Introducing High School Girls To PC Board Assembly

Jerry Newman[1]

Abstract – Beginning in the summer of 2009, this author incorporated basic electronics theory and analog component assembly to the Girls in Manufacturing (GiM) program at the University of Memphis' Department of Engineering Technology. The addition of electronics training further amplified an established two year old program that introduces high school girls to engineering technologies and industrial processes. The girls were allowed to construct their own LED chaser light kit and acquired a better understanding of how electronic assemblies on printed circuit boards control such a significant part of our everyday lives.

Keywords: GiM, Carrier, Cargill, Cummins

BACKGROUND

The Girls in Manufacturing (GiM) [3] program completed its third year in the summer of 2009. It was started by Professor Robert W. Hewitt of the Engineering Technology Department, Herff College of Engineering, University of Memphis. Started in 2007, the program consists of two 1-week sessions for qualified girls in the tenth, eleventh, and twelfth grades. The girls must have a GPA of 3.0 or higher and have documented parental permission to attend the weekly training session. The program initially had over 400 applications the first year, reflecting the interest in the engineering fields. The girls were exposed to lectures and activities that included Bio Diesel, AutoCAD, CNC, Welding, Robotics and field trips to the respective local sponsor companies of Cargill, Inc., Carrier Corporation, and Cummins Diesel, Inc. Funding from the corporate sponsors has made GiM an outstanding program to introduce girls to technological fields that many of them mistakenly believe are male dominated.

PROCURING ADDITIONAL FUNDING

The author was approached by Professor Hewitt in the fall of 2008 with the idea of adding something dealing with electronic components to the GiM program's weekly syllabus. The idea was readily accepted and the search for additional funding commenced due to sponsor funds being fully utilized. The addition of anything dealing with electronics would be limited to two 90 minute sessions so the girls' project had to be fairly simple. Small electronic kits that required basic soldering skills were chosen and this selection meant the department's inventory of two soldering irons had to be supplemented. Funding for the kits and soldering irons to cover the twenty girls per session was estimated at approximately $782.00. A proposal was written and submitted for a mini-grant of $391.00 to the Electrical and Computer Engineering Technology Department Heads Association (ECETDHA)[2]. If accepted, the ECETDHA would fund 50% of required costs up to a maximum of $1,000. The proposal was one of only three mini-grants approved by the ECETDHA in the winter of 2008. The department covered the additional 50% and the electronic supplies were ordered.

ELECTRONICS ASSEMBLY ADDED TO GIM PROGRAM

The addition of basic electronics to the GiM syllabus consisted of an introduction on day #1 to some basic electronics applications in industry and also items that are used everyday that are taken for granted. Basic topics

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that required very brief coverage were transistor theory, capacitors, resistors, and LED applications. The girls were then introduced to PC board design and examples of different applications that use PCBs. Most of the girls had never seen a computer motherboard. A brief lecture and video of basic soldering techniques and soldering safety concluded the classroom portion of their training. Day #2 started with show and tell. The author, assisted by voluntary female technology students, demonstrated safe handling of the soldering iron and again revisited soldering procedures and safety. The girls practiced soldering using spare PC board pieces and resistors until they felt confident enough to start on their kit. It should be noted that the voluntary assistants in GiM were limited to only female undergraduate students. This further stressed that engineering was not just for males.

LED Chaser Light Kit

The LED chaser kit from Chaney Electronics [1] was chosen for its simplicity, cost, and LED lighting oscillator function. It was important for the girls to construct a device that visually did something. Accomplishment is a very important part of any training session. Figure 1 shows the Kit Assembly Instructions that contains a parts list, parts layout, PC board pattern, and component descriptions.

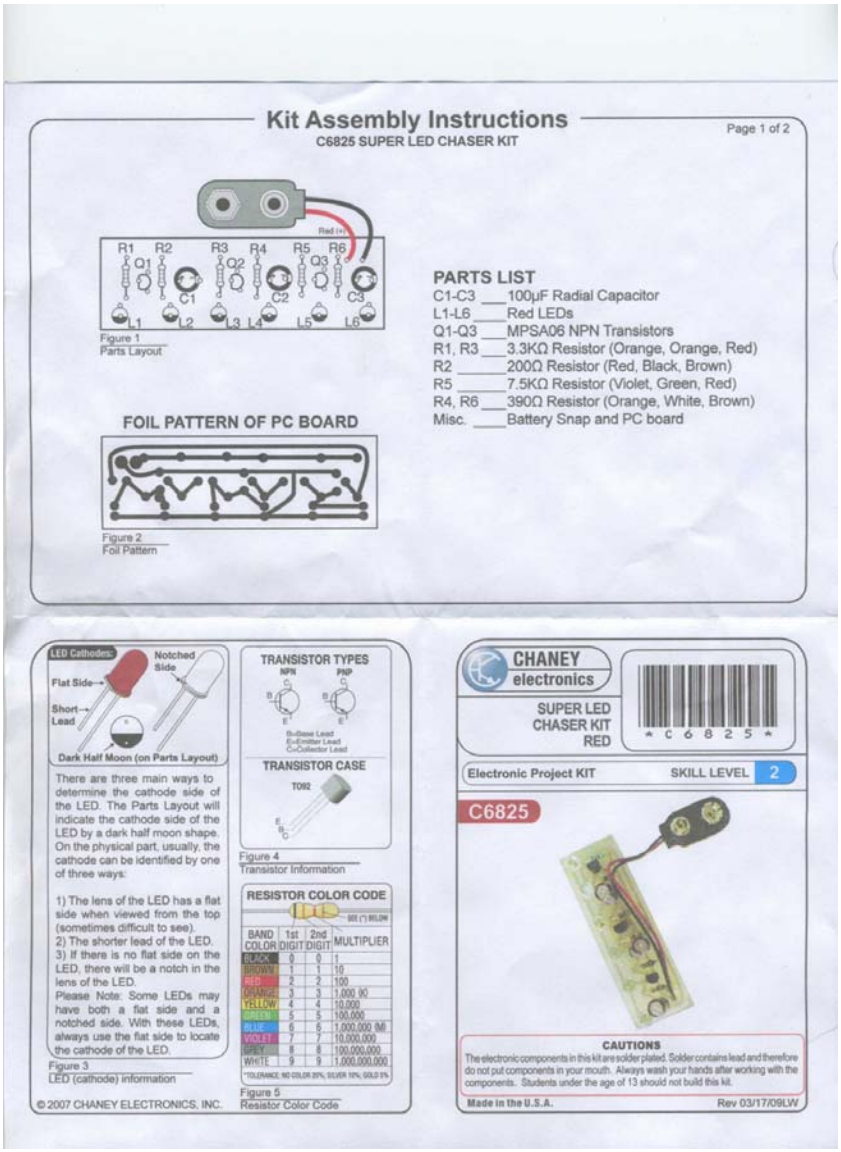

Figure 1. Super LED Chaser Kit Instructions

The girls were required to identify each component and match it to the schematic symbol according to the diagram. Verifying that all parts were in the kit was also stressed. Figure 2 was developed to introduce schematic symbols to the girls so that they could ensure that the kit was complete.

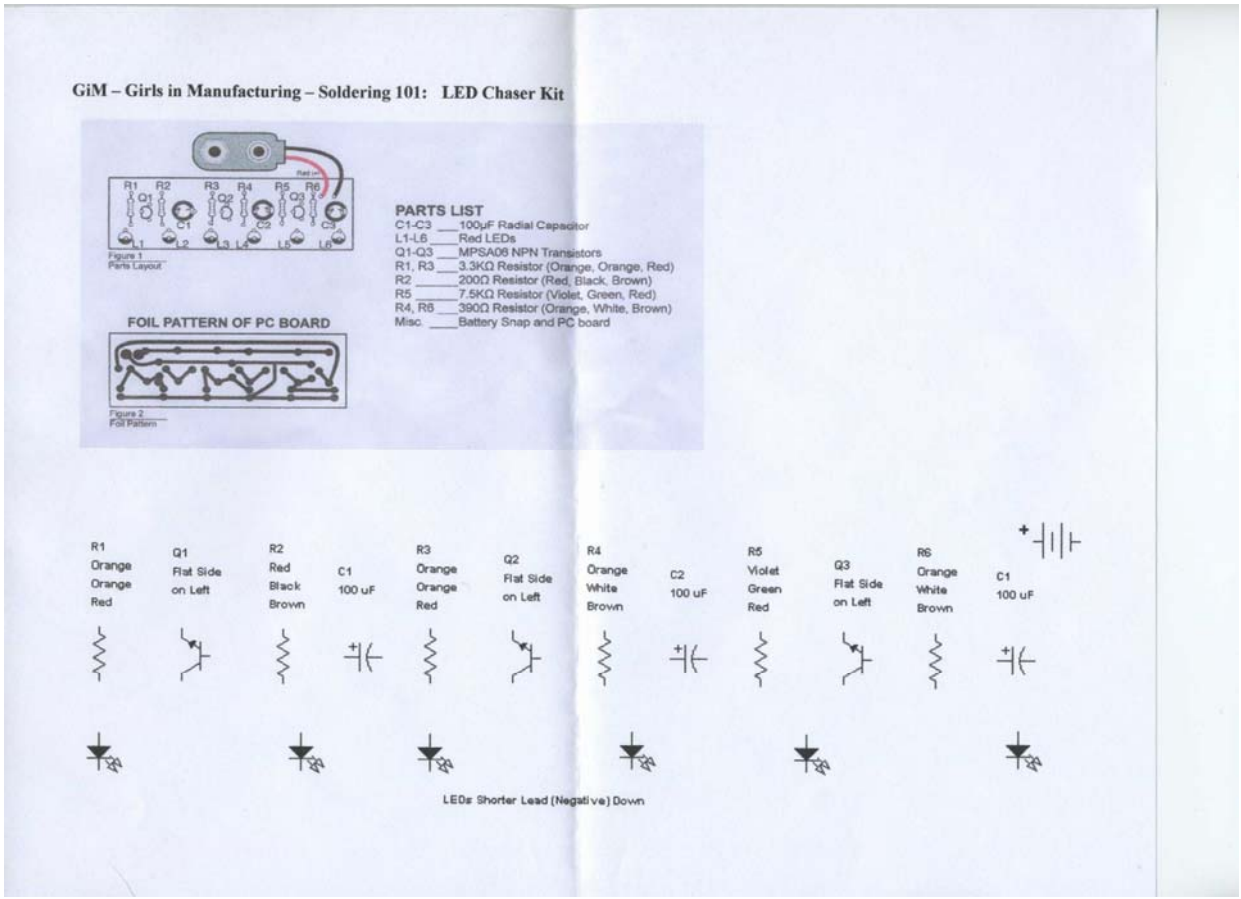

Figure 2. Parts Kit Layout Template

Constructing The Kit

The girls proceeded with assembly of their kits under the supervision of the author and able student volunteers. Figures 3 and 4, respectively, show the girls sorting parts and soldering them to the board.

Figure 3. Sorting and Verifying Components

Figure 4. Commencing the Soldering Process

It should be noted there were minor mistakes that usually occur during most human endeavors and the girls soldering the components on the board were no exception. Figure 5 depicts the rework table containing spare parts and completed rework on minor mistakes.

Figure 5. Rework Table and Spare Parts

Given the amount of time allotted for the assembly of the kit, all of the girls did a very commendable job. Each session during both weeks enjoyed a combined 85% success rate on building a working LED chaser kit in one hour. Due to the time constraint, the author and student volunteers reworked and corrected the minor soldering errors that occurred. Each girl left with a working LED chaser light assembly at the end of the week.

The Completed Product and Graduation

The girls in each session, working in pairs, produced a power point presentation for their parents at the graduation ceremony. The presentation included slides taken of each process that they completed during the week and pictures from their plant tours. The graduation exercise took place in the engineering auditorium with the parents. Excitement and gratitude were displayed by the girls during their presentations. Figure 6 depicts one of two LED kit display tables for the parents on graduation day. The kit was also manually constructed on the breadboard of the department's analog trainer to illustrate the necessity of preliminary design prior to construction.

Figure 6. Finished LED Kits and a Trainer-Wired Kit

Program Surveys

Each girl completed an entrance and exit survey. Noteworthy to mention was their initial excitement about the program. On the exit survey, all of the girls expressed gratitude for their training experiences, plant tours, and their different completed projects. The LED kit was a favorite due to the illumination capability. Some of the future goals mentioned included careers in the various engineering fields, medicine, oceanography, and research. Mathematics, physics, and chemistry were mentioned as favorite high school subjects. All were very serious about completing college. It was a pleasure to meet some of the most dedicated and proud parents at the ceremony. When given the proper parental guidance and motivation, the end product can be a joy and a pleasure to work with.

CONCLUSION

The addition of the electronics training has added an important dimension to the GiM program. Electronics plays such an important part in our daily lives that we simply take for granted sometimes. This latest GiM episode has generated some different thoughts. First on the list is the possibility of the department producing our own prototype boards for the 2010 GiM session programs which would erase much of the cost for prebuilt component kits. There is also consideration for starting an additional coed program to include high school boys, but much will depend on the economy and funding. The additional soldering stations have enhanced the department's training capabilities with our technology students.

REFERENCES

[1] Chaney Electronics, Inc., 9322 N. 94th Way #102, Scottsdale, AZ 85258

[2] Electrical and Computer Engineering Technology Department Heads Association, URL: http://www.engtech.org/organizations.php#ECETDHA

[3] Girls in Manufacturing, University of Memphis, URL: http://www.memphis.edu/herff/gim/

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The author earned an AAS Degree with a concentration in Electronic Technology from State Technical Institute at Memphis, a BS Degree with a concentration in Industrial Technology from Southern Illinois University, and an MS Degree with a concentration in Electronics Engineering Technology from The University of Memphis. His electronics experience includes 24 years of U.S. Navy service, 2 years as a training coordinator in an industrial engineering environment, and 11 years as a faculty member with both Central Texas College and Southwest Tennessee Community College. He joined The University of Memphis faculty full-time in the summer of 2006 and is now an Assistant Professor for the Electronics Engineering Technology program at The University of Memphis.