Chapter XIV

Speech Technologies for Language Therapy

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Abstract

This chapter presents the development and use of speech technologies in language therapy for children with hearing disabilities. It describes the challenges that must be addressed to design and construct a system to support effective interactions. The chapter begins with an introduction to speech and language therapy and discusses how speech-based systems can provide useful tools for speech and language therapy and to overcome the lack of sufficient human resources to help all children who require it. Then it describes the construction of adequate speech recognition systems for children, using artificial neural networks and hidden Markov models. Next, a case study is presented with the system we have been developing for speech and language therapy for children in a special education school. The chapter concludes with an analysis of the obtained results and the lessons learned from our experiences that will hopefully inform and encourage other researchers, developers, and educators to develop learning tools for individuals with disabilities.
Introduction: Language Acquisition and Hearing Disability

Hearing is the means by which humans acquire their spoken language (Flores & Berruecos, 1991; McAleer, 1995). It is mainly through spoken language that a child learns about his or her world, and this is where the development of the intellect begins.

Hearing impairment can range from partial to complete loss of hearing. Hearing impairment or deafness in infants poses a big problem for language acquisition and requires special attention. Although sign language exists, about 90% of all children with profound hearing loss are born to hearing parents, and many parents want their children to be able to communicate with them and others using speech. Therefore, it is very important to find the means for these children to learn to express themselves orally (Delgado, 1999).

Each year thousands of deaf children receive cochlear implants. In many countries, screening newborns for hearing loss before they leave the hospital has become mandatory, and this process is identifying important numbers of infants with significant bilateral hearing loss. Early detection and intervention for these children, including cochlear implants, has dramatically improved the chances for these individuals to lead a normal and productive life in a hearing world. Once these devices are implanted, the children need help learning to perceive and produce speech and language, so speech and language therapy is critically important. Because they are hearing language for the first time, these children often have difficulty making sense of sounds and enunciating clearly.

Speech and language therapy at special education schools typically focuses on three general topics (Valadéz & Espinosa, 2002):

- **Articulation of vowels and consonants:** This refers to the positions of lips, tongue, and teeth to pronounce each vowel or consonant. This is taught by the teacher pointing to her or his mouth and showing the movements, although many of them remain invisible inside the mouth.

- **Intonation, modulation, and rhythm:** These are taught through repetitions, trial, and error, where the teacher corrects each student when speaking. Intonation is marked on a blackboard or on words painted on papers, pinned to the walls using circles that show the syllable that has to be spoken with more emphasis than the others. Rhythm is practiced by clapping while pronouncing certain words.

- **Individualized, one-on-one instruction:** Because each child will have special needs, children in special education programs typically receive individual training sessions with a speech and language pathologist who will focus on the particular problems he or she has, to complement their training along with other children in the classroom.