

End-User Recommendations on LOGOMON, a Computer Based Speech Therapy System for Romanian Language

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Abstract—In this paper we highlight the relations between LOGOMON – a Computer Based Speech Therapy System and dyslalia’s training steps. Dyslalia is a speech disorder that affects pronunciation of one or many sounds. This presentation of the system is completed by a research regarding end-user (i.e. teachers and parents) attitude about the speech assisted therapy in general and about LOGOMON System in particular. The results of this research allow the improvement of our CBST system because the obtained information can be a source of adaptability to different expectations of the beneficiaries.

Index Terms—speech therapy, personalized therapy, end-user attitude

I. INTRODUCTION

There is a powerful preoccupation at the European level in helping the people with speech disorders; that is why there are a lot of *Computer Based Speech Training Systems* (CBST), for both commercial and research purposes. According to [1], a CBST is a system for training speech production for people with speech and hearing impairments.

Statistics [2] show that 10% of children between 4 and 7 years of age, present different levels of speech problems. Although these impairments do not create major difficulties in basic communication, it has been noticed that problems are likely to appear affecting negatively the child’s personality, as well as his social skills [3, 4, 5].

Our CBST system has been developed for Romanian preschool children, to improve assessment of *dyslalia* a speech disorder which affect pronunciation of one or many sounds [6].

Taking into consideration the fact that Romanian language is a phonetic one that has its own special linguistic particularities, we consider that there is a real need for the development of audio-video systems which can be used in the therapy of different pronunciations problems.

The full system targets interdisciplinary research (computer science, psychology, electronics) - having as main objective the development of methods, models, algorithms, System on Chip architectures with regards to the elaboration and implementation of a complete system addressing the therapy of dyslalia affecting pre scholars, in a personalized and user centered manner.

We start with classic CBST architecture and we design and implement, an improved CBST system, named

LOGOMON (Logopedics Monitor). This CBST contains classical modules as *Children Manager*, *3D Articulator Model*, and *Homework Manager* (installed on the child’s PC or PDA) [7]. Our main contribution was to improve the classical architecture with a *fuzzy expert system*. The role of this module is to suggest *optimal therapeutic actions* for each child (number, length and content of training sessions), based on specific information (tests’ scores and social, cognitive and affective parameters) [8, 9].

II. STATE OF THE ART

Selection of most important CBST systems is not an easy task. However, two recent projects have a special place in speech therapy field: OLP and ARTUR. For both projects, experiments’ results are available.

The OLP (Ortho-Logo-Paedia) project [10] has been started in 2002, involving the Institute for Language and Speech Processing in Athens and seven other partners from the academic and medical domains. The project aims to accomplish a three - modules system (OPTACIA, GRIFOS and TELEMACHOS) interactively capable, instructing the dysarthria suffering children. The proposed interactive environment is a visual one and it is adapted with the age of subjects using different games and animations. The audio and video interface with the human subject is the OPTACIA module, the GRIFOS module makes pronunciation recognition and the computer aid instructing is integrated in the third module - TELEMACHOS.

One of the most recently CBST system is ARTUR (*Articulation Tutor*) [7]. The goal of this project is to obtain an integrated speech therapy system with an intuitive graphical interface named *Wizard-of-Oz* and a virtual speech tutor named *Artur*. Based on audio (user’s utterance) and video (facial data) information, the system can recognize and reproduce mispronunciations.

At the Romanian national level, only a few researches have been conducted to the therapy of speech impairments [11]. We can mention the studies made by the *Psychology and Education Science Department* from “Al. I. Cuza” University, Iasi. These studies carry out the development of software, in order to provide stammer witness therapy.

As far as we know, there are not applications of fuzzy expert system in CBST field. That is why we consider our approach being a step forward. The system was developed and tested for Romanian language and for Romanian educational community, but our proposed method is not limited to this language.

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III. IMPLEMENTATION OF TERAPEUTICALLY STEPS IN LOGOMON SYSTEM

Psychological researches [6, 12, 13] have indicated the main aspects regarding dyslalia therapy (Figure 1).

In the first step, which is *Complex Examination*, the speech therapist collects the base data set of information used for the child's diagnostic and future therapy. If in this stage the speech therapist detects other problems like specific illness or affective trauma, he may require *Additional Analysis*.

Personalized Therapy is divided in *Cabinet Therapy* and *Home Therapy*. All kind of exercises are grouped in two main categories: *General Therapy* (mobility development, air flow control, hearing development) and *Specific Therapy* (sound obtaining, consolidation and regular utilization).

Each therapy session contains a *Formative Assessment* and will be followed by home training. After six months, the speech therapist performs a *Summative Assessment* and decides the finalization or the reconsideration of the treatment.

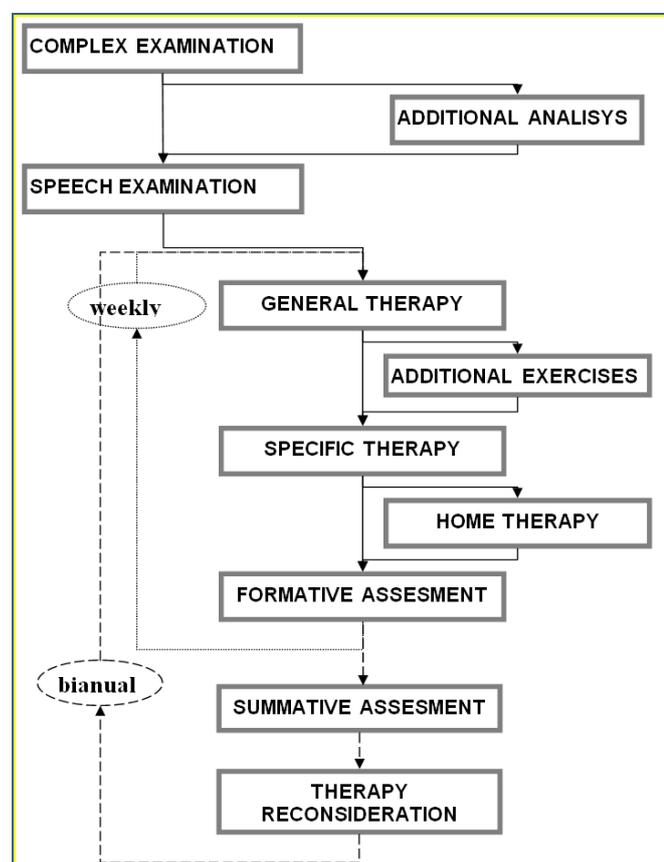


Figure 1 – The dyslalia therapy diagram

A full computer based speech therapy system must contain at least following items [14, 15]:

- monitor program (installed on speech therapist computer, helps on children data management);
- expert system (based on children related information's obtain a personalized therapy path);
- exercises set (for cabinet and home use);
- home training possibility (exercises on personal computer or mobile device).

Architecture of our developed speech therapy system is presented in Figure 2.

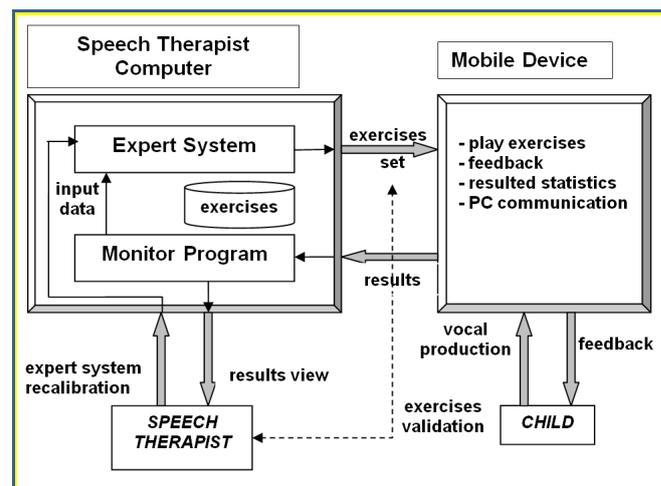


Figure 2 – LOGOMON architecture

One of the main objectives of our CBST system was the development of an expert system for the personalized therapy of speech impairments, which will allow the designing of a training path for pronunciation, being individualized in accord with the defect category, previous experiences and the child's therapy previous evolution.

Base on this information, encoded using fuzzy paradigm, the expert system provides answers to the following questions [8]:

- How frequent should the training sessions be?
- How long should each session take?
- What type of exercises should be used and what content should they have?

Previous research has proved the equivalence between classical approach (the selection of exercises is made at the beginning of the session by speech therapist) and our novel approach (exercises are generated by the system expert) so we may consider that the exercises' choice can be performed either by speech therapist or expert system.

The specific advantages of an expert system addressing therapy of children with speech impairments are:

- the automatic personalized therapy system stores the precise evolution and progress of each child and, by adapting the exercises to each child's current level and progress, the speech therapy may take less time to achieve its result;
- patience, flexibility and unlimited working time whenever the child desires;
- the possibility offered to the speech therapist in order to accurately find out why the system generated some therapeutic proposals;
- an exact evaluation of the progress is difficult to achieve for a human expert; instead, the system is designed to analyze in an objective manner, the evolution of each case on small time intervals.



Figure 3 – The monitor program's menus

Each step presented in Figure 1 has a specific area in monitor program's interface (Figure 3) and each of these menus can be expanded to access specific part of therapy (Figure 4).

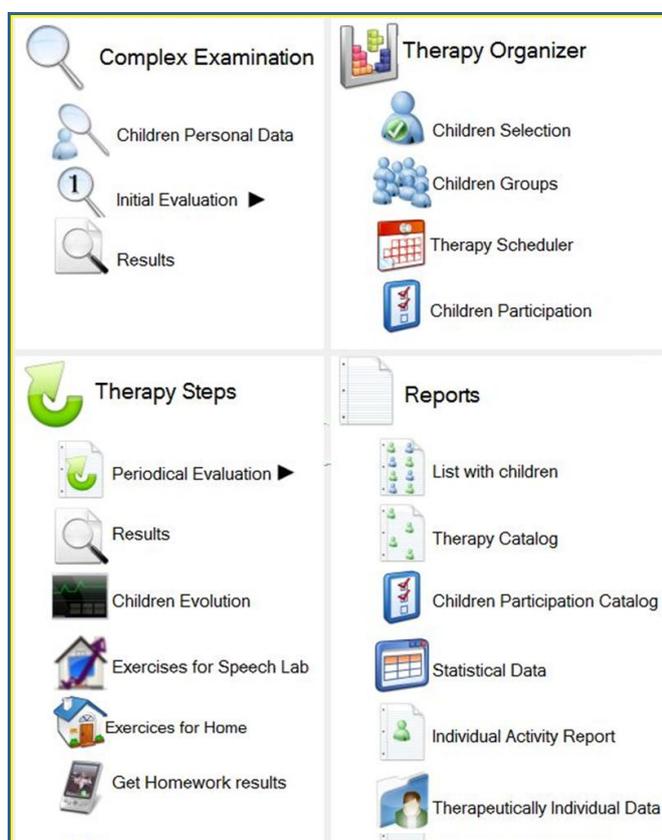


Figure 4 – The main areas of the monitor program's interface

The LOGOMON system is currently in use at RSTC – Regional Speech Therapy Centre of Suceava, Romania and contains exercises [16] based on: 36 exercises types; over than 1 500 image files; over than 10 000 audio files.

IV. THE ATTITUDE OF EDUCATIONAL COMMUNITY ON ASSISTED SPEECH THERAPY

A. Methodology

In this research we wanted to investigate parents' and teachers' attitudes regarding computer based speech therapy in general and LOGOMON system in particular. Our questionnaire contains some items (*independent variables*) that allow us to define subjects groups and other items that reveal subjects' attitude (*dependent variables*).

The *independent variables* are: age, gender, rural or urban, teaching cycle (i.e. kindergarten, primary, secondary or high school), computer using experience, speech therapy experience.

The *dependent variables* are:

closed-ended questions:

- the efficiency of CBST;
- the contribution of logopaed/PC in therapy;
- the relation between children and CBST;
- the utilization of CBST for their own children.

open questions:

- the advantage of CBST;
- the disadvantage of CBST.

The *research purpose*: to identify the teachers' representation regarding the role of computer in speech therapy field.

The *specific research hypothesis*: the subject groups (formed by independent variables) have different attitudes regarding computer based speech therapy.

The *subjects* were 143 persons with following distribution: parents - 30% and teachers - 70% (kindergarten - 27% and primary school - 73%), male - 13% and female - 87%, rural - 52% and urban - 48%. These subjects participated on a detailed presentation of LOGOMON and, after that, they completed a questionnaire.

B. Results and discussions

The attitude of educational community (closed questions) regarding LOGOMON is, in general, a positive one:

- 72% appreciate the efficiency of CBST;
- 53% consider that optimum ratio between PC and logopaed in assisted therapy is 30%/70%;
- 88% estimate a good relation between CBST and children;
- 80% would utilize a CBST for their own children.

The four most mentioned advantages and disadvantage (open questions) of the assisted therapy are:

advantages:

- the children like to interact with computer;
- the unlimited patience;
- the utilization of games;
- the individualization of therapy.

disadvantages:

- the PC addiction;
- the poor feedback;
- the lack of affective support;
- the health problems (eyes, RISE).

recommendations:

- the improvement of feedback;
- the recognition of emotional state of the child;
- the variation of exercises;
- the adaptation with subjects' age.

In order to archive a most detailed analysis on advantages and disadvantages, we look for significant differences between answers of subjects groups (chi-square test - χ^2 test).

The "teaching level" independent variable (Figure 5) generates some differences both on perception of advantages and disadvantages and the χ^2 test highlight them. Primary teachers are more enthusiast because CBST offer lots of exercises in an interactive manner ($\chi^2=3,329$, $p<.05$) and, in

the same time, are more concern regarding children that don't have a PC in their home ($\chi^2=2,959$, $p<.05$). A possible explanation of these differences can be an elementary logopaedic rule: Home therapy is more suitable for older children.

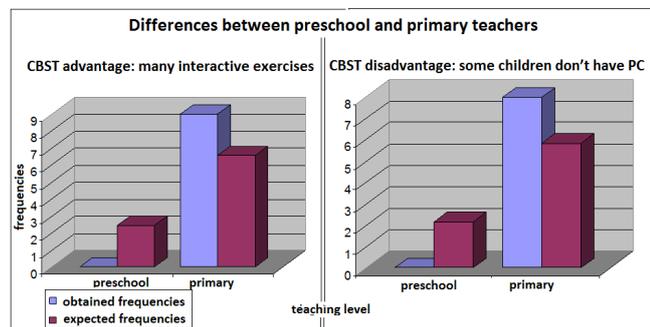


Figure 5 – The differences between preschool and primary teachers

The statistic calculus has shown that there is some significant difference between parents and teachers (Figure 6). First of all, teachers put in front the interest of children regarding PC technologies ($\chi^2=3,248$, $p<.05$). Another difference is the opinion related by the lack of human feedback in CBST systems. Then, teachers are more concerned about this topic ($\chi^2=4,196$, $p<.05$).

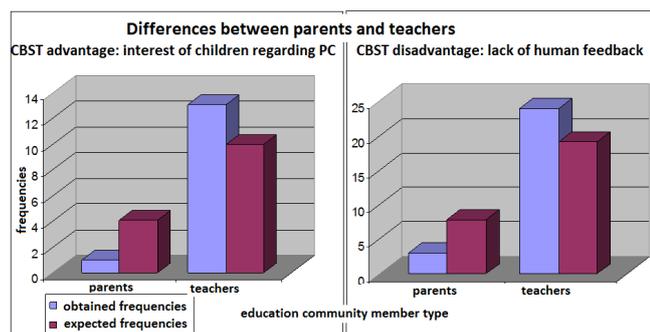


Figure 6 – The differences between parents and teachers

V. CONCLUSION

After the implementation of system was finished, three type of validation was performed: practical validation (RSTC Suceava), experimental validation [8] and educational community validation.

The third level of validation reveals a positive attitude regarding LOGOMON system and highlights some assisted therapy advantages and disadvantages. This representation

allows the adapted CBST software development because the information obtained can be a source of adaptability to different beneficiaries' expectations.

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