Auditory-Verbal Education for Hearing Impaired Children using Internet-based Technologies

OVIDIU GRIGORE, VALENTIN VELICAN
ALEXANDRA CRACIUNOIU
Department of Applied Electronics and Information Engineering
Polytechnic University of Bucharest
B-dul Iuliu Maniu 1-3, Sector 6, 061071 Bucharest
ROMANIA
ovidiu.grigore@upb.ro

Abstract: - The article presents principles of designing and implementing a software application intended for auditory-verbal education of hearing impaired children. Furthermore the paper presents an ActionScript 3.0 based application developed by the authors.

Key-Words: - auditory-verbal, e-learning, software design, implementation

1 Introduction
The contemporary trans-disciplinary research paradigm is represented by human assimilation and processing of a higher volume of information converging from the various cognitive areas.

From a psychological point of view, the assimilation and functionality of an optimum volume of knowledge is synonymous with developing and improving the psychic functions as a whole. This process should begin with developing sensorial functions.

In this context, the auditory function plays a special role, as a result of its three different functional systems: the general orientation system, the auditory-verbal system and the auditory-musical system, thus actively integrating the person in relation with the three specific acoustic realities, namely ambiances reality, verbal language and music.

The malfunctioning of the auditory system determines the human to be subject to a complex restructuring process of the acting strategies and of the sensorial and psychic compensation strategies. The sense of orientation and in particular the development of the verbal language and the performing of its functions will be disturbed; the absence of a fluent communication means bringing into danger the active integration of the person in the life’s social flow.

Recently, the usage of computers becoming more accessible and their introduction into schools, including special schools, might increase the quality of educational and recovery interventions performed at young age children borne with hearing disabilities. A classic methodology of auditory system recovery implies regular visits to specialised cabinets in order to train the child to correlate sound stimuli with images of the emitter. The effectiveness, in this case, could be quite limited as specialised centres are very few and due to distance poorly accessible by some patients. These lacks are added to the causes determining the low intelligibility of hearing impaired persons’ language, decreased scholar performances, and difficult social integration as presented in literature. [8], [9] Also in the case of a large number of children needing treatment, the personnel may be overwhelmed and find it self unable to correctly supervise all the recovery exercises performed by the children.

The methodology of auditory education and of sensorial education knew more or less support from some contemporary technological disciplines [4], [6] yet, many of these technologies became obsolete and were not replaced with time.

Therefore a software application, accessible over internet, combining flexibility, cost efficiency and above all an user friendly architecture, could be very helpful in overcoming the mentioned issues.

The auditory education which prepares the auditory-verbal education was and remains a priority in the recovery methodology panoply, especially for the hearing impaired persons. This is very important for the compensatory process in all shapes of disabilities or development disorders as well as in the early education of children with or without disabilities, thus sustaining the linguistic
development/recovery and their cognitive processes.

The computer assisted education or 'e-learning' is nowadays a growing field. Developed to facilitate the learning process, it presumes logic, sequential ways of presenting information in order to make it easier for the students to assimilate knowledge, in a personal, unconstrained and unsynchronized manner. E-learning type computer applications also aim at making the learning process more accessible, by offering internet based solutions that disseminate information in an easier and more rapid way.

Therefore a computer application, designed to improve the auditory education process of young hearing impaired children should offer not only the advantages of the already tested classic methodology but also, additional, e-learning type characteristics.

2 Problem Formulation

The main problem encountered in developing a computer application in general, and an e-learning application in particular is starting from an incorrect hypothesis.

Before processing the information, the child first has to hear it, listen to it and therefore consciously and actively accept it. The goal is to associate the sound with the visual information.

According to the specialists, there are some distinctive stages that the child should follow in order to successfully complete an auditory-verbal education process:

a) Stimulating the attention towards auditory acceptance;
b) Detecting, differentiating, identifying and recognizing the nonverbal sounds in the nature (objects, natural phenomena, animals);
c) Identifying and differentiating, recognizing and reproducing the verbal sounds; comprehension and articulation of the simple and complex verbal structures.
d) Imposing practice of the prosodic traits of language: rhythm, accent and intonation.

It is therefore mandatory to consider these theoretical stages in order to correctly build a software application with the intended goal.

3 Problem Solution

3.1 Approaches in auditory-verbal education

a) It has to be taken into consideration that the interest in an active auditory acceptance is a matter of motivation, and only then, a matter of education. Developing an active attitude towards accepting the environmental sounds, to the hearing child, but mostly to a hearing impaired child, means enhancing his chances of a better integration not only in the physical environment but especially in the social one, through development of the verbal language and through increasing the informational processing capacity. Therefore a special attention should be granted to auditory acceptance and listening process, for activating this new sensorial channel, for accommodating with this new category of stimuli, the auditory stimulus; for detecting, differentiating, identifying and finding meaning to environmental sounds, including the verbal language which might be firstly perceived as a foreign language, as the literature reveals [1] [2] [3].

An e-learning computer application that respects such considerations should present an appealing interface with abundant games, imagery and sounds, integrating ease of access and interacting with the child up to an emotional level.

b) It is highly important to deliver the stimuli in a sequential manner, progressively increasing the degree of difficulty. It is assumed that a correct perception and association of the stimuli with it’s real correspondent can be done by isolating at first sounds of simple meaning, nonverbal by their nature. A computer application should consequently contain a stage of nonverbal training and testing, presenting sounds and images of their emitter and later on asking the child to carefully listen and then associate sounds with images.

After the understanding of simple sounds has been assured the child can now move to a more challenging level where verbal sounds may be assimilated. It is important though, to remember that a nonverbal training stage is mandatory in designing a software aiding tool as an approach to rapidly developing the verbal language may lead to a lack of the ability to freely categorise the presented material and consequently to a lack of word stimulation. [7].

c) Recognizing and reproducing verbal sounds is the next logic step in the process of auditory-verbal education. At this point the child should be progressively stimulated with verbal structures of
increasing difficulty on similar principles as presented on the previous paragraph.

d) One last but important factor in correctly developing an e-learning auditory-verbal recuperation application is to impose practice of prosodic treats of language. It should not be forgotten that accent, intonation or rhythm are elements that complete the definition of correctness of a language and therefore a section of the computer program should be dedicated to such type of exercises.

3.2 Further Ideas to Consider

An important factor to be treated when designing an e-learning application is the accessibility of the software. A client-server architecture or web-page like applications are to be preferred in order to give the opportunity to children in remote places to access an efficient education method. Furthermore an application designed in such a way, should feature the capability of recording the progress data of students, disseminating the results towards specialists for further analysis.

When it comes to the user interface, the application should contain a setup section in order to modify it’s functionality according to the level achieved by the student. The setup menu should be accessed by the specialists or by a person following closely the specialist’s recommendations. The “education” and “testing” interfaces should be designed in an intuitive and in an “as simple as possible” manner. Implementing a hardware interface that replaces the keyboard or mouse or implementing the application on a touch screen system (where possible) should be also taken in consideration as it is important to maximize the concentration of the child towards the stimuli and not to other factors.

The hypothesis from where to begin in developing a completely independent stimulation algorithm is that an association of the auditory stimulus in a certain manner (frequency, length and periodicity) with the image and with the word defining the image, determines on one hand the development of the auditory memory for that auditory pattern and on the other hand the development of the visual memory for the written shape of the word which designates the source of producing the auditory pattern. A truly general plan to develop such an algorithm is not applicable as efficiency is subject to change due to the user’s ability to learn; therefore in such cases, an adaptive way is to be preferred to a strictly rigid one.

The application should also contain an as broad as possible database of sounds and pictures in order to make it more interesting for the young users. Let us once again remember that by far the most important factor is to attract the child and not to oblige him to use the program.

3.3 An Example of Auditory-Verbal Education “E-Learning” Application

Considering all the presented ideas above, the authors developed an e-learning type application which aims at helping children with affected hearing in associating visual stimuli (in this case pictures of objects, animals or natural phenomena) with sound. The application has been written in ActionScript 3.0 in order to make it accessible remotely, by internet.

The entire architecture features two main sections, a “training” section in which the child has to learn new stimuli and a “testing” section in which the child is verified in order to see the achieved level after a period of training. Both these sections are preceded by a setup screen in which the supervisor can choose the parameters of stimulation.

In the “learning” section, the interface is as simple as possible with images displayed while associated sounds are being played. The supervisor decides when to start the stimulation, at a click of a button. Also, using the setup screen, the supervisor decides the category of stimuli to be used and the delay between the appearance of the image on the screen and the moment the sound is being started. (Fig.1). The child is only requested to watch and listen as a slideshow of pictures and their associated sounds is being displayed. (Fig.2)

![Fig.1 – Education stage; setup screen](image-url)
The “testing” is based on a similar interface (images and sounds) but this time, several pictures (2 – 4) are displayed at a time. The child is requested to choose the correct image associated with a sound being played (Fig.3). The setup screen for the tests, presents more options. As can be seen in (Fig.4), the supervisor can choose the category of the stimuli, the number of questions, the delay between sounds and pictures, the number of simultaneous displayed images, etc. The results of the test are being shown at the end using simple bar graph architecture. (Fig.5)

The application can be found at the following web address: http://ai.pub.ro/education.html

## 4 Conclusion

Integrating some theoretical patterns and some experimental results for psychology and informatics, in order to achieve a new concept with an enhanced degree of appeal and adaptability which will successfully address to different subjects categories (hearing impaired people, with development disorders or without deficiencies) are the basic goals of an e-learning software application design.

### ACKNOWLEDGEMENTS:

This work was supported by CNCSIS – UEFISCSU, project number 853/2009.

### References


