Communication and Web Application Development for Mechanical Pod

Mechanical Pod – Development of Controls

Xuezheng Wang, Tom King, Prof. Bing Dong

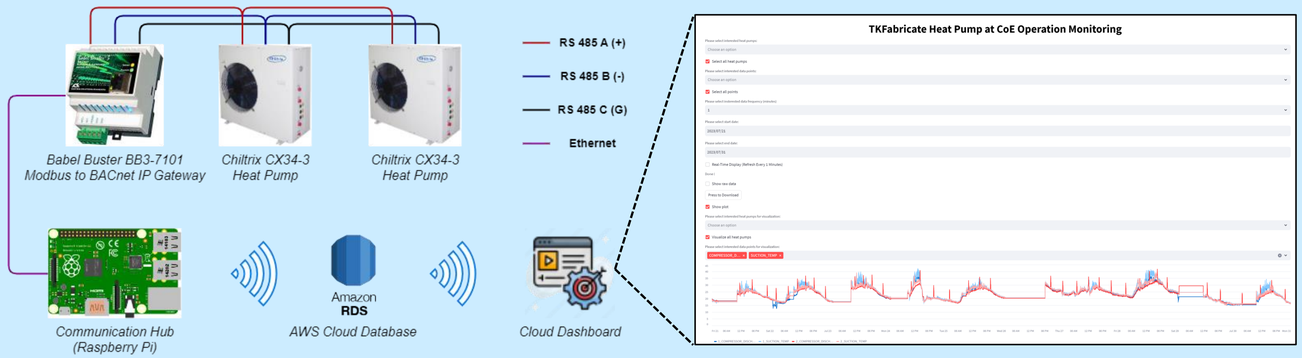
Introduction

TKFabricate is a developer of energy-efficiency retrofits intended for homes in cold and very cold climates. The company is focused on the development and implementation of systems and techniques required for feasible, affordable, and market-driven deep energy retrofits, enabling users to achieve a carbon-neutral economy, increase productivity in the construction industry, and reduce installation costs of mechanical systems.
The mechanical pod is one of TKFabricate's solutions that aims at multifamily building retrofits. The current development of the mechanical pod has two stages: communication and control development. This project focuses on the first stage: communication development.

Methods

The communication of different devices is unified to be BACnet, which is an open standard and allows for interoperability between different devices and systems from different manufacturers.
To transform communication from the protocol inherent in the devices, such as Modbus-RTU, KNX (European standard), etc., to the BACnet communication, a mapping gateway is used. The gateway serves as a master device with the heat pumps as slaves. The gateway communicates with the heat pumps through RS485 and then translates the data into BACnet analog and binary values, inputs, and outputs. From the controller's point of view, the communication and control of different devices is then achieved through the BACnet.
Besides local communication, to facilitate remote monitoring and control of the devices, the cloud service should be developed. Amazon web service (AWS) is used because it facilitates FedRamp certification for cloud products and services. The cloud database is developed to record equipment operations in real time through a local hub. Then a web application was developed accordingly for easy data acquisition and visualization.

Figures



The left figure is the framework of data communication and visualization. The data from heat pumps is aggregated by the gatew ay through the Modbus-RTU communication protocol. Then all aggregated data is acquired by a local hub (Raspberry Pi) through the BACnet and uploaded to the cloud dat abase. A cloud web application is connected to the database for a user-friendly interface.
The right figure shows the web application. The web application requires a unique login credential, which can only be created by the TKFabricate, for security and privacy purposes. Based on the credential, users can access their own devices.
The application allows users to select and download the interested time period and operational points from their devices. The data is cleaned and processed automatically from the back end. Among the selected data, the user can also choose to visualize their interested points with the desired ti me interval.
Besides, a 'real-time monitoring' button also allows users to monitor their devices in real-time.

Results / Discussion

With the proposed and developed framework, easy-to-install yet robust communication can be achieved among devices with different communication protocols.
The web application provides a user-friendly interface for monitoring and analyzing device operations.
Based on the same framework and the application, more devices and the control function can also be integrated to facilitate the coordination control between different devices toward a carbon-neutral solution.

Use the camera on your phone to know more about TKFabricate!

Impact on LMI or Public Health

Turnkey integrated mechanical system for multifamily building retrofits, delivering:

- Net Zero GHG
- Substantial operational savings
- Increased property value
- Drop-in installation
- Improved air quality and comfort
- Increased lifetime tenant value
- Mitigation of non-compliance penalties

Supported by the U.S. Department of Energy
EPIC Buildings Program
Energy Program for Innovation Clusters

Syracuse University
Center of Excellence in Environmental & Energy Systems

CENTERSTATE CORPORATION FOR ECONOMIC OPPORTUNITY

TKF

BEST Lab
Built Environment Science & Technology