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LANGUAGE INTERPRETER FOR THE DEAF CORE USING A VIRTUAL REALITY DATA-GLOVE

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ABSTRACT

This project paper addresses the suitability of a low cost Data-Glove for virtual reality as a tool for reading the hand movements as help for translating sign language for deaf people. The objective is the development and programming of a software interface capable of reading the data provided by the Data-Glove in USB interface for interpretation of the letters of the alphabet in sign language and presentation of its corresponding letter on the computer screen. This is the first stage, the development and test for the Data-Glove communication function, and the test with few alphabet letters.

Keywords: *Language, Interpreter, Deaf Core, Data Glove, Mexican Sign Language (MSL)*

1. INTRODUCTION

Sign language communication is the most commonly used by people with hearing and speech disorders. According to Leybón: "The sign languages are natural languages with unique grammars and independent of spoken languages, which grow innately in time inside a community of users"[1]. Sign language use body as well as hands movements to communicate ideas and words to people who can interpret it. A key part of sign language is provided by the shape (Queirema), movement (Kinema and Kineprosema) and position of the hands (Toponema). A language interpreter system will use these elements to translate from LSM (Lenguaje de Señas Mexicano, Mexican Sign Language). We propose a project with tree stages that will use all these elements, the final goal of the proyect is a system that translates from one person LSM to a computer generated voice speaking the translation form the LSM; in this first stage we will use a Data-Glove to translate the quereima signals to text. With the hands it can spread a lot of information. A device that allows reading the position of the fingers can be used as a tool to assist an individual to communicate information to people who do not understand sign language.

The present paper explains the characteristics of a commercial glove, the available programming languages and provides a guide to develop an application to communicate with the device and the presentation of data on a screen for further analysis and interpretation on a specific interface.

Virtual reality is a computer interface that includes simulation and interactions through different sensory channels in real time, which may be visual, acoustic, tactile, and olfactory stimulus [12].

The high prices that characterize virtual reality devices, has led the search for alternative, less sophisticated as the simulation by conventional computing devices such as keyboard, mouse, and monitor. This is known as desktop virtual reality and into the main computer programs can be mentioned VRML (Virtual Reality Modeling Language), Java 3D [3], Direct X, Maya [6], etc. The limitation of these programs is the complicated interaction for the user as he navigates a three dimensional environment, this becomes a difficult task, since it must combine the functions of the mouse and keyboard to perform more complex movements like walking forward and turn, or rotate and rise. The implementation of a Data-Glove as input device for virtual desktop environments increases the feeling of immersion in the user and allows them to better understand it from within to the development of improved virtual environments [7] .

A. *Previous work*

In the area of technology applied to sign language interpretation will have some significant works in

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two ways, first is to translate the language either spoken or sign language text and the second which means a signer for be translated into spoken or text. In the first case we can cite the work of Fernando Lopez, Javier Tejedor, Daniel Bolaños and José Colas [2], which develop a text transcript of sign language in the presentation to the end user is performed through an animated character in three dimensions and can be used to translate a Web page or a mobile phone to translate a conversation.

In the second case, which is covered by this research, one of the early work is that developed by Sidney S. Fels and Geoffrey E. Hinton in which a multilayer neural network used in conjunction with a VPL glove connected to a DECtalk speech synthesizer to make the system generate audible speech from an input of sign language, which conclude that the system has limitations for using a limited data glove static movements [3]. In 2002, Hernandez, Kyriakopoulos and Linderman present the AceleGlove application as an interface to write in a virtual keyboard by a recognition of 26 signals from ASL (American Sign Language) [4]. More recently Leybon-Ibarra, Ramírez-Barba and Taboada-Picazo [1], developed and implemented a glove with photoelectric devices to distinguish four positions during the flexor movement of fingers distinguishing hand shape a signer performs to communicate through sign language, and functional new development which presents some limitations on the movement of the hand and in the direction of hand movement. In our case, we are using a commercial Data-Glove with more moving capacities and with a minimum cost.

B. Data-Glove

Data gloves are one of today most popular devices for tracking and manipulation of virtual environments. The user uses a glove which has sensors to detect finger flexion, as well as position, rotation and translation of the hand. This information is sent to the computer to be converted into instructions that affect a virtual environment through a software interface. Selecting a data glove for an application is not an easy task. Some factors to be considered are: cost, type of connection, power mode, and available development tools [7].

For the purposes of this paper we use the P5 glove because of its low cost, USB (Universal Serial Bus) which exceeds the RS-232 serial port of Pinch Gloves Glove DG5-VHand, in terms of the power module P5 draws power from the same port, is provided with 3 programmable buttons, an on / off, and unlike others can be programmed for different programming languages including Visual Basic, Java, Delphi and C++.

C. Selected Data-Glove

The P5 glove [13] is a virtual reality device for personal computers, economical and ideal for manipulating three-dimensional environments and in general any environment can be controlled easily as the hand is used in the real world manipulate any object or tool [6]. Figure 1 shows a photograph of the glove and the reception tower in action.

Figure 1: P5 Glove and reception tower

The operating mode of the glove is quite simple. The user moves his hand in front of the tower receiver, which is constantly monitoring a series of infrared sensors, visible or not, found in the palm of the glove and converts those signals into coordinates for the X, Y, and Z; and the direction in degrees to these axes.

D. Mexican Sign Language Alphabet

We obtained the sign language alphabet in Spanish dictionary for sign language Mexicana (DIESELME) [5], Fig 2.

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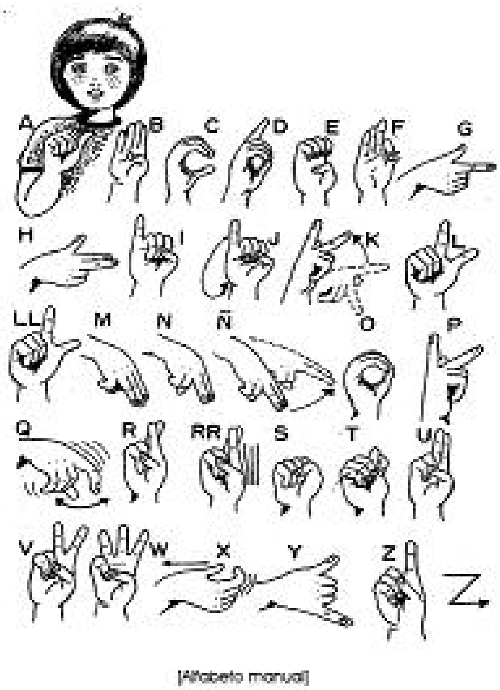

Figure 2. Mexican Sign language Alphabet.

Based on the knowledge of the basic signs for the letters of the alphabet we proceeded to set down the Data-Glove to determine the capacity positions the device was able to run and compare with the alphabet, to assess the number of letters can represent.

2. DEVELOPMENT

To set the Data-Glove there are different development kits, which include the following: SDK (Software Development Kit) official Essential Reality for Visual C + + 6.0, the beta version of dual control of Kenner [11] based on code released by Essential Reality. Of the options mentioned above, the controller Dual is the most attractive because it has the characteristics of the official SDK and add filtering mechanisms to improve data reporting the glove and allows you to program on different platforms such as Java, Delphi, and C / C + + [7].

However, the P5 glove programming took place in the language C + + [10] on the Linux platform, Fedora, mainly due to improved response time that has Linux on their hardware interfaces on Windows. Programming is carried out in C++ using g++ compiler for Linux, installed in the Fedora 8.

A. Test function

"PruebaDatos" function was developed to display the information reported in the glove in text console mode. This makes it easier to focus on the programming of the glove into the details for the interface presented to the user. This function presents the user with data about the position and orientation of the glove and test strips that measure finger flexion. It will use the keyboard in the application menu, and buttons to update the data glove. The program shows the finger values in the next order, from left to right, Thumbs, Index, Middle, Ring, and Pinky. The function output is shown in Figure 3.

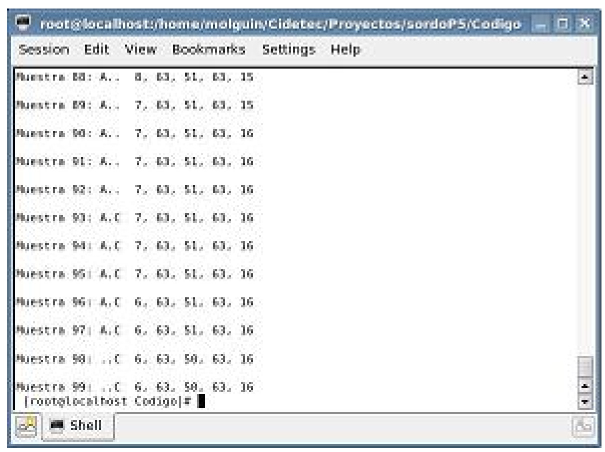

Figure 3, USB data reading RV glove test program output.

The output of the program shows if any of the function buttons are pressed, and the last 5 values show the level of bending of each finger of the glove. It is important to remember that there is a general interface to control the device in a virtual environment, as the marketing of it was focused on the videogame industry. Such is the case that even today's versions of the P5 include three games, a driver for Windows, but no development environment for programming the glove.

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Essential Reality released a development kit for the glove to Microsoft Visual C + + 6.0 free of charge, in order to encourage the development of this without getting a positive response, at least in the field of video games, which could encourage the sale thereof.

B. Movement

To move the virtual hand, just move your glove to the right or left, forward or backward. You can even combine the movements, for example forward and right or forward and to the left, etc.

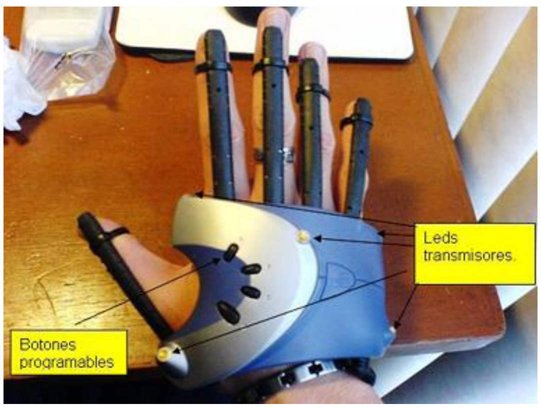

Figure 4. P5 Glove items.

C. Translation and bending of the fingers

You can also bend the fingers of the glove and combined with the earlier movements. Figure 5 shows 4 fingers bent and stretched index pointing forward. Figure 5 shows the glove moving to the left.

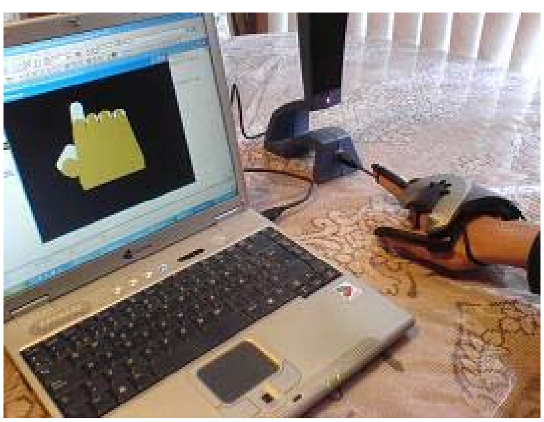

Figure 6. Interface with 4 fingers bent and index finger pointed stretched forward.

This stage of the project only uses the position of the fingers so that does not take into account the spatial position and orientation of the hand. In the next stage of the project we must be using position and orientation.

3. TESTS

First we did some testing of the data provided by the glove to flex his fingers and try some of the letters in sign language, fig. 4

Figure 4. Signs corresponding to the letters I, E, W, V and C, from left to right.

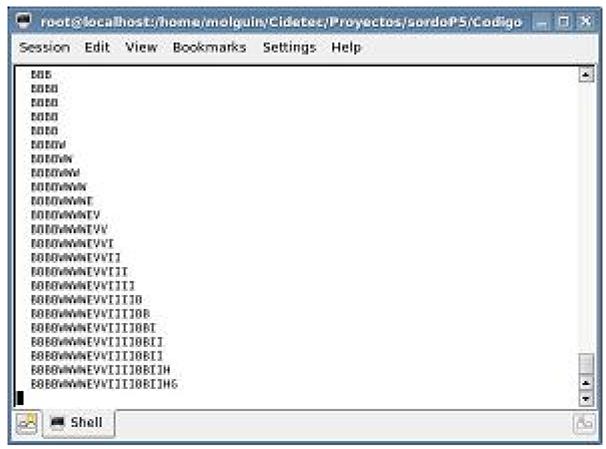

Figure 5. Sign-language interpretation program output.

The first developed function compare the value of bending for each finger and determine their correspondence with some of the letters, if any of them fits the values of a letter contained in the function, then the computer screen show corresponding letter, otherwise nothing is printed, fig. 5. You can see that the glove recognized symbols for letters and G. ECWVH

More letters to try the software recognized the most letters of the alphabet, but the letters that involve hand movements (like the letter J, N or K) or a finger opening (P or R) is not recognized .

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4. RESULTS

In this study we analyzed the most relevant characteristics of P5 glove, and showed by means of a function programmed in C++, how to obtain and display the data reported by the glove, and compared the received data with a small data base for the sign language.

The results have some limitations. For example, in the development of the interface is omitted the translation on the X, Y and Z, due to the difficulty for the user to control the translation in three axes simultaneously. In the case of rotation was kept constant use to make changes to the model in three dimensions, since the glove shows discontinuities in the transmission of data to the computer. The presentation of the interpreted letters always was right if the user do it in the right way, although the presentation time must be adjusted.

5. CONCLUSIONS

The current interface was developed as an independent but is susceptible of being used with an optical system to sense hand movements and not just as also you should also capture the body movements of the user.

The functions performed properly interpreted the letters submitted by the individual, but some letters of the alphabet could not be recognized because the gloves may not report some moves like crossing your fingers.

The next stage of the project is to detect the position and orientation (Toponema) of the Data-Glove and reflect this information in the computer screen. The final stage will reflect the hand movement (Kinema), as well as the previous stages.

The input to the ANN is the value of exponent of reactive power load-voltage characteristic (n_q) and the output is the desired proportional gain (K_P) and integral gain (K_I) parameters of the SVC. Normalized values of n_q are fed as the input to the ANN the normalized values of outputs are converted into the actual value. The process of

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