



Faculty of Information And Communication Technology

**SELF-PACED SPEECH REHABILITATION AMONG
CHILDREN WITH DOWN SYNDROME USING MALAY
AUTOMATIC VOICE RECOGNITION (AVR)**

Lau Kum Hoe

**Master of Science in Information And
Communication Technology**

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**SELF-PACED SPEECH REHABILITATION AMONG CHILDREN WITH
DOWN SYNDROME USING MALAY AUTOMATIC VOICE RECOGNITION
(AVR)**

LAU KUM HOE

**A thesis submitted
in fulfillment of the requirements for the degree of Master of Science
in Information And Communication Technology**

Faculty of Informatoin And Communication Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2015

DECLARATION

I declare that this thesis entitled “Self-paced Speech Rehabilitation Among Children with Down Syndrome Using Malay Automatic Voice Recognition (AVR)” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : LAU KUM HOE

Date :

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis sufficient in terms of scope and quality as a partial fulfillment of Master of Science in Information And Communication Technology.

Signature :.....

Supervisor Name : MRS. SYARIFFANOR HISHAM

Date :.....

DEDICATION

To my beloved family

ABSTRACT

The speech and language learning of children with Down syndrome (DS) are often delayed or impaired. Therefore, children with DS often take a longer time in learning to speak and in certain cases; some of them might not be able to speak properly throughout their lifetime. Learning how to convey verbally is crucial as it underpins the development of other skills like expressing and socializing which helps an individual to communicate with others in the society. Therefore, improving the speaking and language skills of children with DS is essential in promoting an independent living for these children. The Automatic Voice Recognition (AVR) could unfold potentials in promoting the speech rehabilitation among children with DS. Nevertheless, many existing AVR applications were developed based on European regions and the users of these applications were not originally targeted for children with DS. These applications are not applicable to the children with DS in Malaysia. This thesis addresses the feasibility of Malay AVR as an assistive tool in promoting the self-paced speech rehabilitation among children with DS. Three studies were conducted in order to tackle this issue, and all these studies were conducted in the Kiwanis Down Syndrome Foundation (KDSF) centre – a legitimate association that provides speech rehabilitation programs for the children with DS in Malaysia. The first study aims to investigate the current limitations that prevent speech rehabilitation among children with DS in Malaysia. The second study involved the children with DS from the KDSF centres and would help to validate the usability study for the proposed Malay AVR application known as *MyCard*. The third study involved three children with DS who participated in the usability testing with *MyCard*, which aimed to verify the feasibility of *MyCard* as an assistive tool in promoting the self-paced speech rehabilitation for these children. The feasibility of *MyCard* in promoting self-paced speech rehabilitation was sought based on its interactivity, user's experience and its efficiency. Based on these three criteria, the results showed that *MyCard* is feasible for the children with DS who participated in this study. There are evidences showed that these children could understand and interact with the user interfaces' components of *MyCard* which indicated that these children could interact with *MyCard*. The DS children in this study also showed proper responses when they saw the feedback displayed by *MyCard*, indicating that the feedbacks are intuitive to these children. Importantly, the teachers who were monitoring their children during this study also indicated that *MyCard* can be adopted as a supportive tool in their speech therapy routine. Grounded on these, the researcher of this study concluded that Malay AVR can be potentially served children with DS as a self-paced speech rehabilitation tool.

ABSTRAK

Percakapan dan pembelajaran bahasa untuk kanak-kanak dengan Sindrom Down (SD) sering mengalami kelewatan atau kekurangan. Oleh itu, kanak-kanak dengan SD sering mengambil masa yang lebih lama untuk belajar untuk bercakap; dan dalam beberapa kes, sebahagian daripada mereka mungkin tidak dapat bercakap dengan cara yang betul sepanjang hayat mereka. Belajar bagaimana untuk berkomunikasi secara lisan adalah penting kerana ia menyokong pembangunan kemahiran lain seperti menzahirkan perasaan dan bersosial; serta membantu individu berkaitan untuk bergaul dalam masyarakat. Oleh itu, meningkatkan pertuturan dan kemahiran bahasa kanak-kanak dengan SD adalah penting dalam menggalakkan hidup berdikari untuk kanak-kanak ini. Automatic Voice Recognition (AVR) boleh merungkaikan potensi dalam menggalakkan pemulihan pertuturan di kalangan kanak-kanak dengan SD. Walaubagaimanapun, banyak aplikasi AVR yang sedia ada telah dibangunkan khusus kepada kawasan-kawasan di Eropah dan pengguna aplikasi ini pada asalnya tidak disasarkan untuk kanak-kanak dengan SD. Aplikasi ini tidak sesuai untuk digunakan untuk kanak-kanak dengan SD di Malaysia. Tesis ini menjurus kepada kebolehlaksanaan AVR Bahasa Melayu sebagai alat bantuan dalam menggalakkan pemulihan ucapan sendiri di kalangan kanak-kanak dengan SD. Tiga kajian telah dijalankan bagi menangani isu ini, dan semua kajian-kajian ini telah dijalankan di pusat Kiwanis Down Syndrome Foundation (KDSF) - persatuan yang sah yang menyediakan program pemulihan pertuturan untuk kanak-kanak dengan SD di Malaysia. Kajian pertama bertujuan untuk menyiasat kekangan-kekangan masa ini yang berkaitan pemulihan pertuturan di kalangan kanak-kanak dengan SD di Malaysia. Kajian kedua melibatkan kanak-kanak dengan SD dari pusat KDSF, yang bertujuan untuk mengesahkan kajian kebolegunaan bagi cadangan aplikasi ASR Bahasa Melayu dipanggil MyCard. Menurut kepada tiga kriteria tersebut, hasil menunjukkan MyCard boleh dilaksanakan kepada kanak-kanak dengan SD yang menyertai kajian ini. Terdapat pembuktian yang menunjukkan kanak-kanak ini faham dan berinteraksi dengan antaramuka pengguna komponen MyCard yang menuunjukkan kanak-kanak ini boleh berinteraksi dengan MyCard. Kanak-kanak ini juga menunjukkan respon yang baik apabila melihat maklum balas ditunjukkan di MyCard, secara tidak langsung menandakan maklum balas tersebut menggerakkan daya kanak-kanak ini. Lebih penting, guru yang memantau kanak-kanak ini semasa kajian juga menunjukkan yang MyCard boleh digunakan sebagai alatan sokongan dalam rutin terapi pertuturan mereka. Berdasarkan perkara ini, penyelidik dalam kajian ini merumuskan yang AVR Bahasa Melayu ini berpotensi untuk membantu kanak-kanak dengan SD sebagai alatan pemulihan pertuturan sendiri.

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LIST OF ABBREVIATIONS

ADS	-	Autism
ASR	-	Automatic Speech Recognition
AVR	-	Automatic Voice Recognition
DS	-	Down Syndrome
FXS	-	Fragile-X syndrome
FXS-ASD	-	Fragile-X with Autism
HCI	-	Human Computer Interaction
HMM	-	Hidden Markov Model
dHMM	-	Discrete Hidden Markov Model
KDSF	-	Kiwanis Down Syndrome Foundation
month	-	Months
yrs	-	Years
P1	-	Participant 1
P2	-	Participant 2
P3	-	Participant 3
UTeM	-	Universiti Teknikal Malaysia Melaka
UI	-	User Interfaces

LIST OF PUBLICATION

Lau, K. H., Hisham, S., & Draman@Muda, N. A., 2015. Assessing Usability and Fun of Speech Articulation Training for Children with Down Syndrome. *Journal of Network and Innovative Computing (JNIC)*, 3(1), 29-37. Retrieved from <http://www.mirlabs.net/jnic/secured/Volume3-Issue1/Paper4.pdf>

Lau, K. H. and Hisham, S., 2013. Self-paced Speech Rehabilitation for Down syndrome Using Malay Automatic Speech Recognition (ASR). In: *Proceedings of Malaysian Technical Universities Conference on Engineering & Technology (MUCET)*. pp.3-4. Melaka, Malaysia.

Lau, K. H., Hisham, S., and Draman@Muda, N.A., 2014. Assessing Usability and Fun in MyCard: Malay Automatic Speech Recognition For Articulation Training. In: *World Congress on Information and Communication Technologies (WICT)*. Melaka, Malaysia.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter presents the background of the study, statement of the problem, research questions and objectives, hypothesis, significance of the study, and the structure organization of this thesis.

1.2 Background of the study

The Person With Disability (PWD) Act 2008 defines “person with disabilities” as “those who have long term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society”(Children with Disabilities in Malaysia: Mapping the Policies, Programmes, Interventions and Stakeholders, n.d.). In Malaysia, there are seven categories of disabilities defined by the department of Malaysia Social Welfare, mainly: hearing, visual, physical, learning difficulties, speech, mental and multiple disabilities (Jabatan Kebajikan Masyarakat Malaysia, 2015). The learning difficulties refer those who intellectual capabilities that do not conform to biological age and Down syndrome (DS) is one of these learning difficulties.

1.2.1 Down Syndrome in Malaysia

Figure 1.1 shows the number of children with learning difficulties (aged 0 – 12 years old) registered on the Malaysia Social Welfare Department in year 2010 and 2012 (Children with Disabilities in Malaysia: Mapping the Policies, Programmes, Interventions and Stakeholders, n.d.). Based on the statistical data, it showed that the number of cases registered under DS is significant in Malaysia – it had increased by 22% between 2011 and 2012. For others group of children with special needs, the number was only increased by 0 to 8.5% between 2011 and 2012. As the number of cases for DS is significant, this study only focused on children with DS.

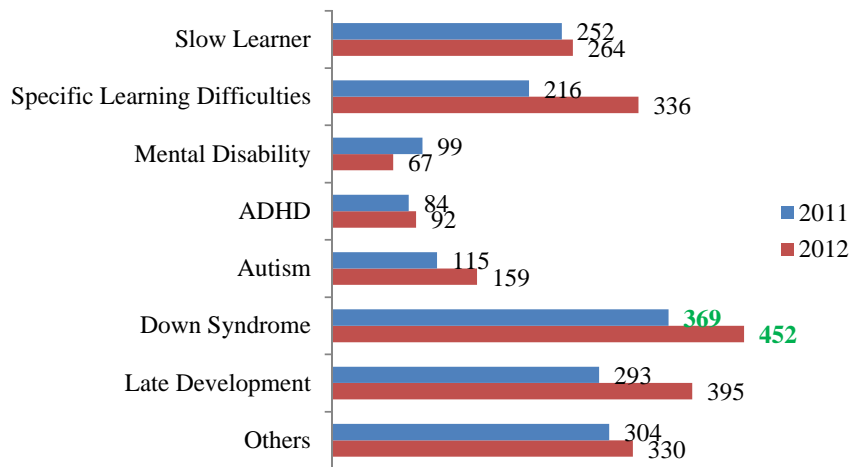


Figure 1.1: Registered Special Need Cases (taken and modified from “Children with Disabilities in Malaysia: Mapping the Policies, Programmes, Interventions and Stakeholders,” n.d.)

Apart from speech-language, hearing, vision and cognitive deficits associated with DS, learning to speak is important for every child as it underpins all the aspects of development, ranging from learning to mental skills. Many evidences suggest that the speech and language skills of children with DS are often more severe than other children

with cognitive impairment (Barnes et al., 2006; Chapman, 2006; Kroeger and Nelson, 2006; Jiar et al., 2012; Kent and Vorperian, 2013). Therefore, helping children with DS to improve their speech and language skills are crucial as part of promoting independent living among these children.

The findings from a preliminary study which was conducted in this study revealed that DS centre may or may not have a speech therapist to provide speech rehabilitation for the children in the centre. Hence, without a speech therapist, the teachers would often have to handle the speech rehabilitation sessions for the children. Nevertheless, many of these teachers lack of experience and are not specifically trained in speech rehabilitation training. In addition, the speech therapist often needs to handle high ratio of children within a class. Consequently, it increases the downtime between two successive speech rehabilitation lessons for children with DS. Apparently, this can hinder the speech rehabilitation progress among children with DS due to the fact that speech training should be practiced daily.

Moreover, children with DS have unique developmental characteristics in the area of speech and language (Stoel-Gammon, 2001a; Roberts et al., 2007; Martin et al., 2009). This causes the children with DS being unable to be spontaneous in talking or requesting during the speech rehabilitation lesson. Thus, the speech therapist or teachers have to constantly motivate the children to participate in the training session during the lesson. Therefore, the speech therapist and teachers from the DS centre are looking forward to an assistive tool which can support the speech rehabilitation training for the children at the centre.

1.2.2 Assistive Tools for Speech Rehabilitation

Pioneering project like *Vocaliza*, *PLASER*, *Villie*, *DEAL*, and *Cuentame* provide available insight to use automatic speech recognition (ASR) or automatic voice recognition (AVR) technology in speech and language learning (Mak et al., 2003; Vaquero et al., 2006; Preben Wik, Anna Hjalmarson, 2007; Saz et al., 2009). With the integrated ASR or AVR, the application of these projects allows users to practice their speech production skills, and at a same time, these users are able to receive real time speech assessment from the application. Promisingly, these projects offer an alternative that can benefit the speech rehabilitation among children with DS in Malaysia.

Nevertheless, the applications mentioned above are not suitable to use by the children with DS in Malaysia. This is because the proposed applications of these projects were developed based on Europe region; thus, they are not suitable to use for the children with DS in Malaysia. Moreover, the users of these projects were not originally targeted for DS; thus, the unique characteristics of DS were not taking into account during the development of the application.

The investigation of the feasibility of Malay AVR as a tool for speech rehabilitation among children with DS is generally observed as a key part of this study. As Khan (2010) points out that the issue of one application which works for one disabled group might not be applicable for the other disabled groups (Khan, 2010). Hence, this study would investigate the extent in which the Malay AVR application can support the speech rehabilitation process among children with DS. Furthermore, this investigation would also help to suggest meaningful usability design guidelines when implementing Malay AVR application for DS in future.

1.3 Problem statements

There are some problems statements are worth to highlight in this study. Firstly, children with DS suffer difficulties on speech and language. These difficulties are associated with their speech developmental profile which is often delayed, disordered or both. As a result, children with DS suffer difficulties to convey verbally in an intelligible manner. Eventually, children with DS show less spontaneous to engage in any activities that required their speech and language skills.

Secondly, the lack of speech therapist in DS centre impedes the speech rehabilitation among children with DS. Without the speech therapist, the teachers have to conduct the speech therapy session for the children in the centre. Nevertheless, these teachers lack of specific skills in the aspect of speech therapy.

Thirdly and lastly, there is lack of assistive tool in supporting the speech rehabilitation among children with DS in Malaysia(Children with Disabilities in Malaysia: Mapping the Policies, Programmes, Interventions and Stakeholders, n.d.). There are some applications from the pioneering project were applied in the context of speech rehabilitation among children with speech disorder. Nevertheless, these applications were developed based on European regions and these application were not specifically targeted for children DS. Thus, these applications are suitable to use for the children with DS in Malaysia.

Acknowledging the problems mentioned above, this research aims to investigate the feasibility of Malay AVR application as a tool for speech rehabilitation among children with DS in Malaysia. Due to the nature of this research, the data were collected from the DS centres. Therefore, a natural approach was adopted as a main research design in this study.

APPENDIX D - Grantt Chart

