**Describe the facts of the course experience.**

**Stick to the facts - imagine a dry narration of a video of you doing your work. The purpose is to prime yourself for the next set of questions that dive into the meaning of the experience. For example, where did you do the work? What were you and your partners' roles and contributions? When did you do the work? Right away? Last minute? Did anything noteworthy happen, like breaking a component, something working flawlessly, etc.**

This course was a wild course. There were many ups and downs in this course but in the end, it was a blast. The course started off very rough with the shortage of parts for our breadboard demo. A lot of groups including myself were scrambling to get the feasibility model in a working state. Once the demo was over, we had to redesign a big portion of our initial design to reduce the complexity of our project. For example, we ran out of GPIO pins, so we needed to use a mux and instead of using ultrasonic sensors we used reed switches for zone detection. The PCB design was interesting. It was very stressful trying to fit all the parts, but I am very proud of the result and how it looked despite there being some simple logic errors that we missed out on. The final assembly was the worst part. All the students were trying to cram into the lab room and there were very little seats available. My partner and I spent the entire week in there because we had poor time management and had to fix errors in our PCB because we overlooked it. We divided the work evenly and spent our time mostly in the lab because the equipment was there for us to use and there were TA’s that could help us out. We tried to do things at least 1 week in advance, but we often took longer than expected because of our lack of knowledge and debugging. Something that was notable in our final assembly was that we soldered all the components onto the PCB without testing component by component and our PCB did not break/have any shorts. A lot of groups had to cut fly wires and redo their PCB, but we got lucky on our first try. In hindsight, we should have tested each component after soldering. Fortunately, we were able to complete the project and get all the core functionality done! This course and the overall process was unlike anything I have ever experienced.

**Thinking from an academic perspective, what specific elements of your learning experiences (undergrad courses, co-op, extracurricular, etc.) relate to this course experience?**

For the software portion, a lot of the coding in ECE 252 and ECE 224 helped. ECE 252 provided a solid foundation for digesting the starter code and API calls. Programming the MCU with our C code was very similar to how we flashed our program on the FPGA’s in ECE 224 and we gained a lot of experience with that. Both ECE 224 and ECE 252 were the foundations on understanding and developing our own specific C code for the Home Security System.

In terms of working with the breadboard and the MCU, I never worked with circuits outside of my academic life. All my knowledge in ECE 140 and ECE 240 was required for creating our initial demo, designing our schematic and PCB, and finally debugging and building our final project. An example of this would be using the low pass filter taught in ECE 240 to help with building a “hardware”. In the 1B term we also worked with Arduinos during the design days which assisted in building a 3-bit binary counter in the code that is used for selecting different channels for the 8 to 1 Mux.

**Based on your knowledge and understanding of the technical topics involved, how was the course experience different from or similar to your expectations going into the term?**

Originally when the projects were introduced, I had a high expectation for learning the design process since there was a lot of freedom to build our own project based on minimal criteria. Prior to this course, I had little to no design experience. As we went on to design our own schematics, then the PCB, and then assembly of our project, it matched what I wanted to learn from this course. It was interesting going through many different designs and picking the best iteration to create our schematics/PCB with.

I knew there was a lot of hardware and debugging involved going into this course. We would be doing a lot of things we were uncomfortable with and we would need to improve our existing circuits skills to create a project that we are proud of. This course matched exactly my expectations. We ran into a ton of hardware problems, some which were simple, and some which were design issues. After a lot of time and help, we were able to solve them and learn from our mistakes. We also learned new concepts such as picking ideal values for pull up resistors.

Since this course is quite new and unlike any course I had taken before, I was expecting a lot of help and guidance from the lab instructors and TA’s. Unfortunately, this was not the case. We got minimal help from the TA’s and got conflicting answers from them. The amount of help that I expected was a lot less than what I received. Fortunately, this wasn’t a horrible thing. We had to solve a lot of our own problems and think outside of the box for solutions when we got stuck. This was a crucial experience as we learned what not to do in the future and what things we should be doing. With every struggle that we went through, we gained insight on what it means to develop a project from scratch.

**Other than what was provided in the lecture and labs, from what sources did you obtain information that you needed to complete the course?**

Most of the information that I obtained was from looking at the original starter code shell, looking at different examples of how to use components in the DriverLib User Guide, and looking at the official code provided for the MSP430FR4133 on the Texas Instrument website. For the DriverLib, we looked at the API calls and read over the comments to figure out how to use certain components such as TIMER A. The other source of information that we used was asking other groups who also did Home Security for some software tips.

Another source that we used was online Arduino code. We looked at some of the code to gain inspiration to help build certain parts of our program. For example, we looked at how a 3-bit binary counter was implemented in code.

**Thinking from a personal perspective, what personal strengths or weaknesses did you experience while working on the project? Think about both STEM and professional skills aspects of yourself.**

In terms of strengths, I would say that I was able to understand the starter code at a high level and modifying it to fit our project specifications. As a result of being able to understand the code well, I was able to fix some of our hardware problems by doing some work arounds in the code. Another strength that I had was soldering the components. I was proficient at soldering the components onto the PCB with making little mistakes because I have steady hands and I am used to working with small components as I build toy models outside of school. I also was able to design the PCB layout well because I am used to using design software such as AutoCAD.

In terms of weakness, one of my biggest weakness was time management. I did not plan out my time well and consequently, I needed to cram during the last week to get our project in a presentable state. I was also a little weak on the general circuit design perspective because my foundations in ECE 140 and ECE 240 are not the strongest. Because of this, I made a lot of simple circuit logic errors that could have been avoided if my fundamentals were a bit stronger. An example of this would be that I chose our pull up resistor value to be 100 ohms which is way too small to do anything useful.

**Articulate what you learned during this course. What did you learn? How, specifically, did you learn it? Why does this learning matter? Why is it important? In what ways will you use this learning? What goals will you set given what you have learned in order to improve yourself and the quality of your learning?**

In this course there were 3 areas that I can categorize what I learned: Software and integration with the MCU, circuits, and Schematic/PCB design. From the software perspective, I learned how to integrate the MCU and our C code together. For example, I learned how to use UART to communicate with the MCU, how to use the LCD, and use the pushbuttons as interrupts to change zone states. I also learned how to use TimerA and send PWM pulses. I learned this from reading the starter code and looking at code examples from the Texas Instrument website.

For circuits, I learned how to use certain components and connect them to the MCU. The most interesting component that I used was the ultrasonic sensor. I was able to display the distance the sensor was reading on the LCD in real time. I was able to learn how to use certain components by reading the user manual, spending a lot of time experimenting, and asking the TA’s for help.

For Schematic/PCB design, I learned how to use the DipTrace software to create our own designs. This was pretty much self taught, and I just played around with DipTrace to understand how it works. Whenever we got stuck, we asked other groups how to do certain things such as how to make test points on the PCB or we asked the TA’s.

All this information that we learned is important because it provides insight on the design process from start to finish. I went through many struggles as this was my first time designing my own product and I learned an enormous amount. I will use what I learned when I build my own side project using MCU’s and in the final year design project. I have a better understanding of what to do, but more importantly, what not to do in the design process. An example of something not to do would be: soldering all of the components of the PCB without testing at every stage. In terms of goals, my biggest goal is to learn how to mange my time and always aim to fulfill deadlines. This will help in the future tremendously and make all projects run smoother. My secondary goal is to build more circuits in my own time. This will help with hardware debugging, general circuit knowledge, and it will be a fun project to show others.