PARLOMA: A Remote Communication System for Deafblind People

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Abstract
This work aims at designing a low-cost communication system to allow remote communication among deafblind people, up to now impossible. Due to their lacking of both the auditory and the visive channel, deafblind people can receive feedbacks and messages only resorting on hand-in-hand communication and only from speakers physically located near them. Such limitation aggravates their situation and cause deafblind people to live behind a wall of isolation from active society.

PARLOMA aims at breaking this wall, developing a tool that can be used by deafblind people to communicate whenever they want and wherever they are.

1. Introduction
One of the main characteristics of human beings is the will to form communities and get in touch with society. A crucial condition to allow this cohesion is communication, which is based on the sharing of a language.

In its typical form, the human language is conveyed through acoustic-vocal modalities. In deaf people, this modality is not accessible and language finds naturally other ways. This modality is called "gestural-visive": the meaning is codified in the poses made by hands, by gestures, and by facial expressions, and it is then received through the optical apparatus. Sign Languages (SL) are true natural languages, exactly like vocal languages: they have a complete grammar and can convey every possible meaning; moreover, but they are totally independent from the latter.

Deafblind people can use neither vocal languages nor SLs, in the latter case because they lack a way to receive the meaning expressed by the signer. For this reason their communication is based on a different mechanism: the receiver’s hands are placed on the ones of the signer in order to follow the signs made. Since the communication is still based on SLs, these variants are called tactile Sign Languages (tSL). Therefore, while it is possible for two normal speakers or two signers to communicate in presence of one another or remotely (either through phone calls or video-calling systems), at the moment there is no way for two deafblind people to communicate with each other if they are not in the same place, given the basic need to touch each other's hands.

The PARLOMA project aims at enabling tSL remote communication, developing a haptic interface which able to reproduce tSL locally, in order to keep communication natural and immediate for deafblind people.

2. Preliminary development
At the end of our research phase, we have developed a first working system that has been already validated by some deafblind interpreters and end-users; all the main Italian deafblind associations have been actively involved through all the phases of the development.

So far, the project has targeted the Italian tSL, the language used by Italian deafblind people and the ones involved with this community; later on, the support will be extended to other tSLs spoken in other parts of the world. In fact, final aim of the project is to develop a system independent from the semantic of the conveyed messages, and thus can be used by people from all over the world.

The proposed system is designed in order to accomplish to three different tasks: (1) sign acquisition and recognition (front-end), (2) sign conversion and transmission, (3) sign synthesis (back-end). Such tasks are performed by three different sub-blocks, i.e., the input module, the transmission module and the robotic hand module.

The input module is connected to a depth camera (the acquisition device) and is able to identify signs made by the human hand in front of the device. This module has been optimized to work in real-time (30 fps) even on a 4-years-old laptop and to be as robust as possible, since the system is supposed to work correctly even when used by people with very different hand shapes.

The transmission module is in charge of encoding the information generated by this first block, sending them through the web, and decoding them in a way that is suitable for the last block.

Finally, the robotic hand module is composed by a 3D printed dexterous low-cost robotic haptic interface and by a controller that uses the information received from the internet to control the robotic interface in a proper way.

Using our pipeline, any user A can sit and sign in front of the depth camera; messages are transmitted over the Internet and received by the robotic hand (wherever it may be in the world) that mimics what A is signing. Finally, a deafblind user B can understand the message by touching the robotic interface with his hands.