NURTURING ENGINEERS FOR IOT: NEXT-GENERATION EDUCATION PROGRAM OF KOSEN BY A VIRTUAL WORKSHOP

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Abstract

IoT has been getting a lot of attention in the global industry. Recent education programs also adopt information technologies such as IoT and ICT to improve the teaching method. However, education of KOSEN is desired to teach how to realize IoT and ICT, not only to utilize information technology. In this education program, we give lectures about social needs of IoT and the management method of a project first. Based on the lecture, students investigate real information applications and then propose their new seeds of information applications independently. They discuss their proposal information applications and choose some seeds taking account of supervisors’ suggestions. Furthermore, some projects are launched to realize the seeds. Students make their project plans and clarify the division of roles in the project. To move their project forward, they can use a virtual workshop in National Institute of Technology, Gunma College. Finally, students discuss their final products within the projects, and then we evaluate deliverables and processes of their projects. The virtual workshop includes visualization of existing equipment, which is placed in laboratories and facilities of our college, by network management. We connect the hardware and software resources to our college network and rebuild the resources to the virtual workshop which is shared across our college. Moreover, we employ new network-compatible IoT products other than existing equipment. This paper describes our plan to nurture IoT engineers in Gunma College.

Keywords: IoT, Education program, Project based learning, Virtual workshop, 3D-printer, Small board computer, Interactive projector.

Introduction

For several years now, IoT, Internet of Things, has attracted attention in the industry fields of the world. The phrase “Internet of Things” was made by Kevin Ashton in his presentation of RFID at Procter & Gamble in 1999 (Ashton, 2009). “IoT” is currently used to mean that various kinds of networked industrial products, e.g. smartphones, home electronics, electrical vehicles and smart homes, aggregate, exchange, and share their data each other to automate diverse human activities. The IoT technology was realized by the price reduction and miniaturisation of sensor devices and the spread of the internet.

Information technologies such as IoT and ICT have been introduced into some education methods too. The Japanese government proposed that companies should proactively utilize IoT, artificial intelligence (AI), big data and robots in order to increase productivity against a shrinking population (2016). In response, Ministry of Education, Culture, Sports, Science and Technology also has promoted an education reform to cultivate human resources capable of supporting the 4th industrial revolution (2016). Therefore, many primary and secondary schools adopted programming education as a mandatory subject and introduced tablet-type computers (hereinafter called just “tablet”) and electronic blackboard systems. Teachers in the schools have been attempting to “visualization” of education to be helpful in finding student’s learning problems by logs accumulated in the tablets, and “active learning” by using the tablets and electronic blackboard systems.

Present Situation of IoT Education in KOSEN

Basically, the goal of KOSEN education is to nurture excellent engineers in the industrial field. Therefore, education of KOSEN is desired to teach how to realize IoT and ICT, not only to utilize information technology.
Most of the present colleges in KOSEN are comprised of conservative departments: mechanical engineering, electrical engineering, information engineering, chemical engineering and civil engineering. Practically, KOSEN has few departments that focus on the IoT technology, which includes the interdisciplinary field between mechanical engineering, electrical engineering and information engineering. However, education of the IoT technology is very important for all departments of the future KOSEN since IoT has a potential ability to fuse all technologies around us via the internet.

Gunma College has five regular courses, offered by above five departments, and two advanced engineering courses, which consist of a production system engineering course and an environmental system engineering course. The production system engineering course has conducted a PBL (Problem Based Learning) class since 2015 (see Figure 1). Students in the PBL class solve various problems given by real local companies, which need knowledge of the IoT technology.

**Efforts to Reform KOSEN Educations: KOSEN4.0**

National Institute of Technology, Japan, which organizes 51 Colleges of Technology (KOSEN), invited the proposals “KOSEN4.0” to reform education of each College in three aspects: 1) human resources development to lead the new industry, 2) regional contribution and 3) internationalization of education. Gunma prefecture, in which Gunma College is located, has promoted the next generation industries in six fields such as an autonomous car, a robot, healthcare, etc. since it is famous for the manufacturing industry like Subaru Corporation. To realize the next generation industries, human resources that can use the IoT technology and work with engineers in different fields are indispensable. Therefore, Gunma College applied for the KOSEN4.0 as “Nurturing Engineers for IoT: Next-Generation Education Program of KOSEN by the Virtual Workshop”, which selected 1) human resources development to lead the new industry and 2) regional contribution in the above three aspects. Specific methods of the education program were designed based on the PBL class for the advanced course of production system engineering.

This education program plans to produce global IoT engineers who lead the 4th industrial revolution while endeavoring to strengthen partnerships between universities, local industries and Gunma Industrial Center (see Figure 2).

**Next-Generation IoT Education Program of KOSEN**

This IoT education program will offer a class “Laboratory of Interdisciplinary Creative Engineering”. In this class, we give lectures about social needs of IoT and the management method of a project first. Based on the lecture, students investigate real information applications and then propose their new seeds of information applications independently. They discuss their proposal information applications and choose some seeds taking account of supervisors’ suggestions. Furthermore, some projects are launched to realize the seeds. Members of each project are composed of students who majored in different fields. Students make their project plans and clarify the division of roles in the project. To move their project forward, they can use a virtual workshop in National Institute of Technology, Gunma College. Finally, students discuss their final products within the projects, and then we evaluate deliverables and processes of their projects.

**Virtual Workshop**

The virtual workshop includes visualization of existing equipment that is placed in laboratories and facilities of our college by network management besides machine tools related to IoT. Although Gunma College has IoT-related hardware and software such as AI, deep learning and robot, college faculty, staff and students do not know how to utilize the resources well. Therefore, we connect the hardware and software resources to our college network and rebuild the resources to the virtual workshop which is shared across our college. However, the resources are not necessarily network-compatible. In this case, we add the resource so that users can confirm whether it can be utilized or not via the network. Moreover, we employ new network-compatible IoT products, a 3D-printer, a small CNC, a stereolithography apparatus, a circuit board plotter, small board computers and Interactive projectors, other than existing equipment (see Figure 3).
Schedule and Final Goals

Progress schedule of this education program is shown in Table 1. For five-year regular course, the virtual workshop was built and a class syllabus of “Laboratory of Interdisciplinary Creative Engineering” was formulated in 2017. The class will be offered to students in the mechanical engineering department, the electrical engineering department and the information engineering department in 2018. Furthermore, the same class will be offered to students of all departments including chemical engineering and civil engineering in 2019. On the other hand, we formulated a class syllabus of PBL for the advanced course of environmental system engineering in corporation with local companies in 2017 because the advanced course of production system engineering has already conducted a PBL class. The PBL class will be offered to students of all advanced course in 2018. The education program of the regular course and advanced course will be assessed by external institutions in 2019. Finally, we are going to share the education program with a lot of KOSEN colleges by packaging the education method. Final goals of the education program are employment growth in the next generation industries of Gunma prefecture and an increase of technological consultations with local companies.

Conclusions

In this paper, we reported the new education program to nurture IoT engineers in Gunma College. To date, the virtual workshop was built and specific educational methods of the program were decided. Practically, this education will be conducted this year (2018). IoT engineers will be increasingly necessary from now on since all the things around us will be connected to the network by the price reduction and miniaturisation of sensor devices and the spread of the internet. Gunma College will continue to nurture IoT engineers, who lead the 4th industrial revolution, in the education program to respond to the technological innovation of IoT.

References


Table 1 Progress schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>Regular courses</th>
<th>Advanced courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>• Construction of the virtual workshop • Formulation of the class syllabus</td>
<td>• Construction of the virtual workshop • Formulation of the PBL class syllabus in the environmental system engineering course</td>
</tr>
<tr>
<td>2018</td>
<td>• To offer the class in the mechanical, electrical and information engineering departments. • Assessment of the program by external institutions</td>
<td>• To offer the class in all advanced course. • Improvement of the PBL class • Assessment of the program by external institutions</td>
</tr>
<tr>
<td>2019</td>
<td>• To offer the class in all departments. • Assessment of the program by external institutions</td>
<td>• Assessment of the program by external institutions</td>
</tr>
<tr>
<td>2020</td>
<td>• To share the education program with a lot of KOSEN colleges by packaging the education method.</td>
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Table 1 Progress schedule