MINI-SUBSTATION MONITORING SYSTEM

Initial Project and Group Identification Document

Professor Dr. Richie
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Purpose

If we look at the present time electric power is the basic necessity for millions of people. Since, we are studying electrical engineering; all the members present in our group are very interested in learning more about electric power, power systems, and power monitoring.

Why conduct remote substation monitoring?

In the electric utility industry the distribution system reliability and operational efficiency is of the utmost importance. The increasing reliance on electrically based technology means that it is more important than ever that power system interruptions are kept to a minimum. Substation monitoring is crucial to reaching this goal.

SCADA

A monitoring system that is used for controlling and gathering data usually in an industrial setting has come to be known as SCADA. Broken down, this is Supervisory Control And Data Acquisition. The term SCADA describes the entire system as a whole. A SCADA system is made up of many components that communicate together in order to monitor and control particular pieces of equipment or a type of station. The system might contain components such as: a graphical user interface (GUI) which would run on the main supervisory computer and allow a user to control the system remotely, this is also called HMI (human machine interface), a network of sensors or relays for inputs and outputs of the information that is being monitored, and communications and software to monitor, keep track, and trend data that is being monitored.

Wireless vs. Bluetooth

The introduction of Wi-Fi (802.11b, g, n) was one of the first major steps towards the expansion of wireless networking and these communications have risen to speeds up to 11mbps. It can have a very far range and fast data transfer compared to Bluetooth. It has since grown and 802.11a and g have been released and are going strong. Due to its history of reliability and relatively inexpensive hardware, 802.11g has improved the performance of 802.11b and works with older versions as well.

Bluetooth was created to connect two devices point to point and not necessarily using a computer to do so. It has a limited range of about 30 feet and is only rated at about 700 kb per second. The advantages of wireless far outweigh the disadvantages of Bluetooth. Wireless can vary in range but on average is up to 300 feet. The data transfer is up to about 54 Mb per second, which us much greater than the 700 kb per second. Bluetooth is mainly just to connect two electronic devices and wireless can be scaled up to many with no problems. Security can be an issue with either one of these communications but in a wireless network, you can specify what types of devices you what to talk to

each other and the user's access. This is why we chose to use wireless rather than Bluetooth.

How does our system work?

Our system draws on data from sensors to accurately assess the condition and capacity of a transformer unit. Factors important to this achievement include monitoring changes in output to evaluate transformer loading, providing information on current, voltage, power factor and impedance during operation to determine how the system protection circuitry is performing, as well as analyzing fault conditions wirelessly. Monitoring all of these conditions allow power system personnel to develop trend data and improve reliability and performance. Automated early warning devices will alert you to developing fault conditions that could lead to equipment failures and power outages. This allows providers to remotely monitor substations saving on maintenance cost, manpower, and service down time.

Project Description:

The Mini-Substation Monitoring System will be comprised of a functioning substation protection relay, wireless communications, a data collection and monitoring device, a graphical user interface, and a fault recognition and notification system.

Goals:

- Monitor electrical values for a simulated miniature power substation.
- Check the status of the protection relay.
- Send status messages via wireless router.
- Communicate status and faults of relay via text messaging and email.
- Easy to use graphic interface.
- Device to be enclosed in a protective case.

Specifications:

- Collect and record Wattage, Voltage, Current, as well as fault protection and power factor.
- Notifications to be made within one minute of fault detection.
- Wireless communications accomplished via 802.11g standard.
- Poll for data every 100ms.

- Device panel enclosure to be a 16x14x8 inch plastic weatherproof case, NEMA rated.
- Fault protection to occur with a load greater than 5 amperes.
- The panel will include:
    1. A protection relay device (exact model to be determined).
    1. A 0-5 ampere latched relay (exact model to be determined).
    2. Small red and green lights to indicate “closed” and “open” conditions on the relay device, respectively.
    3. A local switch to control the latched relay (breaker).
    4. A wireless router in order to network with the computer.
    5. A strobe light to go along with the alarm fault conditions.

- The graphical user interface (GUI) will include:
    - Easy to use, graphic push buttons.
    - An open and close button to remotely trip the relay.
    - Multi-level pages to include but not limited to, full metered values, alarms, breaker status, layout and trends.
    - Router information
    - Faults, text messages, and email notifications.

Overall Objective:

To complete senior design 1 and 2 while satisfying the objectives set out in this initial document. Also we would like to finish our design to the specifications in order to have a working prototype at the end of senior design 2. Please note that specifications can and will change during the course of the semester.