EE 491 WEEKLY REPORT 6 ***Date: 3/6/2017***

Group number: DEC1706

Project title: Renewable Energies Lab

Client &/Advisor: Prof. Ajjarapu

Team Members/Role:
Leader: Travis Merrifield
Webmaster: Elika Korhonen
Communications: Noah Chartouni
Idea Holder: Josh Pachl & Steve Ukpan

- **Weekly Summary**

This week we accomplished a complete understanding of how the MPPT works and function within the solar model. We discovered that we do not need a battery to obtain the maximum power point for a specific set of parameters on a solar panel. This was important because it was an idea that we had been struggling with for the last two weeks. It was discovered that equivalent resistance can be obtained based on the duty cycle. This was verified by simulation and documentation. It was assigned that now we must observe the limits that our model has as far as loads and parameters of that nature. We also need to create models of the battery and loading that is involved using the batteries . This will need to be done by after spring break which is plausible being that there is two weeks.

Past week accomplishments

- We we created I-V curves with varying load and presented our knowledge on the subject. Prof. Ajjarapu was pleased and approved of us mainly focusing on developing a standalone solar system while the next senior group will focus on a standalone wind generation system.

- Simulated a working solar cell to boost converter with and without the previous senior design group Maximum Power Point Tracking block diagram

- **Pending issues**
  - **Elika:** None at this time
  - **Josh:** Most of the issues that were pending last week were resolved. We were able to move on to a new set of objectives this week.
  - **Noah:** Read literature on MPPT and get a functionality understanding of how one works. Start to look at possible solutions to increase power on the solar side.
    Travis: None at this time.
  - **Steve:** Develop MATLAB code to create our own MPPT control system. Determine implications and use of a battery into our current solar cell model

- **Individual contributions**

NAME	Hours this week	HOURS cumulative
Elika	7	44
Josh	7	38
Noah	6	30
Travis	6	38
Steve	9	38

  - **Elika:** Studied PV and MPPT literature extensively. I spent many hours searching and understanding how boost converters play a role in impedance matching to control the current and voltage in a circuit. I also gained a deeper understanding of how an inductor and capacitor controls the current in the circuit to trade the voltage for current flow. I was able to discover the equation for relating the duty cycle to impedance while Travis and I were trying to manually solve it.
  - **Josh:** This week was all about figuring out how the mppt works. We finally figured it out when Elika and Travis discovered the equation that related duty cycle of our boost converter to the equivalent resistance seen at the terminals. I put in some work trying to solve this problem. The main thing that I did was simulate a changing duty cycle and record the resistance values that were seen at the terminals of the Solar panel. I then put this information along with some other calculation and some information about MPPT into slides for the presentation.
  - **Noah: :** Looked over presentation making checks for spelling and layout etc. Tried to recalculate our values for our duty cycle to try and find out why our output values were coming out with too much ripple.
  - **Travis:** Finally got a working simulation, minus the use of a battery. To do this we needed to create a matlab script of the MPPT. Most of us tried, but none of our solutions seemed to work smoothly. I asked the previous group for permission to use

theirs for the time being and they agree. Elika found some groundbreaking equations that helped us prove my the MPPT works. I helped him verify these equations. I generated curves that showed the proper duty cycle for irradiance of 1000 and 600 at 3 different voltage levels. This became a useful tool to quickly see if our model was working correctly.

- **Steve:** Tested and analyze our current model to ensure we were getting proper values for different irradiance and loads. Attempted to create MATLAB code for MPPT but couldn't fix the errors

- **Plan for coming .week (please describe as what, who, when)**
  - **Elika:** Further understanding applications and power storage for a solar system. Our advisor stressed studying load balancing for charging and drawing power. Having a battery in the system introduces some redundancy and ability to smoothen out our power usages. I will learn how important batteries are to the system as well as how to properly size them.
  - **Josh:** The main objectives that I have for this week will involve learning how a battery is implemented as part of the Solar Panel System. It is an essential part because it allows us to hold the voltage for our stand alone system at a certain level. Part of verifying how this battery plays a role will be to model a daily load and then also modeling how the sun and other factors will behave over a typical time period.
  - **Noah:** Will research the use of batteries and how to implement them within our current setup. Will also calculate a small model for average load throughout a typical day for our current setup.
  - **Travis:** I will first use our simulation to find the maximum load that the pv cell can provide maximum power. This will be key in knowing when we need extra power from the battery. I will research other implementations of a battery with a PV cell and brainstorm ideas as to how we can use that information in our model. I will also try to expand and be more specific about what are goals are readjust to make them more feasible.
  - **Steve:** Read documentation on batteries being implemented with a solar cell. Figure out limitations of the load for our DC/DC converter model and understand effects of varying load with the MPPT.

- **Summary of weekly advisor meeting (if applicable/optional)**

  Our meeting went very well this week. We presented our findings about how the MPPT function operates. We presented that the boost converter represents and equivalent resistance to the solar panel based on the duty cycle. This was verified by simulations in simulink and the data was recorded and shown in excel. We also then went on to discuss that the MPPT program just has to adjust the duty cycle based on an incremental voltage which is done by writing code to compare the power after the increment and the power that was measured previously. Overall Dr. Ajjarapu was pleased with the meeting we had this week because we were able to address all the concerns that he had about our understanding of MPPT.The last thing he assigned us for MPPT is what are the limits of the boost converter as far as equivalent resistance is concerned which directly correlates to how the battery interacts as and with the load. He also assigned us to a new set of tasks which included modeling a load and how the battery interacts with the system as a whole. This includes specifics of when and when not to charge the battery as well as sizing for the battery. We will have two weeks to have a working model and understanding with the battery included in the system.