I. Group Identification

Name	PID	Major
Daniel Allen		CpE
Richard Velez		CpE
Jonathan Nguyen		EE
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II. Project Motivation

The motivation behind this project stems from receiving an electric bill every month that is higher than expected despite making a wholehearted effort to reduce power usage. It can be difficult throughout the course of a month to keep track of how much power is being used and what exactly is using the most. That is where the idea of this project takes over and that is to help power conscience users keep track of their power consumption throughout the month by revealing what devices are consuming how much power and reporting it to the user.

III. Goals and Objectives

The main goal of this design is to reduce the overall power consumption in homes that implement this type of system. The main unit that displays all of the information will report each device in the home and the amount of power it is using. In addition a history can be kept that helps a user track power consumption from month to month in an effort to reduce overall usage.

IV. Specifications and Requirements

Creating a centralized unit paired along with satellite components capable of tracking power consumption at each individual power outlet and reporting back to the user the kilowatt per hour measurement of each device plugged in is the goal of the design. The motivation behind this design stems from the lack of power monitoring in current day homes. Most homes were the owner has not purchased individual devices to plug into each outlet does not include a way other than going outside to read a meter to determine how much power is being used. Given the option to read the external meter, a home owner would not know the break down of why the amount of power consumed is where it is. That is where the design of this project tries to take over. Using an array of micro-controllers with a centralized unit can give the user an ability to track individual devices and make the necessary adjustments to control how much power they are using as well as being aware of how much power they are using.

At the center of the system is a Video Graphics Array (VGA) screen, roughly seven to eight inches in size, that is driven by a micro-controller that will display to the user different information about the devices that are currently being powered within a home. The software will be written to display each outlet and the power being consumed on each port. From the measurements taken at each outlet a monthly bill can be calculated and displayed to the user to allow them to make adjustments if necessary. To begin with a user can enter how much per kilowatt hour their power company charges them and using that information it will be possible to calculate a monthly bill based off what is being reported to the main unit. The VGA display using the micro-controller and available memory can have the option to keep track of previous months bills and energy usage to give the user an idea of how

much power they have been using over an extended period of time and if they have been making adjustments. Other pertinent information that can be displayed can be a manipulation of the measurements already recorded. This can include any various charts and histories that are deemed useful.

The satellite components of the system include the micro-controllers that will be used to measure the kilowatt per hour power usage at the outlet. The micro-controller will be designed to measure individual draw at each port instead of the outlet as a whole so a user can better diagnose which device is drawing which amount of power. It is still uncertain if some implementation can be accomplished which will allow reading across a device such as a surge protector. At the minimum the overall power draw from the surge protector that is plugged into a wall can be reported to the main unit depending on which outlet is drawing the power. Each micro-controller will use radio frequencies to send and receive information and the current method to be implemented is through the use of radio transceivers, however other possibilities may be considered depending on the available technology. The use of a transceiver is necessary because the micro-controller will sit behind an outlet out of sight from the user and transfer the information at request from the transceiver at the main unit. Each micro-controller will also have a simple liquid crystal display (LCD) soldered into the board that will display the kilowatt hour measurement. This will allow for debugging and verifying that the information being sent to the VGA display is indeed accurate.

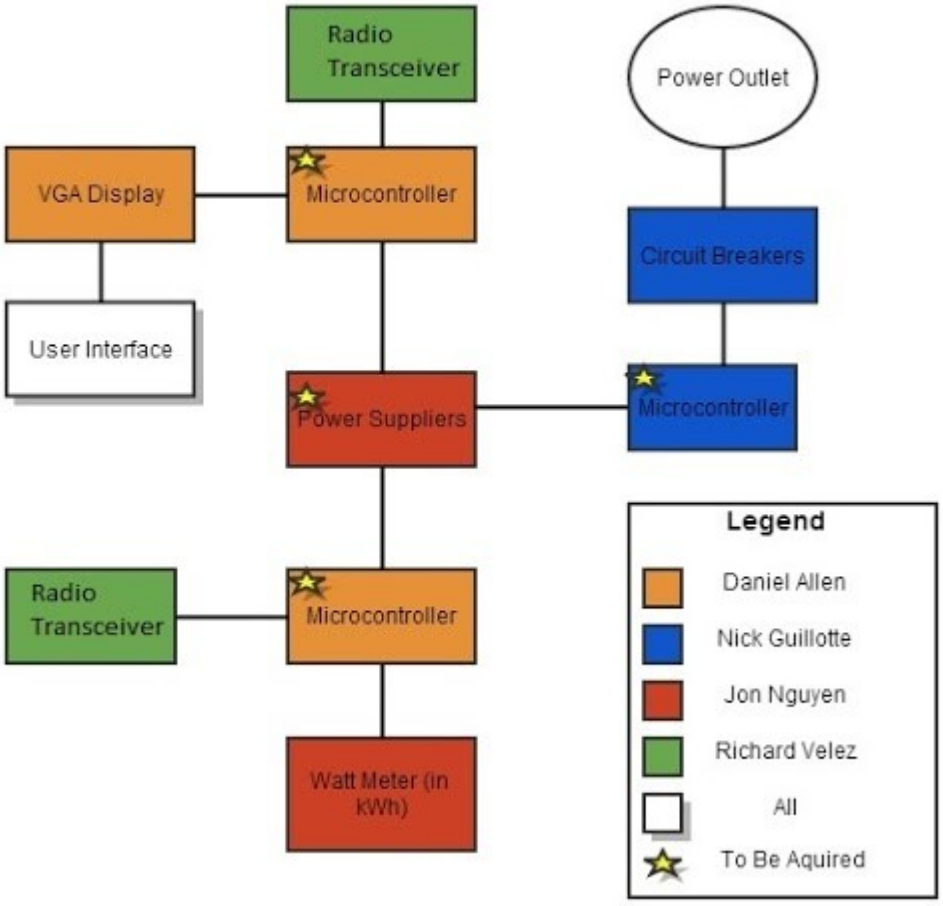
Other options being considered includes a remote controlled circuit breaker. The circuit breaker will be installed with the micro-controller at the individual outlets. The main device can be programmed by the user to allow it to turn off devices if certain thresholds are being crossed. As an example, a user can specify what devices are permitted to be turned off in the event that at current monthly bill calculations, the power usage is surpassing monthly expectations. The device will be intelligent to make the best guess at turning off the appropriate device or devices with as little interference as possible to lower the power consumption. The main unit can be designed to sound an alarm before a device is turned off, alerting the user that the event is about to occurs without surprising them. In addition, the tripping of the circuit breaker can be canceled by the user and they can then proceed to turn off appropriate devices if they choose to.

In addition to the circuit breaker, an application is being considered that can run on certain mobile operating systems such as Android. This will allow the user to control the monitoring system from their handset instead of the VGA wall unit. The monitoring from the mobile unit will include the same features and will allow the user to keep track of power consumption as well as review past usage. The application will also be able to receive alerts if any device is going to trip the circuit breaker at a specific outlet, allowing the user to make adjustments or cancel the operation.

V. Statement on Energy Sustainability

While other prototypes of this system have more than likely been attempted and completed several times over they have never been implemented in the home. It may be due to the overall cost of implementing the system but if every home had one it is reasonable to assume that power consumption could be reduced. A system that would report to a user over a network how much power they are using in comparison to their neighbors could help motivate people to lower their usage. Their are many things that people do over a month and furthermore the year that wastes energy and if it could be displayed to them in their home and in a precise way rather than seeking out a power meter somewhere outside, it could make them more aware of how much power they really are using, rather than just seeing a bill once a month.

VI. Block Diagram



VII. Project Budget

Item	**Estimated Price (USD)**
7” VGA Screen	200
Outlet Duplex (3)	15
Soldering Iron	15
Solder	8
Flux	8
Pacific Coast Remote Circuit Breaker (3)	345
PCB Fabrication (4 boards) (10 days)	387.12
Breadboard	5
Radio Frequency Dev Kit (4)	400
Micro-controllers (4)	40
Miscellaneous Resistors	10
Total	**1433.12**