

A Practice on Lego Mindstorms for Computer Science Freshman Experimental Education

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Abstract. Computing Essentials is a foundational course that introduces the hardware, software and their operations across the board for the students in computer and related specialties. We introduce some new items such as LEGO mindstorms and App inventor to replace the MS office operation in experimental education. The results on nearly 400 freshmen show that the students pay more attention to this course, and the course reform receives positive evaluations.

Introduction

The course of Computing Essentials includes many basic concepts, basic theories and basic knowledge about computer hardware and software. This course is the foundation of many later specialized courses. In this course, the most important feature is the integration of theory and practice. Except for some important theories and knowledge, forming the ability of operation and applying them into practice are required. Consequently, our experiment course plays a key role which will help students to accomplish the accumulation of practice, consolidate theory and knowledge, be familiar with basic computer-related operations.

In previous experimental course, the students are required to master the MS office and some other related issues. For several years' practice on this subject, we found that the students dislike the course. So we try to reform this experimental course [1,2].

First, we call for students to know the architecture of computer, master the internal structure of personal computer. Secondly, they should be familiar with the method of typing Chinese and English, also be familiar with the operation and usage of Microsoft Visual Programming Language(VPL) [3] to control the simulated robotic and LEGO mindstorms [4]. Then, be capable of applying the App inventor to create their APKs and to run them on their cellphone. At last, students need to know the making use of webpages tools like Dreamweaver and et al.

Course Design

Computing Essentials Group

There are eight elite members in our teaching group on computing essentials, include three professors, two assistant-professors, and three lectures. They are so familiar with teaching and gaining a lot of praise on this subject. For example, Prof. Tang is the group leader, and she taught this course since 2001 since the education activity is supported by the provincial government. So we have a good fundamental to put the reform into practice.

Students Information

We have totally 400 students in each grade in our college, and they are divided into several majors, such as Computer Science, Software Engineering, Automation, Electronic Commerce, Network Engineering, Information Management and Information System, Educational Technology. All the students except from Automation major will have Computing Essentials course in their first semester in our college.

Course Design

Before 2015, every specialty in our college of computer and information science are required to finish all the tasks list as follows in their experimental course on Computing Essentials. First, the students should know the architecture of computer, and master the internal structure of personal computer. Secondly, they should be familiar with the method of typing Chinese and English. Also be familiar with the operation and usage of window operating system, and then, should be capable of applying the office automation software including Word, Excel and PowerPoint to solve everyday problems. At last, students need to make use of Internet tools to finish their homework.

With the improvement of students' computer skill, experimental course on Computing Essentials did not receive enough positive evaluations [5]. Because these freshmen had the same course in their middle school even some in their primary school. The difference between our course and their previous course is the language of the textbook. In our course, all the textbook in this course is English, the major barrier for the freshmen is that they cannot find the menu on computer which are described in the textbook.

Something must be changed in our experimental course to attract students' interest. Since LEGO mindstorms and App inventor are introduced into Arizona State University and the teaching practice is shown to be more effective than ever before [3]. So we replace the MS office operation in our experimental course with LEGO mindstorms and App inventor, the details are list as follows:

Computer Structure & Typing and Lan Configuration. Students are required to finish three tasks in this experiment include observing the internal structure of PC, typing and construction& configuration of LAN based on the wireless AP.

Part I: Basic Concept of VPL and LEGO Mindstorms. Control Simulation Robotics by Using Microsoft Visual Programming Language 4-PartI: Basic Concept of VPL and LEGO mindstorms.

Part II: Simulation Robotic Programming. Control Simulation Robotics by Using Microsoft Visual Programming Language 4-PartII: Simulation Robotic Programming.

Part I: Basic Concept of App Inventor. App Inventor to create APK(Android), Part I : Basic Concept of App Inventor.

Part II: Building a Simple App. Using App Inventor to create APK(Android), Part II: Building a Simple App.

Web Pages Design. Web pages Design (Use vs2010 to build a simple asp. net web pages).

Course Design. To finish a course design from six given subject (like word, excel, webpages, flash and Photoshop, Ulead studio et al).

Experimental Course Implementation

Experiment Class Hours

On the basis of the teaching plan, the experiment course has amounts to 14 class hours, and is classified as demo, verification and design. There are 6 demo experiments, which sum up to 12 class hours. So students should do the other experiments outside the classes. Students should submit lab reports in turn according to experiment items. Students' experimental scores will have assessed synthetically by the score of their lab reports and the other scores at the end of one semester. Students should do experiments according to experimental instructions, and some experiments are required to submit their own works to teacher.

Main Instruments and Equipment

Hardware: P4 and above, at least memory of 1G. Software: Window XP/7/10, basic typing software and Microsoft office 2003, 2010, Microsoft Visual Programming Language, VPE, App Inventor, Android Simulator, Flash CS3, Photoshop CS 8, Ulead VideoStudio 11, Visual Studio 2010.

Contents

We mainly focus on LEGO mindstorms. We have two tasks on LEGO mindstorms. The first task concerns on the basic concept of the LEGO mindstorms, and the second task contains a detail work which need the students to complete. Here we will list the details.

Part I: Basic Concept of VPL and LEGO Mindstorms. Because we haven't enough LEGO mindstorms for all students, we will first introduce a simulator to students. Microsoft Visual Programming Language 4(VPL) [4] is a tool to develop codes to control the LEGO EV2 (not EV3), and it has the simulator to simulate the control process of LEGO mindstorms.

In this task, students will be asked to use VPL to realize a Text2Speech program. The program should give a prompt dialog, when user input some sentences in the dialog, program can calculate the length of the sentence and the speak out it. Figure 1 shows the flow chart of task1, and Figure 2 depicts the result of the program.

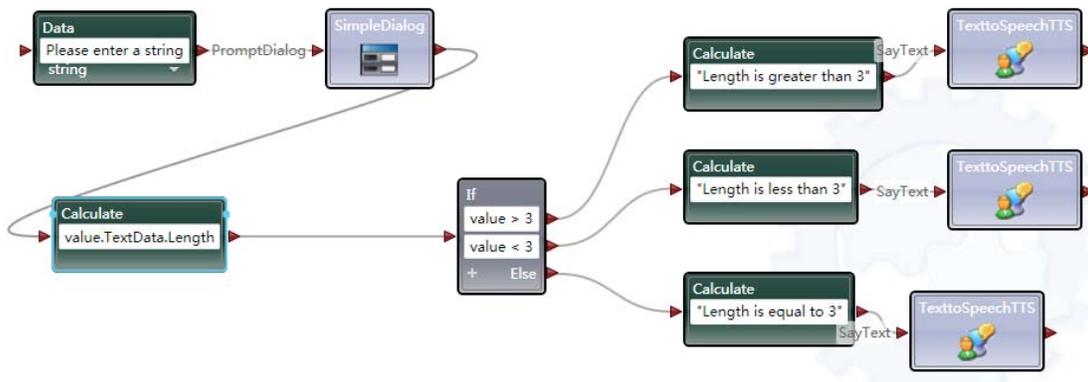


Figure 1. Flow chart of task 1.

From Figure 1, we can see there are mainly three part in the flow chart. The first component is the input, and then the logic test unit, the last is the output module. From this flow chart, we can also found it is very easy for a freshman to complete this task thus freshmen will enjoy this task.



Figure 2. Results of text2 speech program.

From Figure 2, we know the result of the program. It asks user to input a sentence, and then the program speaks out how many characters in the sentence.

Part II: Simulation Robotic Programming. Students are required to complete two programs in this task. The first program should be written in Microsoft Visual Programming Language 4, and the program will be run in the simulator [4].

The second program should be written in ASU Visual Programming Environment also known as VIPL (Visual IoT/Robotics Programming Language Environment) [3]. The flow chart of the program can be seen in Figure 3. Before running the program, students will connect the LEGO EV3 at first by using Bluetooth (in our experimental environment, the WIFI cannot be used to connect EV3), and then choose the properly connection method, also make sure the properties of the EV3 brick had been properly set. At last we should set the port for control LEGO EV3, usually we will choose COM4, the details of the port information can be seen in the properties of EV3 Bluetooth.

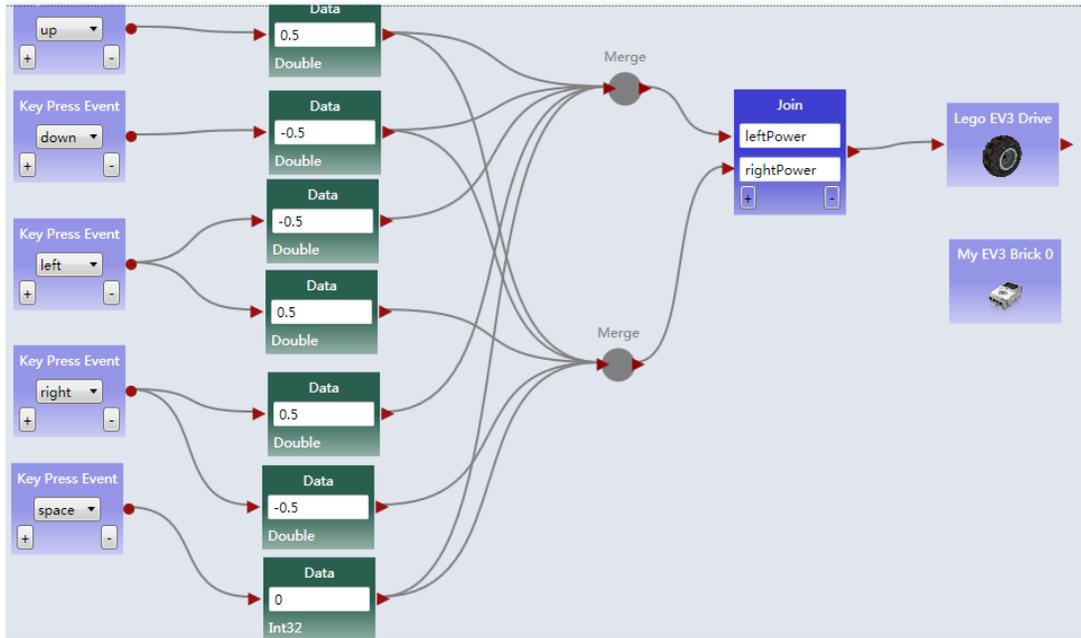


Figure 3. Flow chart of the simulation robotic programming.

From Figure 3, we know that the program allow user to keyboard cursor key to control LEGO EV3, and when space key had been pressed LEGO EV3 will stop. All the control signals had been transfer to the two wheels of EV3.

Outcomes of Running the Course

We have implemented this teaching reform on grade 2015 which accounts for nearly 400 students. After one semester teaching practice, the results of the course design for all the candidates show that the teaching reform gains positive evaluations. More students are interested in our course. They spend more time on doing the experiments. Meanwhile, we have established a teaching system on how to put the new computing essentials' experiments into practice.

Summary

In this paper, we have introduced our recent teaching reforms on the freshmen in our college. Students are required to make programs to control LEGO mindstorms instead of just doing MS office operation before. The teaching practice on nearly 400 students show that the reform gains positive evaluations.

Acknowledgement

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