Design and Implementation of Advanced HCI Education

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Abstract. Existing HCI courses are usually designed for advanced undergraduates and graduates. And most of them do not have independent lab course. The practical parts are confined to the form of projects in the curriculum. This paper presents a new lab course called Media and Cognition and its lab platform. The new lab course is more appropriate and more general education for junior students with less professional knowledge. By using a larger, scalable and complete design of experiments, included five project modules and thirty-seven knowledge points, the lab platform integrates many contents of existing HCI courses, and offers more knowledge about media expression and human cognition to meet higher requirements of computer education. The other contributions of this work include: provides Open-Educational-Resources (OERs) for short-term foreign exchange students. Now the lab course has served more than one hundred students every semester. Over thirty pieces of achievements are produced in each year. The Statistics of feedback demonstrates that Media and Cognition and its lab platform can improve the students' ability of developing HCI projects.

Keywords: Media and cognition lab course · Human computer interaction · Media expression · Open educational resources

1 Introduction

Human Computer Interaction (HCI) courses are essential in computer education. There are a lot of existed HCI courses [1–3]. In generally, these courses are introduction to high-grade undergraduates or graduates (even Ph.D. level) to HCI research. The practical experience is given by some small research projects. There is no independent lab course offered. This paper presents a new lab course called Media and Cognition which is more suitable for junior students in the lower professional degree and range. And construct a richer scalable HCI lab platform. The Media and Cognition lab course is a flexible and fully experiments platform with five project modules and thirty-seven knowledge points, and has a OERs approach to ensure the self-study and other departments' students get their educational resources.

The contribution of this paper is that a new lab course called Media and Cognition which is more suitable for junior students to HCI research is provided, and an integrated laboratory platform is developed to offer more models about media expression

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and human cognition besides HCI contents. Moreover, a collaborative laboratory will be able to access via the network to solve the sync-work issues of short-term foreign exchange students; Finally, some OERs resource for other students are provided to give them an intuitive understanding of this course and platform.

This rest of paper is organized as follows: Sect. 2 illustrates the system's design of curriculum and experiment module, Sect. 3 details the analysis and assessment given from students. Finally, Sect. 4 presents conclusions and future work.

2 Course Architecture

2.1 A. Overview

The overview of Media and Cognition lab course which include five project modules and thirty-seven knowledge points is shown in Fig. 1. These modules are:

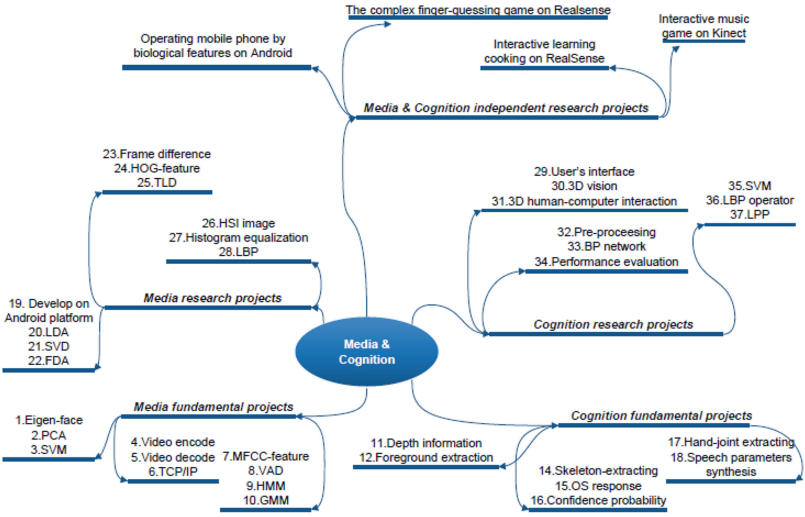

Fig. 1. Five project modules and thirty-seven knowledge points

- Media fundamental projects.
- Media researching projects.
- Cognition fundamental projects.
- Cognition researching projects.
- Media and Cognition independent researching projects.

After trained and guided by these projects, Students have the ability to propose and complete a series of new projects by themselves. Students are no longer the passive recipients of knowledge. As the subject of the project, they can complete their projects from design to implementation, verification, testing and other related work. These projects include some similar contents to other HCI courses. In contrast, our

requirement of professional background knowledge is lower. Because the platform provide a number of ready-made modules which the students only need to combine to achieve the goal. For example, in the project of "Face recognition on Android", the baseline called "X-face" included pre-processing, face detection and face recognition and developed in Eclipse is open to students. They can easily build a basic face recognition program on baseline and further propose their own algorithms to improve the performance of recognition. Undergraduate students can choose to complete some given topics, and complete their final designed HCI topics which can reflect their mastery of the basic HCI knowledge and methods. These contents are suitable for junior students without advanced professional knowledge to generally HCI research.

2.2 B. More Knowledge

In this lab course, there are two types of *Media*: *Media in machine* and *Media in human*. The former means the common digital contents such as text, audio, video and image which can be received and recognized by human. This kind of *Media* is collected by real sensors such as keyboard, microphone, camera or video recorder; the latter means the mental contents such as words, sounds, landscapes and events mapped into the human's brain. This kind of *Media* is collected by human's sensory organs such as eyes, ears, mouth or bodies. But, as before, both of them still have the same and most important function: To carry information. Followed, there are two types of *Cognition*: *Cognition of machine* and *Cognition of human*. The former means the machine's algorithms or methods such as speech recognition, face recognition, video surveillance or any other interaction between machine and the outside world; the latter means the neuronal activity in human's brain about the outside world.

And, as before, both of them still have the same and most important function: To process information. Therefore, the relations between Media and Cognition are displayed in Fig. 2.

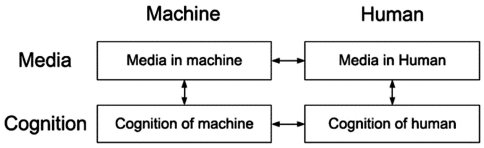

Fig. 2. The relations between media and cognition

–*Media of machine* is the target of *Cognition of machine*, and *Cognition of machine* is to process *Media of machine*; similarly, *Media of human* is the target of *Cognition of human*, and *Cognition of human* is to process *Media of human*.

–*Media in machine* is generated to fit human's organs, which can collect the information and transmit them to *Media in human*; at the same time, *Media in human* is the reflection of *Media in machine* and the outside world. The relation between two *Media* is interdependence and mutually generated each other. For example, film, as a kind of media, utilize the principle of visual staying phenomenon, which belongs to the

human's cognitive functions. As an important part of information and entertainment, there is no doubt that film has significant effect on human's life, especially human's cognition and understanding to the outside world.

–*Cognition of machine* is to simulate *Cognition of human*. In fact, almost all the algorithms to process Media are simulating the human's processing mode; at the same time, *Cognition of human* is the maker of *Cognition of machine*. All the algorithms are produced by human until now. Although the machine's ability is stronger than any time, the relation between machine and human is still like children vs. adults. Although children have basic behavior of adults, children's expression ability (*Media*) is limited and the understanding ability (*Cognition*) is smaller than adults. The relation is like mobile-phones vs. smart-phones. Although mobile-phones have basic functions of smart-phones, the media types of mobile-phone is limited and the human-computer interaction module is less than smart-phones.

In fact, the relation between Media and Cognition we presented is: *Media*, as the carrier of external information, preserves and transmits human's cognition to surrounding environment; *Cognition*, as the carrier of internal information, receives and processes the projection from surrounding environment to human's brain. By understanding how they work in this way, students can finally implement their more rich and varied systems than existed.

2.3 C. OERs

OERs has a long history about 14 years. MIT OpenCourseWare [4], one of the most famous and widely used open courseware projects, was started with "the materials used in the teaching of almost all of MIT's subjects available on the Web". OpenCourseWare is "delivering on the promise of open sharing of knowledge". This OpenCourseWare and other well-known open courseware projects such as CMU Open Learning Initiative [5] and MERLOT project [6] are belong to the family of OERs of public fundamental course and professional course which generally included digital high quality academic and educational contents such as courseware, class video or software development platform.

The ordinary remote experiment uses the following forms as: Online Lab Remote Lab and Measurement based Lab [7–9]. Remote Experimental Platform of Media and Cognition is served for overseas exchange students to learn course and obtain credits. The platform help them participate with their local classmates and implement a real-experiment on real devices conducted remotely by Internet. The minimum bandwidth and communication requirements are satisfied by the special network. The students are free to use any developing language(C, C++ or Java) and software that the most suitable for their projects. It is beneficial for students to earlier adapt the remote co-operation mode in their future working environment and cultivate their spirit of cooperation.

3 Analysis and Assessment

We collect both quantitative and qualitative feedback for our courses via unofficial online evaluation system and printed questionnaire. A five point scale survey with 20 online questions collected the local students' evaluation on improving their capacity about this course. The evaluations questions were the following for example:

- How many points you give on promoting your program coding ability?
- How many points you give on improving your system design skills?
- How many points you give on increasing your innovative capacity?
- How many points you give on teacher's responsibility and initiative?

Table 1. Quantitative feedback of local students

Students	Local students		
Year	2013	2014	2015
Number of students	29	56	146
Number of respondents	10	25	92
Percentage of respondents	34.5 %	44.6 %	63.0 %

Table 2. Quantitative feedback of OERs students

Students	OERs students		
Year	2013	2014	2015
Number of students	1	4	4
Number of respondents	1	4	4
Percentage of respondents	100 %	100 %	100 %

Table 3. Quantitative feedback of other departments students

Students	Other departments students		
Year	2013	2014	2015
Number of students	2	5	22
Number of respondents	0	1	16
Percentage of respondents	0.0 %	20.0 %	72.6 %

Table 1 shows the summary of online feedback received from local students for three years. The percentage of respondents grew up from 36.5 % to 63.0 %, which indicates their enthusiasm of participating survey increased year by year. Table 2 shows the summary of online feedback received from overseas exchange students use OERs for three years. The percentage of respondents remained 100 %, which shows overseas exchange students had more and continued enthusiasm of participating survey. Table 3 shows the summary of online feedback received from other disciplines students for

three years. The maximum percentage of respondents is 72.6 %, which reflecting in part that other departments students had obviously increasing interest in survey.

The online surveys' results are displayed in Fig. 3. *(Increasing) innovative capacity* item has the most five point which shows that the course has the positive effect on improving students' innovation. On the other hand, *(promoting) program-coding ability* item has the most four and three point, which we assumed the reason is: some projects proposed by students have some ready-made software modules.

As a supplement to the online evaluation, the printed qualitative questions for students were the following for example:

- What is the best point of view you learn from the course?
- Compared with other similar experiments, do you think your development on the virtual platform need more or less time?
- Which item you selected in all the independent optional items?
- What aspects are the main improvement this course needed?

For three years, more than 100 printed feedback were received. These studies indicated that students began to view media and cognition from the perspective of the interactive relationship. The OERs platform is helpful for overseas exchange students to learn and co-work with local students. And the students come from other departments got started to learn HCI with basic principle and feel its charm in this course.

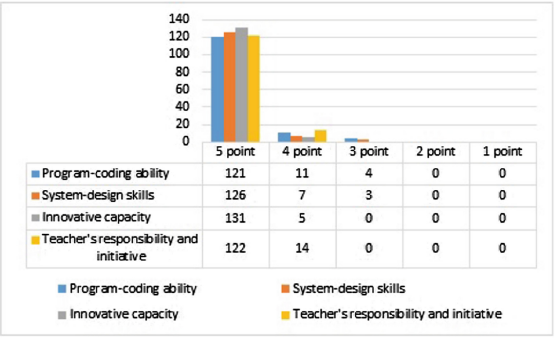

Fig. 3. Analysis of all online survey data in recent three years

4 Conclusion

Media and Cognition lab course, which covers five project modules and thirty-seven knowledge points, hopes to provide the latest and most populous HCI experiments for students. This course provides many different platforms and topics to help students achieve their HCI projects, along with the flexibility for all the students to form teams and create new topics based on their own knowledge structure. The survey for students indicates the students' innovative capacity, improving system-design skills, promoting program coding ability increased year by year.

In the next step, to get more feedback and information, a system-level analysis method will be considered to find the important factors of generating the creativity and imagination in students' mind.

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