

## **ECE-GIRLS: High School Girls Explore Electrical and Computer Engineering Program**

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Dr. Na Gong is currently an Assistant Professor in the Department of Electrical and Computer Engineering at North Dakota State University. She received her Ph.D. in Computer Science & Engineering from University at Buffalo, The State University of New York in 2013. Dr. Gong's research interests lie in VLSI and embedded system, with an emphasis on intelligent energy-efficient data storage system. Dr. Gong has been an Associate Editor for Microelectronics Journal, Journal of Circuits, Systems, and Computers, and Mobile Computing. She has also served as track chair for IEEE International SoC Conference 2014. She has also served in technical program committees for a number of IEEE and other international conferences. Dr. Gong received 2014 NDSU Development Board of Trustee Endowment award and 2014 NDSU Centennial Endowment award.

### **Dr. Jinhui Wang, North Dakota State University**

Dr. Jinhui Wang has been an Assistant Professor in the Department of Electrical and Computer Engineering at North Dakota State University (NDSU), since Aug. 2014. His research interests include low-power, high-performance, and variation-tolerant integrated circuit design, 3D IC and EDA methodologies, and thermal issue solution in VLSI. He has more than 80 publications and 6 patents in the emerging semiconductor technologies. Dr. Wang has been with the editorial board of Microelectronics Journal, and served as the associate editor of Journal of Circuits, Systems and Computers. He has also served as the track chair for IEEE International SoC Conference 2014 (SoCC2014), the technical program committees for IEEE international conferences, including IEEE International SoC Conference 2016 (SoCC2016), 2015 (SoCC2015), 2014 (SoCC2014), 2013 (SoCC2013), 2012 (SoCC2012), IEEE International Conference on Solid-State and Integrated Circuit Technology 2016 (ICSICT2016), 2014 (ICSICT2014), IEEE International Symposium on Embedded Multicore/Many-core Systems-on-Chip 2016 (MCSoc16), 2015 (MCSoc15), and IEEE 11th International Conference on ASIC (ASICON2015).

# **ECE-GIRLS: High School Girls Explore Electrical and Computer Engineering Program**

The Girls Explore Electrical and Computer Engineering (ECE-GIRLS) was a three-day program which aimed to introduce high school female students to the attractive fields of Electrical and Computer Engineering (ECE), instill girls' interest in ECE, and to increase the number of female high school graduates majoring in this field.

## **1. Introduction**

Science, technology, engineering, and mathematics (STEM) programs have seen a steep increase in recruitment and employment of women during the past three decades. While impressive gains have been made in mathematics, biology, and chemistry, women are still far less likely than men to major in ECE. According to the American Society for Engineering Education (ASEE), ECE has the largest gender gaps among all engineering fields. The percentage of Bachelor's degrees awarded to women is only 12.7% in ECE compared to 32.9% in chemical engineering, 39.2% in biomedical engineering, and 45.5% in environmental engineering [1]. Similar to this national trend, the current percentage of female undergraduate students in the author's department is less than 10% (45 out of 454). The author is also the only one female faculty (out of eighteen faculty members) in her department.

In contrast to this gender imbalance issue, the ECE job market is very strong and is expected to increase within the next ten years. According to the US Bureau of Labor statistics, the number of Electrical Engineers and Computer Engineers in employment was 389,400 in 2012, making up the largest branch of engineering [2][3]. Accordingly, there is a definite need to attract more female students into ECE programs, developing a more diverse workforce.

## **2. Recruitment**

The activity was announced on the NDSU ECE Department webpage, NDSU ECE facebook page, NDSU IEEE website, and NDSU IEEE facebook page. Posters were put on in all high

schools in the Fargo-Moorhead area and emails were sent to all students with the help of school offices. To reach the economically disadvantaged students, no participation fee was required. Seven female high school students were selected to participate in ECE-GIRLS.

**Calling all girls in 9th -12th grade**

**FAQ's** **NDSU**

**E C E GIRLS**

**GIRLS IN ELECTRICAL AND COMPUTER ENGINEERING PROGRAM**

**Why should I attend ECE-GIRLS?**  
Join us for a great program on the field of Electrical and Computer Engineering (ECE). You'll get to do really cool stuff with someone who also like ECE. You can make a difference in the lives of people and this planet.

**When and where?**  
For all girls in 9th -12th grade **December 8th, 10th, 12th 4: 15 pm- 6:45 pm** at ECE department, NDSU.

**How much does ECE-GIRLS cost?**  
**No participation fee.** Each participant will receive a ECE-GIRLS long-sleeve shirt and a USB flash driver. Food is provided. Transportation is not provided.

**How can I apply?**  
Please download application form online and send emails to Dr. Na Gong [na.gong@ndsu.edu](mailto:na.gong@ndsu.edu).

**No participation fee, food is provided.**

**Working on Hands-on Projects**

**Meeting ECE Professors and Students**

**Tour NDSU Laboratories**

**Funded by NDSU Development Foundation and IEEE Circuit and System Society**

**For more information contact:**  
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Figure 1: Sample Poster Used at Recruiting Events

### 3. Program Activities

A variety of activities were incorporated, exposing girls to ECE hands-on experiences and role models. Specifically, girls participated in the following activities:

- Attending a lecture on ECE from the department chair: On the first day, the girls had a one-hour meeting with Professor and ECE Department Chair Dr. Scott C. Smith. During the meeting, Dr. Smith gave a presentation to the girls and introduced ECE programs including the different areas in ECE, faculty, undergraduate and graduate programs, class sizes, and salaries of graduates. Dr. Smith also answered the girls' questions such as application requirements and curriculum design.

 <b>ECE-GIRLS 2014 Activity</b>	
<b>Dec. 8, 2014, Monday</b>	
<b>4:15 pm</b>	Orientation (Long-Sleeve Shirt and Flash Driver Pick-up)
<b>4:30 pm – 5 pm</b>	Meeting Department Chair Dr. Scott C. Smith
<b>5 pm – 5: 40 pm</b>	Meeting Female Professors in Engineering
<b>5:40 pm – 6:45 pm</b>	Demonstration and Discussion of Senior Design Project by Dr. Mark Schroeder and Dr. Jacob Glower
<b>Dec. 10, 2014, Wednesday</b>	
<b>4:15 pm – 5: 30 pm</b>	Meeting Female Graduate and Undergraduate Female Students
<b>5:30 pm – 6: 45 pm</b>	Hands-on Project: FPGA Board Based Piano
<b>Dec. 12, 2014, Friday</b>	
<b>4:15 pm – 6:00 pm</b>	Tour NDSU Center for Nano-Scale Science and Engineering
<b>6:00 pm – 6: 45 pm</b>	Survey

Figure 2: Basic Program Schedule

- Meeting female professors in engineering: The low participation of women in ECE programs is partially due to the lack of understanding of what ECE program entails. To present various engineering program information, the girls were provide a faculty-student meeting. Girls met three female professors in engineering including NDSU distinguished professor Dr. Kalpana Katti in Civil and Environmental Engineering, Women-In-Research Chair Dr. Yechun Wang in Mechanical Engineering and Vice President of IEEE Red River Valley Section Dr. Na Gong in Electrical and Computer Engineering.
- Touring research laboratories in ECE. The girls also toured research laboratories in ECE. During the tour, they were introduced to different research equipment and various research projects.
- Learning outstanding senior design projects: The outstanding senior design groups introduced and demonstrated their senior design projects to the girls.
- Meeting ECE female undergraduate and graduate Students: To encourage girls to pursue study in ECE, they also met ECE female undergraduate and graduate students and asked questions about many topics including campus life and job opportunities.



NDSU ECE senior design groups met the girls



ECE student Mariana Lopez Jaimez introduced her project



Girls met female professors in engineering



Girls met female graduate and undergraduate Students



Girls were working on the FPGA piano project



Girls were playing their implemented FPGA piano



ECE students Valdemar and Riya presented their project



Girls visited the Center for Nanoscale Science and Engineering (CNSE)

Figure 3: Selected Photos of ECE-GIRLS.

- Working on group project on FPGA-based piano: A Verilog programming and FPGA implementation based group project – keyboard piano- was designed to expose high school girls to important ECE concept and encourage them to pursue an engineering degree in college and then a career in engineering.
- Touring university ECE facilities: In addition to equipment and facilities in the ECE department, there are great resources available at NDSU to ECE faculty and students. The Center for Nanoscale Science and Engineering (CNSE) provides IC testing resources includes 77,000 square feet of clean room, laboratory and engineering spaces. CNSE conducts electronic miniaturization research and fabrication in the Class 10,000 and 100 cleanrooms. Finally, the girls toured NDSU Center for Nano-Scale Science and Engineering and learned the facilities and projects there.

#### **4. Evaluation**

To evaluate the program, student surveys were conducted at the beginning and the end of the program. Issues addressed in the surveys included: (1) student motivation, (2) prior knowledge of ECE topics and technologies, (3) interest to pursue ECE degree in college, 4) effectiveness of ECE-GIRLS, and (5) support provided by faculty and graduate student mentors. The evaluation form is attached in the appendix.

Fig. 4 summarizes the survey results. The participants rated the ECE-GIRLS favorably. All of them agreed that ECE-GIRLS helped them have a better understanding of ECE topics, increase their self-confidence in scientific ability, and they had greater interest in ECE careers.

Selected “Comments/Suggestions” responses:

*“This is a great program and should continue in upcoming years!”*

*“I suggest to have the categories of all types of engineering field and it could be more than three days.”*

*“I would like to thank all the professors, staffs, and students who gave me the opportunity to explore the field of electrical and computer engineering. My experience with ECE-GIRLS has been a fun and exciting experience and I will for sure recommend this program to other girls who are also interested in engineering.”*

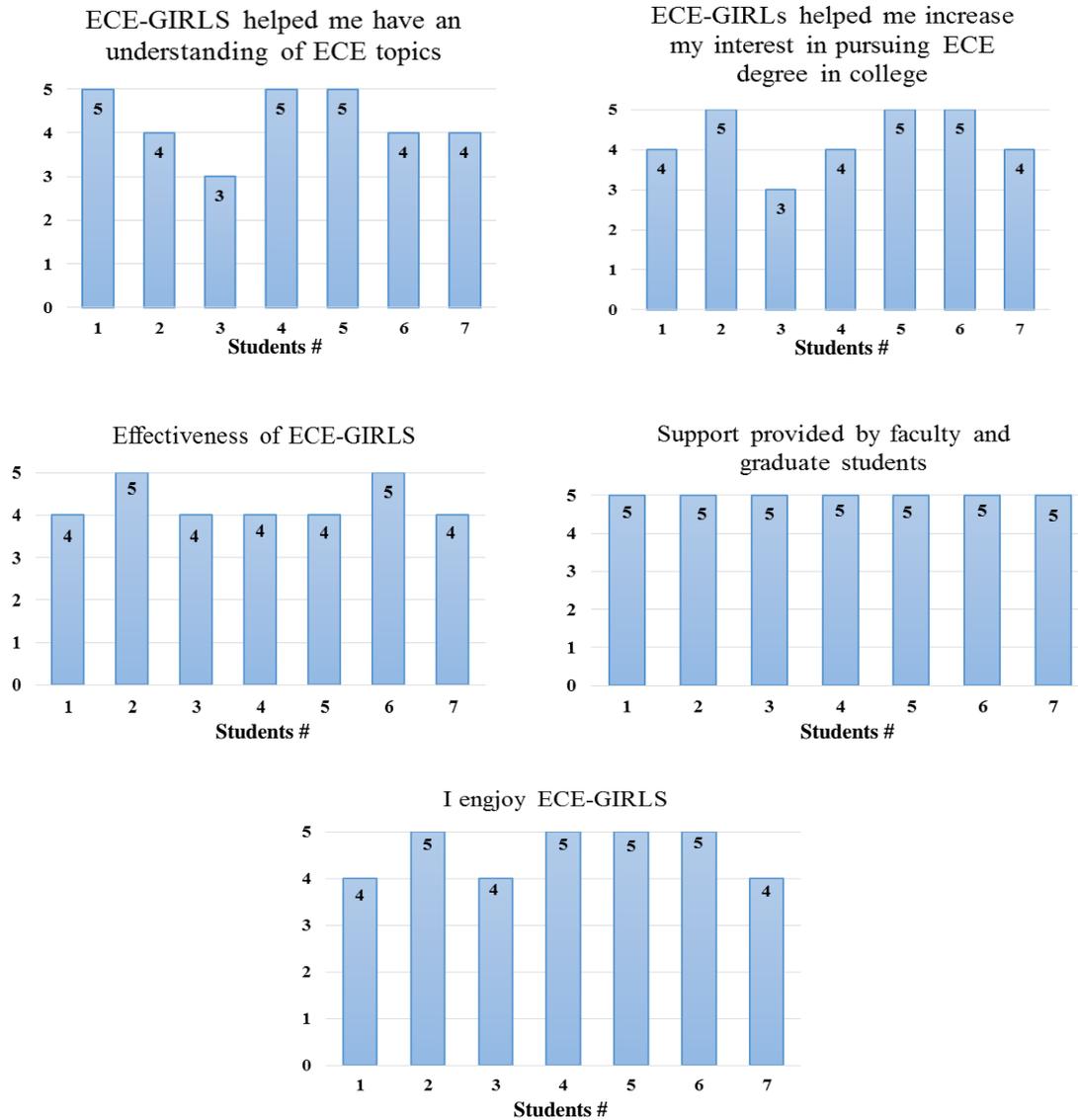


Figure 4: Survey Results.

## 5. Conclusion

With the support of IEEE Circuit and System Outreach and NDSU Development Foundation, seven female high school students were selected from the Fargo-Moorhead area to participate in ECE-GIRLS; and a variety of activities were incorporated to expose the girls to ECE hands-on experiences and role models. We have received very positive student comments about these practices. ECE-GIRLS is a pilot attempt and opportunities exist for increasing participation and refining overall program activities based on the survey results.

## **Reference**

- [1] B. L. Yoder, "Engineering By the Numbers," 2012, [Available Online]  
<http://www.asee.org/papers-and-publications/publications/11-47.pdf>
- [2] Electrical and Electronics Engineers. [Available Online]  
<http://www.bls.gov/ooh/architecture-and-engineering/electrical-and-electronics-engineers.htm>
- [3] Computer Hardware Engineers. [Available Online]  
<http://www.bls.gov/ooh/architecture-and-engineering/computer-hardware-engineers.htm>

# Appendix A: Students survey form for ECE-GIRLS



## 2014 NDSU ECE-GIRLS Evaluation Form

Your Name: \_\_\_\_\_  
 High School: \_\_\_\_\_  
 Grade: \_\_\_\_\_

Please evaluate the following aspects.

	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
A. I enjoy ECE-GIRLS					
B. ECE-GIRLS helped me have an understanding of ECE topics					
C. ECE-GIRLS helped me increase my interest in pursuing ECE degree in college					

Please rate the program overall on a scale from 1 to 5: **5 = Excellent; 4 = Very Good; 3 = Good; 2 = Fair; 1 = Poor.** Please circle the number representing your evaluation.

A. Effectiveness of ECE-GIRLS	5 (Excellent)	4	3	2	1 (Poor)
B. Support provided by faculty and graduate mentors	5 (Excellent)	4	3	2	1 (Poor)

Will you encourage other girls to plan and participate in ECE-GIRLS in the future?

Yes                      No

**Comments/Suggestions**

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_