Remote monitoring of temperature and humidity using Arduino and Cloud Storage

Statement of Objectives

- Transmit T&H data from remote Arduino to master Arduino via RF protocol
- Transmit T&H data from master to cloud storage/HMI using Wi-Fi TCP/IP protocol
- Send Commands from master to remote Arduino relays depending upon sensor readings

List of Problems/Issues to Overcome

- Setting up and configuring cloud storage server to communicate with master Arduino
- Procuring all required materials and parts
- Setting up 2-way RF communication using multiple channels
- Troubleshooting code

List of Deliverables

- Bill of Materials
- Commented Source Code
- Picture demonstrations of working project
- Report outlining the project with descriptions of potential future implementations.

NERC PRC-005 – Protection System Monitoring

Statement of Objectives

- **Objective1:** Create a PMU scheme where a PMU concentrator (SEL-RTAC) collects current magnitudes and angles from feeder and transformer protection relays (SEL-487E) to compare and determine if any issues exists with the device's CTs. This will be accomplished by verifying Kirkoff's current law is not violated. Enough measuring points will be needed to pinpoint which CT is in error. CT errors will be routed to an HMI.
- **Objective2:** Create a system where critical communication channels are automatically monitored by a central automation controller to alarm an HMI if latency is high or packets are consistently lost.
- **Objective3:** Create a system where the diagnostic records of protective relays are constantly polled. Any diagnostic warnings or failures will be logged and then an SCADA HMI alarm will be generated.
- These objectives would be useful for anyone building a NERC PRC-005-2 compliant system

List of Problems/Issues to Overcome

- **Issue1:** Will have to time synchronize all protective relays within 1us accuracy. Will also need redundant measuring points for scheme to work, which would likely be available since most utilities use a primary and backup relay for each feeder and transformer.
- **Issue2:** Will need to monitor at least two protocols. "Critical" suggests use in protection applications. Obviously we can monitor PMU data, but we could also generate and monitor IEC 61850 GOOSE traffic. We will also need to calculate some standard statistics that would be useful for a SCADA operator to monitor.
- **Issue3:** Configuring an automation controller (RTAC) to continuously parse the terminal response of each relay. Parsing diagnostic responses will give the operator a much more detailed explanation to a failure than simply monitoring the relay's diagnostic alarm contacts.

List of Deliverables

- **Deliverable:** Demonstrate a system of relays that feed PMUs, PMU/GOOSE communication statistics, and diagnostic data to an automation controller. PMU data will be unsolicited, communication and diagnostic data will need to be polled. All of this data will logged in a central sequence of events recorded. A central, interactive HMI will be developed to monitor all alarms and statistics. This can be presented in a presentation or report.

Microgrid Monitoring and Control

Statement of Objectives

- Demonstrate hybrid microgrid using solar, battery storage, and diesel generator
- Control solar curtailment when battery SOC reaches 100%
- Start/Stop generator through controller based on SOC of battery and solar production
- Remotely monitor hybrid microgid BESS system

List of Problems/Issues

- Identify compatible components so control and integration can be done without 3rd party controller
- Diesel generator start/stop control based on demand and battery SOC using battery cell voltage
- Solar curtailment based on BESS SOC load demand

List of Deliverables

- Test integration of solar inverter to charge controllers
- Test start/stop command to generator
- Test protection settings so battery is protected from over charge or over discharge.
- Fuel savings due to decrease diesel generator run time

Garage Door Controller and Monitor

Statement of Objectives

- Learn how to use Rasberry Pi
- Log garage door status
- Generate alerts
- Remote control of door

List of Problems/Issues to Overcome

- Garage door status
- Controlling garage door
- Issuing alerts
- Storing data
- Communication

List of Deliverables

- Source code
- List of components
- PowerPoint on final product

Automated Safety Rod Torque Testing Tool

Statement of Objectives

- Acquire analog torque signal
- Acquire motor position data
- Implement controller logic
- Develop local GUI to adjust testing parameters
- Save data in portable format
- Enable trending of historical data on separate machine

List of Problems/Issues to Overcome

- Design analog input ADC utilizing SPI
- Implementing user adjustable control algorithm
- Recording measurement data in portable format
- Design of user interface for remote data analysis and trending

List of Deliverables

- List of materials
- Circuit layouts
- Controller w/ HMI, and trending/historian program files
- Operational demonstration and presentation

Fault Tree analysis of 61850-2

Fault

- Determine the fault tree analysis for a 61850-2 substation
- Compare failure rate with tradition copper based system

List of Problems/Issues to Overcome

- Finding data for failure rates for each components
- Creating the appropriate failure trees

List of Deliverables

- Drawing of fault trees and failure rates
- Presentation

Experimental Platform Over-Power Safety Device

Statement of Objectives
- Obtain a greater understanding of data acquisition systems
- Connect a variety of devices to build an over-power safety device in a lab environment
- Report system information to operator

List of Problems/Issues to Overcome
- Learn C programming language to program Arduinos
- Integrate new hardware and software into an existing system
- Develop control scheme and data processing using LabView software

List of Deliverables
- Develop and deliver a functioning over-power safety system.
- Demonstration video of the system operation
- Presentation of the project development.

Model Power Grid

Sponsor : University of Idaho Electrical and Computer Engineering Ambassadors

Statement of Objectives
- Build a model power grid
- Design controls using Raspberry Pi
- Collect data and monitor system status
- Create curriculum for ECE Ambassadors use

List of Problems/Issues to Overcome
- Use Pi to simulate faults in system for students to solve

List of Deliverables
- Model of power grid
- GUI on Pi for SCADA system
- Software
- Curriculum
- Presentation

Anaerobic Algae Digester

Statement of Objectives

- Create a scalable/modular model for varying needs and uses
- Learn how to optimize coding/algorithm for automation
- Integrate numerous sensors for user viewing

List of Problems/Issues to Overcome

- Optimizing cycle time of digestate in each chamber(HRT) for max energy production
- Creating a readable GUI
- Complete automation of system for long periods of time (24/7)

List of Deliverables

- Paper discussing the needs and process of developing a large-scale model
- Discussion of sensors and optimal communication protocol for each
- Feasibility of biofuel as an energy source

Using DNP3 for Controls via a Substation Network

Statement of Objectives

- Develop Configurations for the SEL-351S, OrionLX RTU, Siemens Ethernet Switch
- Check communication between devices
- Prove Control functionality

List of Problems/Issues to Overcome

- Configuring a 351S relay for DNP3 Control
- Configuring an Ethernet Switch for network access
- Configuring an RTU for communication to the Relay
- Demonstrate control functionality

List of Deliverables

- High Level Network Topology
- Visual evidence of control
- Written report of the entire process

Secure IoT Wireless Data Transfer Module

Statement of Objectives

- Design a reliable, high quality, and secure platform
- Develop an IoT data transfer module to securely transmit data for use in water/wastewater treatment industry
- Develop a Visio diagram for an IoT platform/communication template
- Transmission of data through cell wireless

List of Problems/Issues to Overcome

- Obtaining IoT platforms and components
- Obtaining access to Test Lab
- Learning to work in the Lab environment
- Learning to connect, program and run device

List of Deliverables

- Device meets objectives
- Top Level IoT logical diagram with data transfer and security features
- Report of results

Power Consumption Monitor

Statement of Objectives

- Monitor power consumption of a device
- Send data to phone/device through text/email

List of Problems/Issues to Overcome

- How to accurately monitor power consumption
- Learn how to use raspberry pi to collect and send data

List of Deliverables

- Device that meets objectives
- Report

Power Plant Distribution Automation System

Statement of Objectives

- Reduction of Auxiliary Loading for Combine Cycle Power Plants
- Reduction of Equipment Sizing for Auxiliary Loading for Combine Cycle Power Plants

List of Problems/Issues to Overcome

- Planning/determination of dynamic loading
- Having enough margin for Seasonal Peaks
- Not interrupting process
- Test Plans

List of Deliverables

- Template for Load Priority List
- Network Arrangement
- Distribution Layout
- IO List
- Automation Costs vs. Energy Savings
- Report

Updated SCADA Test Bed

Statement of Objectives

- Add SCADA BACnet Direct Digital Controller (DDC) to Industrial Plant Equipment (IPE)
- Tie SCADA DDC into Energy Management and Control System (EMCS) and supporting software

List of Problems/Issues to Overcome

- Learning software for DDC
- Learning software for EMCS
- Network connectivity permission issues
- Working with IT Team

List of Deliverables

- Operational SCADA for specified IPE
- Report documenting efforts, data types recorded, control algorithms, screen shots of the HMI displays

Centralized, secure, and remote accessible SCADA test bed for University of Idaho

Statement of Objectives

- Design and implement a secure SCADA test bed with connection to all U of I campuses in the state

List of Problems/Issues to Overcome

- No centralized SCADA test bed for U of I campuses
- SCADA test bed state estimation analysis for attack and defense tests only exists in few institutions and laboratories.
- Working with university IT policies

List of Deliverables

- Secure, centralized and remote accessible SCADA test bed
- Build attack/defense scenarios for state estimation analysis (DNP3 and IEC 61850)
- Presentation

Self-Watering Irrigation System

Statement of Objectives

- To create an Arduino-based SCADA system that reads a moisture level from a sensor and then dispenses water to a potted plant.
- To export the moisture data into a graphical format.

List of Problems/Issues to Overcome

- Manual plant watering requires constant surveillance.
- A simple timed watering system has the potential to overwater plants.
- Design/Construction of system

List of Deliverables

- Visual confirmation through pictures/video that the system functions as intended.
- Logged data in a graphical format showing the moisture level of the soil over time.
- Report