse of the Eclipse Sparkplug B v1.0 standardized specifications, MQTT communication protocol, Espressif ESP development platform as well as the Arduino-based framework, for the implemetation of the embedded library. Analysis of cybersecurity features (privacy and security) of the MQTT communication standard, with emphasis on embedded platforms and ESP32.
- Design and development the C/C++-based modular software library, following the MQTT Sparkplug B standard. The custom C/C++-based library must be integrated as part of the Arduino ecosystem for ESP-based platform, so it can be easily integrated and instantiated from any Arduino and ESP-based projects to provide this type of communications.
- Validation and testing the developed library as part of a IoT device system, for example a smart power plug (like, Delock 11827 Power Monitoring Smart Plug) or a custom environmental monitor device with sensors (temperature, humidity, movement). The validation tests should be performed in a controlled laboratory environment, as well as later in home environments (H2020 SUSTENANCE project).

Our goal is to release this library as Open-Source, therefore the library should be well tested and validated as well as analysing all the requirements for open-source code.

PRACTICAL INFORMATION

Student profile: from HBO-ICT, ACS or EE with knowledge in embedded software C/C++, IoT solutions, wireless technologies, and passion to developed embedded systems for real applications and interested in the energy transition challenges.
Contact: Javier Ferreira Gonzalez (j.ferreiragonzalez@saxion.nl), Eyuel Ayele (e.d.ayele@saxion.nl)
More information: at www.saxion.edu/ami