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| Calvin College |
| Sr. Design Project Proposal |
| Home Power Monitoring |
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# Executive Summary

As energy consumption grows at an ever increasing rate people strive to become more energy efficient. The purpose of this project is to create a home energy monitor that enables a consumer to measure and track home power consumption. In doing this the consumer would be able to track how the energy he is purchasing is used. The design team seeks to design a system that would allow a user to monitor the power usage in a home on either a circuit-by-circuit or outlet by outlet basis. A system such as this would then have the ability to display real-time usage information on a user-friendly interface. Armed with this information, homeowners will be able to make more informed decisions about their energy consumption. Such a system as this would ideally be capable of communicating with a future “smart” power-grid to facilitate data transfer to and from the power company. The design team estimates that the goals of this project will be completed by May 5, 2011. At this early stage of development the team is unsure as to an exact development budget.

# Introduction

Electricity, in some form or another, has become the basis for our western culture. But, with the cost of energy at a premium and growing concern about the future of energy production it makes economic and ecological sense to monitor how energy is used in a home. Since the early days of home electricity, meters have been used to track usage. While these meters may have become more sophisticated, they have not been touched by the advent of computer monitoring systems. The design team seeks to build a device that could either cohabitate with, or replace the standard power meter used to measure the amount of energy delivered to a home. In doing this, it makes sense to track how the energy that is delivered is used throughout the home, possibly even allowing the homeowner to setup a power-plan that would enable him to active decide how the energy he has purchased will be put to use.

# Project Description

## Objective

The team seeks to design a system that would allow a user to monitor the power usage in a home on a circuit-by-circuit or even outlet by outlet basis. Such a system would provide real-time usage information via a simple to understand interface. Because our design will likely be housed in or near the electrical panel, it makes sense to include real-time monitoring of the status of all circuit breakers and other pertinent information related to power in the home. Finally, a system such as this would ideally be capable of communicating with a future “smart” power-grid to relay data to and from the power company.

## Method

The initial implementation will focus on the ability to actively monitor power usage in the home and display this information locally. Such a device would function like a one of the Kill-A-Watt devices, simply showing how much power is being drawn at that outlet at any given time. With this capability the system would be able to actively monitor the power used on an outlet by outlet basis.

Once the ability to monitor a single circuit is proven, the base station, capable of collating all the data into a single location will need to be designed. This base-station, likely housed in or near the breaker box, should be robust enough to withstand the environment that it exists in with no ill effects from extreme temperatures or other weather. In order to accomplish this, the team will need to design a communication protocol for all the devices in the network to relay their data in an order fashion back to the base station. The base station, once the data has been collected would be required to report usage information to the user. This could be done very simply by a locally hosted web-page that the user could access from any computer on their home network or via a display unit.

With these two pieces of hardware in place, the team will focus on extending the capability of the system to include other monitoring, reporting, and control features. For instance, providing interfaces to the smart power-grid; electrical generation devices (wind turbines, micro-turbines, and solar power devices), power factor monitoring, or other features deemed worthwhile that could provide added value to the consumer.

A stretch-goal for the project will be to add functionality that would allow the consumer to create a “power-plan” to control the usage of electricity purchased from the power company. This would allow the consumer to actively choose whether to use power purchased during peak or off-peak times, and to customize a plan that would provide the most usage for the amount paid. Such a system could include statistical analysis of past usage to provide the user with enough information to make the best choices.

The goal is to make this project modular, with the ability to add extra components into the system to extend the functionality. This means that once the base system is done, it could be extended to include any features that a consumer would find useful.

## Evaluation

Our project will be evaluated based on the simple criterion of: does this product provide an added value to the user. This means that the product is capable of actively monitoring the consumer’s power usage in a way that is non-intrusive to their way of life, nor intrusive to their power usage. Equally as important, our project must be equally as accurate as the current meters already in use by the electric companies.

# Timeline

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| --- | --- | --- | --- |
| **Task** | | **Deadline** | **Status** |
| 1 | Find group | Mid Sept. | done |
| 2 | Decide on project | Early Oct. | done |
| 3 | Find sponsor | Mid Oct. | pending |
| 4 | Submit proposal | Mid Oct. | pending |
| 5 | Determine specific guidelines for project | Late Oct. | incomplete |
| 6 | Begin designing | Early Nov. | incomplete |
| 7 | Initial testing | Late Dec. | incomplete |
| 8 | Prototype | Late Jan. | incomplete |
| 9 | Check in with advisor & sponsor |  |  |
| 10 | Modification as necessary |  |  |
| 11 | Test again |  |  |
| 12 | repeat 9 to 11 as needed |  |  |
| 13 | Begin building final prototype | Late Mar. | incomplete |
| 14 | Present final design | Early May | incomplete |
| 15 | Turn in reports, documentation etc. | Early May | incomplete |

# Budget

This budget proposal is crafted based on devices that exhibit similar functionality and do not represent a final bill of parts or other expenses. It is a very rough draft for estimation purposes. When the project enters its initial design phase, these estimates can be re-evaluated based on feasibility, need, and available funding.

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| **Description** | **Name** | **Vendor** | **Product No.** | **Price** |
| Microprocessor (A) | Arduino | Sparkfun? | ? | $100 |
| Microprocessor (B) | Beagleboard | DigiKey | 296-23428-ND | $149 |
| Commercial Study | TED 5000 | ? | ? | $200 |
| Display | ? | ? | ? | $100 |
| Connectivity | ? | ? | ? | $100 |
|  |  |  |  |  |
| Total |  |  |  | $700 |
| Replacement fund |  |  |  | $300 |
| Budget estimate |  |  |  | $1,000 |