Design and Implementation of a hybrid personal response system

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Abstract. Over the past four decades, educators have recognized the value of using technology in the classroom and since then have made many attempts to provide 21st century learning opportunities for their students [1]. To increase student and teacher interaction, as well as engagement and motivation, a technology called Personal Response Systems (PRS) has been incorporated in the modern educational system. In this paper will be introduced our personal response system (PRS), which was implemented as a thesis in the University of Western Macedonia during year 2013-2014.

Keywords: Response System, Embedded Systems, Arduino, Web Programming, technology in education.

1 Introduction

Palfrey and Gasser (2008) use the term "*digital natives"* to describe those who were born after 1980 and raised in a digital world. On the contrary, those who were born before 1980 are called *"digital immigrants"* [2]. Digital immigrants adapted to the Internet whereas digital natives are born into a world of digital communication technologies and are accustomed to technological devices, such as computers, Internet, cell phones, ipods, MP3 players, and electronic gaming devices, as an integral part of their daily lives [3]. However, the educational methods that are used today, remain the same with those that were used to enhance learning to digital immigrants during their time as students. Digital natives are in institutions that do not use technology to keep them engaged, motivated, and successfully learning.

Technologies, when embedded in instruction to support the cognitive and social processes of learning, can provide unique opportunities for educators [4]. An educational innovation that has been introduced in some universities abroad, is a

synchronous interactive training using wireless personal response systems. Recent searches have shown that a personal response system can significantly improve classroom interactivity [5]. Interactivity is a critical variable in learning [6]. Student–teacher interaction is ranked highly among factors influencing learning [7]. When students interact with instructors, they are more actively engaged in learning [7]. A personal response system permits students to respond to multiple choice questions and see the results of their answers in real time inside the classroom.

A personal response system is a useful tool for helping instructors assess student comprehension and improve pedagogy. Using this system, instructors can [8]:

- Quickly determine student comprehension. Instructors can ask questions using the response system during class to assess student understanding of the material. Also, the real-time, in-class feedback allows instructors to refine their methods immediately, if needed.
- Immediately adapt pedagogy during class. With this system, instructors can provide stronger instruction by adapting to student learning right in the classroom, rather than waiting for homework or tests to reveal student comprehension. For example, if the results of a poll show that many students chose the wrong answer to a question, then the instructor can refine their instruction by adjusting the pace of their presentation or providing further clarification. Likewise, if the histogram of results shows that most students answered correctly, the teacher knows their instruction has been successful and can move on.
- Easily give and grade in-class quizzes. Using a response system allows instructors to easily give quizzes during class and display the results quickly, either to themselves or to the students as well.
- Take attendance. A personal response system is an easy way for instructors to take attendance quickly during class, particularly with larger classes. Instructors can even take attendance more than once with little classroom disruption.

In the next chapters will be described in detail our PRS and its functions. More specifically, in the second chapter will be reviewed four similar systems to our system indicating the advantages of our system over the others. In the third chapter will be presented the architecture of our system, analyzing both software and hardware. In the fourth and last chapter will be described the experimental use of our system in a real class and the conclusions obtained from this.

2 Related Work

There are several audience response systems on the market today [9]. Four of them will be introduced in this paragraph describing their strengths but also their weaknesses.

iClicker [10] (www.iclicker.com), designed by physicists at the University of Illinois, is a good simple system. The software is native on both Windows and MacOS. The software adds a small menu bar to the screen without interfering with the presentation software. Users can vote through voting devices provided by iClicker or through their smartphones downloading the iClicker application.

In comparison with iClicker, our system needs no extra software (PowerPoint, Keynote or other software) in order to work. Also our system needs no installation either saving you space and time.

Turning Technologies offers TurningPoint, which can be configured for a variety of settings: higher education, K-12, or corporate applications. TurningPoint features superb compatibility with PowerPoint: a TurningPoint menu bar appears just below the PowerPoint menu bar. Questions are entered directly into PowerPoint slides [11].

Unlike our system, TurningPoint needs installation.

INSIGHT 360 is a classroom instruction system leverages clickers, interactive whiteboards, mobile devices and ExamView content together in one platform to encourage interaction between educators and students. Insight 360 is designed to support the latest technology used in education, such as the iPad®, Android™ tablet or web-enabled devices.

Unlike our system, INSIGHT 360 has to be installed on a computer. There are two separate applications to download depending the user's role: the teacher edition and the student edition.

Qwizdom Virtual Response transforms any smart device into a student clicker. Students can connect to a training session using an iPad, smartphone, tablet, or any Web-enabled device. Live feedback can be viewed privately by the instructors, presented to the group, or displayed on each user's device.

Although everything works fine in this system, Qwizdom's voting devices for students (Q4 and Q6 Clicker) seem to be a little confusing.

3 Our system Architecture

Our system is co-designed in hardware and software in order to be more flexible. Users may have access to our system via notebooks, tablets or smartphones but also via our voting devices designed and implemented by us. In this chapter will be introduced both software and hardware used for the implementation of our system.

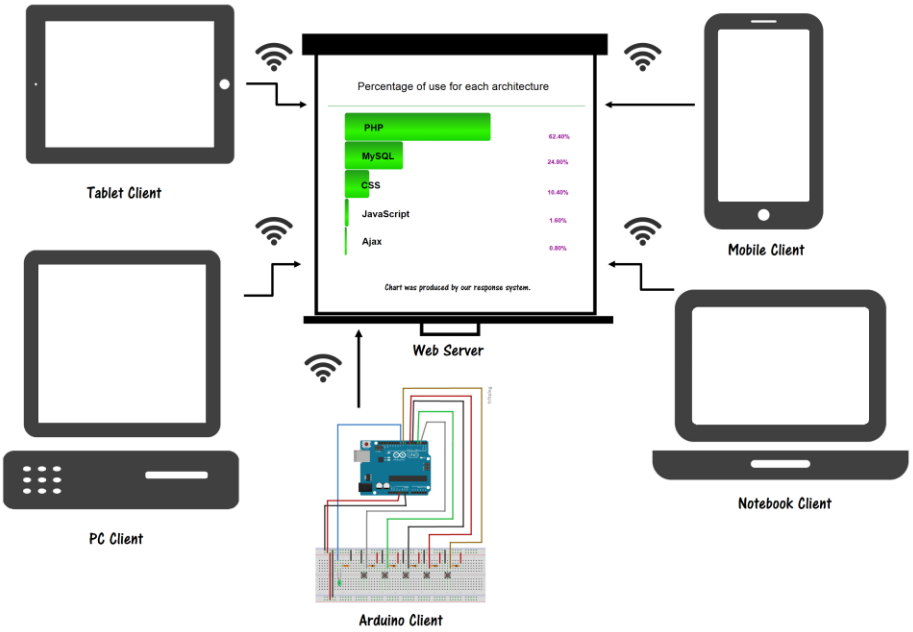

Fig. 1. Architecture of our system.

3.1 Software

For the development of our website we used PHP and MySQL. Using PHP scripting and MySQL database enables programmers to create applications that will run on just about any computer, regardless of operating system. PHP has thousands of programming functions to facilitate almost any task. Our website passes successfully the validation test of W3Schools for HTML5 and CSS3.

Using the website of our system, users have the ability to create custom polls and archive their results. Results give instructors a "snapshot" of students' comprehension and helps them to improve their teaching methods for a better lesson delivery. Instructors can also set through our website the validity period of their polls. Validity period of a poll is the period during which, users are allowed to vote for this poll. Our system allows instructors to set visibility of results as they want. It is at the discretion of the instructor if the results of a poll will be visible or not to the audience.

There are three kinds of users who have access to our system:
Voter: In the voter's level, user can only vote in one or more polls, made by the instructor. Voter has no right to make his own polls. Obviously, students belong to this level. There is no precondition to be a voter.

Single User: In the single user's level, a user can make his own polls and put them to a vote. In order to be someone a single user, he needs access codes to the site of the system.
Administrator: In the administrator's level, user has full control of the system. Administrator can do all the things that a "Single User" does, but he can also insert or delete other users, reset their passwords or delete their data if there is need to do so.

All system users have the right to vote. A vote can be submitted in two ways:
Vote from the website: Users can choose their answer from the website of the system. There is a list with all live polls running at that time. User just chooses the poll he wants to participate and he is transferred to a page like that in Figure 2.
Vote with voting device: Users can also vote through voting devices, which are given to them during the course.

For the implementation of our voting device we chose to use Arduino Uno board. Arduino is a very good choice for fast and cost effective prototyping. Arduino voting device was programmed in the Arduino IDE environment, which is an open source software. Arduino language is based on C/C++.

4 Hardware

Our system was set up in an arduino architecture microcontroller, and more particularly to microcontroller Arduino Uno. It is an open source platform of prototyping electronics based on flexibility and ease of use of hardware and software. The arduino devices can interact with the environment by receiving signals from a variety of sensors. Projects based on these microcontrollers can be independent or they can communicate with software running on a computer.

The concept of shield in arduino architecture, is the incorporation of additional hardware to the microcontroller which gives a new property, especially in communication. By adapting the shield, serial communication (via usb) is converted to the corresponding communication that is provided by the shield. For the development of this system, the shield that was needed, is the arduino WiFi shield.

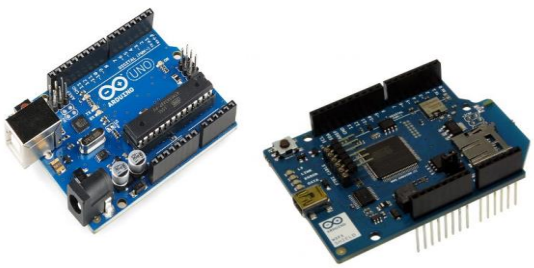

Fig. 2. Arduino Uno & Arduino WiFi Shield.

For the implementation of our voting device we used an Arduino Uno R3 board, an Arduino WiFi Shield, one breadboard 830 Tie Point, 5 Tact Switch 6x6mm 5mm 4pins, 1 LED Diffused 3mm green, 5 Resistors 10Kohm, 1 Resistor 330ohm and Breadboard Jumper cables.

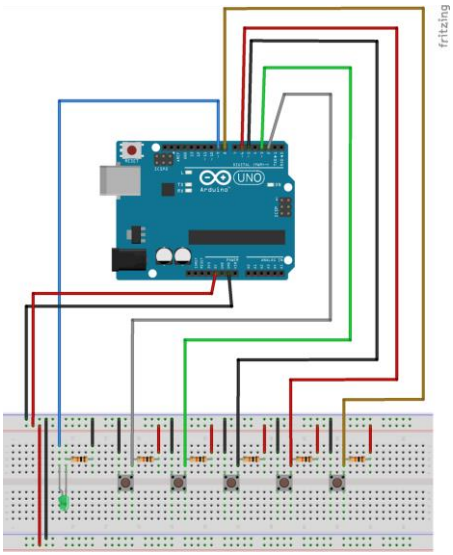

Fig. 2. Circuit of our prototype voting device. Image was produced using fritzing.

5 Experimental use / Conclusions

Our system was tested in a real class for a semester, during winter 2013 at the University of Western Macedonia with most impressive results. Dr. Minas Dasygenis introduced PRS in his courses for the lesson of operating systems. Eighty three students participated in this survey.

The majority of students (81.9%) strongly agreed or agreed that the PRS system made the class better (Fig.3). Students also agreed or strongly agreed that PRS encouraged participation in class (85.3%), allowed them to respond anonymously (91.2%), and made some topics clearer (77.7%). However, there was a minority of students who had negative impressions of the PRS: 9.5% felt that the PRS slowed down the class and 13% felt that the professor depended too much on the PRS.

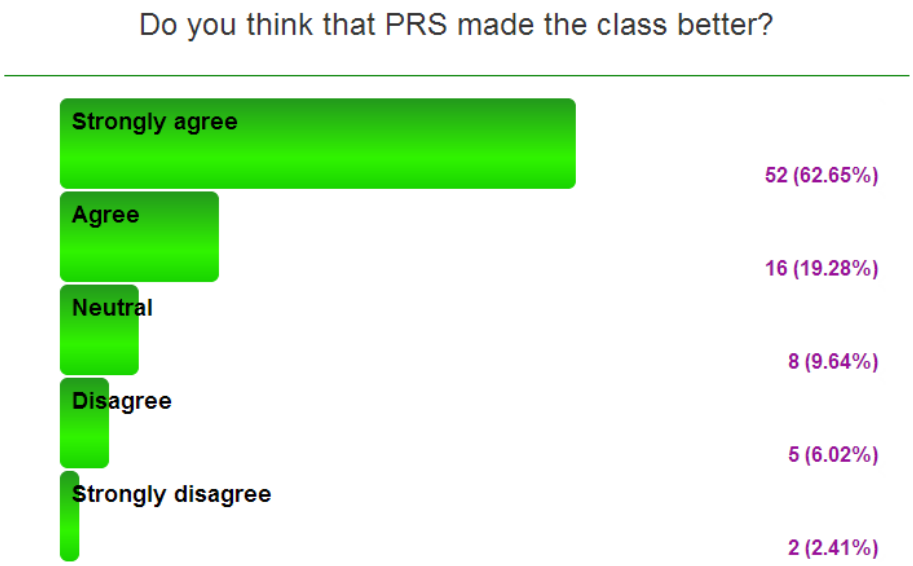

Fig. 3. Results of how students evaluated the use of PRS in the class.

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