EE 491 WEEKLY REPORT 8 ***Date:3/20/2017***

Group number: DEC1707

Project title: Electromagnetic Train

Client &/Advisor: Professor Song Jimming

Team Members/Role:

1. Yap Yong Sheng (Team Leader)

2. Norfarahin Nordin (Communication Leader)

3. Chung Sheng Su (Webmaster)

4. Shi Xiang Lim, Larry (Concept Key Holder 1)

5. Mustafa Hafez(Concept Key Holder 2)

- **Weekly Summary**

  Throughout this week we managed to finish the design documentation. The design plan contains the basic design principle of our project.

  - **Past week accomplishments**

    Yong Shen

    All the members went to the meeting with Professor Song on March 7th. We showed him the demo of the project and everything works fine. Next, we discussed the things we need to do after the Spring Break.

    We share the Design Document with 4 members including myself. Each of us did 2 parts and I did the Introduction and the Deliverables of the Design Document parts. I explained everything clearly in the document. Next, I did some research on the wooded stick to build the coil using the copper wire. This is the link that I found on Internet. I think we need 7/8 in of diameter for the wooded stick because we have to make sure the diameter of the coil is bigger than the diameter of the magnets. Therefore, the train can pass through.

Link:
http://www.michaels.com/1%2F4in-x-36in-dowel-by-woodgrain-millwork/10529503.html?mkwid=skGpXB54A%7Cpcrid%7C147297967104%7Cpkw%7C%7Cpmt%7C%7Cpdv%7Cc%7Cprd%7C10529503&cm_mmc=zadv_PLASearch-_-google-_-Kids-_-Model+Trains+RC&utm_source=google&utm_term=&utm_campaign=Kids&utm_medium=cpc&utm_content=skGpXB54A%7Cpcrid%7C147297967104%7Cpkw%7C%7Cpmt%7C%7Cpdv%7Cc%7Cprd%7C10529503

Larry Lim

- Finishing the Design Document.
- Research on topic

Chung Sheng Su

This week I am in charge of setting up the website for our group as my role is a webmaster. I have managed to create the website by following the steps given on blackboard. However, I did not complete to update everyone's profile and the weekly's report as I still need to ask from my group members this week. If everything goes well, I should be able to complete the website by next week.

Mustafa Hafez

Works on the concept of the electromagnetic train.

Electromagnetic Train: The Physics Behind How It Works v.2

Superconductivity

A key fact about superconductors is that below a certain critical transition temperature T0, most metals experience exactly zero resistance to direct current flow. "The loss-free current-carrying capability of all these materials is very dependent on the magnetic field as well as on temperature", according to J.C. Gallop from his book *"SQUIDs, the Josephson Effects and Superconducting Electronics"*. Above some critical magnetic field intensity (H0), the superconductivity of the material is eliminated.

If a superconductor is cooled through its transition temperature T0, the magnetic flux is released throughout the rest of the material. Hence creating a perfect diamagnet. The critical field H0 of the material increases as the temperature falls below the critical temperature

According to Alan Durrant in *"Quantum Physics of Matter"* , "Just as a wheel on frictionless bearings would spin forever without slowing, the absence of resistance allows the current in a superconducting loop to circulate without diminishing, and this current source needs no voltage to sustain it. Somehow, the electrons in a solid are able to flow in perpetual motion with no scattering at all due to defects or to thermal agitation." In other words, the current will last *almost* infinitely.

"The induced current flowing in normal conductors dissipates its energy in the circuit resistance and disappears rapidly once the magnetic flux stops changing, but in a superconductor, the induced current will persist indefinitely."

"It flows in the direction given by Lenz's Law, i.e., in the direction that produces a magnetic field that opposes any change in the applied magnetic field (assuming the applied field is less than the critical field H0). As there is no resistance, the supercurrent has a high enough value to fully cancel out any applied magnetic field"

"Thus, magnetic flux cannot enter a superconductor, as the induction of a large loss-free current, flowing in the surface of the superconductor prevents this."

Any magnetic flux that is "already present in a normal material is expelled when it goes through the superconducting transition on cooling". This process is called the *Meissner Effect*.

"The Meissner Effect similarly involves the induction of a loss-free current in the surface of the superconductor to create the internal field that cancels out the applied field."

To summarize, the lower the temperature, the greater the magnetic field. As a result of this lower temperature, the superconductor experiences ZERO resistance and hence, it generates its own internal magnetic field. This field cancels out any external fields and this internal field can maintain itself without an external voltage.

Appendix:

"**SQUIDs, the Josephson Effects and Superconducting Electronics", J.C Gallop, pp. 1-2 (Source found on Wikipedia- "Superconductors")**

"Quantum Physics of Matter", Alan Durrant, pp. 102-103

Norfarahin Nordin

Throughout this week, I completed the design plan by dividing the task of writing by parts among the members. Other than that, I also did some research on improving the speed of the train and the trade off of it.

- **Pending issues**

  More parameters are needed in this demonstration before the full model is developed.

- **Individual contributions**

NAME	Individual Contributions	Hours this week	HOURS cumulative
Yong Shen	Find the correct diameter of stick that has to be used as a based to form the turns.	4	25
Farah Nordin	Merged design document, and all the reports for the website	4	24
Larry Lim	Worked on the research of improving the design.	4	25
Chung Sheng	Worked on the website for the group project.	4	21
Mustafa Hafez	Worked on the theoretical principle of the project.	4	21

- **Comments and extended discussion**

  The parameter needed to be varied and increased as the optimum condition of the electromagnetic train to be achieved.

- **Plan for coming week (please describe as what, who, when)**

  At the end of next week, we will held a meeting among members to demonstrate a few samples of the coils with difference number of turns and gaps.

- **Summary of weekly advisor meeting**

  Improve the parameters of the coil.