



Some aspects of using the XBOX Kinect technology in the human – computer interaction class¹

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Abstract: *The technological development has lately provided a large spectrum of its application in different areas of everyday life. The principles and education methods that were used before are still being implemented, but the technology greatly affect them. One of such improvements is XBOX Kinect, which can be easily used in every structure of education system. By using interesting and visually appealing manner of teaching, the students' interest in taught subjects increases. XBOX Kinect has been applied in the Human – Computer Interaction class, where the aforementioned interaction has been emphasized. This paper describes the use of XBOX Kinect in this class in order to have better approach to teaching theoretical basics in more interesting and efficient way. The paper brings the possibilities of Kinect, with the analysis of its application in education so far and description of software that comes along. Also, the difficulties in its implementation are given as well.*

Keywords: XBOX Kinect; Education; Human-computer interaction

1. INTRODUCTION

The last fifty years have brought a vast number of technological accomplishments and progress like no other period in human history before. All of that wouldn't be possible without transistors and semiconductors. Since then, the development of computers and computer technology has been increasing exponentially and reached scales that were possible only with the science fiction writers from the beginning of last century.

Modern Hollywood blockbusters have in some way influenced the designers and engineers of modern computers and user interfaces. One of them is Minority report by Steven Spielberg from 2002. In this movie, the protagonist played by Tom Cruise controls the computer with gestures. A few years later, the vision of this movie's director came true and the device that enables the control of computer by gestures has been introduced. In this

¹ Research presented in this paper is supported by Serbian Ministry of Education, Science and Technological Development through national projects "Infrastructure for electronically assisted learning", III-47003

case, it was the game console Nintendo Wii, with Wii Remote controller, publicly shown in 2006. This controller was able to track the position of the player and control the virtual character by user's gestures. Its presence was the turning point in the development of this type of devices. Later on, in 2010, Microsoft has announced Microsoft Kinect, supplement to the XBOX 360 console. Its popularity is based on the possibility of connection to the computer, thanks to the published drivers and Software Development Kit (SDK). In this way, it is possible to use it in the areas that are not strictly related to the entertainment industry. Since the devices that Kinect belongs to can be classified as gesture tracking devices, this type of user interface is known as NUI (Natural User Interface) [1].

One of the basic elements of the human – computer interaction is the user interface, which is supposed to bring the feeling of comfort while using computer, and to facilitate the usage of computers. This is the main reason why the development of user friendly interface is of big importance in computer science. The goal of human – computer interaction on the user interface level is to perform operations effectively, the control of the device operations, and to get feedback from machine that helps operator in decision making process [2]. User interface is the system upon which the users interact with the machine. It involves hardware and software components. User interfaces often reflect the general philosophy of the operating systems makers, and are also the trademark that distinguishes them on the market [3]. The development of user interfaces, also with the development of all components of operating systems, is determined by and in course with the development of computers themselves.

One of the most important moments in software development is turnover from design that was primarily targeting intensive computations to the design targeting intensive presentation [4]. The history of this development process can be divided in three eras: batch processing (1945 – 1968), command line usage (1969 – 1983), and graphical user interface (GUI) era (after 1984). The story begins with the development of digital computer. The starting dates of next two eras represent the occurrence of interactive time sharing and GUI.

This development process was followed by the science and education growth, so some technological accomplishments were of big importance to the development and advancement of teaching process. Along with the use and development of computers, the education system has included the devices that were not imagined to be such an important part of the teaching process. These devices are numerous, and this paper describes one of them that has potential to become very important to the education process.

2. XBOX KINECT AS EDUCATION TOOL

2.1. The working principle of the device

The gesture tracking is based on series of observations of human activities and environmental conditions in order to achieve main goals of the recognition process [5]. The gesture recognition requires sensor that generate and receive signals. The software that can interpret sensor readings is required as well. The gesture recognition is based on past events. Through the learning process, the software can predict future positions. The goal of gesture tracking is the detection and observation of objects in motion via the sequence of recorded images [6]. When multiple images are recorded using camera, the first step is to differentiate moving objects from static background. The working principle is following [7], [8]:

- The projector emits known pattern of infrared (IR) light to the surrounding objects.
- The sensor observes the scene and detects changes in the projected pattern, which depend on the distance and shape of an object.
- The sensor sends received data to the control logic (computer system) for further processing.
- The received data are processed and 3D map of object is formed (3D map in this context represent the collection of 3D coordinates that form the surface of observed object).

In Fig. 1, the appearance of XBOX Kinect is shown. Also, its main parts are labeled (RGB camera, IR projector, and IR sensor).



Figure 1. Locations of IR projector, sensor and RGB camera on XBOX Kinect

2.2. The usage of Kinect in education

The potential that Kinect has as a gesture tracking device in education is large. Kinect can support kinesthetic pedagogic practice in order to develop bigger somatic – kinesthetic intelligence among students. Even though it facilitates the creation of meaningful interaction in the classroom [9], Kinect has to be integrated with the computer, projector, and compatible software. From the teaching tool aspect, due to the multiple types of interaction it supports, Kinect has a potential to improve interaction, the student participation in the teaching process, capabilities of teachers to present and manage multimedia materials, and to create discussion models. As an addendum, students can use information received from Kinect to create highly interactive multimedia solutions. Because of the intractability aforementioned, the Human – Computer Interaction class can be improved and advanced in relation to the standard models of teaching methods applied in this class.

By using software tool Avatar Kinect, it is possible to animate distance learning, cooperation on projects, and socialization between students. Avatar Kinect uses gesture tracking together with facial recognition in order to assign a special avatar to each student and onscreen representation of student in real time, which imitates the way the user smiles, talks, and behaves. It can be connected to upon eight persons on different physical locations. By using this tool, much less bandwidth is needed comparing to the regular video calls, since the real time animation of avatar needs a bit larger bandwidth than to transmit

voice call [10].

However, with aforementioned possibilities, one of the main advantages of Kinect is the possibility of studying programming techniques. Students would write programs in an interactive way, creating real time avatar control applications, where they would use techniques of object – oriented programming [11]. In this way, by doing an animation of interactive processes in an efficient and interesting manner, students would gain desire for further learning. Fig. 2 shows the example of controlling avatar using Kinect.



Figure 2. *The control of avatar using Kinect*

2.3. The usage of Kinect in classroom

1) *Kinect as teaching tool*

Kinect, along with other types of devices, tends to adapt to large spectrum of requests that has been facing. The most common activities and elements that one such device needs to accomplish are flexibility, universality, multimedia support, efficiency, interactivity, etc. The usage of Kinect needs to be planned in advance, and the device needs to be put in the classroom so the interaction with students is at maximum. The teachers need to think of activities that will be done using Kinect. The main obstacles in using Kinect are teaching curricula, which are in some part in oppose to using kinesthetic practice. By connecting it to the computer and projector, Kinect can enable doing some activities by gestures, which improves the cognitive possibilities of a human. The possibilities of Kinect can be used in activities such as determination of trajectory of an object, where students in person can check the results [9],[11]. Some of main characteristics of Kinect as teaching tool are:

- Flexibility,
- Multiuser support,

- Animation of students.
- 2) *Kinect as learning tool*

The main quality of Kinect important for learning process is its motivating capabilities. Kinect can be integrated into simulated environments and in this way to increase the possibilities of such environment. Second main quality of Kinect is its communicability. By using multimedia options and kinesthetic memory, student is enabled direct visual contact with teaching material. The third possibility of Kinect is software compatibility. In this way, Kinect with used software support development of personal knowledge and capabilities.

In Fig. 3, the example of Kinect Explorer window is shown. It can be seen the way Kinect recognizes human gestures by mapping certain points on human body. This is crucial for understanding the working principle of Kinect.

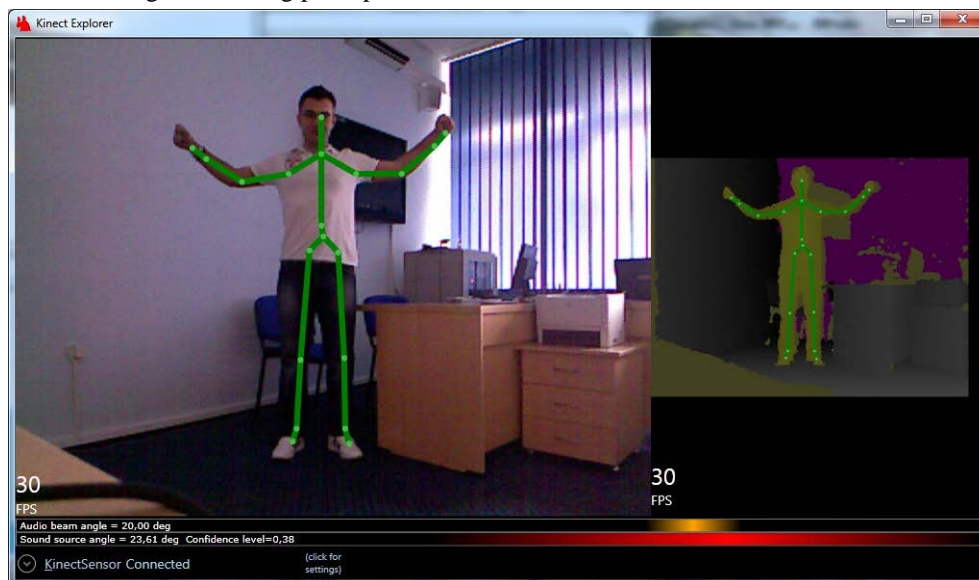


Figure 3. *The appearance of Kinect Explorer window*

2.4. Limitations of Kinect

Technical limitations can be due to required space for classroom in which Kinect can work undisturbedly. Recognition can be done only on two actors, while other participants have to be out of working area. The price of the device can be the problem somewhere, too.

One of the problem is that not large number of teachers would engage into changing teaching curricula and adapt them to the new technologies. However, in the Human – Computer Interaction class, Kinect is of great importance. In order to prevail the gap between old teaching methods and new ones, Kinect can be used as tool in laboratory exercises. In this way, both the teachers and the students, would get used to new teaching methodologies.

3. CONCLUSION

Following the development of modern computer user interface, the user has gain full

control of human – computer interaction. This type of interaction is natural and intuitive, based on gestures and voice, and represent step through in human perception of interaction with machine. At the beginning, the voice and movement recognition algorithms were quite imprecise, but in time, they were improving and today, they have satisfactory percentage of success.

The aforementioned analysis of usage of Kinect in education clearly suggests that the use of this device is desirable and it improves creativity and willing to work among students. However, Kinect is needed to be integrated with other devices, such as computer or projector. Beside hardware, the usage of appropriate software is important as well. The future use of Kinect will depend primarily on future software solutions and the dynamic of their development. With all the difficulties, Kinect is capable of being the device that will improve learning process.

ACKNOWLEDGEMENTS

Research presented in this paper is supported by Serbian Ministry of Education, Science and Technological Development through national projects “Infrastructure for electronically assisted learning”, III-47003

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