MedicBot: A New Virtual Assistance For The Children With Auditory Processing Disorder

by

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FOREWORD

This report was written for my Research Subject in Artificial Intelligence at the ÉTS - École de technologie supérieure. The report was executed as an literature review of applying the information technology in solving Auditory Processing Disorder issue. First I like to show my gratitude to the my supervisor Sylvie Ratté for her suggestions, encouragements and guidance in writing the report and approaching the different challenges during the issue. My work examines the application of virtual assitant related to the monitoring, diagnosing, and making the treatment for the Auditory Processing Disorder children based on aritificial intelligent technology.

MEDICBOT: UNE NOUVELLE AIDE VIRTUELLE POUR LE ENFANTS ATTEINTS DE TROUBLES DU TRAITEMENT AUDITIF

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RÉSUMÉ

Le trouble auditif central affecte jusqu'à 5% des enfants d'âge scolaire qui ont de la difficulté à traiter l'information qu'ils entendent et qui sont généralement qualifiés d '«auditeurs médiocres» [1]. Ils ont une capacité auditive normale, mais il y a un décalage entre ce qui est entendu et ce qui est compris. Les chercheurs médicaux parlent d'une «élite prévenue», car ces personnes ne sont généralement pas moins intelligentes que les personnes non handicapées. Pourtant, ils parviennent rarement à un diplôme d'entrée à l'université; ils se perdent en chemin à cause des installations de réserve manquantes offertes dans les écoles primaires et continues. Ils ont besoin de besoins et d'attention particuliers pour apprendre et montrer leur potentiel de fait. Ce rapport porte sur le MedicBot: une nouvelle assistance virtuelle pour les personnes atteintes de troubles du traitement auditif dans des environnements d'apprentissage fournis par des simulateurs de réalité mixte. Après une présentation de l'état de l'art scientifique sur les besoins spécifiques des étudiants affectés, il sera précisé dans quelle mesure l'assistance virtuelle utilisée dans le soutien et la thérapie des étudiants peut non seulement répondre à ces besoins mais aussi les soutenir dans leur étude. **Mots-clés:** Artificial intelligence, auditory

processing disorder, AI, APD

[1] http://caddac.ca

MEDICBOT: A NEW VIRTUAL ASSISTANCE FOR THE CHILDREN WITH AUDITORY PROCESSING DISORDER

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ABSTRACT

Central Auditory Processing Disorder affects up to 5% of school-aged children who have difficulty processing the information they hear and are usually characterized as "poor listeners"[2]. They have normal hearing ability, but there is a disconnect between what is heard and what is understood. Medical researchers talk about a "forestalled elite" since these people are commonly not less intelligent than non-handicapped individuals. Still, they rarely make it to a university-entrance diploma; they get lost on the way because of missing standby facilities offered in primary and continuative schools. They require special needs and attention in order to learn and show their de facto potential. This report deals with the MedicBot: A new Virtual Assistance for the Auditory Processing Disorder people of learning environments provided by mixed-reality simulators. After a presentation of the scientific state of the art on the specific needs of affected students, it will be elaborated in how far virtual assistance used in the support and therapy of students can sufficiently not only meet those needs but support them in their study. **Keywords:** Artificial intelligence, auditory processing disorder, AI, APD

[2] http://caddac.ca

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LIST OF ABREVIATIONS

AI	Artificial Intelligence
APD	Auditory Processing Disorder

LISTE OF SYMBOLS AND UNITS OF MEASUREMENTS

a	Première lettre de l’alphabet
A	Première lettre de l’alphabet en majuscule

INTRODUCTION

Auditory processing is the ability of the central auditory nervous system(CANS) to use and process auditory information received peripherally by the two ears. Auditory processing disorders (APD) are typically seen in individualswith normal hearing sensitivity and are characterized by an inability of the central auditory neurons to mediate higher-order auditory processing skills (e.g., speech in noise, binaural processing, temporal processing, and closure). Individuals with APD manifest listening difficulties in challenging listening conditions, show deficits in spatial location (localization) of sounds, and face difficulties in decoding rapid rate stimuli **?**. The effects of APD can be devastating because as an input disorder, it has the potential to impair the abilities for spoken language comprehension, learning, and cognition in schoolage children.

One of the main problems in identification of APD is that this disorder often coexists with other comorbid conditions in school-age children such as attention deficit disorders, language learning disorders, and learning disabilities **?**. This makes differential diagnosis of APD difficult. Also audiologists routinely use primarily language-based auditory processing measures for diagnosis of APD even though it is not clear whether deficits on linguistic (verbal) tasks are more likely to be associated with APD than nonlinguistic (e.g., tonal) tasks. In a study by Rosen et al. **?**, it has been shown that school-age children with suspected APD exhibited poorer performance on auditory tests in both verbal (Consonant Cluster Minimal Pairs) and tonal (Tallal Discrimination Task) conditions, relative to age-matched controls. There is also dispute regarding formulation of the appropriate test battery for evaluation of APD (e.g., **??**). Cacace and McFarland **??** contend that, for a diagnosis of APD, testing should address the primary deficit in processing of acoustic information in the auditory modality and deficits should be shown to be absent or reduced in other (e.g., visual) modalities. While this notion is disputed by other studies **??**, there is consensus on the need for valid tools that challenge listening in the auditory modality for school-age children with APD.

The diagnosis encompasses a number of overlapping clinical syndromes (Jerger and Musiek, 2000; Hind, 2006), and its underlying pathological basis is poorly understood. Of those children complaining of symptoms consistent with APD, only around 5% have an underlying structural or other obvious neurological cause (Chermak and Musiek, 1997).

On the other hand, artificial intelligence (AI) is a self-running engine for growth in healthcare. According to Accenture analysis, when combined, key clinical health AI applications can potentially create $150 billion in annual savings for the US healthcare economy by 2026. AI in health represents a collection of multiple technologies enabling machines to sense, comprehend, act and learn[3] so they can perform administrative and clinical healthcare functions. Unlike legacy technologies that are only algorithms/ tools that complement a human, health AI today can truly augment human activity. With immense power to unleash improvements in cost, quality and access, AI is exploding in popularity. Growth in the AI health market is expected to reach $6.6 billion by 2021–that's a compound annual growth rate of 40%. In just the next five years, the health AI market will grow more than 10x.[4]. AI applications focus on Robot-assisted surgery, Virtual nursing assistance, Administrative workflow assistance, Fraud detection, Dosage error reduction, Connected machines, Clinical trail participant identifier, Preliminary diagnosis, Automated image diagnosis, and Cybersecurity[5].

Neural networks are adaptive statistical models based on analogies with human brain structure that can learn to estimate and iteratively change values of the parameters of some population using specific input and output variables **?**. An artificial neural network (ANN), often just called a "neural network" (NN), is a mathematical model or computationalmodel based on biological neural networks. Artificial neural networks can be used to model complex relationships between input and output variables and explain patterns of data. The construction of the

[3] Accenture; "AI is the Future of Growth"

[4] Frost & Sullivan

[5] https://www.accenture.com

neural network typically involves three different layers with feed-forward architecture. This is the most popular network architecture in use today. The input layer of this network is a set of input units, neurons that are fully connected to the hidden layer with the hidden units that are in turn fully connected to an output layer. The output layer supplies the response of neural network to the activation pattern applied to the input layer. Neural network modeling has been used in healthcare research to characterize and predict a wide variety of health-related issues such as infant mortality**?**, brain surgery decisions **?**, pharmacokinetic parameters of antibiotics in severely ill patients **?**, and auditory dysfunction inAlzheimer's disease **?**. Neural networks can be used to model cognitive processes by a feed-forward, backward propagation algorithm called multilayer perceptrons (MLPs). These networks usually organize their units into several layers. The information to be analyzed is fed to the first layer called the input layer, followed by intermediate hidden layers, finally leading to the output layer for processing **?**. Unlike multiple linear regression models used to predict performance from known variables, artificial neural networks need no prior knowledge or assumptions because they can learn and generalize from data that are even noisy or imperfect **?**. The current study was conducted to probe if reducing extrinsic redundancy in the P300 Auditory Event-Related Potentials (P3AERP) task compromises auditory processing in school-age children with and without APD. Extrinsic redundancy can be reduced in several ways, but, for the purposes of this study, two stimulus-related variables (competing noise and rapid rates) were used. The rationale for reducing the extrinsic redundancy was that competing noise would limit spectral processing abilities needed to discriminate frequent and infrequent stimuli on the P3AERP task while rapid presentation rates would stress the temporal processing capabilities of the auditory system and these would have particular influence on P3AERP latency and amplitude measures in those children with reduced intrinsic redundancy (children with APD). Neural network modeling was performed statistically to discover hidden and nonlinear associations between input (stimulus rate and competing noise) and output variables (P3AERP latency and amplitude).

CHAPTER 1

PROBLEM DEFINITION.

1.1 Detect APD early

How to identify, recognize, and diagnosing students with Auditory Processing Disorder (APD) based on their sentiment behavior, speech, and response.

1.2 Solve APD daily

How to help users to solve their issues above and comment the therapy to them by training.

CHAPTER 2

CHALLENGES AND OBJECT

2.1 Challenges

Identify and recognize the sentiment and emotion speech features. Faster handling of responding for real time used cases. Data authenticity, confidentiality, ready, and integrity for real time applications. Understand the context and sentiment of the complex sentence and explain it into the multiple simpler sentences. Maintain the APD user identity, location, security, and privacy

2.2 Objectives

Enhance privacy system to Identify, Recognize, and Diagnose Students with APD. Improve the accuracy and performance of speech recognizing to detect the semantic behavior or the meaning of the speech. Develop algorithms to convert the complex sentence to the simple sentences with the insightful and easily understanding. Develop algorithm to evaluate and analyze the progress of APD therapy

CHAPTER 3

PROPOSED SOLUTIONS

3.1 Table layout tests

Tables have the same constraints than the figures, except for the caption that has to be on top.

Table 3.1 Test of a long table caption, with linebreak.

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3.2 References test

3.2.1 References to the bibliography

Reference from the bibliography Doe *et al.* (1999c).

3.2.2 References to the list of references "refs"

References from the list of references "refs", declared at the beginning of the document **?**.

3.2.3 References to a label of the document

Reference to a Figure associated to a label: Figure **??**.

3.2.4 URL references

3.2.4.1 Test of "href"

Href is used to integrate a link to a text: Link to the template page..

3.2.4.2 Test de url

Url is used to format a clickable link: http://www.etsmtl.ca/Etudiants-actuels/Cycles-sup/Realisation-etudes/Guides-gabarits.

CHAPTER 4

EXAMPLE OF A THESIS BY ARTICLE, WITH INTEGRATED ARTICLE

First name Last name[1], First name Last name[1]

[1] Département de Génie Mécanique, École de Technologie Supérieure,
1100 Notre-Dame Ouest, Montréal, Québec, Canada H3C 1K3

Article soumis à la revue « Vecteur environnement » en septembre 2010.

4.1 Section 1

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CONCLUSION AND RECOMMENDATIONS

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APPENDIX I

APPENDIX EXAMPLE

1. First section of the appendix

1.1 Figures in annexes

Figure-A I-1 Figure in an appendix.

In the annexes, the figures are declared in the same way. Their numbering changes automatically (e.g. Figure I-1).

1.1.1 Tables in annexes

Table-A I-1 Table in an appendix.

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(a) first figure

(b) second figure

(c) third figure

(d) fourth figure

Figure-A I-2 Subfig example.

Same behaviour for the tables (e.g., Table I-1).

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