CONTRIBUTION TO PEDAGOGICAL BACKING MODELS BASED ON ICT AND INTELLIGENT SYSTEMS AS SUPPORT TOOLS FOR SPECIAL EDUCATION AND SPEECH AND LANGUAGE THERAPY.

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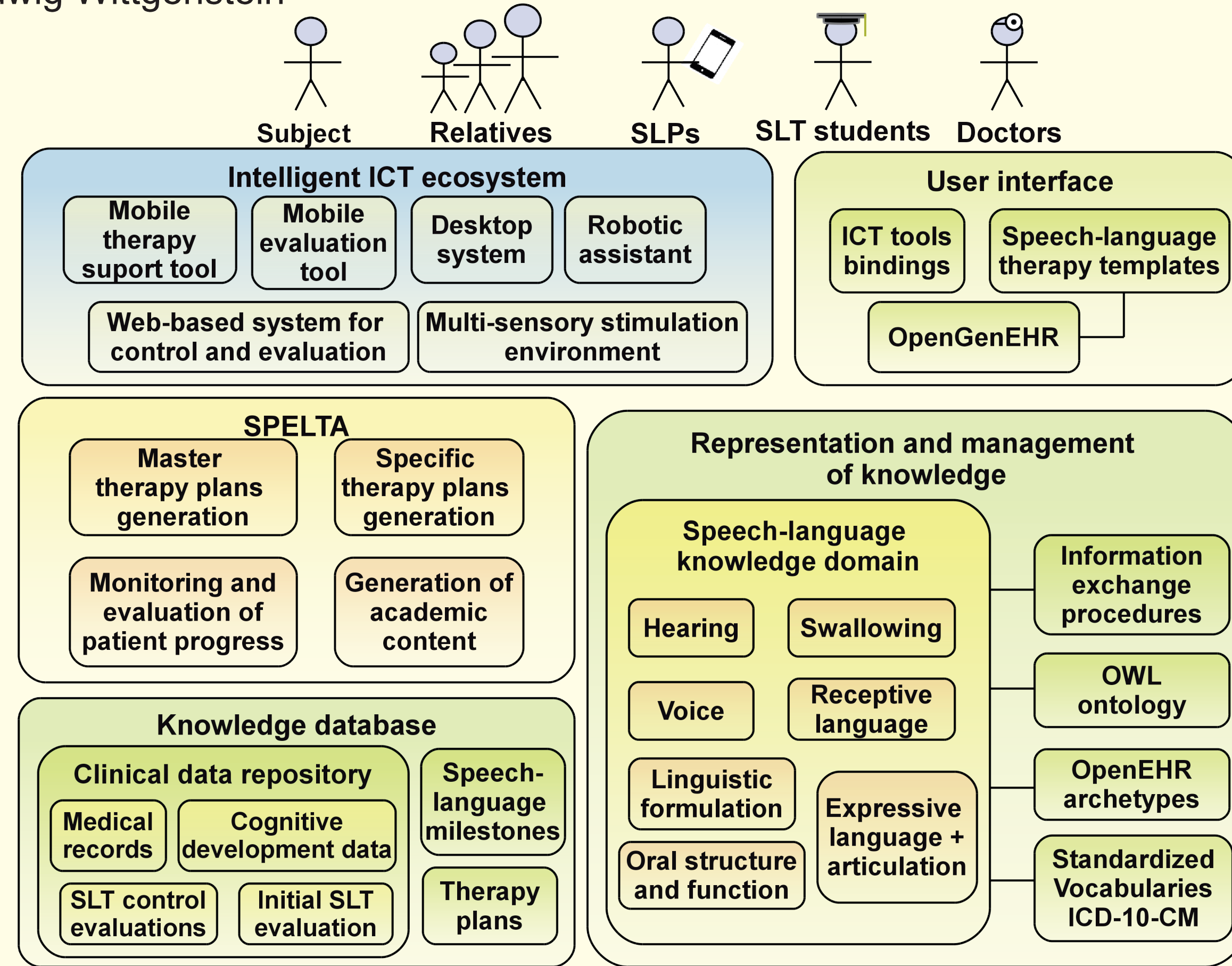
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MOTIVATION OF THE WORK

*The limits of my language are the limits of my world.*
Ludwig Wittgenstein

• The WHO (World Health Organization) and World Bank estimate that a billion people live with some form of disability.
• There are currently no reliable and representative estimates based on actual measurement of the number of children with disabilities.
• Nowadays 60 million people live with hearing loss while 15 million suffer stutter in the world.
• There is a lack of significant services for children with disabilities in the field of speech therapy.
• Currently does not exist a tool that combines the different agents involved in speech-language therapy, like planning of therapies for long-term and short-term, automatic generation of contents/activities for special education, etc.


RELATED WORK

• The most of the proposals developed are focused on specific disorders, and generally do not rely on standardized vocabularies and clinical repositories. Likewise, they do not provide support for patient suffering disabilities as cerebral palsy, intellectual disabilities, autism, among many others.

Caballero-Morales and Trujillo-Romero, 2014
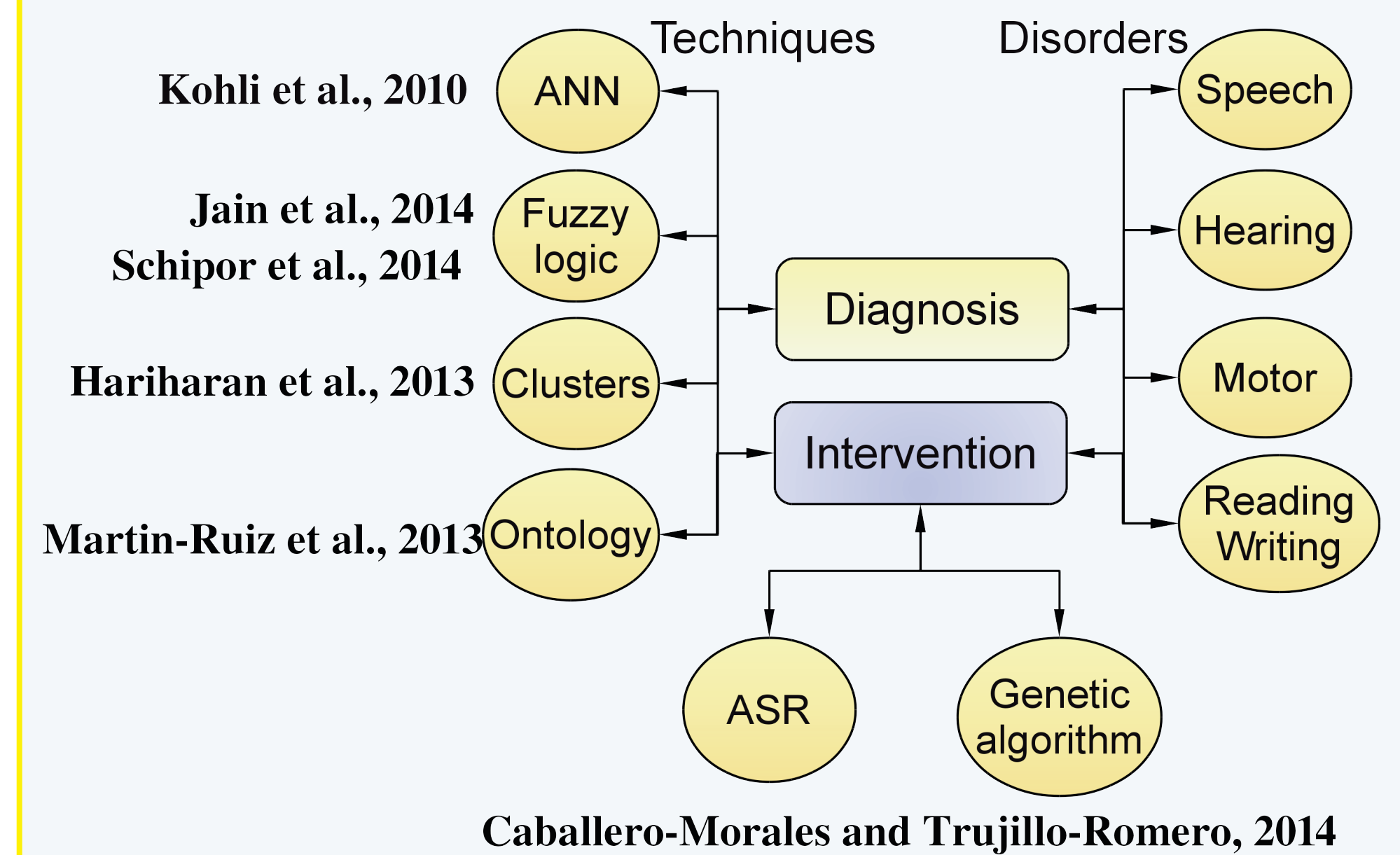
THESIS OBJECTIVES

• Develop a support model for special education and speech-language therapy based on intelligent processes, ICT and automatic content adaptation.
• Study the existing techniques to achieve the personalisation, adaptation and composition of contents for special education.
• Propose new backing methods for speech-language therapy and automatic generation of educational contents through a new support schema for speech-language pathologists, teachers and other researchers, as well as to patients and their relatives.
• Develop an intelligent prototype and a corpus consisting in 200 real cases of children suffering from several disabilities related to speech and language.
• Validate the performed processes with support of speech-language pathologists in contrast with traditional techniques (manual planning, manual assessment of children, etc.).

RESEARCH PLAN
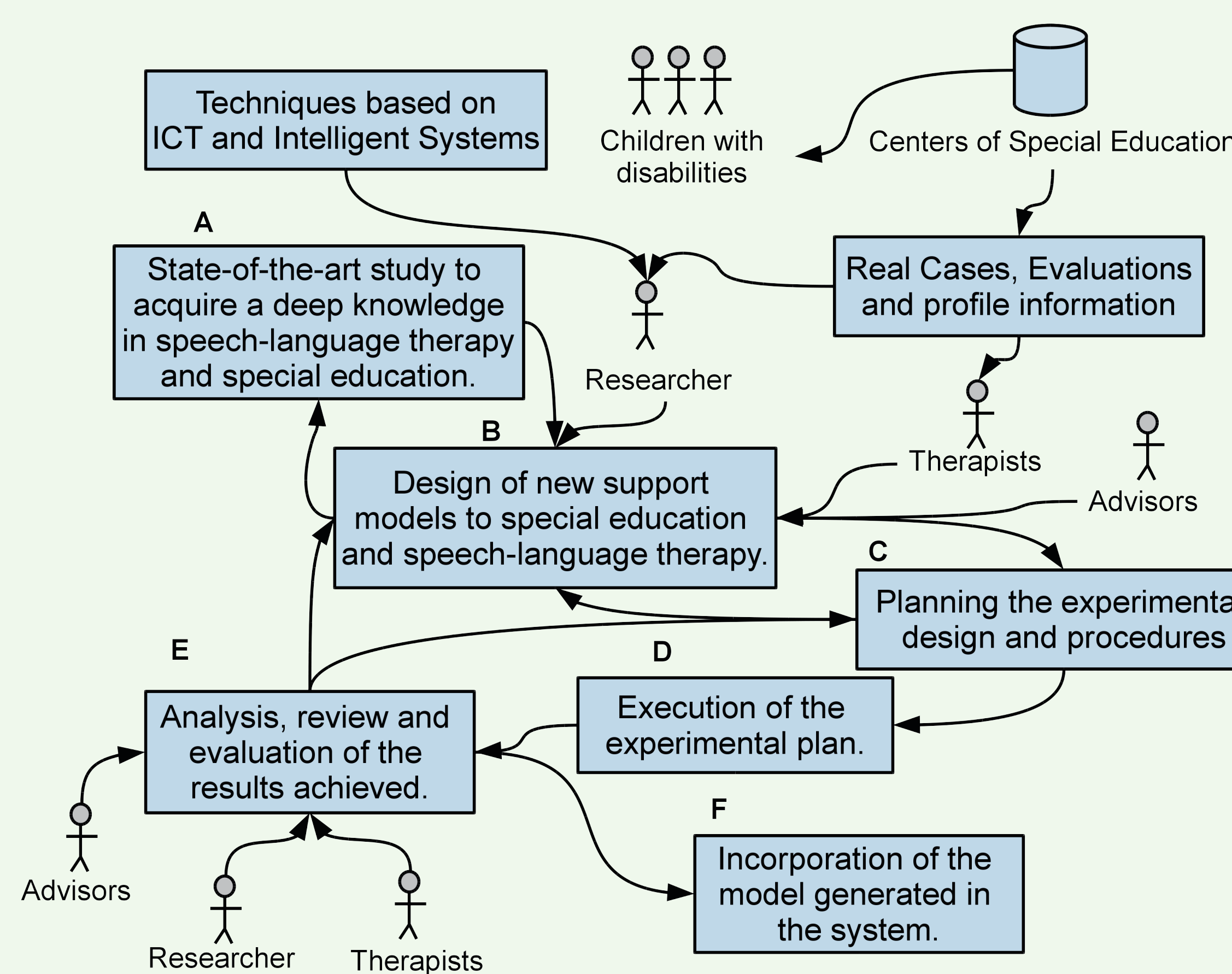
NEXT YEAR PLANNING

Given the results achieved with the initial research, we propose the following activities and lines as future work:
• Explore the possibility to use algorithms based on neocortex to generate therapy plans.
• Explore the viability to develop an intelligent module focused in competencies, disorders and knowledge areas to provide support in the characterisation and analysis of the children's profile.
• Analyse the possibility to develop transformation distance/measures between two representation spaces of speech-language's cases: the space of diagnosis, initial evaluation and analysis of the child's profile, and the space of therapy plan.
• Explore the viability to develop a intelligent module to provide to therapists the logical structure to collect and perform relevance feedback of the generated therapy plans.

PRELIMINARY RESULTS

We have developed some of the most important elements of an Ecosystem to support the SLT:
• A robotic assistant based on mobile devices.
• A mobile environment to support several activities and exercises of articulation therapy.
• An expert system to automatically generate long-term therapy plans.
• A set of prototypes of archetypes, ontologies and templates to represent the SLT knowledge.
• A new model to generate specific therapy plans using a data mining approach.
• On the base of this research has been developed a international H2020 project that involves several companies, universities, and health authorities from 8 countries.

PAPERS 2015 (IN PRESS):

• **SPELTA: An expert system to generate therapy plans for speech and language disorders**. Expert Systems with Applications, In press.
• **An ecosystem of intelligent ICT tools for speech-language therapy based on a formal knowledge model**. In 15th World Congress on Health and Biomedical Informatics (MEDINFO). São Paulo, Brazil : MEDLINE.
• **RAMSES: A Robotic Assistant and a Mobile Support Environment for Speech and Language Therapy.** In 5th International Conference on Innovative Computing Technology. Vigo, Spain: IEEE.
• **SPELTRA: A Robotic Assistant for Speech-and-Language Therapy.** In 17th International Conference on Human-Computer Interaction HCI: Springer. Los Angeles, USA.
• **A multilayer mobile ecosystem to support the assessment and treatment of patients with communication disorders**. In 7th International Conference on E-Health, Gran Canaria, Spain.
• **Modelling domain knowledge of Speech and Language Therapy with an OWL ontology and OpenEHR archetypes.** HEALTHINF. Lisbon, Portugal : INSTICC.

Robotic Assistant   Mobile environment for SLT   Desktop/Web system for SLT

Intelligent ICT layer

Expert system

Multi-level PAM + KNN

Ecosystem to support SLT

Knowledge layer

Templates   Archetypes   Ontologies   Standardized Vocabularies

ICD-10-CM

DSM5

REFERENCES:

[1] S. O. Caballero-Morales, S. O., and F. Trujillo-Romero, "Evolutionary approach for integration of multiple pronunciation patterns for enhancement of dysarthric speech recognition," Expert Systems with Applications, vol. 41, no. 3, pp. 841-852, 2014.
[2] M. Hariharan, K. Polat, R. Sindhu, and S. Yaacob, "A hybrid expert system approach for telemonitoring of vocal fold pathology," Applied Soft Computing, vol. 13, no. 10, pp. 4148-4161, 2013.
[3] K. Jain, P. M. Mishra, and S. Kulkarni, "A Neuro-Fuzzy Approach to Diagnose and Classify Learning Disability," In Proceedings of the Second International Conference on Soft Computing for Problem Solving, pp. 645-657, 2014.
[4] O. Schipor, S. Pentiuc, and M.D. Schipor, "Improving Computer Based Speech Therapy Using a Fuzzy Expert System," Computing & Informatics, vol. 29, no. 2, 2010.

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