EEL 4924 Electrical Engineering Design

(Senior Design)

Preliminary Design Report

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Project Title:

The Electric Split

Team Name:

ESplit

Team Members:

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Project Abstract:

The goal of our project is to analyze the amount of power a home consumes and use this information to evenly divide up the power bill based on individual rooms. This would be especially useful to college students with apartment style housing as it would split bills evenly amongst roommates based on their individual room's power usage.

Our project will be using a small-scale four-bedroom model home to base our results on, as to make the project easier to demo. Each room will have a corresponding circuit-breaker which will be used to monitor and record consumption much like a current homes power meter does. This data will be sent to a microcontroller (probably the MSP430) at the end of each bill cycle and a final power cost will be generated for each room. Data will be displayed on a LCD, which can be accessed at the end of each billing cycle to display the individual rooms power consumption and proportional cost numerically and graphically.

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Introduction:

The electric Split project finds application in the domains of effective energy management and accompanying visual representation of data through software. This project was designed to effectively divide a monthly electric bill amongst multiple roommates based on each individual's power consumption. This in turn would allow each roommate to only pay for the amount of power they use (instead of just dividing a total electric bill by the number of roommates). We believe this system will help roommates be more conscious of personal power usage and provide a fair solution for splitting electric bills. The Electric Split system will also help target any circuitry problems a home may have.

To make our system easier to demonstrate, we will be using a small-scale model home that we will build and wire ourselves. We will create a three-bedroom home with a living room and kitchen. The system will be able to calculate the energy usage for each individual room in the house. The living room and kitchen will serve as the common area of the home. The energy consumption of the common area of the home will be divided up evenly amongst the roommates at the end of each billing cycle. The system will be user friendly and customizable to fit any billing cycle. Information will also be displayed through a LCD that will have wireless capability.

Features:

Once this system is installed in a home the user will be able to:

- Accurately divide an electric bill according to rooms
- Target problems regarding electric load
- Make individuals more aware of energy wasted
- Numerically display the amount each roommate owes at the end of each utility billing cycle

Figure #1 (Simple System Block Diagram)

Technical Objectives:

- The first problem would be appropriately and safely scaling down a home (so we aren't working in a dangerous range of 200 Amps)
- The model home will have to be wired appropriately to correctly represent the circuitry of an actual home
- Receiving data from the clamp on power meter
- Correctly reading the data into the MSP430 microcontroller that will then calculate the correct amount each roommate owes for the electric bill
- Being able to display data on a LCD screen which will be user friendly and presentable

Concept/Technology Selection:

The Electric Split will be a product that can be installed into practically any home. Therefore, the technology must be simple and easy to install. The LCD screen must be user friendly and customizable to fit the billing cycle of utility companies.

Example:

The following is a scenario in which The Electric Split would be advantageous:

College style housing- 3 bedroom home, 3 roommates

Roommate #1- Does not spend much time at home and is very cautious of energy consumption

Roommate #2- Is always home playing video games in his room and has a mini fridge and space heater.

Roommate #3- Have a mini fridge, but does not spend much time in his room

The electric bill for the first three months was averaging around $340. Roommate number one and three were getting tired of paying the same amount for the electric bill every month even though roommate number two was clearly using the most electricity. Therefore, The Electric split was installed.

The following is The Electric Split's three month reading:

Room	Month #1	Month#2	Month#3
#1	10%	45%	45%
#2	8%	40%	52%
#3	12%	38%	50%

Chart #1 (Percent Energy Consumption)

The Electric Split's three month readings helped:

- Allowed the three roommates to accurately divide the electric bill proportionally each month.
- Made roommate #2 more aware of how much electricity he is using so that he become more cautious
- Target a faulty outlet in room #3 that was drawing too much load

Figure #2 (Example of possible LCD that could display Energy Consumption)

Cost Objectives:

Components	Cost
MSP430	$9.00
LCD Screen	$30.00
Clamp on Power Meter	$200
Wires and Outlets	$40.00
Misc.	$10.00
Total	$289

Chart #2 (Cost)

Division of Labor:

Shahin Pourkaviani is responsible for hardware design

- Building of model home
- PCB design and layout
- Power meter

Vivek Tumrukota is responsible for digital design

- Programming of MSP430
- LCD functionality
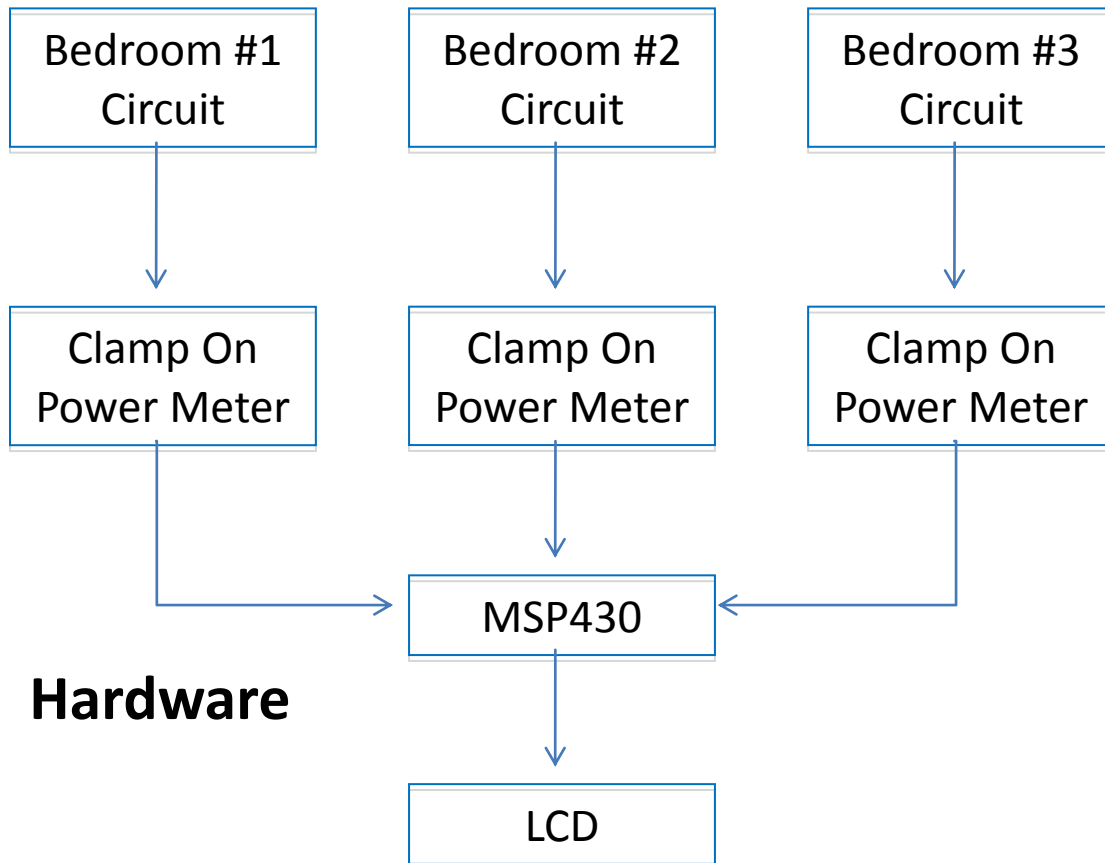- Wireless communication

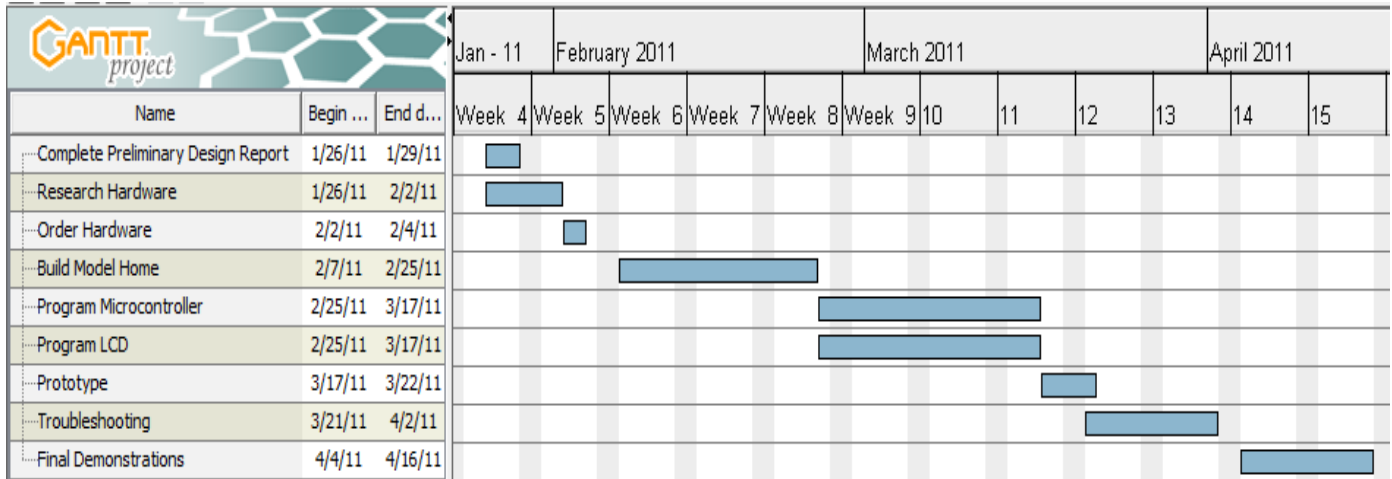| Bedroom #1 Circuit	Bedroom #2 Circuit	Bedroom #3 Circuit
↓	↓	↓
Clamp On Power Meter	Clamp On Power Meter	Clamp On Power Meter

Hardware

MSP430

LCD

Figure #3 (Hardware Block Diagram)

Name	Begin ...	End d...
Complete Preliminary Design Report	1/26/11	1/29/11
Research Hardware	1/26/11	2/2/11
Order Hardware	2/2/11	2/4/11
Build Model Home	2/7/11	2/25/11
Program Microcontroller	2/25/11	3/17/11
Program LCD	2/25/11	3/17/11
Prototype	3/17/11	3/22/11
Troubleshooting	3/21/11	4/2/11
Final Demonstrations	4/4/11	4/16/11

Chart #3 (Gantt Chart)