

Exploring the Teaching Reform of Wireless Sensor Network Course Based on Establishing Emerging Engineering Education

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Abstract

This paper discusses the reform of core courses in Internet of Things (IoT) Engineering using Wireless Sensor Networks (WSN) course as example. The reform will be based on the Emergent Engineering Education (3E), and in view of the problems in the currently curriculum, it focuses on three aspects, enriching teaching methods and resources, focusing on the unification of theory and practice, as well as improving the level of teachers' scientific research abilities. The essential reason for this reform is to cultivate and train new talents who are capable of being creative and easily adapting to new situations.

Keywords

Emerging Engineering Education; Internet of Things Engineering; Wireless Sensor Network; Teaching reform.

1. Introduction

The Ministry of Education has been actively promoting the construction of 3E since 2017. Relevant notifications have been released, upon the foundation of “Fudan Consensus”^[1], “Tianda Action”^[2], and “Beijing Guide”^[3], on the research and practices of 3E in exploring the new method of engineering education personnel training. It aims to keep up with this new phase of scientific and technological revolution and industrial transformation, as well as to serve and support a series of major national strategies such as “One Belt and One Road”, “Internet plus”, and “Made in China 2025”. The Internet of Things (IoT) is one of the emerging strategic industries advocated by the government which has become a popular new major in colleges and universities^[4]. The major of IoT engineering has become the banner of 3E construction as it requires the students to have innovative consciousness, entrepreneurial spirits, and practical abilities^[5]. The Ministry aims to cultivate both application-oriented and compound talents who are capable of systematically master the relevant theories, methods, and skills, as well as having the ability and creativity to analyze and design the IoT system.

Wireless Sensor Networks (WSN), as a multi-disciplinary course, combines together sensor technology, embedded technology, and wireless communication technology. It is one of the essential supporting technologies of the IoT, and it is also a core professional course in the university curriculum. However, the course is also well-known for its difficulty level due to the abstract theories and a large quantity of complicated contents. As such, to train innovation talents, based on 3E, with the traditional teaching method of simply explaining the contents in classes, seemed almost impossible. The IoT major in Sichuan University of Science and Engineering (SUSE) was established in 2012. After several revisions of personnel training program, the WSN course was set up in the sixth semester and positioned as a professional core compulsory course, which includes 40 class hours of theoretical teaching and 8 class hours of experimental teaching. The students showed a lack of enthusiasm for this study, and their interest in the course is only diminishing. In searching for the best solution for the current situation, some theoretical and experimental teaching is discussed to improve the effect and quality of teaching, in hope to build a solid foundation for the cultivation of more IoT talents.

2. Teaching status of WSN

2.1 Theoretical teaching

The theoretical teaching of WSN is still carried out in the traditional teaching mode and relies on teachers' explanation of the basic principles and technologies in WSN. The contents depend on the teaching materials which have different emphases^[6]. In addition, most of the current textbooks are based on theoretical explanations, and only a few of them have practical contents. However, due to different infrastructures, those textbooks with practical contents are not suitable for every educational institution.

Using the course of SUSE as an example, the course of WSN focuses on the development of wireless sensor environment, communication and networking technology, supporting technologies, protocol standards and access technologies. Due to the characteristics of this course, the theoretical knowledge is quite abstract, and the content covers a wide range of knowledge. The course prerequisite is high, and many students fear the WSN course before learning it. The existing class hours are not sufficient to cover all contents in the curriculum, especially as the course involves the explanation of some algorithms, the derivation of mathematical formulas and the abstract network protocol communication. The students easily lose interest in this course as obstacles are overloading, causing them to give up learning altogether.

2.2 Experimental teaching

WSN is a highly practical course. The purpose of experiments is to strengthen the mastery of the basic theoretical knowledge in order to enhance the students' ability in operation. However, most of the current experimental courses are severely lagged behind as opposed to the theoretical courses. Teachings in theory and practice are easily separated. In addition, due to high cost in equipment and maintenance, institutions have limited access to wireless sensor hardware equipment. Usually, several students are to share the operation of one set of equipment, which cannot exert the subjective initiative of each person, thus affecting the enthusiasm of learning. For the wireless sensor network teaching platform, the manufacturer has encapsulated the experiment. Experiment results can be seen through a few simple steps, and the students are only required to follow the instructions without understanding the principles and specifications of the application. The purpose of learning becomes ambiguous causing students lose interest in learning over time.

In addition, the practical class hours are inadequate. With only 8 class hours of experiments in this course, new technical materials such as TinyOS operating system are easily slipped as time is extremely limited. The lessons conclude before students are properly introduced to the course, which deeply affects the efficiency and quality of WSN teaching. From personal experiences in teaching implementations, we have concluded that it is not only difficult for students to learn, and also difficult for teachers to teach. The situation in teaching of WSN is common issue in many universities^[7-9]. It is an urgent matter to reform the curriculum, so to adapt to talent training model of the new engineering.

3. Reform of WSN teaching based on 3E

The construction of new engineering requires active response to explore new educational concepts, structures and models, aiming to cultivate outstanding engineering talents that can adapt to changes with the times^[10]. According to the actual teaching experience of WSN course, the author believes that the teaching reform of WSN can be discussed from the follows.

3.1 Taking "Internet plus" as an opportunity to enrich teaching methods and resources

With the rapid development of Internet technology, the emerging forms of teaching are subverting the traditional teaching mode. Learning on the network makes fewer limitations on time and space both for teachers and students. Various forms of network resources such as micro-video can be used to divide the teaching content into blocks. In addition, animation is suggested to explain the key point of the abstract content of WSN. By constructing of a learning platform for WSN on the basis of "Internet Plus", teachers can answer questions online, and explain the problems of most students in the

classroom, in order to achieve the goal of online and offline mixing teaching. Teaching-related documents and video resources can also be shared among teacher and students. For the students, preview and review of the video further strengthen the connection and integration of their knowledge system.

3.2 Focus on the unity of theory and practice to strengthen students' practical ability

Leading students to visit “smart home” and “RFID” laboratories to show the application of the IoT and WSN in life can inspire their interest in learning this course. The institution should hire the first-line engineers from the enterprise to enrich experience of practicing innovation and entrepreneurship. It is necessary to increase experimental class hour at least to 16 for the WSN conducted by SUSE and make sure that the practice course is not less than one-third of the theoretical course to enhance student's practical ability. Less demonstration experiments and more designed or comprehensive experiments are a great help to develop the initiative ability of students. Students are encouraged to participate in domestic and foreign competitions. In addition, communication and cooperation with famous universities and corporations or society is also the good direction to try. It may be considered to build an open laboratory and provide a good experimental environment for students to carry out independent research. Only by continually exploring in practice, discovering problems, and solving problems can inspire students' ability to innovate.

3.3 Raising the teachers' scientific research ability and teaching competence

New technologies are constantly being produced, but the course content has not been updated synchronously in the teaching process. Teachers are the organization and implementers of teaching activities. Only high-level teachers can cultivate high-quality talents. It requires teachers to study business knowledge hard, and strive to improve their own quality. Thus they can continue to add new knowledge in the teaching process and broaden students' horizons. On the other hand, teachers can absorb more excellent students to their own scientific research team and guide students to think independently. The young students are more active in thinking. Their new ideas may be the source of teachers' scientific research innovation which can nurse teaching work better.

4. Conclusion

Based on the requirements of 3E, this paper explores three aspects to reform the WSN course teaching, taking the current teaching situation into consideration. Enriching teaching means and resource based on “Internet Plus”, focusing on the unity of theory and practice, and improving teachers' scientific research ability can be used to strengthen students' ability of innovation and entrepreneurship.

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References

- [1] Hu Bo, Feng Hui, Han Wei-li, etc. Accelerating the establishment of new engineering and technical disciplines and promoting the innovation in engineering education: a review of the symposium on the strategy of developing higher engineering education [J]. Fudan Education Forum, 2017, 15(2):20-28.
- [2] Zhang Haisheng. The practice exploration and classification development of “emerging engineering” construction in the colleges and universities of China [J]. Chongqing Higher Education Research, 2018(1):41-55.

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- [3] Gu Peihua. The concept, framework and implement approaches of emerging engineering education (3e) and the new paradigm [J]. *Researches in Higher Education of Engineering*, 2017(6):1-13.
- [4] Zhao Linag, Jin Xing, Zheng Fang. Implementation of the innovative practical teaching of wireless sensor networks [J]. *Research and Exploration in Laboratory*, 2014, 33(10):194-198.
- [5] Liu Guiyun, Wang Qing, Wang Jiaqing, etc. Discussion on teaching of wireless sensor networks technologies [J]. *Research and Exploration in Laboratory*, Jiaoyu Jiaoxue Luntan, 2017(43):103-104.
- [6] Yang Yimin. Exploration on the teaching reform of wireless sensor network [J]. *Dazhong Keji*, 2016, 18(9):87-88.
- [7] Ren Qianqian. Analysis of the course setting of wireless sensor network [J]. *Modern Computer*, 2017(16): 23-25.
- [8] Shen Lin, Luo Shaohua. Study on the mode of college-enterprise cooperation in the course of "Wireless Sensor Networks" in application oriented undergraduate [J]. *Wuxian Hulian Keji*, 2018(6):94-96.
- [9] Hao Jie. The challenges of how to teach wireless sensor networks and efficient solutions [J]. *Modern Computer*, 2016(35):75-77.
- [10] Tang Haitao, Zhang Liming, Zhang Zhongmin, etc. The platform construction of national internet virtual simulation experimental teaching center [J]. *Research and Exploration in Laboratory*, 2018(1): 139-142.