

Professional Assessment

Alex Sklar

12/2/15

ECE 480

Team 9

1. ECE 480 has been a rigorous culmination to my undergraduate career at Michigan State University. Throughout this semester, senior design has tested my knowledge and allowed me to hone my skills for professional growth. The electric bike project has allowed me to learn essential skills from my team members and facilitator that I am sure will be used throughout my entire career.

During this semester ECE 480 was focused on achieving the learning objectives that were defined in the first week of class. As shown below, I believe that I have achieved all of these learning objectives and contributed to the team and course outcomes.

The first learning objective is “Preparing an engineering design proposal that has clearly stated specifications and design criteria, including realistic constraints, based on the problem area presented to the group.” This was achieved as both a report and as a presentation during the semester. We discussed our proposal of using an AMS rotatory sensor to control each of the phases of the alternator and energize them at the optimal time.

The next objective was “Sharing in the day-to-day design activities and management of the project.” This objective was achieved in our team by splitting the team into two teams. I was part of the hardware team which focused on the power electronics and the PCB layout while the software team focused on the programming of the microcontroller. This worked well because our team was composed of electrical engineering majors as well as computer engineering majors.

The third objective was “Sharing in the presentation of oral and written reports.” To achieve this objective, our team split each presentation and report into sections. Each team member then specialized in a specific section and wrote their content for that section. Once each section was completed our team came together and critiqued each other’s section.

The fourth objective was “Sharing in the demonstration of results at key milestones during the life of the project.” The objective was achieved by documenting all tests in our design notebooks and taking videos when our motor finally was able to spin efficiently.

The fifth objective was “Evaluating the project's progress and outcomes against a clearly articulated set of criteria.” This was achieved by focusing our design on efficiency and utilization of this motor on an electric vehicle. During our testing process we have been constantly testing our efficiency of our different codes to find the optimal program to run our motor.

2. Along with my duties of being the team lab manager, I was able to demonstrate my technical skills during this project. Our proposed design was to create a motor controller for an electric vehicle that is powered by an automotive alternator. The proposed idea was to use a rotary sensor to provide an absolute reading of the rotor angle reading to the microcontroller. This allows for maximum control of the rotor and allows the microcontroller to know which stator coils to energize and the position in which allows maximum torque and efficiency.

To achieve this proposed design there were two main components of the motor controller, the hardware/power electronics, and the microcontroller/software. I decided to focus most of my time on the hardware/power electronics because I have much less experience and knowledge of microcontroller than the computer engineers in our team.

As a team we picked out the properly rated mosfets for our project that had the proper switching capabilities and current ratings for our project. Once we had the parts, I created an H-Bridge circuit with the mosfets that allowed for each coil of our alternator to be energized individually and in each polarity. This circuit also has diodes that are used for regenerative braking. I then worked with my team to test this circuit by connecting it to LEDs to signify each coil and separate polarities. I then worked with our sponsor and team to interface BJT transistors to drive the gate of the mosfets. This allowed the 3.3V output of the microcontroller to drive the gate of the mosfets.

After the H-Bridge circuit was working I designed a similar circuit to control the rotor of the alternator. This used just one N channel mosfet and allowed the rotor coil to be connected to either 12V or just an open circuit.

Because our circuit can draw large amounts of current it was difficult to test our design using a breadboard. This required the design of a printed circuit board. Tyler and I designed a printed circuit board in Eagle that contained very thick traces connected to the mosfets. This allowed for the circuit to draw high currents without the board melting. These abnormally thick traces required us to manually route the traces on the board instead of using the popular “autoroute” feature.

During the design of the PCB I was also in charge of ordering parts for the final board. Because many of these parts are not in the included library of Eagle, it was necessary to model many of these parts to be used in our PCB.

Once our PCB was fabricated I was able to work on the soldering portion of our project. I then worked with my team to troubleshoot all of the problems with our board and finalize our hardware circuit and got it ready to be used to optimize the code on the microcontroller. I then worked on securing testing equipment and worked with the team to test each code and come up with solutions to each problem that degraded our efficiency.

3. Along with my technical roles I have participated in many assignments that tested my technical communications. The first assignment that I was able to work on was the GANTT chart. During this assignment our team was able to work with MS Project to help us develop a chart to organize our timeline for the semester.

The FAST diagram was another assignment that tested my technical communication. The FAST diagram assignment taught me how to organize our project in a way the demonstrated all of the features that were required in a way that demonstrated how we were going to achieve our goals and why we needed each goal.

The proposal presentation and report were our team’s first major assignments that dealt with technical communication. During the report I assisted in writing various sections and helped proofread the final product. For the presentation I focused on the flowchart and the high level concept of our entire design to help convey how all of the parts of our project work together.

Writing an application note was the most in depth technical communication assignment that our class worked on this semester. I wrote an in depth tutorial on how to create a board file from a schematic file in Eagle. This tutorial used a real hardware circuit as an example and was optimized for the fabrication in the Michigan State ECE shop.

Our most recent presentation that was given was the technical presentation. Our team communicated the technical aspects of how automotive alternators work. I was tasked with describing the electromagnetic field theory. I broke this large concept into three parts. The first section was describing the field produced by a DC current in a wire. The next section was describing how AC fields produce both electric and magnetic fields. The final section described how electromagnetic fields can produce a torque.

4. Throughout my college career I have always had an interest in power electronics and renewable energy/ electric vehicles. This project has allowed me to explore this topic and realize that this is the direction that I would like to pursue. I have applied to the University of Colorado Boulder for graduate school to study power electronics and renewable energy. My goals are to receive a Master's degree and start a career in renewable energy.

5. This project has been a major discovery process. I have come to hone many of my strengths and also realize many improvements that I need to make. Some of my strengths that I realized are my analog circuit design skills, my focus to perfect our final project, and my technical communication skills. I realized that I need to improve on my organization skills by organizing my data collection in a digital format in tables that can be easily read. Another area that I need to improve on is my presentation skills. I need to practice my section more and become more fluid in my delivery. A final area where I could see improvement is my programming skills. Although I was able to understand the code that our team was using, I am not nearly as proficient at programming microcontrollers as the software specialists in our group.

6. As senior year is coming to a conclusion my thoughts for the future are starting to come together. In five years I hope to be graduate from the University of Colorado Boulder with a Master's Degree and potentially start a business. I hope to be involved in making other

businesses “greener” and less dependent on nonrenewable energy sources. If I am not able to start a business within these five years I hope to join a startup that is in the renewable energy field and help grow this business to be dominant in the industry.

7. To achieve my goal of starting a business in the renewable energy field I will first need to receive my Master’s degree from the University of Colorado Boulder. I will also need to pass the FE exam and work on obtaining my PE certification. It will be necessary to work under a PE during this time to acquire the knowledge and hours to take the PE exam. I will also need to learn about entrepreneurship and how to start a business. I am hoping to not only learn more technical skills but how to apply what I have learned in the business world.

Alexander Sklar

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Education

Michigan State University

- Majoring in Electrical Engineering
- GPA: 3.838
- Expected Graduation: December 2015

Work experience

Eaton Corporation

May 2015-Aug. 2015

Field Service Engineer Intern

- Conducted tests and assisted in startup and troubleshooting of industrial power distribution equipment
- Site Testing Lead
 - Coordinated testing schedule and location with Contractors
 - Maintained weekly testing progress
 - Assigned roles to team members to complete testing requirements
 - Managed test results and data

Williams International (Walled Lake, MI)

June 2014- Aug. 2014

Electrical Engineering Intern

- Assisted in creating Pspice models of exciter schematics
- Calibrated and improved circuit for fuel metering pump monitoring box to pass EMI testing
- Assisted in developing an automated test rack for the Power Control Module
- Modeled parts for various projects on ProEngineer

ECE 302 (Electronic Circuits) Grader (East Lansing, MI)

Jan. 2014- May 2014

- Graded homework and exams for ECE 302

Mathews Electric Consulting and Investigations

Jun. 2013-Aug. 2013

Summer Intern

- Assisted in the forensic investigation of suspected electrical failures in buildings and products
- Assisted in the restoration of industrial electrical power systems
- Laboratory examination and testing of electrical components and devices

Organizations

Audio Enthusiasts and Engineers Club (East Lansing, MI)

Sept. 2013 – May 2015

- Design and build circuits for audio projects as a team for Engineering Design Day
- Assisted in design of Color Organ to connect to Theremin for Design Day

Alpha Epsilon Pi Fraternity (East Lansing, MI)

Sept. 2011 - Current

House Manager

- Executive board position in charge of setting up and maintaining the Chapter House

Skills

- | | |
|----------------|---------------|
| • Matlab | • ProEngineer |
| • C Programing | • Pspice |
| • HFSS | • Eagle |

