

Body

My participation in Senior Design this semester has greatly enhanced my educational experience in the field of computer engineering here at Michigan State University. Having worked at an internship for two years at Xerox Corporation in Rochester, New York, I can say that this is easily the one class in the curriculum that accurately simulates a real-world engineering environment. I will now use the rest of this document to describe my trials and tribulations of the semester in greater detail.

Dr. Goodman lists in his syllabus for the class several objectives that we as students need to be able to meet in order to successfully get through the semester. The first is being able to describe various types of technical communications and the reason for using them. I have met this objective by learning about Serial Peripheral Interfaces, Parallel Communications, and the I²C protocol. My technical role for the team was creating the hardware/software interface between our PIC18F4550 microcontroller and the Sensirion SHT10 temperature/humidity sensor that we decided on using for our thermostat. The SHT10 chip communicates serially with its corresponding microcontroller, and so I learned a great deal about the timing and cycling of serial communications between devices. Serial communication only involves two lines, a data line and a clock line. The only outside hardware that is required for such a layout is a pull-up resistor to release the DATA line to a high state when being driven by the SHT10. Also, I have been helping with our memory module, which uses a parallel interface to communicate with the microcontroller. While this is easier in terms of timing, because all communications happen synchronously, rather than sequentially, it requires many ports on the microcontroller to be reserved. We also looked into using the I²C protocol to enable communications between the microcontroller in the interface plate and the microcontroller in the thermostat. I²C

is excellent for low speed communication between devices. Because our system is very low speed, this would have been a good fit. However, because communication is only in one direction, from the thermostat to the interface plate, we decided that we could use three instruction lines to pass encoded instructions to the HVAC system, and the code would have been much simpler. Another facet of this course is developing the ability to prepare technical reports. I have met this objective by preparing well-written portions of our project's pre-proposal in addition to writing a technical application note on the hardware/software interface between the PIC18F4550 and the SHT10. Our facilitator, Peter Semig, gave me high marks in regards to my attention to detail and professional tone on these assignments. As a result, I am confident that my ability to prepare a technical report is quite high. The third objective is to write a team proposal for a major design project, and gain approval from our sponsor. Our first meeting with the sponsor in January went really well, and we were excited to embark on a project of such economic and environmental progress. Our proposal at the beginning of the semester was well-received, and we set out on completing our project. In the second week of April, we met with our sponsor again and showed them our prototype that we plan on showing during Design Day. They were very pleased with our product and the professional manner in which we presented it. As a result, I feel we succeeded in creating a successful proposal that was approved by a corporation or organization of large influence. As this course is heavily team oriented, the ability to understand and work in Peer Response Groups is a very appropriate objective. We spent a few minutes at each Saturday meeting discussing how we could work better as a team and be more productive. By scheduling daily times where we could all be in the lab together, we made much more progress than when we were showing up to the lab individually. We also felt comfortable sharing our thoughts on how the group, or individuals were operating, which made it easy to identify problems before they became anything major. I was responsible for developing some of the content for our oral presentations. Through this experience, I have learned that my speaking skills are much stronger than I initially thought. However, my ability to develop the

corresponding visual props that go with needs work. Many of the presentation slides that I made were bland and too formal in style. I now understand that presentation slides need to feature more eye-catching material, and less essay-style structure. Career assessment and planning is very important as well. However, most of my experience in this area has been with my dad, as he is an electrical engineer for Xerox and we have constantly talked about career objectives since my senior year in high school. As a result, I feel my advancement in this area due to senior design has been very minimal. One area that I have learned a great deal about has been in the field of ethics and professionalism. Dr. Strangas' lectures were very informative on certain situations in which I have either already experienced, or am sure to experience in the near future. I found that there is a great deal of conflict between making an ethical decision and one that is more profitable for the company. I have never been in a situation where I have gone against my own ethics in order to better the company, but if I am faced with that in the future, I now know how my decision making process affects both myself and the company. As our product is designed to be used in residential housing, the thermostat and interface plate needed to meet all Underwriters Laboratory standards for household electrics. This is why we took the standard 24 volt AC signal from common HVAC systems and converted that into 5 volts DC to power all of our electrical peripherals. One of the design objectives for this project was that the homeowner could modify the system as need be without having to call a licensed electrician. By avoiding the use of 120 volt household electricity, we have met that standard. UL standards are also why we chose to mount the interface plate inside of a standard switch box, because those are already approved for residential use. Some of the key tools that were used in developing our product were MPIDE development software and Visual Studio. In my technical role, the hardware connections were straightforward. All I had to do was follow the datasheets to connect the correct pins to either a voltage source, chassis ground, or an input/output pin on the microcontroller. The key to success for my interface was learning how to use the MPIDE debugging software that hooks up to the PIC microcontroller. This

debugging software allowed me to see whether humidity and temperature data was being transferred from the SHT10 back to the PIC or not. By stepping through each line of code, I was able to isolate the problem to a bad definition in a port register. Without understanding how to use this software, I would still be chasing that issue. I also used Visual Studio to design the ASHRAE conversion program that will be featured in our thermostat. Being a computer engineer, I have vast experience in coding C++ in Visual Studio. Therefore, this part of the project was very simple for me. Having worked in design teams at Xerox Corporation, and now in this class, I can say that working in groups has many benefits. If an individual member gets stuck on his or her specific portion of the project, he or she can bounce ideas off of fellow group members instead of spending lots of time with little advancement. Even engineers that are in the same field have different strengths, and it is much better to use all of these abilities to maximize potential. However, if group members cannot put in the work needed, then it can be quite destructive to the design process as the other group members get frustrated at having to spend time to inform them of previous discussions or even having to burden extra parts of the project in addition to their own. Effective teams listen to all ideas and compromise on them to where the consensus is that the design is the best possible. Every individual will have a different opinion on certain things, and as a result it is important to present ideas in a concise but intelligent manner so that the purpose of the suggestion is known. Teamwork in system design allows for the integration phase to go very smoothly. If all team members are on the same page, then implementing individual modules together should be very simple due to the fact that issues have already been discussed. However, if everybody does their part of the project and then tries to piece-meal it together, the results can be quite disastrous as things do not work as they might seem. Throughout the semester, I have demonstrated the ability to find information on engineering through outside sources. I have been to the engineering library to read about serial communication and digital timing patterns in order to get a strong grasp on my ideas of development. I also took the time to read the datasheets for the

microcontroller and SHT10 device to fully understand the way in which data is stored and retrieved. This gave me an idea of exactly what was going on when these devices were in communication with one another. There is third-party software that interfaces the SHT10 with Atmel's line of microcontrollers. When I took a look at their code, it gave me great insight into how digital communication systems were coded. It also allowed me to optimize my design with influences from these outside programs. Using the internet was a tremendous tool in my arsenal to develop the interface. I was able to use the internet to get sample code from Sensirion in addition to the aforementioned third-party software to see what optimizations I could make to my program to ensure that it was as failsafe as possible. At a point in time, I became quite frustrated in my relative lack of development mid-semester. Realizing that complaining would not solve the issue, I was able to use the internet to scour for alternative solutions in case the SHT10 interface did not pan out. I found a wealth of information on analog temperature and humidity sensors, as well as calculating their conversion functions to a real-life number. However, in the end, the SHT10 interface proved to be a success and this information was thankfully not needed.

My technical responsibility for our project was to develop the software and hardware interface between a PIC18F4550 microcontroller and the Sensirion SHT10 temperature/humidity sensor. In addition to this, I had to take the ASHRAE standard for temperature, humidity and comfort level and convert it into a C language program that could be run on the microcontroller. Creating the ASHRAE program was very simple as I feel am very fluent in C++, and coding and debugging the program in Visual Studio proved to be little effort. This program would allow the thermostat to take humidity and a pre-determined comfort index and calculate a temperature for the HVAC system to maintain. The formula for creating this program was provided in the documentation for the ASHRAE standard. The software that controlled the SHT10-PIC interface would poll the sensor and obtain accurate temperature and humidity readings. I spent time looking at sample code from Sensirion and third-party sources in order to educate myself about serial communication. Once I felt confident in my

understanding, I wrote a program from scratch and tried to run it. When it did not work, I used the debugging software to find where the problems were in my code in order to get the interface between the two devices working. Constraints were identified on cost, practicality, safety, and ease of use. The SHT10 was a perfect fit for our application due to the fact it does the digital conversion for both temperature and humidity, unlike more popular sensors which may only do one, or the signals are analog. I used the PIC18F4550 microcontroller due to its low cost (\$10.00), numerous ports for hooking up the LCD screen and memory for my other group members, and USB flash capability which met one of our needs to have plug-in upgradeability. In developing this interface, I have learned that the design process is tedious and stressful at times. I, personally, fell victim to setting way too ambitious of a schedule for myself, and it created a lot of unnecessary and unwanted stress when I failed to meet my now unreasonable targets. It is real easy to say a hardware interface will only take two days to create, but it is a lot harder to actually perfect it in such a short period of time. Looking back on this, I wish I would have been more realistic with my time allocation to the technical activities, as it would have given me much more peace at night. Work was partitioned based on prior development experience. For example, I have experience in both hardware and software, so I chose to do the SHT10/PIC interface. Anthony built power supplies for General Motors, so he volunteered to do the power supply and conversion. Matt Palmer had experience in microcontroller communication, so he decided to code the interface between the thermostat and interface plate. In addition, we used our skills to help the other team members when possible. I am the only computer engineer in the group, so I lent my knowledge in programming to Scott and Matt whenever they asked for it. During our weekly meetings, we evaluated each individual's module and offered suggestions to help speed the design process up as well as simplifying the integration phase. I did not have very many design iterations. The first was when I realized we needed to have USB upgradeability in the thermostat, in addition to the interface plate. That is why I chose to switch to the PIC18F4550 from the PIC19F4520. I almost decided to use analog instruments

to measure temperature and humidity due to software issues, but thanks to good teamwork with Matt Palmer, we managed to solve the software problems. As a result, the module I have designed is verbatim what we decided at the beginning of the semester.

Throughout the duration of the semester, I have had the opportunity to present technical communications to a variety of audiences. The two lectures that we had to develop for this class allowed me to hone my speaking skills in front of a familiar audience. I participated in the presentation of our proposal, our technical lecture on the I²C communications protocol, and giving a design presentation to our sponsor at the Michigan Commission of Energy offices in downtown Lansing. The design presentation in Lansing involved us showing the members of our sponsoring commission our ideas for the interface plate, in addition to describing the electronic background that structured our project. I was a featured speaker at all of these presentations. I have done technical writing on our pre-proposal, the actual proposal, the individual application note, and our design issues paper. In order to ensure that my writing style was directed at the proper audience, I made liberal use of the Writing Center at the library to get opinions and ideas about the tone of my writing. I found these sessions to be quite informative.

This course has had a minimal effect on my career objectives and goals. My main goals coming into Michigan State University as a freshman were to either graduate with my bachelor's degree and find a lucrative job in computer engineering, or attend a high-end graduate program to further my education in digital circuit design. Working with digital devices for the majority of this class, it has actually furthered my desire to work in this field. Where this course has affected me, however, has been with group communications and planning. Several of my team members have a family with a wife and children, and scheduling around that is quite difficult. I found myself getting frustrated at them not being able to meet us on weekends due to these obviously important commitments. What this predicament has taught me, is how to voice my concerns in a way where my point gets across, but I understand where they are

coming from. In high school, I tended to be very abrasive in addressing similar issues, and I believe that working with this fine group of individuals for three months has helped me refine my communication skills.

My strengths that I have demonstrated throughout the semester have been a strong work ethic, the willingness to always be learning, and attention to detail. I have not missed a deadline for any assignment due for this class, nor have I come close to doing so. I felt it was important to get work done ahead of time, so that way other group members or people that could be of assistance could offer advice or suggestions on how to improve designs, presentations, or written assignments. As per my technical role, described earlier in this paper, I was responsible for developing a software and hardware interface between a microcontroller and a temperature/humidity sensor. This process is something that I had never done before. While interning with Xerox Corporation, I did one summer of software development and one summer of digital design, but never a product that integrated both facets together. My first prototype was terribly constructed as I had no idea about interfacing. However, I took the time to research the appropriate material, and also sought help from friends in other design teams that were willing to lend expertise. This provided me with the ability to learn the technical process, without having it spoon-fed or done for me. I feel that working through problems in this manner is the best way to do so, because it allows you to make progress without getting stuck for weeks, and it gives you the opportunity to learn heaps of information that could prove useful in the future. I also paid a great deal of detail to precision in our written and visual reports. I have sat in on important meetings at Xerox before and have learned that professionally created presentations can take you much farther than ones that appear rushed or poorly written. However, I have had my downfalls for the semester as well. My time management between this class and my other classes could have been done much better. In the beginning of the semester, I would never come into lab to work on my project unless I could devote at least two hours at a time to working solely on development. However, I realized that even if you can get into the lab for an hour or so, that time can be used very productively

and can help erase time spent later in the week. Another weakness that I felt exposed itself was my lack of confidence in speaking to my team members as an equal, despite being project manager. As mentioned previously, some of my team members already have a developing family. I understood their reasons for having to miss important meetings and not being able to contribute as much to the written and visual aspects of the class, but I was still frustrated over it. I never found a good way to mention this to them, because I felt I did not have the ability to do so being someone that does not have a family. I wish that I could have developed a better rapport with my team members, so that I would be able to speak my mind on the subject and not have to worry about becoming an outcast for bringing up a sensitive subject. However, this was a minor issue that eventually resolved itself as we found more convenient meeting times, and even communicated via phone when important technical developments arose.

I see myself in a favorable position within the next five years. I have already been offered and accepted a job with Raytheon Missile Systems in Tucson, Arizona working on embedded systems within missile bodies. Aeronautics has been a field of great interest to me, ever since I first visited an airport as a young boy. This job is allowing me to live a dream, by doing something I love and something that is not commonly heard of amongst my friends and family. I hopefully see myself still at Raytheon in five years, with a masters degree in digital circuitry either from the University of Arizona which is right in Tucson, or if I am eligible for an out-of-state graduate fellowship provided by Raytheon, to follow up on my current acceptance into the Electrical Engineering program at the prestigious University of Michigan. I have been blessed with tremendous opportunities upon graduating Michigan State, and I plan on making the most of them.

There are several steps that I will need to implement to make my five year plan a reality. I need to continue to demonstrate the precision to detail and strong work ethic that have put me in this position, in addition to developing strong working relationships with my coworkers. Raytheon is a very group oriented company, and communication with co-workers will be integral to both the

company's and my success. I also need to learn how to balance a strong social life with a solid working life in order to feel happy about where I am at. Moving to Arizona is quite a monumental experience, because all of my friends and family are either in New York or Michigan. It will be important to meet new people and develop friendships to allow me to relieve some of the in-office stress that is common in high-level engineering professions. If I can continue to apply my abilities and traits that have placed me in this situation, I feel that I can comfortably meet my expectations for the next five years.

Appendix

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David Mohabir

Objective

Seeking a position of employment in the field of computer/electrical engineering in either hardware or embedded software upon graduation of Michigan State University in May of 2007

Employment

9/2001-6/2003 Gananda High School Macedon, NY

Lab Assistant/Work Study Aide

During the two years I worked for teacher Mark Pellegrino, I was responsible for lab preparation and cleanup. Responsibilities included tending to experiments, gathering data, and keeping the experiment area sterile. I also kept track of student performances using Microsoft Excel and Access, as well as using Word to write draft letters for Mr. Pellegrino.

4/2002-current Target Corporation Victor, NY

Various Positions

Target was my first experience in the public workforce. I have been trained and work in several areas including cashier, food service, guest services, product flow, sales floor representative, stock control and electronics.

9/2003-5/2005 Michigan State University East Lansing, MI

Professorial Assistant

Reporting to Dr. Edward Rothwell of the Engineering Research Complex, this position had me working in a lab, setting up equipment and collecting data on electromagnetic reflections and transmissions. I was also responsible for creating schematics using Cadence Tools and writing programs in MATLAB that provided simulated data.

Summer 2005 Xerox Corporation Webster, NY

XCEL Summer Intern

I participated in the Xerox Collegiate Experience for Learning program by being an intern under the management of Kevin Aubertine. In my duration with the group, I worked heavily with computer data structures and systems, in addition to organizing many files for a software release just prior to my departure. My main focus was coding in C++.

Summer 2006 Xerox Corporation Henrietta, NY

XCEL Summer Intern

In the most recent summer break, I worked under William Lindenfelser in the XOG/EDIC department of Xerox Corporation. My tasks included schematic design and circuit board layout, soldering by hand, administrative

projects involving Microsoft Word and Excel to monitor our inventory of needed parts, and learning about JTAG protocol for designing more complete test strategies. I used DxDesigner as the design tool to lay out JTAG test fixtures for our copier circuit boards.

References

Dr. Edward Rothwell – rothwell@egr.msu.edu

Mr. Mark Pellegrino – Mpellegrino@gananda.org

Mr. Kevin Aubertine – Kevin.Aubertine@xerox.com

Mr. William Lindenfelser – Bill.Lindenfelser@xerox.com

Mr. Andy Gitsis - (585) 425-0800

Education at M.S.U.

- Majoring in Computer Engineering, with a graduation date of May, 2007
- Through the fall semester of 2006, G.P.A is 3.495 after 115 out of 128 credits necessary
- Member of the National Society for Collegiate Scholars
- Member of the IEEE organization
- Treasurer of Eta Kappa Nu, the honor society for Computer and Electrical Engineering, Michigan State chapter
- Tutor at the Michigan State University Math Learning Center in algebra and calculus

High School

- Graduated with a 4.1 G.P.A.
- A member of the National Honor Society, Gananda Chapter
- Participated in Student Government, Soccer, Alpine Skiing, Golf, Instrumental Band, Jazz Band
- Captain of the Varsity Golf Team in the Spring of 2003.