UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	*Carrier Corporation*	Date Submitted	4/11/2019
Project Title	*Data Acquisition system for Industrial Machines – Phase 2* **CARR_DATA2**	**Planned Starting Semester**	Fall 2019

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical		Electrical	2
Computer	2	Systems	
Other ( )			

Company and Project Overview:

Carrier is a world leader in high-technology heating, air-conditioning and refrigeration solutions. Carrier is a part of UTC Climate, Controls & Security, a unit of United Technologies Corp., a leading provider to the aerospace and building systems industries worldwide.

Built on Willis Carrier's invention of modern air conditioning in 1902, Carrier is a global leader in heating, air-conditioning and refrigeration solutions. In addition to the familiar residential products, Carrier has a vast array of heavy capacity commercial products for buildings and hi-rises of all types. These sophisticated units contain a wide variety of technologies including air handlers, air/water chillers, sensors and building automation controls.

The 9701 Old Statesville Rd Charlotte NC Carrier facility contains design engineering, test engineering and manufacturing operations. Some product examples are shown below:

The Fall 2018 CARR_DATA Engineering Senior Design team developed a proof-of concept data acquisition device for communication with industrial controllers to be able to collect data for extended periods of time. In this project, students will take the "Phase I" work and build on it to improve the functionality and reliability.

Background about Intended Use:
A field service technician will often try to collect data in real time from a chiller/rooftop unit. Currently, the data is captured by hooking up a laptop, cables, converter, etc over a proprietary bus. Sometimes the tech has driver issues, and the hardware to convert the proprietary bus to USB is not cheap. A solution that uses the more industry standard bus (BACnet) is preferable, and a self-contained unit is easier than setup than a laptop with proprietary hardware which is the current approach. BACNet is used in wide variety of industrial machines – so this can be used for products made by other companies too. From student's perspective, getting to know an industry standard communication protocol is very useful.

If desired by students, Carrier engineers will provide initial guidance about component selection, software tools to use, resources to start continue the programming effort from the Phase I starting point.

Project Requirements:
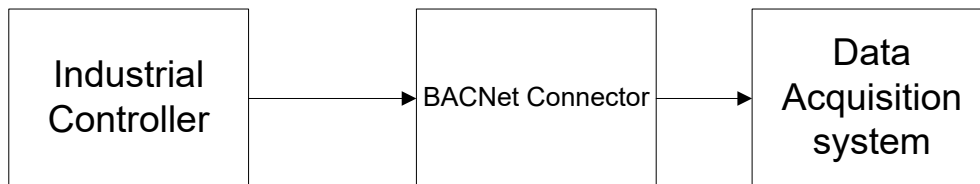
Background from the Phase I Project Requirements:
Data acquisition system shall be based on open source hardware (Arduino/Raspberry Pi).
Final solution shall be enclosed in an IP67 enclosure and no larger than 6"x4"x3"

Data acquisition system (DAS) shall be powered by 5VDC, 2.4Amp source.

Data acquisition system shall read RS-485 port and buffer/store the data in internal on-board storage. When internal on-board storage is full, data shall be transferred to a SD card. If the card is

full, old data from the card shall be deleted. Data coming in over the port will be BACNet protocol (most common standard for Building Management Communication)

User shall be able to start/pause/stop collecting data by pressing a hardware button or pressing a "Run/Pause/Stop" buttons on user interface.

If the system loses power, it shall automatically restart when power is restored. Data that made it to the SD card should exist across the power cycle. The team needs to make sure that there is a way to prevent data corruption in the event of an unexpected loss of power. When power is restored, capture starts again (if one was already running), but can be recorded to a new file.

There shall be a watchdog function, which will monitor health of data collection process and will reboot the system if it detects a communication loss.

All components shall be rated for 10ºF-125ºF, 95% relative humidity

The unit shall be tested for continuous operation for 120hrs

User shall be able to transfer data from DAS to a computer over Ethernet.

Cost of the components (BOM cost) used in the unit shall not be more than $100. Labor not included.

Project Requirements for Phase 2:
In 2019, students shall develop a more capable system –

1. The System shall be able to collect data from 2 analog inputs, 2 digital outputs by using add-on cards
2. The System shall be able to operate 4 digital outputs by using add-on cards
3. The System shall be able to support Wi-Fi (802.11n, with WPA2 encryption) for data connection
4. Commands to operate digital outputs will be accepted remotely (via Wi-Fi)
5. Users shall be able to remotely download the data stored in the system (secure ftp)
6. Provide ability to configure the Wi-Fi connection via WPS (other methods are acceptable but configuration method shall be self-contained, i.e. the DAS shall have ability to configure itself by taking user inputs.)
7. The overall system needs to be packaged in an enclosure, with wi-fi antenna outside the box.

The Raspberry Pi based system, developed in 2018, will be expanded to support remote connectivity and I/Os

Here are examples of expansion boards which can be used:
https://www.robotshop.com/en/raspberry-pi-high-precision-ad-da-expansion-board.html
https://nimbelink.com/products/raspberry-pi-skywire-adapter/

Expected Deliverables/Results:

- Bill of material of the DAS box, including power supply, enclosure, hardware
- Assembly instruction
- Source Code
- Documentation for the source code
- Working Demo unit
- Collected data for 120hrs
- Test data showing timestamps of the data are real-time
- A method to configure the unit to collect the points

Disposition of Deliverables at the End of the Project:

Demo system will be provided to the Industry Supporter at the end of the Expo unless the Supporter directs otherwise.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

Design Reviews are required to be held at Carriers 9701 Old Statesville Rd Charlotte location. Other skills that will be utilized:

- Embedded software development
- Serial data communication
- Mechanical packaging
- Electrical design
- Project management