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Virtual Sign – A Real Time Bidirectional Translator of Portuguese Sign Language

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Abstract

Promoting equity, equal opportunities to all and social inclusion of people with disabilities is a concern of modern societies at large and a key topic in the agenda of European Higher Education. Despite all the progress, we cannot ignore the fact that the conditions provided by the society for the deaf are still far from being perfect. The communication with deaf by means of written text is not as efficient as it might seem at first. In fact, there is a very deep gap between sign language and spoken/written language. The vocabulary, the sentence construction and the grammatical rules are quite different among these two worlds. These facts bring significant difficulties in reading and understanding the meaning of text for deaf people and, on the other hand, make it quite difficult for people with no hearing disabilities to understand sign language. The deployment of tools to assist the daily communication, in schools, in public services, in museums and other, between deaf people and the rest may be a significant contribution to the social inclusion of the deaf community. The work described in this paper addresses the development of a bidirectional translator between Portuguese Sign Language and Portuguese text. The translator from sign language to text resorts to two devices, namely the Microsoft Kinect and 5DT Sensor Gloves in order to gather data about the motion and shape of the hands. The hands configurations are classified using Support Vector Machines. The classification of the movement and orientation of the hands are achieved through the use of Dynamic Time Warping algorithm. The translator exhibits a precision higher than 90%. In the other direction, the translation of Portuguese text to Portuguese Sign Language is supported by a 3D avatar which interprets the entered text and performs the corresponding animations.

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1. Introduction

The evolution of science and the emergence of new technologies combined with the commitment and dedication of many teachers, researchers and the deaf community is promoting the social inclusion and simplifying the communication between hearing impaired people and the rest.

Despite all the progress, we cannot ignore the fact that the conditions provided by the society for the deaf are still far from being perfect. For example, in the public services, it is not unusual for a deaf citizen to need assistance to communicate with an employee. In such circumstances it can be quite complex to establish communication. Another critical area is education. Deaf children have significant difficulties in reading due to difficulties in understanding the meaning of the vocabulary and the sentences. This fact together with the lack of communication via sign language in schools severely compromises the development of linguistic, emotional and social skills in deaf students.

The Virtual Sign project intends to reduce the linguistic barriers between the deaf community and those not suffering from hearing disabilities.

The project is oriented to the area of sign language and aims to improve the accessibility in terms of communication for people with disabilities in speech and/or hearing, and also encourage and support the learning of the Portuguese Sign Language.

The work described in this paper has three interconnected modules. These include a gestures translator in Portuguese Sign Language (PSL) to text, that collects input data from a Microsoft Kinect device and a pair of data gloves, a translator from Portuguese written text to PSL, that uses a 3D avatar to reproduce the animations of the gestures corresponding to the written text, and a module consisting of a serious game designed to improve the learning of PSL. The first two modules are independent from the game. The game is one application of the bi-directional translator between PSL and written Portuguese with a specific aim like many other applications that may be developed.

Several technologies have been integrated including the Blender modelling software, the Unity 3D and Ogre game engines and the integrated development environment Microsoft Visual Studio together with a set of multi-paradigm programming languages, namely C# and C++.

We expect that the bi-directional translator between PSL and written Portuguese (the first two modules mentioned above) will have several applications, mainly directed to assist the communication with deaf people in classrooms and in public services. The serious game is expected to make the learning of the PSL easier and more motivating however this article focuses the translation modules only.

In the remaining of this paper we briefly describe the Portuguese Sign Language, in Section 2, followed by a revision of related work, in Section 3. Section 4 gives an overview of our proposal, while Section 5 provides the technical details of the translation from sign language to text, Section 6 provides details of the translation from text to sign language and Section 8 presents the conclusions.

2. Related Work

Although it is a relatively new area of research, in the last two decades have been published a significant number of works focusing the development of techniques to automate the translation of sign languages with greater incidence for the American Sign Language [4], and the introduction of serious games in the education of people with speech and/or hearing disabilities [5].

Several of the methods proposed to perform representation and recognition of sign language gestures, apply some of the main state-of-the-art techniques, involving segmentation, tracking and feature extraction as well as the use of specific hardware as depth sensors and data gloves. Deusdado [6] writes about the use of new technologies for dissemination and teaching of sign language, highlighting the use of 3D models (avatars) in the translation of words to sign language. Kulkarni et al. [7] provide an automatic translation model of static gestures corresponding to the alphabet in American Sign Language (ASL). In this model three feature extraction methods and a neural network are