EE / CprE / SE 492 – sdmay20-10
Power Scraping Module
Week 6 Report
4/2/2020 -4/16/2020
Client: Honeywell FM&T
Faculty Advisor: Gary Tuttle

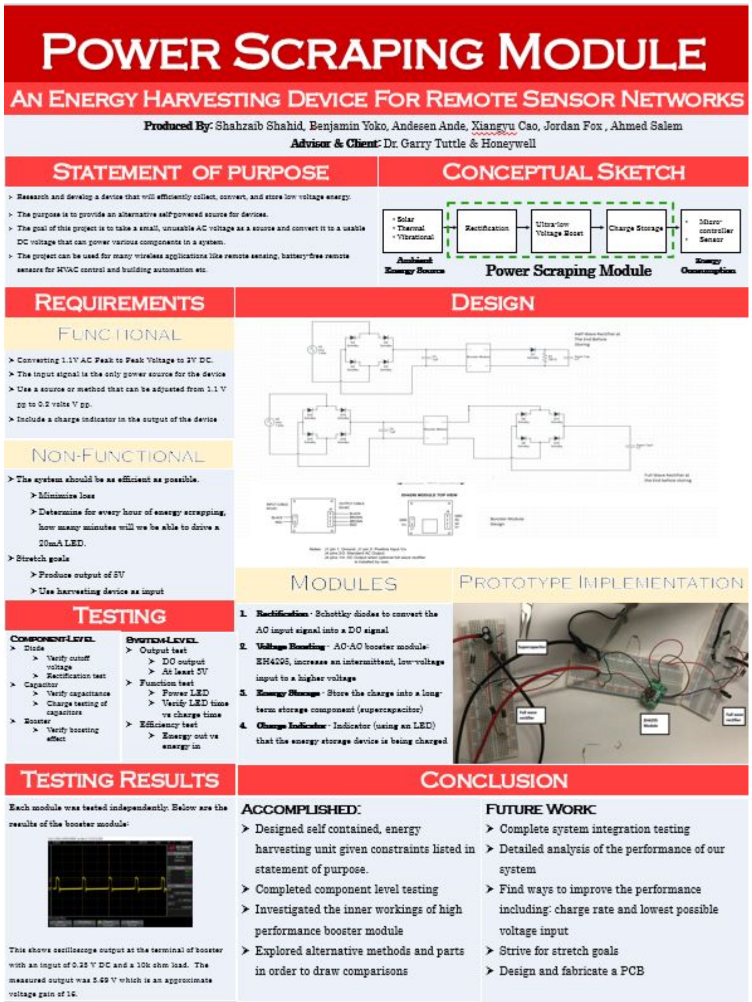
Team Members/Role:

Jordan Fox — Chief Engineer
Xiangyu Cao — Design Engineer
Andesen Ande — Design Engineer
Ahmed Salem — Test Engineer
Ben Yoko — Test Engineer
Shahzaib Shahid — *Team Leader*

Weekly Summary
During these two weeks we've been gathering different approaches as requested by our client in late April. The datasheet we were provided for our booster module is pretty minimal in describing how it works so we are still trying to figure out if we are able to get a better understanding. We have been working towards the three main deliverables: presentation, poster, and final report. We have been upgrading our last semester design document and will convert to the final report. We finished up the poster rough draft and plan to make some minor changes. We will begin working on our poster during this week.

Past Week Accomplishments

Poster Rough Draft- Andesen and Jordan



Sections Andesen was responsible for: Testing, Test Results, Conclusion, Conceptual Sketch and General layout

Sections Jordan was responsible for: Statement of purpose, Function/Non-functional, Modules, Selecting/Editing images, Styling

Edits suggestions:

- Include operational environment section
- Shorten phrases
- Take out conclusions
- Rewrite statement of purpose
- Take out component level testing

Alternative Approach Findings- Ben

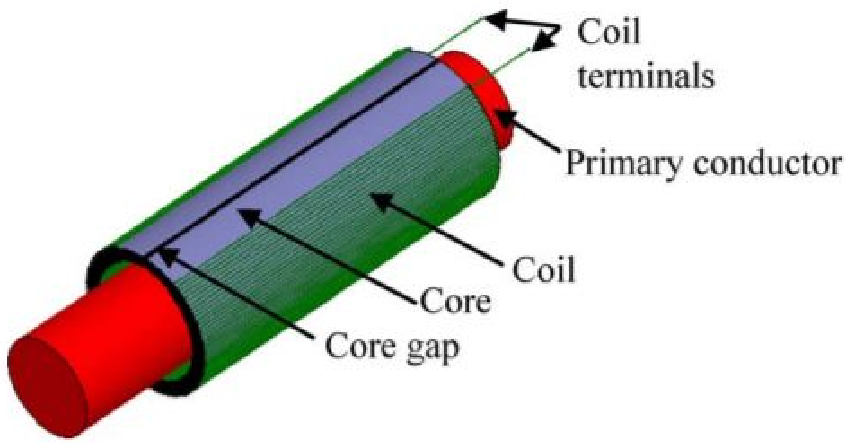


Fig. 1. Multiturn coil on a magnetic core around a current carrying conductor.

This approach is application specific: energy harvesting for wireless sensors for power systems. The principle concept shown above is called an energy coupler that takes a multiturn coil on a magnetic core around a current carrying conductor (power line conductor). AC power can be collected electromagnetically and is then fed into a voltage multiplier to produce a DC output. From our research we found that several energy harvesting devices end up using some type of voltage multiplier configuration. A voltage multiplier and charge pump were alternative routes we considered going instead of using a transformer. However we ended up finding a self-contained unit with impressive performance. What we gained from this is the perspective of in the context of remote sensor networks what are performance differences from specialized units versus general application boosters like our current module.

Link: https://scholarcommons.sc.edu/cgi/viewcontent.cgi?article=1004&context=elct_facpub

Design Document

- Section 1- Shahzaib -a little grammatical editing but no major changs
- Section 2- updated proposed design - Shahzaib
- Section 3 - Task Decomposition - Ben
- Section 4- update roles/responsibilities, updated budget tables, revised project timeline- Ahmed
- Section 5 - updated booster testing, even testing that was unsuccessful Cao
- Section 6 - no changes at this time - Jordan

Current understanding of our booster module:

Both of our booster modules work by utilizing a transformer-oscillator stage. When enough energy input is given to the modules to power an oscillator that will then take the DC input signal and oscillate it. That input signal will then drive the primary winding core of a transformer which will produce a voltage gain of about 75-150. The module uses a RC network and MOSFET to control the oscillator-transformer cycle at a frequency determined by the input impedance. The reason this module is impressive is the variability in input sources: thermal, mechanical, solar, electro-magnet, etc. Other reasons include being able to acquire <0.1 V and 100 uA while not using any power when off. This leads to a device that can capture energy intermittently and at energy levels that would normally go to waste.

The main distinction of these two booster modules we bought are the impedance matching characteristics. One module has a nominal input impedance of 50 ohms while the other has 950 ohms. We mistakenly forgot to set the function generator to the appropriate impedance (50 ohms) and we believe had we done that our supercapacitor would have charged as intended. We have a good general understanding of how it works, it’s intended use-cases, and expected performance. We want to strive for the clearest and most in-depth understanding we can. Our client has requested that in our final presentation we mention the operation of the booster module when introducing it. Our faculty advisor felt the datasheet was brief and suggested we reach out to the chip design company or find similar designs to enhance our understanding.

Individual Contributions

Name	Estimated Hours this week	Estimated Hours Cumulative
Jordan Fox	1	19.5
Xiangyu Cao	3	24.5
Andesen Ande	2	21.5
Ahmed Salem	1	18
Ben Yoko	1.5	23.5
Shahzaib Shahid	3	24.5

Plans for the upcoming week

- Edit each other's work on design document- name of editor
  - Section 1- Andesen
  - Section 2- Andesen
  - Section 3-Cao
  - Section 4 -Jordan
  - Section 5 Shahzaib
  - Section 6-Ahmed
- Make poster revisions- Andesen
- Meeting with client on 4/22- all team members
  - Discuss alternate approach findings
  - Update on date and time of final presentation. Ask if there's anything more he requires from us and if current understanding of the booster module is sufficient.

Final Report - Use updated design document and make additions

- Revised Project Design - Shahzaib
- Implementation details - Ahmed
- Testing Process and testing results - Cao
- Context -Ben
  - Related products
  - Related literature

- Appendix I -Cao
- Appendix II - Andesen

Presentation

Make any changes necessary and practice what to say. Do a run through it April 24th.

- Problem Statement-Ahmed
- **High Level Overview- Client requested 1 specific example-Ahmed**
- Functional Requirements-Andesen
- Technical Considerations and Constraints-Andesen
- Potential Risks and Mitigations - Ben
- **Design Plan - Make a design to keep or not.**
- System Design - Shahzaib
- Functional Decomposition -Ahmed
- **Component Selection-Make a decision to keep or not.**
- **Functional Test Plan-Describe how we tested. -Jordan**
- Capacitor Testing - Ben
- Rectification Testing - Cao
- **Booster Testing-update slide - Shahzaib**

Likely additions:

- Where we left off testing/accomplishments-Cao
- Any conclusions about performance or expectation-Ben
- Alternative approaches we considered-Shahzaib
- Future works-Andesen