EEE 193A

Instructor: Russ Tatro

Senior Design Student Guide:

The First Semester

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By: Ogheneruno Onovakpuri

Abstract: *There are many factors that go into having a successful first semester of senior design. You have to form a team and pick the members of your group. You have to choose the design idea that you want to create. You have to find and recruit technical advisors. And you need to follow the system design process with rather detailed communication requirements. It is important that you need to be well prepared. Understand that the first semester of senior design is the most intense semester of your college career but could also be the most fun.*

I.   INTRODUCTION

Many people underestimate the first semester of senior design by believing it is just another course. Finally you get the chance to build something of your choosing and really be an engineer. But it can be the most underestimated class you take in college because you are not sure what to expect. There are many factors that go into having a successful first semester of senior design. First, you have to build and recruit the members of your group, decide on the design you want to create, find technical advisors, and perform the design process. Many of these tasks prove hard for students because this is their first time tackling such a self-determined task. In the following student guide, I will share the problems I encountered during my first semester of senior design, and suggest ways you could prepare yourself to have a successful first semester of senior design. The first thing that you have to understand is that the senior design process is very time consuming. You must balance time for senior design with your other classes, work, and family. Good time management it is important. You must meet with your team at the beginning of every week and decide how much time you should devote to the project for the upcoming week. This team time agreement along with the timeline of tasks that will be discussed later in the guide will help your time management and show you where the appropriate time for study in your other classes. Since your teachers in other classes usually provide you with a syllabus for the semester, you know ahead of time when your midterms will be so you and your group members can plan to spend less time on your project during the week of your midterms. Since my group members and I had most of the same classes we always planned to meet right after our last class.

With regards to having a job during your first semester of senior design, I wouldn't recommend it. Since this is a first project experience for many students it is important that you leave as much time open as possible. If it is essential for you to work during your first semester, discuss this need with your team members. See if they could schedule the group meetings around your work week. But if possible try to cut down some of your work hours during your first semester, and make up for it during the second semester when you will most likely have less of a workload. The final aspect of senior design that will be different is the even more limited time you will have to spend with your family. Most of your family understands that you are in college. So carefully explain to them that you are about to start the most important class of your entire major, and that you will not have as much time to spend with them. Most family members will support you and tell you that if you need anything they will help you out. It is important that you are well prepared and understand that the first semester of senior design is the most intense semester of your college career.

II.   CHOOSING YOUR TEAM

You should be thinking of your senior design project up to one full year before you enter into senior design. Some things that you want to start thinking about this early are what system or device do you want to design and the system design process. Once you have this figured out it

will make it easier when you are choosing your team. If you know your design will have some programming, as most designs do, it would be wise to acquire at least one member in your group who can program. Depending on the amount of programming required, you would vary how many members in the team specialize in programming. For instance, if you are designing a system in which you want to create a user interface, you should make sure that at least two members in your group are proficient in programming. Also when picking your group members you should try to choose at least one member that has interned for a company or has past technical work experience. Doing so will provide your group with someone that has experience and understands the pace that the design should be following. A person with industry experience will also know what troubleshooting steps to take when problems arise.

When I entered senior design I did not have a group or design. On the first day of lab, fortunately, there were two other students who were in the same position as me. We got together and discussed what each other's goals as far as graduation goes, and we discussed each other's skill sets because we wanted to see if we could find a common ground. We decided that we had similar interests and decided to form a group. It is very important that you find out the goals of each of your team members and when they plan on graduating, because depending on this information, you can decide who will give their all into the project. For instance, there was a group that took senior design during the same time frame as me and had two group members who didn't plan to graduate for another two years after they started their senior design. The problem was that these two members didn't contribute much to the design because they knew that they could always retake the class if they failed which unfortunately ended up happening. This is why it is important to determine the focus of every potential team member before you decide to form a group with them.

My group consisted of three students, Tony Dominguez, Ryan Ebuen, and myself. We were part of the Smart Grid related senior design. Since my group was a late addition to the Smart Grid lab we had to struggle to come together as a group and at the same time keep up with the pace of everyone else. After the first few weeks of criticism, we began to understand what was expected of us. As a group, we also came to understand what each of us were capable of and then came into our own as a group. Something that may help your group mesh together as a team is by doing activities outside of your senior design where you will learn about each other.

III. PROBLEM STATEMENT

Put your group together quickly because this will allow time for you to start planning everything else involved with the beginning stages of your senior design. If done in the semester or two prior to your senior year, this will essentially give you more time than the allotted two semesters. After you have chosen your group the next thing you want to do when it comes to your design is to first identify a societal problem. This assignment is where you identify a very

general problem in society that your group will later try to tackle with your design. A good problem statement lists symptoms, suggests the problem's likely causes, and estimates the resources needed to solve the problem. It serves to communicate to the user, to management, and to the technical people that the analyst understands of the nature of the problem and an initial sense of the problem's resource implications. This is where my group and I struggled. We not only struggled finding a general problem, but we wanted to make sure the solution to our problem could be solve with a smart grid related design. The problem we identified was vampire electrical loads in the residential home. Looking back on our societal problem we feel that it is better to choose a problem on a commercial level. For instance we could have looked at the same vampire loads but in commercial buildings. By expanding your societal problem to a bigger scale, you are now allowing your design to save consumers more money. Also, it is important that you and your group clearly understand your problem statement, because the better you understand the problem, the more likely you are to create a design that is relevant to solving the problem.

Once my group identified our societal problem, we researched how much money we could potentially save consumers by our design solution. We found out that in an average U.S. family home, standby power is only 7% of a total household energy usage. But that standby power is estimated to cost U.S. consumers $3 billion year. During further research we found out that as of January 2011 there will be a new law that limits the amount of standby power per device in the residential home to no more than half a watt. So in our problem statement we stated all of these findings, which are important because we wanted to prove that we had a real societal problem, and it is worth our time designing a solution to this societal problem. In our problem statement write-up, based on our understanding of the problem, we briefly stated our intended design idea that solves some aspect of the problem. For this assignment you don't want to get too much into the design, as the details of your design is reserved for the design idea write-up.

IV. DESIGN IDEA

Based on your understanding the societal problem you are addressing, your design idea is where you describe the system that you are designing, along with any associated components. For your design idea you are now stating your overall design by breaking it down into subsystems that each group member will help design. Your design idea should cover the technology employed, and what skills each member has that will help them finish their system. When creating your design idea it is important that you and your group understand that this assignment is a course proposal, and you will be graded based on if you did what you said you were going to do in your design idea. Keeping this in mind it is important that you set reachable goals for you and your team, because if you fall short of your design goals this could negatively affect your grade.

For example, my group and I proposed in our design idea that we will have three specific components to our design; however by the laboratory prototype presentation we only had two of

the components working. Although not always the case, we were allowed time over the break to finish the final component because we had a specific timeline, and a plan how we will use our winter break to finish the final component. The design idea must demonstrate that it addresses the societal problem. It is important you keep in mind that you are creating a solution to a known problem. Your group should do some research on what other similar solutions exist. Once you identify what other companies have created that is similar to your design, talk about what you and your group are doing different, and how are you being innovative.

For our design, my group and I decided to implement a design that will help control and monitor power, which addresses our societal problem. We found out there were products such as the "Kill-A-Watt" that allows consumers to monitor power. Also, we found many products such as "Bye Bye Standby", which allows consumers to control power via remote control. What my group decided to do that was different was implement a three component device that will allow user to both monitor and control vampire electrical loads (standby power) in the home, via a user interface. What is unique about our device is that the consumer will have full control of any appliance connected to our designed outlet. This will be done using a user interface which controls all of the outlets. The user has to identify what is plugged into the outlet and decide what type of energy saving mode it will go to when the appliance is not in use. For example, if one were to connect a standard lamp to our outlet, the user may cut the power completely from the lamp when it is not in use so there isn't wasted energy when it is off.

When you are thinking of your design idea, the main focus should be how can you make your design more innovative that what is out now. Another aspect in which our design was innovative is that our whole system communicates wirelessly with each other. This was an important aspect in making our device innovative because we noticed in our research of other devices that most of the devices that was for standby power, didn't incorporate a wireless design, like our system.

You should detail your design idea and write a report the explains your design concept. The report will be in the current IEEE format with a cover page, abstract, introduction, main topics, conclusion and references, and glossary. The report length is variable but in the 5 to 10 pages range with single line spacing just like this document. The first part of your design should state your design in 150 characters or less and is called the Elevator Pitch. Your elevator pitch should not have any technical specifications, or talk about price. Our Elevator Pitch was "We want to allow for residential energy efficiency by allowing consumers to control and monitor power". As seen in our elevator pitch we didn't talk about any components our circuits that we are going to use in the design, or how much it will cost. The purpose is to have just enough information, to keep someone interested in your design.

V.   DESIGN PROCESS

Once you have identified your societal problem and your design idea, you and your team of engineers are ready to build your design. First it is important that you identify the skill sets of each member and assign tasks accordingly. From the beginning of the semester you will assign a team captain which is a position that rotates among all the team members. This leader will be responsible for the whereabouts of each group member at any given moment, and how far each group member is in completing their design. Since this team leader will be responsible for most of the documentation, they should not have such a heavy load for their design. As part of the design process you will create team milestones so you know what to work towards every week.

For our project, the way we split our design was by having Tony Dominguez work on the circuit for the main head unit of our design. Ryan worked on most of the programming of the Xbee wireless and the PIR sensor. And I was assigned to do the user interface. In the beginning we were all helping each other with our subsystems; however as time progressed in the semester we decided to completely work on separate subsystems, and integrate all of the systems at the end, so we could try and move forward in our design at a faster pace. So Tony was strictly in charge of the power control aspect of our design. With his system he allows the consumer to control the power to any of their appliances that is plugged into our system. While Tony was building his system he encountered a problem. When he had the circuit built as he desired, he started to test the input and output voltages, and noticed some problems. The circuit was design for us to get a voltage increase at the output, but instead we were getting a voltage drop. After several different tests and troubleshooting we could not find the solution to the problem. So our next step, was taking our circuit schematic to our technical advisor, Professor Tatro. On his advice, we did some calculations and found out that the desired output voltage was impossible with the circuit that my group and I had built. We were trying to use a toroidal coil (inductor) to induce current, or in other words we were trying to use the inductor as a current transformer. Also we were using the wrong type of operational amplifiers, therefore our voltages were not as desired. We were pointed in a more reasonable direction that made us rebuild our whole project but saved us many man hours later.

Figure 1: Tony Dominguez working on Main head Unit

Ryan was completely in charge of monitoring the power consumption of the user. This was to notify the user of how much power each appliance is using. Ryan was also in charge of integrating the passive infrared (PIR) sensor with our whole system. To be able to monitor power Ryan used a current transformer. With this Ryan was able to read the current from any appliance that is plugged in and he did some calculations in his program so that the user would see the amount of watts used. The PIR sensor tells us if someone is in the room so if it is triggered all standby power is automatically turned on. Before we were monitoring power, the PIR sensor was able to wirelessly work with the system. After we were able to wirelessly monitor power we were no longer able to make the PIR sensor work wirelessly. The reason for this was because Ryan didn't know how to allow more than to Xbee wireless to work on the same channel simultaneously. So we decided that for the first semester that would be sufficient enough. In Figure 3 you will see an example of how the power monitoring works in excel.

**Figure 2: Ryan Ebuen working on PIR sensor circuit**
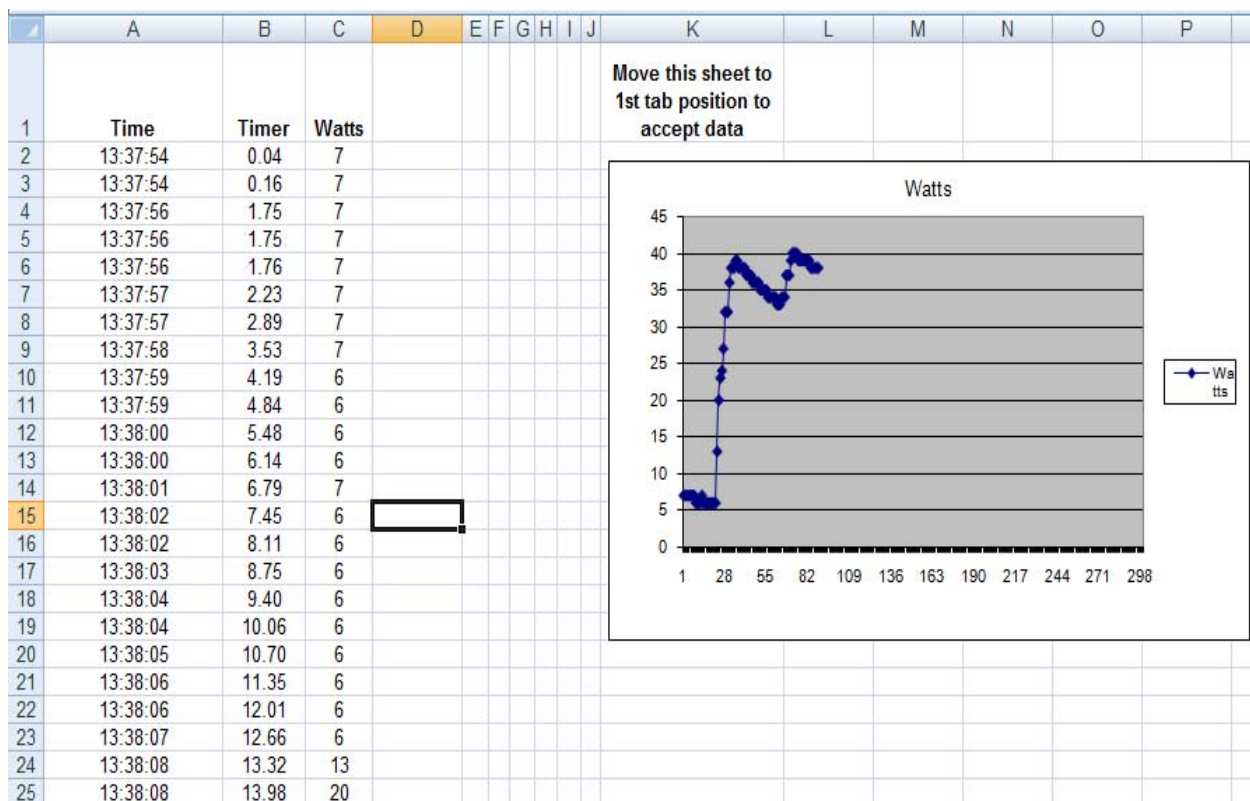
**Figure 3: Acquiring power usage in excel**

For my part I was to design a user interface that would make our design more user friendly. A big problem was that no one in our group specialized in programming so we knew

this would be a tedious task. First I had to choose which program would be easier for me to use. We originally wanted to create a graphical user interface in MATLAB because we had already programmed in MATLAB previously. However Professor Tatro brought it to my attention that LABVIEW would most likely be easier for me learn and then use to design a user interface. The problems I then encountered were due to my lack of previous experience with LABVIEW. I spent over 50 hours reading manuals and tutorials on how LABVIEW works. This is why it would be beneficial to have a group member that has experience with programming. Since LABVIEW has many graphical controls, the hardest initial effort is finding and integrating all of the blocks that work together. After many weeks I was able to build a good user interface in LABVIEW but still needed to add it to our other built systems. Since I started the user interface so late in the semester, because we initially worked on the same system, and because we had a lot of documentation to do, we were not able to integrate the user interface into our design system by the end of the term. To get a time extension and avoid a grade deduction for our missing user interface, we had to create a viable holiday timeline, and then complete the user interface during the semester break. In Figures 4 and 5 below are screen shots of what our user interface will look like.
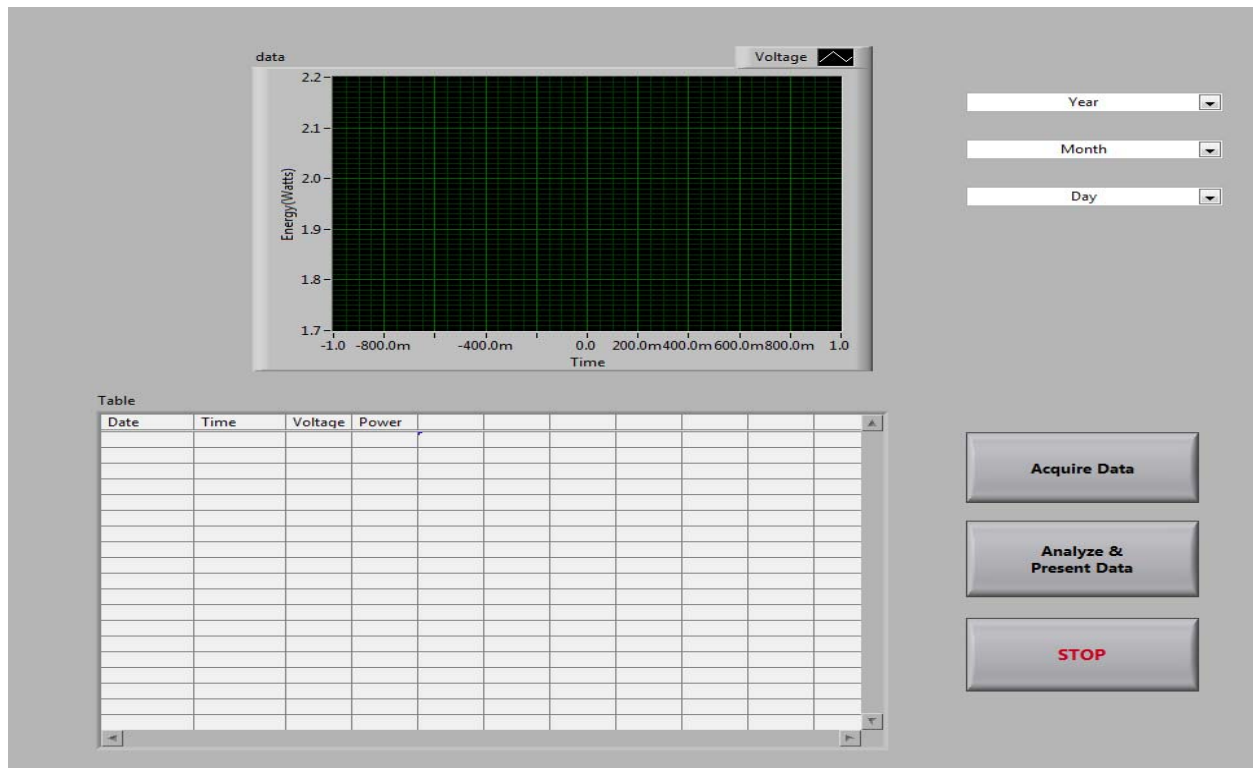
Figure 4: Screen shot of User Interface
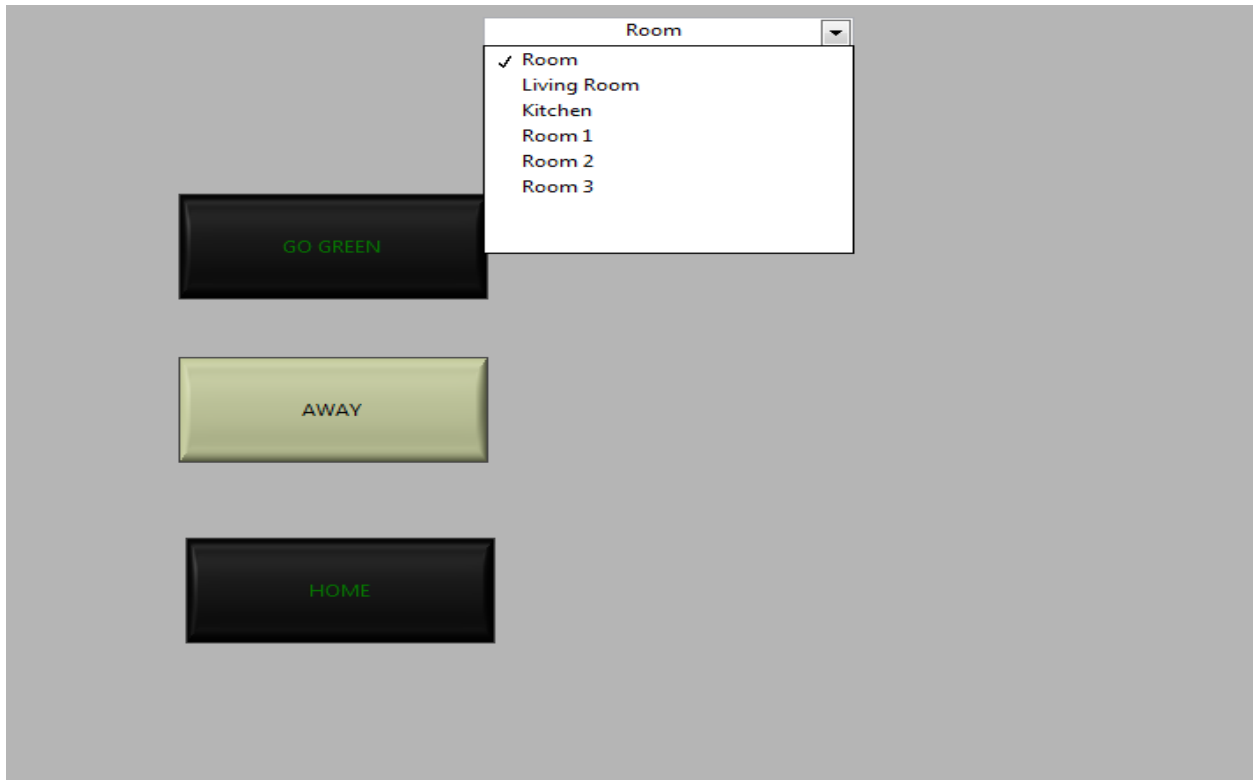
Figure 5: Screenshot of user interface

Figure 6: Lunar Onovakpuri working on the user interface

VI.   BREADBOARD PROOF

The first milestone that you want to work towards accomplishing is the breadboard proof. The breadboard proof is where you show that your design and theory works. This demonstration shows you have a viable project. By the nature of this early stage, you will not have had time to build a system, but your goal should be to show some aspect of your entire design. This is where Professor Tatro says, "Spend the next 5 minutes to show that I should spend an afternoon on this (approach, filter, widget, sensor, and so on)? The 5 minute session says to move on. Spend the afternoon on (approach, filter, widget, sensor, and so on) to see if I should spend a week on this. The afternoon session says to move on. Now spend a week with a clearly identified goal as to how this time and effort moves the project forward." This saying is that you don't want to spend time on any particular aspect of your design if it is not going to be a vital aspect to your design. For instance, don't spend too much time working on a user interface, if you know it is going to take much more time than you have set aside for it, and if it is not a vital part to your design.

For our breadboard presentation we wanted to simply model the part of our final design that will monitor energy usage for the user. Since our final design would not only be able to monitor energy usage it would also be able to log this data and wirelessly send it to the consumer via computer interface, we wanted to create a model of this. We submitted a parts list submittal two week before our breadboard presentation assuming that we would receive the parts in time for our presentation. We had specifically ordered parts for our breadboard presentation and once we found out that we would not get the parts in time, we had to pay for the parts out of our own pockets. So what we sought out to do was take the Kill a Watt, which monitors energy, and implement a wireless device to this that would log and send the data. After researching we found that the Xbee 802.15.4, would accomplish this very task. Other parts we used to build our device were 1N4001 diode, 10,000uF capacitor, 2 x 10k resistors and 2 x 4.7k resistors.

V. FIRST DESIGN VERIFICATION

The first big milestone you have to look forward to is the first design verification. Here is where you and your team demonstrate the essential elements of your design idea. You are demonstrating real hardware and software that are an important part of your final system. A goal of the first design verification is to gather up the team and review the design idea, and see if you and your team are on the right path to have a working lab prototype by the end of the semester. This is an opportunity where your team could reflect on the lessons learned so far. If you are on the right path, you should be able to show all the essential elements of the design are plausible, within the team skills and financial resources.

In preparation for the First Design Verification, we knew our hardware presentation had to exceed that which we presented during the Breadboard Presentation. As the first Design

Verification fast approached, the power controlling circuit consisting of the relays and microcontroller was assembled. Circuit protections were added to avoid problems such as using bipolar junction transistors acting as very low power switches for the relays and to impede reverse current to short the microcontroller, and a diode protected relay setup. Simultaneously, the software and hardware was being tested to ensure we could communicate wirelessly using the ZigBee 802.15.4 chips. Here we followed a user guide to make the task a little less troubling. Another aspect we worked on during this time was the sensing mechanism of the system, via PIR sensor. After having the basic hardware built as independent systems, our main focus shifted to the software. This task was greater than we had anticipated. First we had to get the microcontroller to control when the relays should trigger or not. Second we worked on having the microcontroller associated with the PIR light and LED when the PIR sensor was triggered. Finally we had to work on getting our ZigBee (XBee) wireless communicating and transmitting data. Once we overcame most of our obstacles with the coding, we moved on to the preparation for the Design Verification.

For the Design Verification we were asked to update documentation make our project progress known. To achieve this we had to update our timelines and tasks, and create a Risk/Impact analysis chart to indicate the importance and criticalness of each part of the project. Updating the timeline and tasks was quite simple because we were aware of the near term objectives and therefore quickly completed this, but we also had to include next term work which is a bit more challenging to achieve as we must forecast what we will work on and when. The Risk/Impact analysis presented another challenge in that it made us assess the components of our project and rate them. We found that there are three major points that had to be addressed, mainly our inexperience with programming, and creating a user interface that is simple and intuitive. We have made great progress in all stated points, but are still working on the user interface. When Design Verification day came we were prepared and presented our materials to the instructor. First, we demonstrated our hardware functioning independently, such as our relays controlling the lights, or the PIR triggering a LED to turn on when motion is detected. After the presentation and comment session with the instructor, he assessed our progress and evaluated our presentation and work.

VII.   SECOND DESIGN VERIFICATION

After your first design verification you should have a real good idea on how far your team is from having your final laboratory prototype done. For some groups you have to go back to your timeline and spend more time on your design if you were told by your advisor that you are far behind. If this is the case you have a lot of work to do from the first design verification until the second design verification. The second design verification is similar to the first design verification, but this time you are demonstrating real hardware and software in a system that includes all the functional blocks of your design. Since the second design verification is just a couple of weeks before your final system prototype presentation, you should show significant

progress in system integration. Hold team discussions on the tasks still pending before the working laboratory prototype demonstration in a few short weeks. Once this is complete you and your team will again have a good idea on how far you are from completing your final system prototype, which means you should hold a meeting and discuss what changes could be made if you are behind, and adjust your timeline accordingly. At this point if you still have a lot of work that needs to be done before you have a working prototype then you are off schedule and need to discuss with the course instructor options. This is where my group and I realized the third component of our design, the user interface, wouldn't be done in enough time, and therefore received an extension.

For the Second Design Verification our job was to integrate all the systems we created for the first Design Verification and any additional ones into one fully or near fully functional system. To achieve this my group combined the power controlling relays with the current detection system which utilized a current transformer that outputs a voltage, and a voltage detection circuit which identifies when an appliance is in the ON state. The current transformer outputs a sinusoidal voltage. Since there are negative voltages we had to fully rectify the wave. To do this we used a LM 358 op-amp as showed in Figure 7.
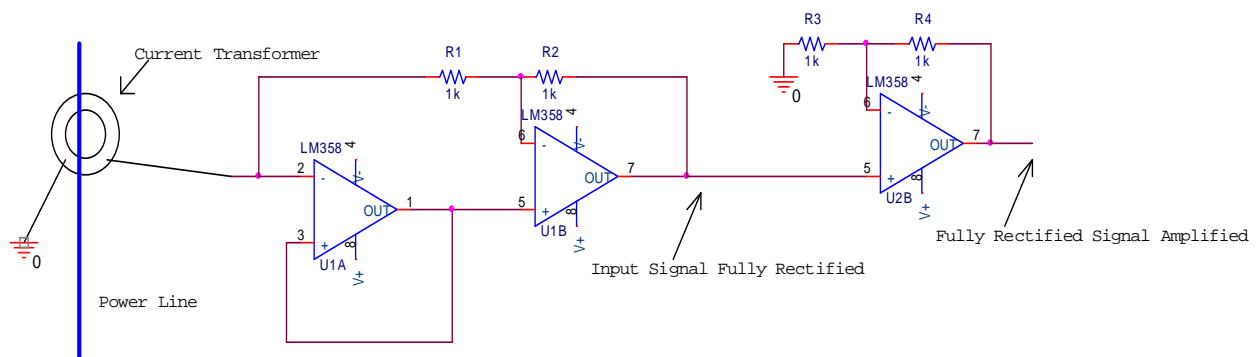
Figure 7: LM 358

The first two op-amps fully rectify the signal, which is then inputted to an AD converter then from the convertor we wrote code so we can display the power usage. The last op-amp is an amplifier and we amplified it enough just so our MCU can detect whether the appliance is in standby state or in the "on" state. Physically combining these systems into one was fairly simple, the truly challenging part was again, the coding. The challenge was in getting the microcontroller to simultaneously communicated and receive data from all these now subsystems. After spending numerous hours debugging these issues and allowing the components to run independently but with a single microcontroller because of its multicored nature, we were able to get all the parts working simultaneously. Once everything worked, we began testing and found that we needed to do debugging. To eliminate the bugs we used a solid-state relay that does not have a significant magnetic interference with nearby circuit components.

Finding and acknowledging our bugs enabled us to move on and begin preparing for the second Design Verification.

For the Second Design Verification we prepared a PowerPoint presentation along with our fully assembled hardware system in a demonstration to the instructor. We also updated the documentation (again!). The PowerPoint presentation in this design verification was not a course requirement, but as the all other lab teams used a PowerPoint we felt compelled to follow suit. Our hardware was assembled and fully functional, but with a couple minor bugs that are in the works of getting resolved. An accomplishment from the First Design Verification was that we were able to determine when motion was detected and enabled the relay to allow for an appliance to be turned on. The turning on of the appliance, in this case, an incandescent light, triggered the electrical energy detection system. The presentation began a little slow as the instructor indicated there were certain elements of in the presentation missing, but was impressed with the progress in our hardware. Our updated documentation included the updated timeline until the end of the Spring term and the tasks until the end of the project. Another thing that we could have done better was that it took us too long to get into what our design was. The instructor said that our presentation was fairly boring. The problem on our side was that we were presenting as if we were presenting to our instructor, however Professor Tatro told us to present as if we were presenting to consumers, i.e. to sell our product. This was very valuable criticism because we had to take this to improve on for our final prototype presentation.

VIII. FINAL PROTOTYPE PRESENTATION

The final milestone of the semester you want to reach is the final system prototype demonstration. In this final presentation of the semester, your team wants to demonstrate a working laboratory prototype that is exactly what you stated back in your design idea. Keeping in mind that this is just a laboratory prototype, you do not need to have clean printed circuit boards. Here is where you show all the functionality of your design idea. You are presenting real hardware and software in a system that addresses the societal problem by the use of your design idea. The final prototype presentation could be looked at as a dress rehearsal for the final system presentation at the end of the second semester since in both cases you will be presenting to an audience. You want to keep in mind that there will be representatives from industry at the presentations along with the engineering faculty so you if you are unprepared in any way this will have a negative outlook on your group and your design.

During the Second Design Verification there was a couple of flaws in our system which we wanted to perfect. The main problems with our system, currently, are that we can't read the voltage accurately if we are using the relay. This is something that Tony will be working on. Another problem with our system is that we want to monitor voltage wirelessly when our system is working correctly and simultaneously have the PIR sensor work wirelessly with our system. The aforementioned problem is something Ryan will work on. He knows it's just coding so he

will start trouble shooting once we complete our documentation. For our presentation we got together the weekend before in order to prepare a quality PowerPoint. By Monday we had our slides done and we spent the next two days practicing our presentation, and the night before our presentation, we presented in front of another group in our lab so we could get some feedback. On the day of presentation my group decided to dress professional because we knew this would be a lasting memory of our first semester of senior design. During our presentation I felt everything went well. At the end we had some questions, but since I was well prepared and I knew our design very well, I was able to answer all the questions presented to our group. The only criticism we received after was that, I shouldn't have gestured too much because the audience tends to pay more attention to my gestures than what I am saying. Besides this everything was positive in regards to our feedback.

IX.   DOCUMENTATION

For the week following the Second Design Verification, we got straight to work on the documentation. First we updated our timeline for what will be doing until the end of the semester. Next, we got to work on the documentation that is due on December 1. We broke the work up evenly. Since Ryan is team leader he made sure all the documentation for the whole semester is both on hard copies, and electronic copy (via USB flashdrive). Tony was assigned to do the main part of the documentation where we tell an engineering story. He started from the beginning of the semester until the Second Design Verification. I was assigned to pick up the engineering story from Second Design Verification until the end of the Fall semester. I was also assigned to do the user guide for our design. The deadline date we set to have everything done by was Monday, November 29. For the user guide I created, I had images and instructions on how to use it. The only negative feedback I got with the user guide was that it needed to be longer.

The first and most important thing is that all your documentation should be in IEEE format. Another thing to keep in mind is that all documentation should contain *efficient brevity*. The weekly report is documentation that is due every week. In your individual weekly report you discuss tasks assigned at the beginning of each week and you also discuss what was accomplished by the end of every week, along with the hours worked. Finally you talk about tasks assigned for the next week. Since each document needs brevity you should discuss any problems that you have had during the week in this report. Another document due every week is the team weekly progress report. This is similar to the individual weekly progress report except you are now reporting on the team problems and accomplishments as a whole. It is important that you use *efficient brevity* in this document because this is how the advisor and instructor of the lab know what is going on in your group. Too vague and progress cannot be determined. Too detailed and the advisor may not have enough time to wade through the information overload to determine the group's progress.

In the beginning of your senior design you will need to create both an individual timeline and a group timeline. While creating your timeline keep in mind when and how the tasks of the project are going to be accomplished? Your team should create a draft outline of the anticipated tasks of your project over the two semesters of senior design. Assign a teammate to these anticipated tasks and show when a task starts and ends. Present a large poster board timeline in a professional manner. These should be left at your work station so that if the instructor or advisor walks in he can clearly see on any given day, where each group member is and how close he is to completing his assigned task. I recommend that you have a timeline listing all your tasks and then on a separate document you describe in detail each task, according to the timeline so that the person looking at your timeline when they refer back to your explanation of each task. If your timeline utilizes different colors, those colors should have some type of representation to them. Your poster board should be able to be easily updated. Make it fun, creative and useful. Communication within the team is always critical. Think of ways to keep each other (and the instructor) informed about what you are doing, are going to do and what you did.

X.   CONCLUSION

The senior design process is supposed to be fun and informative for you. It is not created just to add stress to your semester. If you follow the guides provided, you will be insured to have a very successful first semester as senior design. The mistake that many students make is assuming that since senior design is only two units and that they don't have to set aside that much time for this design. However, the truth is that it is recommended that each group member spend an average of 20 hours per week working on the design. This is why it is not recommended to be working during your senior design, since you no doubt will have other classes that you need to provide time for. By picking a good group and being well organized you will not have problems with time management. One of the things you definitely don't want to do is to wait before the night before documentation is due to rush and type it. This only proves to hurt you as points will be docked. This also proves true for waiting until the night before a design verification or your final prototype to work on your hardware, because problems can arise the night before which can turn your senior design into a nightmare.

An important thing that will help you out during your entire senior design process is have a technical advisor. This proves to be very important because as with all programming and circuit designs, problems will arise. Ensuring you have a technical advisor will be good because you have someone with more experience than you, and someone to go to when problems arise.

 Prepare in advance for every task and ask your advisor if you need help with anything instead of assuming your theory works, or to quote Professor Tatro "Plug and Pray". For

example, we plugged our device into the wall while testing and didn't know that the line voltage needed a separate ground so we connected to the ground for our circuit, and as a result we switched a circuit breaker and burned an amplifier on our board. Although there wasn't any costly damages this could have been prevented by simply asking an advisor. If you follow the right course in your first semester you will have fun creating your design.

References

http://www.csus.edu/indiv/t/tatror/Senior_Design/Senior_Design_Lab_Index.html
- Problem Statement
- Design Idea Statement
- Project Timeline
- Bread Board Proof
- First Design Verification
- Second Design Verification
- Second Design Verification Lecture
- System Prototype Documentation
- System Prototype Presentation

Appendix

In this appendix you will see pictures of the circuit used in my design, and also images of documentation to give you an idea of how your documentation should look. Most of your documentation such as timeline's and weekly tasks, and risk analysis should be at your work station, for your instructor to easily identify where you and your team are in your design progress. For your team and individual weekly report it is important that you talk about everything your group discussed, bought, and did. This way the instructor has a good overview of your group.
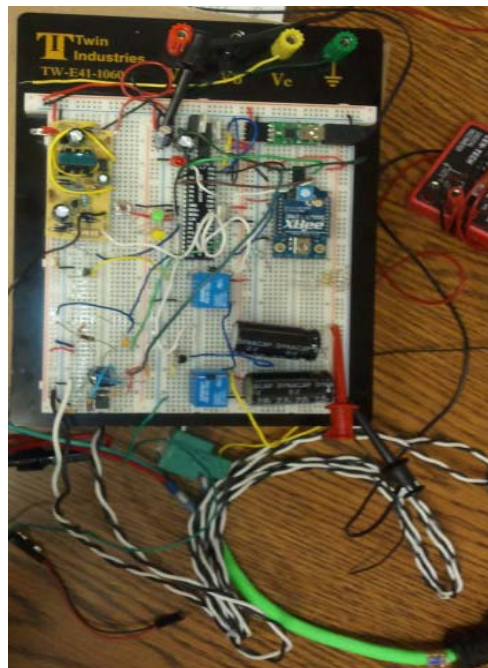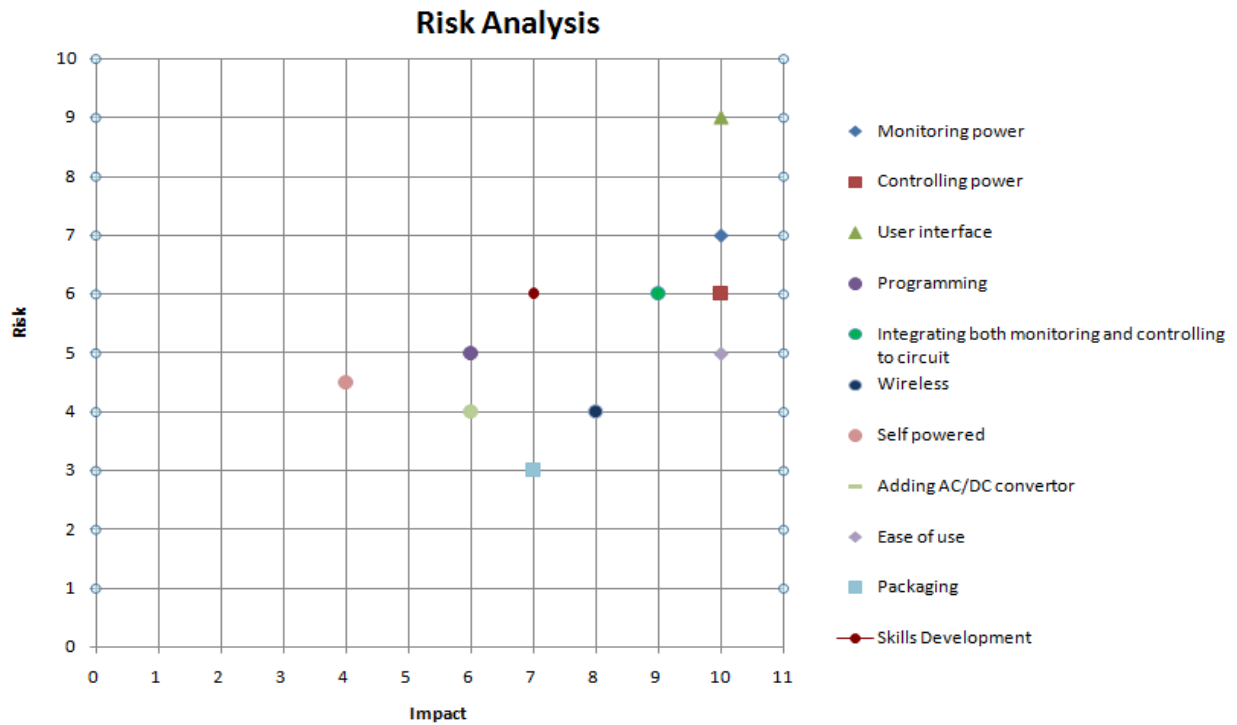

Figure 8: Picture of Main head unit
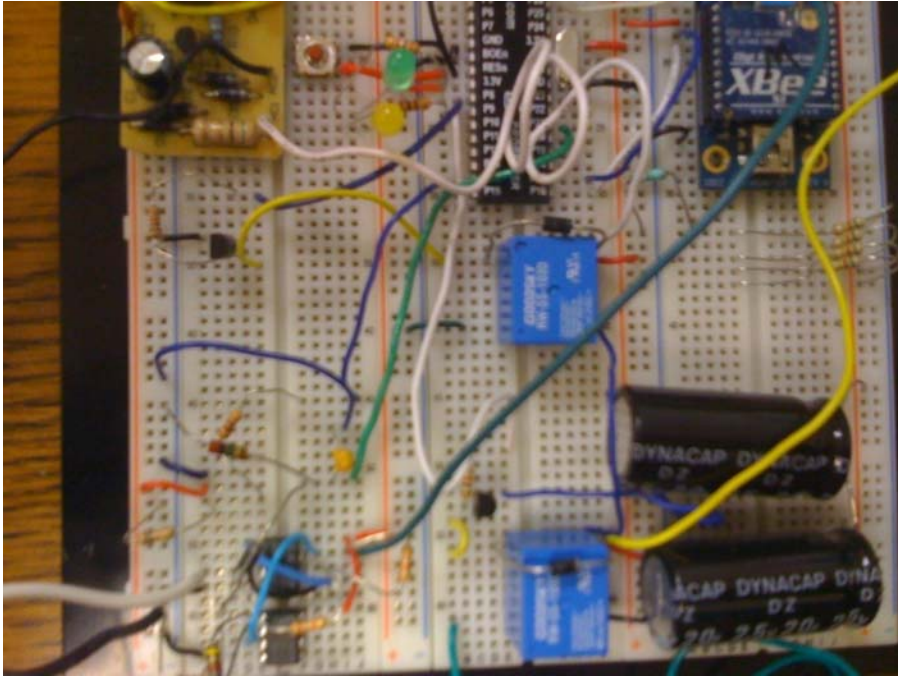
Figure 9: Main head unit
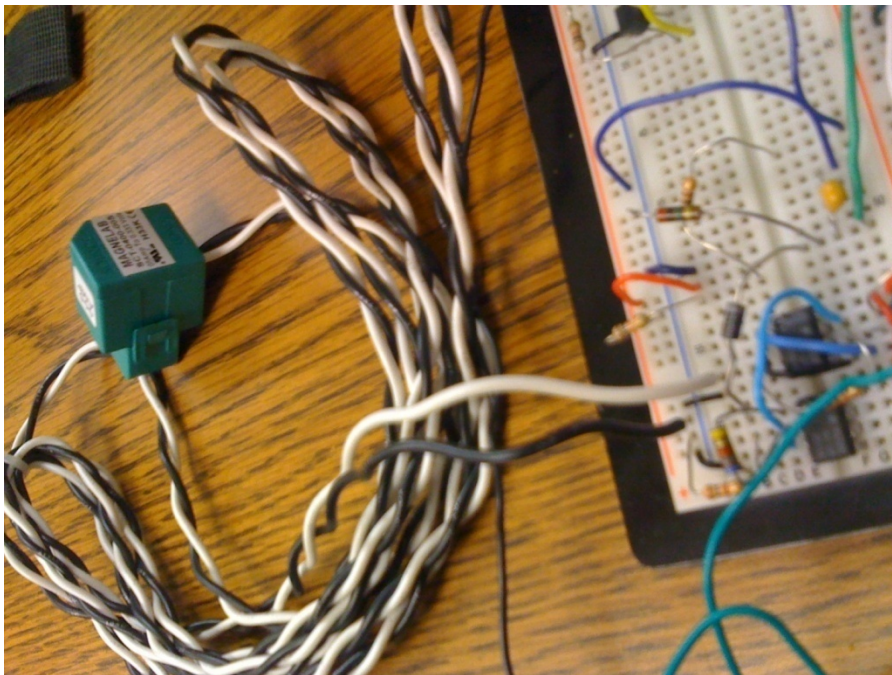
Figure 10: Current Transformer

Figure 11: Risk Analysis

Week 12: 11/14-11/20

LABVIEW reading excel files- My group and I were planning on having LABVIEW log the power usage directly from our circuit so; this was the program I was working on in LABVIEW. Recently we have discussed and decided that it would be better to have the data we log show in excel. So what I am working on is have this data that we log in excel, show up in LABVIEW. I am hoping that this doesn't take too long, since I already started reading how to do this. From what I read the hardest part will be getting the real time values in LABVIEW as excel is logging the data. If I finish with this program this week Tony is going to help me work on being able to control the Xbee wireless in LABVIEW. For this part of the user interface we want the user to be able to control their power by Boolean controls in LABVIEW.

Integration of systems- For our design we have three components that we want to integrate. The main unit is the power board, where one end is plugged directly into the wall, and at the other end is where you would plug your appliances into. The parts that we want to integrate with e main power board is the PIR sensor which is on a separate board which is going to be communicating wirelessly with our power board which will detect when a user is home. These two along with the user interface that is created on LABVIEW is what we will integrate together. The hardest part will be getting the LABVIEW software to work with the hardware. This integration part should mostly be done by this week because of the design verification; however the LABVIEW may take a few more days so the complete systems integration will be complete by Friday.

Documentation- For the documentation this includes completing the all the required documentation for this week before design verification 2. This includes updating the timelines for the tasks we have left for this semester and also the tasks we have assigned for next semester until May. Also included in our documentation tasks we plan on doing rehearsals for our design verification.

Figure 12: Example of Weekly Tasks
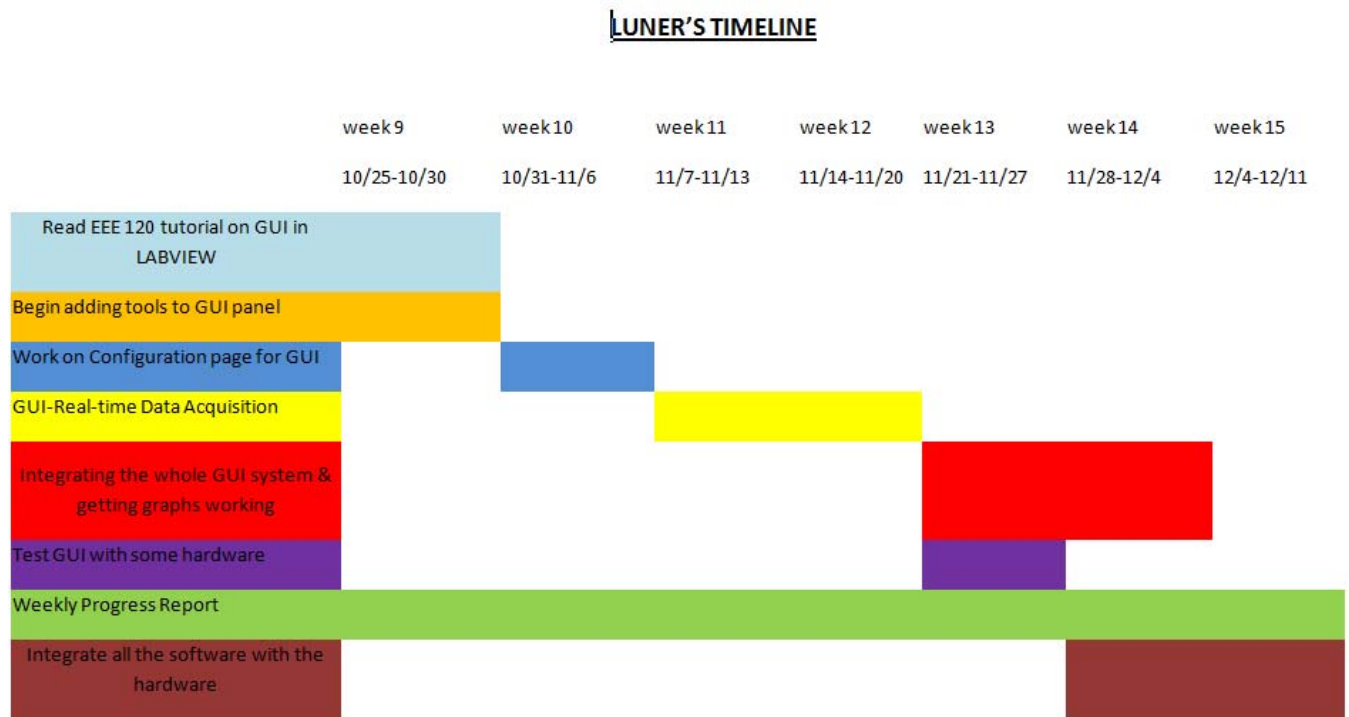
Figure 13: Example of Timeline

Week 13: 11/21-11/27

Thanksgiving – During this week Luner will continue to work on LABVIEW interface for both what we plan to have done by this semester and start on the interface for next semester. And we will work on documentation due for prototype demonstration.

Week 14: 11/28-12/4

Documentation- For the documentation this includes completing the all the required documentation for the prototype presentation. This includes problem statements, design idea, user guides, etc. We also will be typing everything up so that we can have electronic copies of all documentation.

Prototype Debug/Testing- We will be running tests on our system making sure that we are ready to present for our final prototype demonstration. Most of the design will be complete by now the only thing we will continue to work on is seeing if we can implement anything to our circuit to allow the capacitor to dissipate slower, because it is acting as a battery in our circuit.

Presentation- We are going to practice our presentation for the prototype demonstration. We are going to start our power point presentation and discuss the order in which we will talk, and how we are going to present everything.

Week 15: 12/12-12/18

Presentation- We will be finishing up with our power point and finish discussing the order in which we are going to talk. We will also finish all of our documentation for the prototype demonstration.

Figure 14: Another Example of Weekly Tasks

Senior Design Weekly Progress – Team Report   **Date:**

Team Members: Luner Onovakpuri

Tony Dominguez

Ryan Ebuen

Hours Worked: 50

Group Meeting Minutes:

We have been discussing what we want to show for our first design verification. So far we have decided to show our integration of our PIR sensor with our Xbee. The main part of our design we want to show is the circuit we have built that will detect when an appliance is on, that is plugged in to it. Another thing that we have been working on is a graphical user interface. So far we have found it fairly easy using the interface in MATLAB however the problem that we are facing is being able to do a graphical user interface with real time data acquisition in MATLAB. I have asked professor Kumar for help with this and he referred me to a student's project that has used it GUI before so we are currently working on this.

We found out that the circuit we have been working on for the last 2 weeks is not going to accomplish the task we sought out for it. After discussion with Professor Tatro the toroidal coil that we are using isn't funtiong the way we thought. We wanted to wrap a wire around it so that this would induce current and act as a current transformer. However, our circuit was functioning as well so we found out that we will need current transformers. We have ordered two 5amp current transformers, once we get those in we can replace our inductor and our circuit should function correctly.

Summary of Team Accomplishments:

1.   We were able to get the PIR sensor working with the Xbee wireless. We now have wireless communication.

2. Bought 5 amp current transformers.

Figure 15: Example of Team weekly report

Senior Design Weekly Progress – Individual Report   **Date:** October 13, 2010

Name: Luner Onovakpuri

Hours Worked: –

        Wednesday October 6, 2010 – 2hrs

        Thursday October 7, 2010 – 4hrs

        Friday October 8, 2010 – 4hrs

        Saturday October 9, 2010 – 5hrs

        Sunday October 10, 2010 – 0hrs

        Monday October 11, 2010 – 2hrs

        Tuesday October 12, 2010 – 4hrs

Tasks Assigned: - for this reporting period – include hours worked by task.

1. My tasks for this week was to continue contacting companies in regard our senior project to try and get prototype for a similar design, to help make our design more innovative.

2. I also was assigned to work on the spin code for the PIR sensor and to work on incorporating the code from the Xbee chip to work with the PIR sensor.

Accomplishments:

1. Got contact information for people at General Electric and Intel. I have contacted both representatives and the gentleman from GE has got back to me saying they will get me in contact with someone who could further help me within a few days.
2. I also started to work on the code incorporating all of our devices together, with Ryan. By our first design verification we want all aspects of our design working together. So I have been working on how the PIR sensor is going to work with the Xbee wireless. I have been working on the code for about 7 hours and it's near its completion.

Tasks Assigned for Next reporting period:

1. Have code that incorporates the Xbee with the PIR sensor working.
2. Should be nearer to getting prototype for GE or Intel's design similar to ours.

Figure 16: Example of Individual Weekly Progress Report