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Non Inmersive Virtual Reality for Improving Teaching Processes

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***Abstract*—**The following paper shows an interactive tool which main purpose is to teach how to play a flute. It consists of three stages the first one is the instruction and teaching process through a software application, the second is the practice part when the user starts to play the flute (hardware specially designed for this application) this flute is capable of capturing how is being played the flute and the final stage is the one in which the data captured are sent to the software and the user is evaluated in order to give him / she a correction or an acceptance

***Keywords*—**acoustoelectric devices, computer applications, learning systems, music, technological innovation, virtual reality

I. Introduction

THE teaching processes need a change of the methods used until now. Teachers and students must evolve to take advantage of the technological resources that are offered nowadays. Technological tools require leaving the behaviorism pedagogy and adopt constructivism pedagogy in which the student has the ability to create and produce much more, giving a more representative role to the student, recognizing that he/she is the main actor in the learning process.

Alexander's study found that the use of technology did not in itself result in improvements in the quality of learning but that success depended on the design of the whole learning experience. Academic development programs are needed to encourage teachers to focus not only on changing content and adopting new teaching strategies, but also adopt an ongoing, reflective approach to student learning [1].

Making the teaching more interactive allows the student to learn on his/her own way, especially in music areas there are some difficulties for students who are subjected to inappropriate patterns of study. The skills and abilities could be different from each other. At the same time, it is seen in the society the need to develop technological teaching tools and interactive models more efficient, making the learning process more enjoyable.

The significant changes that today's students bring with them when they start their post-secondary education creates an urgent call to understanding the different ways they learn and therefore, to change the ways institutions educate them. But it is time not only to radically change the way teaching takes place, but also, to redesign curriculum, graduation processes, evaluation methods, infrastructure needs, and so on [2].

One of the main ways to teach in a technological way is using virtual reality which is not a representation of a specific experience in the actual world, but it is a new mode of experience where various sensory and imaginary experiences are fused. This is not simply a way to understand and effectively access the actual world, but it is a driving force that carries forth the human activities and it is an independent reality that gets feedback from those activities. Users can experience virtual reality that is unrelated to the physical world [3].

The virtual reality helps in making the education more contemporary it generates in young people the desire to research and learn about different stuff. Therefore it was decided to develop the "Virtual flute" in which an electronic device with software has the purpose to accompany and guide the student through the process of learning how to play a flute. The dynamic of the device has three stages a first one that gives all the instructions to the user, a second one where the hardware captures the way how is being played the flute and finally a feedback of these data to the computer and the response to the user. Along with the device an educational pedagogy is integrated it ensures the success of student learning.

II. Non inmersive (desktop) virtual reality

The incorporation of multimedia into instructional methodology and delivery systems in music education has enhanced the teaching and learning process, and empowered educational institutions to meet the rising expectations of the twenty-first century. It is also clear that electronic equipment allows students to engage in individual music learning and creation according to their own needs and ability, and at their own pace; and it can extend their access to information beyond that allowed by traditional classroom resources, thereby broadening the scope of their knowledge. [4]

The "virtual flute" implements non immersive (desktop) virtual reality which offers less real sense than immersive virtual reality, but when it is accompanied by hardware it permits the possibility to the student of being in contact with the instrument that needs to play. The feeling is much more real than if they only see the information in a computer. In addition the feedback from the captured data from the sensors allow for seamless interaction between the student and this educational tool.

VR is a kind of technology that enables users to get sensory experiences on real things in a similar way to the one that they use when they interface normally with physical world. Such

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experience is only simulated; it does not mean a new experience has occurred. In other words, virtual reality is nothing but an artificial reality which is a substitute for natural reality that is felt in the actual world [3].

In the music field when someone wants to learn how to play an instrument is important to use a hardware which simulates the musical instrument and the student could be in contact with an object similar to the real one and be prepared for when he/she needs to play a real instrument.

New technologies related to computer music make it possible to not only create new types of music by ourselves, but also to learn conventional music more easily [5].

The principle purpose of the "Virtual Flute" is to facilitate the learning process on how to play a flute, offering a new way to practice and study the basic musical notes. Using this tool the student could practice whenever he/she wants as fast as each one decides, this allows a more enjoyable learning process. Nijholt thinks that technology can make music education more efficient by taking time consuming, less creative, essentially 'practice' activities and offering them in a context in which students can master them individually, leaving more time for teachers to focus on the communicative/creative skills of music [6].

Therefore is seen the important role that has the technology to develop different methods of participation in music and its processes: learning and practice.

III. METHODOLOGY AND MATERIALS

Two methodologies were implemented the first one which handled the development of theoretical research and the second which designs the interactive tool. The research methodology was based in theories from Mendez [7], Lerma [8], Tamayo [9] and Cerda [10]. The following are the most important electronic components of the interactive tool:

The sensor Mpxv 4006 Freescale is used to measure the flow of air from the user's blow when he or she plays a music note. To identify the parameter of average pressure when the flute is played in the right way were taken different samples from people with knowledge about how to play the flute correctly, noting that the results were close to a range of values specified in the driver program to analyze and compare.

TABLE I
RESEARCH METHODOLOGY IMPLEMENTED

Stages	Description
Topic description	In this stage was determined the interactive tool scope and its limits.
Problematic	In this part was seen and defined the "for what" of the learning device
Objectives	In this stage were clarified all the functions that should have the virtual reality tool.
Justification	In this stage was determined the motivations for the development of the device
Similar examples	In this part, was made a research about existing research and development about similar projects.
Definition of the methodology for developing the tool	In this stage it was determined how would be developed the interactive tool.

TABLE I I
METHODOLOGY DESIGN FOR THE ELECTRONIC DEVICE

Stages	Description
Planning	In this stage was defined what will be done, the list of activities, team work, materials that constitute the device and the required tools.
Requirements	At this stage was set out the different characteristics that the device must have.
Analysis	In this part was analyzed the requirements and the possible ways to develop the interactive tool, building a model to determine the physical structure and technology used.
Devices design	In this stage were made the sketches, proposals for structural design and performance.
Construction	In this stage was made the flute's implementation with the sensors, signal conditioning and data transmission
Tests	In this part were made some tests of the flute's performance including the software.

For sensing the position of the fingers on the virtual flute are used eight reflective sensors. The Reflective Optical Sensor, CNY70 has a compact construction where the emitting light source and the detector are arranged in the same direction to sense the presence of an object by using the reflective IR beam from the object. The operating wavelength is 950 nm. The detector consists of a phototransistor [11].

At the moment the finger is positioned over the hole, there is a reflective surface that makes the role of the medium of reflection for the infrared beam emitted by the diode, and then receiver transistor conduces current.

TABLE III
OUTPUT VOLTAGE (PRESSURE SENSOR)

User	Volts
1	2.01
2	2.23
3	2.16
4	2.34
5	2.37
6	2.26
7	2.27
8	2.31
9	2.13
10	2.11
11	2.13
12	2.46
13	2.54
14	2.27

IV. VIRTUAL FLUTE DESIGN

To design the flute was taken into account the fact that it should capture the notes do, re, mi, fa, sol, la, si, do' the following data (Table III) were obtained at the output of the pressure sensor when 14 people who played in the right way the flute then was made the algorithm that analyze and discriminate between the correct and incorrect notes played.
The analysis of the results, generates a voltage range in which the note is being well played, which corresponds to approximately 0.326 psi or 22.2x10 ^ -3 Atm or 2.25 KPa.

Fig. 1 Virtual Flute

The figure above shows the two designed flutes the one in the left is a own model in which the electronic components are inside. The other one in the right is a traditional flute and the electronic components are in the little green box next to it.

Fig. 2 Children playing the Virtual Flute

The Fig.2 shows two of the ten children who have played the flute and have learnt the basic musical notes

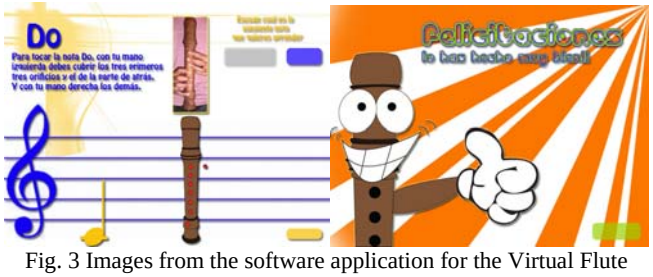

Fig. 3 Images from the software application for the Virtual Flute

The Fig.3 shows some images from de software application designed for the virtual flute device these pictures are colorful and animated in order to be enjoyable for the children who are the main users.

V. Results

The main result was the successful development of the hardware device that captures the musical notes which are being played on a flute and transmitted the data to the computer, where the interaction is consistent and efficient.

The combination of music instruction, the sensors and the communication with the computer, generated a electronic device in which has an application of software that was developed in Java, Netbeans, and it provides the necessary information to the student to learn how to play the basic notes on a flute and gives the opportunity to practice and be evaluated, according to this the computer sends data to an electronic circuit for identifying what note should be captured by a PIC microcontroller, the data are captured from the sensors of the hardware part (air pressure and fingers position) are analyzed and returned data to the software which provides a correction or an acceptance of performance, thus completing a cycle of information and feedback aimed at the understanding and successful learning.

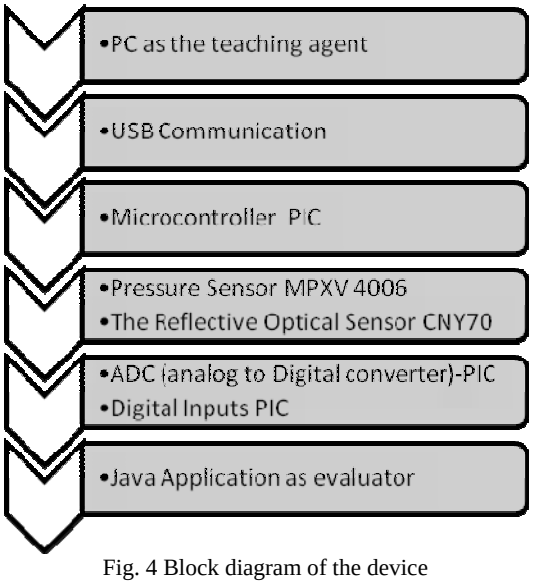

Fig. 4 Block diagram of the device

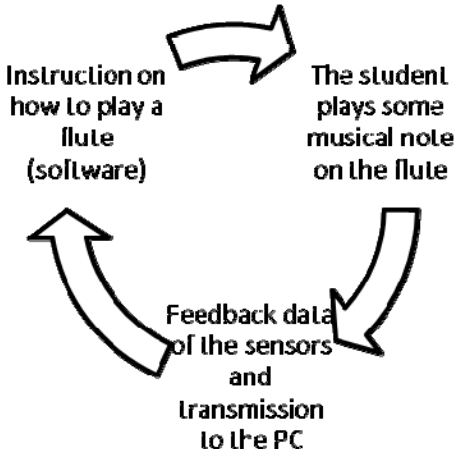

Fig. 5 Device Interaction

The software makes the instruction to the user, displaying the correct way to play a flute, when the user has reviewed this information with the speed that he/ she wants and how often he/she desired necessary then they could choose the appropriate type of test to perform, creating a kind of

constructivist pedagogy which offers to the student the necessary tools for the learning process.

VI. Conclusion

When simulating existing media the computer takes on the educative value of that media which is moderated or expanded to some degree based upon differences between the traditional medium and the computer simulation in terms of cost, convenience, features and perceived relevance. The computer may be used to create new learning opportunities unlike those possible with previous media. The value of software for education is most clearly evident when the computer opens up new opportunities for music making not previously possible or accessible. Software adds greatest value when it makes a qualitative difference. [12]

The device developed for this application is remarkable and makes a qualitative difference from the interactive devices made until now, because is able to sense (capture) the musical notes that are being played by a user, join with a software application that guides the user interested in how to play a flute, noted the importance of implementing educational tools, which makes more efficient and effective the learning process, demonstrating the importance of electronic devices.

An academic impact was generated because the Virtual Flute brings improvements in the research and implementation of such devices and at the same time with these devices provides an innovative way of teaching that makes an easier and more interesting learning process.

The device allows acquire knowledge to develop new technological tools based on virtual reality as virtual laboratories, immersive simulators, virtual worlds, interactive games, design and development devices based on motion capture technologies.

Besides implementing a constructivist pedagogy is very important to ensure user training. The virtual flute has been tested by ten children who show a learning rate of four musical notes after forty minutes of practice and the learning of the eight notes in about three hours of practice divided according to each student desires. This is why the Virtual Flute is a useful and enjoyable to supplement the teachers and make knowledge more accessible.

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