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Electronic Tool that Helps in Learning How to Play a Flute

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***Abstract*—**This paper describes the development of an electronic instrument that looks like a flute, which is able to sense the basic musical notes being executed by a specific user. The principal function of the instrument is to teach how to play a flute. This device will generate a significant academic impact, in a field of virtual reality interactive that combine art and technology. With this example is expected to contribute in research and implementation of teaching devices around the world.

***Keywords*—** Flute, Hardware, Learning, Virtual Reality.

I. INTRODUCTION

THE learning and / or musical training are complex for many students because they do not have enough tools, for example they do not have someone or something that continually motivate and guide them for training in musical performance as a contemporary art. Also there are people who are subjected to inappropriate patterns of study for their skills and abilities in the learning process in this area. These factors cause dissatisfaction in a specific group that wants to work on their artistic abilities.

At the same time, we see in our society the need to develop teaching tools and technology of interactive models more efficient and attractive, making the learning process more enjoyable. The non Immersive virtual reality[4] offers in this case, an option where the interesting and useful interactive educational simulators are an innovative way of presenting to a student the information that is required to learn, giving the opportunity to be evaluated and followed throughout this process, leaving behind the traditional teaching, instead implemented a constructivist pedagogy.

Therefore it was decided to develop the "Electronic tool that helps in learning how to play a flute" in which an electronic device with software has the target to accompany and guide the user 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 senses the note and finally a feedback of these data to the computer. The following document shows the systems implemented for the realization of the device. One will find all needed to understand the functioning of the hardware, the progress made with their results and applications where the device would operate in an optimal way.

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II. MATERIALS

A. Pressure sensor

The sensor Mpxv 4006 Freescale is used to measure the flow of air from the blow that leads the user when he or she play a music note on the electronic instrument. It works from 0 to 6 kPa, and is responsible for allocating a voltage value to the air pressure with a reference value of 4.8V for the maximum pressure to 0.17V for the minimum. To identify the parameter of average pressure when the flute is played the right way were taken different samples of people with basic 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 each moment of execution.

The operating characteristics of this pressure sensor:

- Pressure Ranges: 0 - 6kPa or 0 - 0.87 psi
- Voltage supply: 4.75-5.25V
- Current supply: 7 - 10mA
- Operating Temperature: -40 ° - 125 ° C
- Response time: 1 ms [1].

The above characteristics determine the ease of using a device like this, its maneuverability in the prototype and its operating qualities that make it an excellent mechanism for implementing within the device.

B. Reflective Optical Sensor with Transistor Output

The 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 [2].

The Fig 2 shows the construction of the sensor, its operation and the polarization circuit, this sensor will be implemented in each hole of the flute to identify when it is being covered by a finger or not. 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, making driving transistor receiver.

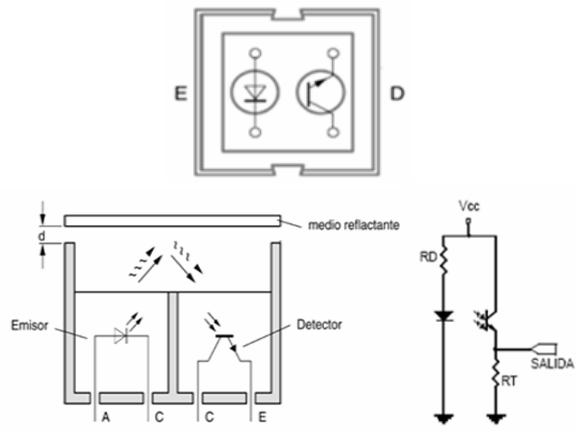

Fig. 1. Sensor CNY 70

C. Wind Instrument

A wind instrument is a musical instrument that contains some type of resonator, in which a column of air is set into vibration by the player blowing into a mouthpiece set at the end of the resonator. The pitch of the vibration is determined by the length of the tube and by manual modifications of the effective length of the vibrating column of air. In the case of some wind instruments, sound is produced by blowing through a reed; others require buzzing into a metal mouthpiece [3].

The Fig 3 shows the implemented prototype of housing, which allows opening the main tube, to give the possibility to locate the electronics needed to operate.

Fig. 2. Designed flute

The following table shows the values of voltage measured at the output of the pressure sensor, in tests to persons educated in the art of playing the flute, these data are the parameters used to design an algorithm that discriminates between a note that it is played the right way and it is not.

TABLE I
VOLTAGE AT THE OUTPUT OF THE SENSOR

User number	Voltage at the output of the sensor
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

This results in a small voltage range in which the note is being well executed, which corresponds to approximately 0.326 psi or 22.2x10 ^ -3 atm or 2.25 KPa

III. Results

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

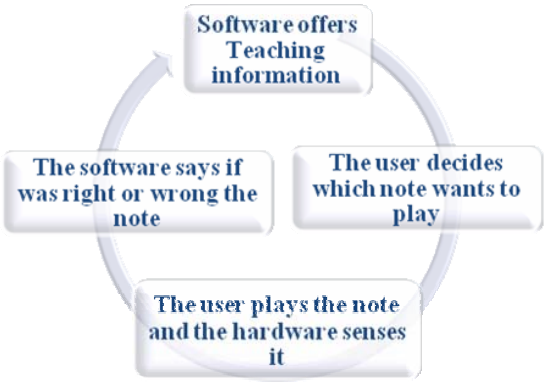

Fig. 4 System Dynamic

The combination of music instruction, the sensor and the communication with the computer, resulting in the electronic device in which a trial software developed in Java, Netbeans, provides the necessary information to the user to learn how to play the basic notes on a flute and gives the opportunity to choose which of them want to practice, according to this decision, the computer sends data to an electronic circuit for identifying what note needs to sense, by a PIC

microcontroller, the data are captured from the sensors (air pressure and fingers position) are analyzed and returned data to a 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. The software complies with the task of instructing the user to display the correct way to playing a flute, when the user has reviewed this information with the speed you want and how often it is necessary to choose the appropriate type of test you want to perform, creating a kind of constructivist pedagogy which is available to the student the necessary tools for the learning process and it makes use of these, as it is more convenient and useful. When the test is chosen, data are sent to a PIC microcontroller, which identifies the note that must be play by the user in the following seconds, then analyzes the input of the position of the fingers by the digital inputs of microcontroller and the air pressure exerted by the blow of the user, using analogue digital converter from the same integrated to be compared with the expected feedback and response to a computer (USB communication)[5], specifically to the software in Netbeans, indicating the student qualities or their shortcomings in implementation. Thus, it generates a dynamic conducive to the goal of teaching the correct way to play a flute.

IV. Discussion

A device able to sense the musical notes that are played by a user, with software that guides a user interested in learning the art of playing a flute. It noted the importance of implementing tools, which makes more efficient and effective operation of the circuits that are required, demonstrating the importance of electronic applications in low and high impact exploration in different aspects, as in this case in the arts and music pedagogy. An academic impact was generated, this project 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.

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