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**DEVELOPMENT OF A NATURAL USER INTERFACE FOR INTUITIVE  
PRESENTATIONS IN EDUCATIONAL PROCESS**

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**Abstract:** *This paper presents the new methodology for using a Natural User Interface (NUI) dedicated device (e.g. Microsoft Kinect™, Wii Remote) in PowerPoint type presentations, by achieving additions and changes in real time, on the same screen with the presentation. Kinect™ and Wii Remote are peripheral low-cost devices that allow users to interact with data, using body gestures and voice commands. We propose a series of intuitive NUI actions based on body postures, gestures and voice commands used to make additions to the classical presentation such as underline, highlight, drawings, diagrams, various smart-arts. The GUI of the developed program is similar to the one of the classical Windows™ PowerPoint program. There were performed tests and calibration of equipment, in order to modify / correct the positions / movements attached to each action. Method raises the presentation, especially in human - computer communication technique. The innovations used can increase public interest.*

**Keywords:** *NUI, Kinect, Wii Remote, body postures, voice commands*

## **I. INTRODUCTION, PEDAGOGICAL MOTIVATION**

In the educational process, the support for the presentations displayed at courses, seminars and laboratory hours are the PowerPoint slides. Usually, a simple on-screen slide is not enough for students to understand complex information, requiring additions like verbal explanations and sometimes, to complete the presentation, there are needed drawings, sketches, charts, flowcharts or arrows. In order to create a presentation, there are used various methods today, from the simplest ones (projecting the slides on the whiteboard and the usage of water-based markers to overwrite) to some more complex, like using interactive whiteboards which can be written directly with special pens.

However, there are moments when the screen size is too large and the lecturer is not even near it. The same thing happens when there is not used a projection screen and the presentation is displayed on a white wall. In these cases, it is required a new approach for teaching methods, especially for emphasize and addition of information in real time.

### **1.1. New technologies used in education**

Virtual and augmented reality technologies were introduced more than three decades ago with the goal of providing sophisticated visualizing capabilities and multi-sensational human interfaces, and facilitating the development of new application systems for industrial and public use. Over the years, not only has the variety of virtual reality (VR) and augmented reality (AR) technologies grown, but their functional capabilities and usability have improved. VR and AR technologies have found their ways into critical applications in industrial sectors and also in the fields of education and entertainment [10].

The use of VR as an educational tool has been proposed and discussed by several authors. Virtual environments (VEs) offer the possibility to recreate the real world as it is or to create completely new worlds, providing experiences that can help people in understanding concepts as well as learning to perform specific tasks, where the task can be repeated as often as required and in a safe environment [4]. The range of technologies that are currently used include CAVE environments, reality theatres, power walls, holographic workbenches, individual immersive systems, head mounted displays, tactile sensing interfaces, haptic feedback devices, multi-sensational devices, speech interfaces, and mixed reality systems [10]. Modern VR system are composed by different devices (for visualization and force feedback) able of deceiving the human sense in a way that the users has the impression of acting in a world generated by the computer [8]. AR is a new form of the man-machine interaction. Computer-generated information is shown in the user's real field of view. The shown information is context-dependent concerning the viewed object [5].

Web-based teaching provides a new paradigm for imparting knowledge, enabling both on campus and distance-learning models; students can access the learning material anytime by operating remotely from any location. As a result, learners can progress on their own initiative to study the content of the course. In particular, the Web can give the learner the means to access information flexibly and individually: he can choose what to view, how long to view it and how many times to view it [7].

## 1.2. Educational contexts, advantages of new technologies in education

Educational uses of new technologies present a number of advantages with respect to traditional learning practices. Constructivism is the fundamental theory that motivates educational uses of VEs. Constructivists claim that individuals learn through a direct experience of the world, through a process of knowledge construction that takes place when learners are intellectually engaged in *personally meaningful task* [4].

As general definitions, including Wikipedia, a *natural user interface* (NUI) is the common language used by developers of computer interfaces to refer to a user interface that is effectively invisible, or becomes invisible with successive learned interactions, to its users. The word *natural* is used because most computer interfaces use artificial control devices whose operation has to be learned. While the interface requires learning, NUI based activity is eased through design which gives the user the feeling that they are instantly and continuously successful. This can be aided by technology which allows users to carry out relatively natural motions, movements or gestures that they quickly discover control the computer application or manipulate the on-screen content. A common misunderstanding of the *Natural User Interface* is that it is somehow mimicry of nature or that some inputs to a computer are somehow more 'natural' than others.

Here are some examples of interfaces commonly referred to as NUI:

Perceptive Pixel (2006) This equipment is a multi-touch interfaces and support a variety of interaction commands with on-screen content using both direct manipulations and gestures (Fig. 1.a).



**Figure 1.** Natural user interfaces  
(a) Perceptive Pixel, (b) Microsoft Surface, (c) 3D Immersive Touch)

Microsoft Surface takes similar ideas on how users interact with content, but adds in the ability for the device to optically recognize objects placed on top of it. In this way, users can trigger actions on the computer through the same gestures and motions as Jeff Han's touchscreen allowed, but

also objects become a part of the control mechanisms. So for example, when you place a glass on the table, the computer recognizes it as such and displays content associated with that glass (Fig. 1.b).

3D Immersive Touch (2007) is defined as the direct manipulation of 3D virtual environment objects using single or multi-touch surface hardware in multi-user 3D virtual environments. Apple also seems to be taking a keen interest in *Immersive Touch 3D* natural user interfaces over the past few years (Fig. 1.c).

New technologies are developed for gestures recognition in order to transition autonomously for vocational tasks for individuals with cognitive impairments. The proposed system for vocational task prompting is based on Microsoft Kinect sensor. Using Kinect means that the users need not be bothered with sensors that can be intrusive [2].

Hands-free gesture and speech recognition NUIs are not a full replacement for more conventional interaction methods; for example, not all users have the necessary muscular agility and dexterity, physical room space, or large enough screen size (for comfortable viewing from the user's minimum distance away from the sensor) to use a Kinect sensor, and more conventional navigation of virtual globes with a 3-D mouse or a multitouch screen can sometimes offer more precise and smooth control of the 3-D map [1].

At this point, we can underline the positive role of new technologies in educational process and how to use the equipment and new methods. It can be said that implementation of these technologies bring significant benefits in the educational process.

## II. USED EQUIPMENT AND TECHNOLOGY

Human gestures are a natural means of communication and allow complex information to be conveyed. Using gestures and voice for interaction with computer-assisted systems can be of great benefit, particularly in scenarios where traditional input devices are impractical [9].

The main used principle for our methodology is motion detection. This represents a process of confirming a change in position of an object relative to its surroundings or the change in the surroundings relative to an object.

Motion can be detected by: sound (acoustic sensors), opacity (optical and infrared sensors and video image processors), geomagnetism (magnetic sensors, magnetometers), reflection of transmitted energy (infrared laser radar, ultrasonic sensors, and microwave radar sensors), and electromagnetic induction (inductive-loop detectors), and vibration (triboelectric, seismic, and inertia-switch sensors).

In our case, this detection can be achieved by either mechanical and electronic methods (Wii console) or optical (Kinect). In addition to discrete, on or off motion detection, it can also consist of magnitude detection that can measure and quantify the strength or speed of this motion or the object that created it.

### 2.1. Used equipment

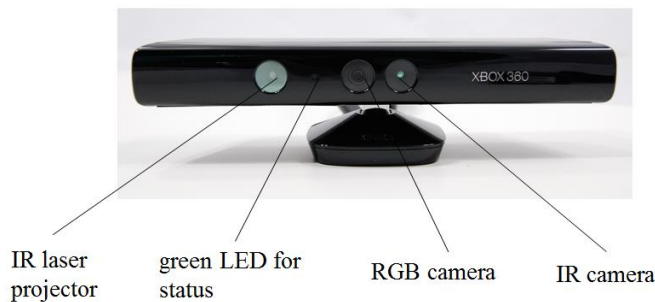
Gesture recognition enables humans to interface with the machine (HMI) and interact naturally without any mechanical devices. Using the concept of gesture recognition, it is possible to point a finger at the computer screen so that the cursor will move accordingly. This could potentially make conventional input devices such as mouse, keyboards and even touch-screens redundant. Gesture recognition can be conducted with techniques from computer vision and image processing.

Xbox Kinect is a motion-sensing input device that's a revolutionary new way to play games or command a personal computer using the human body and voice instead of a controller.

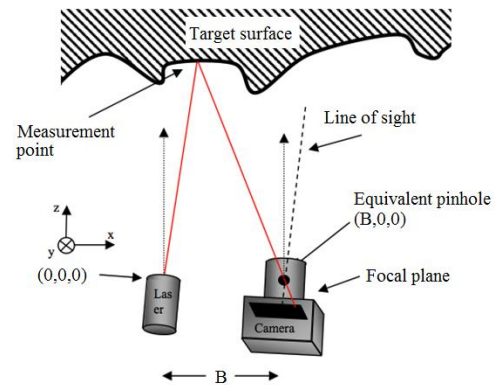
The device features an RGB camera, depth sensor and multi-array microphone which provide full-body 3D motion capture, facial recognition and voice recognition capabilities. The Kinect sensor's microphone array enables the PC to conduct acoustic source localization and ambient noise suppression. Also, on the bottom of the sensor is an IR laser class-1, completely safe for eyes (Fig. 2).

Two separate video streams which come from the Kinect: (i) one 640x480 (VGA) 30FPS stream from the RGB color camera; (ii) one 640x480 11-bit 30FPS image stream which is the output 3D depth image after processing.

Kinect implements a subset of Prime Sense's natural interaction reference design, which originally specified a much higher resolution color sensor and 60FPS depth image.



**Figure 2.** Xbox Kinect™ sensor

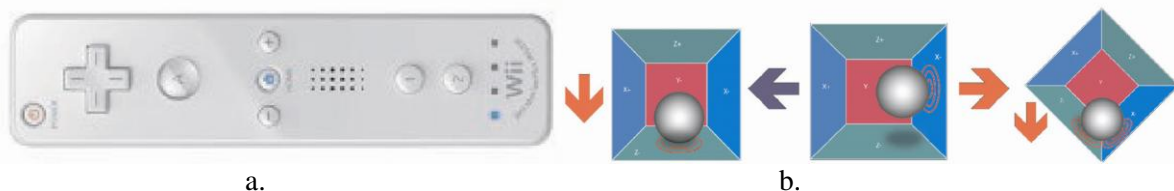


**Figure 3.** Principle of the method

Kinect sensor uses a structured light IR projector and sensor system. The principle of structured light sensing is that given a specific angle between emitter and sensor, depth can be recovered from simple triangulation (Fig. 3). Expand this to a predictable structure, and the corresponding image shift directly relates to depth.

The Kinect sensor is used, in addition to his main role - Xbox games console interface, in many applications involving motion tracking techniques, so: navigating and exploring in Google Street [1], using for physical rehabilitation [3], determining risk of musculoskeletal injury in the workplace [6].

The Wii Remote, also known as the Wiimote, is the primary controller for Nintendo's Wii console (Fig.4.a). A main feature of the Wii Remote is its motion sensing capability, which allows the user to interact with and manipulate items on screen via gesture recognition and pointing through the use of accelerometer and optical sensor technology.



**Figure 4.** Wii Remote (a) and working principle of the accelerometer (b)

An accelerometer is a device that measures proper acceleration, which is the acceleration it experiences relative to free fall and is the acceleration felt by people and objects. Put another way, at any point in space-time the equivalence principle guarantees the existence of a local inertial frame, and an accelerometer measures the acceleration relative to that frame (Fig.4.b).

## 2.2. Used software

In order to install Kinect sensor, we have used Brekel Kinect drivers (<http://www.brekel.com>) for Microsoft Kinect sensor because this drivers' package as it is able to make connections with other software installed on computer. To send commands from Kinect to PC, we have uses open source software Kinect PowerPoint Control (<http://www.codeplex.com/>). Otherwise, to install Wii Remote on PC we have used BlueSoleil software (<http://www.bluesoleil.com/>) that can connect via Bluetooth to the distance of 10...30 m without problems.

Voice command in Windows 7 is one of the latest implemented systems by Microsoft. List of commands includes commands for using common controls, keyboard keys, working with text, punctuation marks and special characters. Full list can be found at <http://windows.microsoft.com/en-US/windows7/Common-commands-in-Speech-Recognition>.

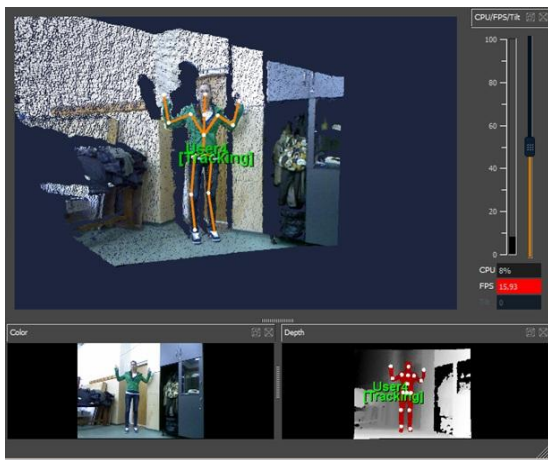
Microsoft PowerPoint programs are the interface between public and presenter.

### III. METHODOLOGY

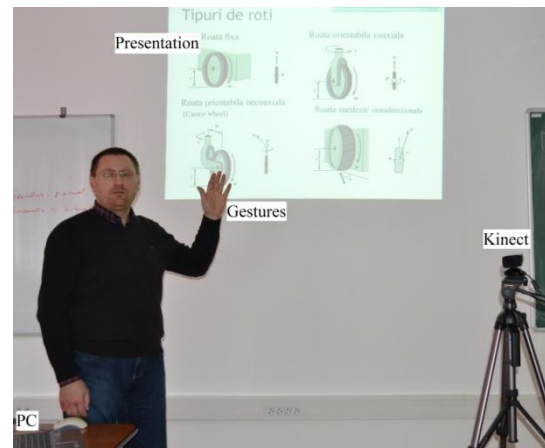
To start the presentation, we use the voice commands of Windows 7: *Start* => Switch to *PowerPoint* => Press *F5* => Page Down. Before that, the system must be configured and customized so: Start – Control Panel – Speech Recognition – Start speech recognition; in this way, it will adjust the equipment used for voice commands.

In order to improve the quality of presentations will be used Kinect sensor and Wii Remote. The Kinect sensor is able to use for human body tracking. The equipment provided a good accuracy over the range of 1.0 m to 3.0 m from the camera with an effective field of view of 54.0° horizontal and 39.1° vertical [6].

The working principle consists in recognizing human figure and above that it will apply a skeleton (Fig. 5). This skeleton is defined by line segments connected between them by rotation joints. Any movement of the human subject will lead to a change in the position of the skeleton; the default rotation couplings between segments will record changes in value. These records are retrieved by software and processed in commands used in various programs, including presentations (Fig. 6).

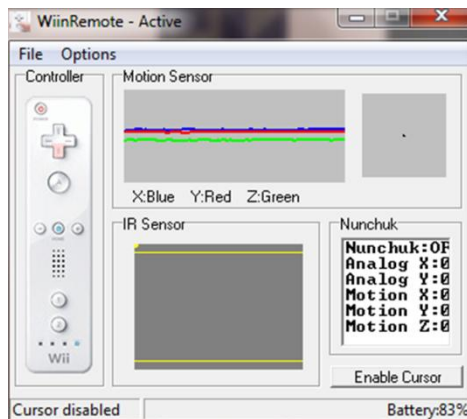


**Figure 5.** Brekel skeleton configure

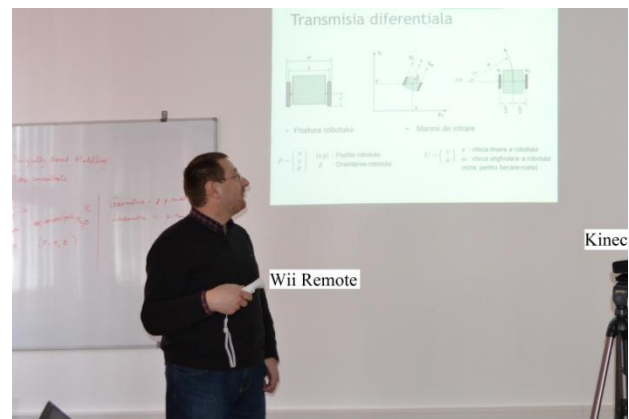


**Figure 6.** Proposed methodology - Kinect

To use the Wii Remote, this equipment should be installed using BlueSoleil software. This sensor will not work just as a common mouse, but can implement multiple functions. After the Wii Remote becomes active, we can set the functionality of each button on the console (Fig. 7), using the motion sensor (accelerometer) or IR sensor. After assignment of functions to each button on the console, they are stabilized and can be used for various applications, programs, taking the place of a mouse. In addition to common commands, Wii Remote is able to provide a response in force (haptic) for special commands (Fig. 8).



**Figure 7.** Wii Remote configuration



**Figure 8.** Proposed methodology - Wii Remote

## IV. CONCLUSIONS

The proposed method has important results in various directions, especially in how to support the presentation. It is possible to configure the equipment so that the presenter, in his gestures, equipment to act accordingly.

The advantage of the developed application is the usage of low cost equipment to create an intuitive human computer interface that improves the traditional presentations.

Another advantage is that the presenter can make additions, underlining, highlighting directly on the slide out to be checking on the slides.

For presenters who are not near PC only, this method allows control of the presentation by several methods; it can dismiss the assistant who handles running slides.

In general, this method can make a variation in the presentation, increasing public interest, which may be of any age and level of education.

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