Wireless Power Panel Meter (WPPM)

Senior Project Proposal
ETEC 471
Kyle Coan & Phil Perrigo
Abstract

We have decided to create a wireless power panel meter (WPPM) for residential use. This is because we are trying to follow a green movement in reducing energy consumption. By using current transformers and voltage transducers along with a MCU it will allow us to readout things such as: voltage, current, and power. The current transformers will connect to the household wiring at the panel which is 3-wire single phase also known as split phase. With this information we can calculate the power consumption of the whole household and estimated energy costs for the day/week/month. We will implement a wireless LCD readout in kWh via the ZigBee board that will allow the consumer to place it in an area where everyone in the household can be aware of usage. With all of the information that the system will provide, the user in turn will be more in control of their power consumption and reduce it based on usage and cost.

Description

We will use split core clamp-on current transformers and voltage transducers to measure line current and line voltage. The CTs will clamp on both of the 120v lines of the 240v 3-wire system. 240v is called 3-wire single phase which consists of two 120v lines with a common neutral (see diagram on the right). With that information, we will then have to convert the analog signals from the CTs and VTs through an A-D converter before we transmit the data. Next, we will use the Zigbee sensor reference board to transmit the digital data to the network coordinator board. Once the network coordinator board gets the data, the MC9S08GT microcontroller will process the data and compute power. The data will then be displayed on the network coordinator board LCD.

The MCU on the Zigbee Development board will contain the C code for the power meter program. The hardest part of the project in our opinion is going to be transmitting the signals and getting the MCU to read them correctly. We will use the buttons on the front of the Zigbee main board to essentially scroll up or down to view different power statistics. With one button dedicated as a reset for the kWh total stored in memory.
Block Diagram of WPPM

Current Transformers ➔ Voltage Transducers ➔
A-D Converter ➔
Zigbee Transceiver ➔
Zigbee Dev. Board
MCU

4 Buttons

Data Out to LCD

Product Sketches

Current Trans. will hook to wires at the main disconnect

Circuit Breaker Power Panel

Data Out to LCD
Background and Benefits

Today we hear more and more about how everyone needs to do their part in reducing our wasteful habits. Whether that be less dependence on fossil fuels or simply remembering to turn the heat before you leave the house. Residential houses and apartments consist of a large percentage of power consumed here in America. If there was an easy way for people to be conscious about the amount of power they use in real time and the cost associated with it there would be an incentive to reduce the amount of power used.

While doing our research we found that there are two very distinct products that are already out on the market. This first one is The Meter Reader, from Energy Monitoring Technologies, Inc. The Meter Reader’s design is very similar to the design we would like to do. It uses clamp on current transformers that plug into the unit. It appears that this product is not wireless. It is a fairly simple unit with only 4 buttons on the front. Its features include:

- Displays electricity used in dollars and cents
- Displays electricity used in kWh
- Projects next electric bill based on local rates
- Displays instantaneous power being used in kWh
- Line current and line voltage

Another product that we found while researching was a Power Portal by Comverge. There was a link to this company’s website from Zigbee’s website. This product is different in design from our proposed project but it still displays kWh totals for overall household usage. The Power Portal appears to receive updates from the service provider that in turn update the handheld unit. Their product is designed to work with their smart meter base that reads real time kWh usage and then transmits that data to the user directly. Our product will be wireless as well but once it is all setup the Zigbee board will communicate with the MCU on the network board displaying usage in real time. Our system will not be service provider dependent.

Global Impacts:

The power monitor we will build can change how people live on a day by day basis and influence them to conserve more energy. When you are aware of the power that you consume in real time and the cost that is associated with it, you can be reminded to turn off the bathroom light before you go to sleep or unplug your home entertainment center. With a wireless display the user is able to carry the meter around with them, or mount it somewhere in the house. For example if you have it mounted near your front door you can check the power level in your house before leaving for the day and make sure you didn’t forget to turn anything off. By reducing the amount of energy you consume the major power companies will in turn be able to produce less electricity, and in the process using fewer natural resources, reducing their impact on the environment. Additionally, this will reduce stress on the power grid and allow a higher percentage of the power produced to come from renewable energy sources.

Demonstration
To demonstrate our project we are going to build a 4’x6’ wall built to code specs to accommodate a power panel and two GFCI (ground fault circuit interrupter) outlets. The outlets will be mounted in J-boxes. Providing our CTs and all other components are small enough, we want them to fit inside the panel behind the cover. The wall will have vertical studs with sheetrock mounted to them similar to a real wall in a house. The panel will be mounted flush to the sheetrock. Since after all this power meter is going to be modeled for a house. We think for cost and demonstration purposes we will use a smaller panel most likely a 100A panel which is the smallest size legal by code. As for powering the panel since it won’t actually be in a wall where the main 240v feeds are we are considering making a 240v extension cord that will power the panel from the 240v plugs underneath the computer tables. Since we won’t be able to have a full house load hooked up, two circuits should do for demonstration purposes. Connected to each circuit will be an appliance and or some other piece of electronic equipment that has a decent continuous amperage draw while it is on. We need two circuits because we want to demonstrate a load on each 120v legs of the 240v feed. Our system will monitor the current on each leg and add the total kWh usage in to one kWh total.