Keynote Speech (2015.09.08, at WCET 2015 in Kuala Lumpur, Malaysia):

Interdisciplinary Making: Handicrafts and Programming, LilyPad Study Group Activities! Speaker: Tomoko Yoshida, Kyoto Notre Dame University, Japan

## 1. Introduction

I will explain these topics:

- Programming Education in JAPAN
- Materials of Study for programming education; LilyPad Arduino for wearable computing
- Extended PEN for Products with LilyPad Arduino
- LilyPad Study Group at Kyoto Notre Dame University

## 2. Programming Education in JAPAN

2.1 "Promotion of education on programming" in "Japan Revitalization Strategy 2015"

The Japanese government has been promoting IT education, including programming at primary and secondary schools. This year in the new strategy called, "Japan Revitalization Strategy 2015", the Japanese government includes "Promotion of education on programming at the primary, secondary and higher education" for "Diffusion of ICT to the whole society" in the section Acceleration of the preparation to the new era, the 4th Industrial revolution.

2.2 Curriculum in "Technology" in junior high school in Japan from 2012

In Japan from academic year 2012, "the mechanism of

measurement and control by programs" has become required in junior high school for the subject of "Technology and Home Economics."

3. Materials of Study for programming education 3.1 Typical teaching materials are cars and robots

For programming education, especially "Technology" in junior high school, teaching materials using cars and robots have been reported; however, other teaching materials seem not to be considered. These materials sometimes pose problems such as hardware knowledge requirements and difficulties of assembly. Students who do not possess good mechanical sense usually get very frustrated with the construction process before they reach the stage of interaction by using programs.

3.2 "Physical Computing" for programming education

I believe it is important for students to realize why it is necessary to write programs. To realize the necessity, Physical Computing might be a better approach, because students can experience interaction with physical objects by using programs.

3.3 Wearable Electronics for programming education

In order to find attractive learning materials of Physical Computing for programming education, our research group focused on wearable electronics and E-textiles. These materials help to appeal to a different demographic of young people, who, like me, are not interested in making robots or line tracing cars. We noticed LilyPad Arduino around 2013, which is one of Arduino family.

3.4 LilyPad Arduino for wearable computing

The LilyPad Arduino board is designed for wearable electronics that can control devices such as LEDs with programs. Before we sew with conductive thread on fabrics, we can wire with jumper wires. It is easier to understand wired circuits than bread board connections, at least for me it is easier.

4. Extended PEN for Products with LilyPad Arduino 4.1 What is PEN ?

The Programming Environment for Novices (PEN) was originally designed in 2005 for introductory programming lectures by our research group members. It's open source software. The language constructs including input/output instructions of PEN are expressed in Japanese, our own language. Therefore novices easily understand the points without translations. PEN is implemented as a Java application, so the platform is not specific to any one processor or operating system.

After our research group noticed the field of wearable computing, we extended PEN to be able to develop programs for LilyPad Arduino in 2014. We also designed additional functionality in "PEN" for simulating the "LilyPad Arduino" on the screen.

4.2 Extended PEN

Our group members extended PEN to be able to develop programs for LilyPad Arduino supports "sensor input and control output" features like this. Firstly, PEN language processor converts the code from PEN into the Arduino language. Secondly, PEN executes the compiler of Arduino IDE and it converts this into binary code. Last of all, the binary code is uploaded to the LilyPad Arduino.

4.3 LilyPad Board Simulator on PEN

We also designed "LilyPad Board Simulator on PEN" as plug-in software for simulating LilyPad Arduino on the screen. This simulator was released in December, 2014.

I used "LilyPad Arduino Development Board", extended PEN and "LilyPad Board Simulator" for my programming class in 2014 fall semester. About this practical lesson I am going to present the research titled, "Development and Use of a Programming Environment for Learning the Mechanism of Measurement and Control by Programs" at CSCEET 2015..

5. About LilyPad Study Group 5.1 What is LilyPad Study Group?

LilyPad Study Group is the name of making cute or "Kawaii" products with about 20 female students and faculty members serving as participants. Originally we used lilyPad Arudino for making "Kawaii" products, that is why the group was named like that. However, now members don't have to use LilyPad Arudino for making products. We use it when we need.

5.2 History of LilyPad Study Group

In June, 2014, rather accidentally the Group organized. We have a Web site which has details of each study meeting, including photos and handouts. It also includes products we made. (http://lilypad.pen.jp/)

From now on, I will show you our products in three separate steps.

5.3 Products in Step 1

In Step 1, we made products with "LilyPad Arduino and a temperature or light sensor for input and LEDs for output"

basically. In addition, for input we used buttons and for output we used beeper speaker (buzzer), too.

- "Love Check Apron"
- "OS Judge Apron"
- "Piano Bag"

5.4 Products in Step 2

In Step 2, we made products with not only "LilyPad Arduino and LilyPad LEDs" but also "GEMMA and NeoPixel" by Adafruit.

- "Ribbon-chan"
- "Programming Language Judge Apron"
- 5.5 Products in Step 3

Step 3 started around the beginning of 2015. In Step 3, we make anything cute or "Kawaii" and simple things we can love. Sometimes we use microcontrollers such as LilyPad Arduino or GEMMA, but sometimes we don't. We start to use LEDs originally coated with UV(ultra-violet) resin, reed switches or reused parts from children's toys.

- "Cloth Sign Board of LilyPad Group"
- "Firefly squid sparkles when attack"

In addition, since last autumn we love littleBits. It is the easiest way to prototype and to learn with electronics. Some of our members made a cute and attractive car by using littleBits modules and LEGO parts, which starts when the sound goes. It is a car, but we think it is "Kawaii".

5.6 Members and Supporters as Collaborators

To look at the progress of our group, members and supporters

take a serious role. All the items we introduced in Step 2 and 3 were ideas by our members or supporters. Some members like needlework, but some members don't. Some members like programming, but some don't. We help each other regardless of gain and enjoy it. We are good collaborators.

## 6. Conclusion

My research project with Prof. Matsuura and his research group members started in 2013 as Physical Computing with LilyPad Arduino for programming education. Then Mr. Nakamura and I organized "LilyPad Study Group" with some students and enjoy making things for "Interdisciplinary Making: Handicrafts and Programming".

First of all, we always used a microcontroller and wrote programs, but now we use them only if we need them for our production. These days, I regard our productions as artistic creations, not just electric appliances.

The maker culture is a contemporary culture representing a technology-based extension of DIY culture. While enjoying it, we learn practical skills for the desire that we want to make something. I believe it is the most important thing to learn practical skills, including programming.

And I feel that there exist substantial obstacles toward the adoption of making things as hobbies into education. We must solve many obstacles for programming education if we use wearable computers in the classroom. But I anticipate that our group activities and advice of students can help us find better strategies to overcome these obstacles.

(Tomoko Yoshida, 2015.09.08, at WCET 2015 in Kuala Lumpur, Malaysia)