

**UNIVERSITI TEKNOLOGI MARA**

**INITIAL RESPONSE ANALYSIS OF  
ROBOT-BASED INTERVENTION PROGRAM  
(RBIP) FOR CHILDREN WITH AUTISM  
USING HUMANOID ROBOT NAO**

**LUTHFFI IDZHAR BIN ISMAIL**

Thesis submitted in fulfilment  
of the requirement for the degree of  
**Master of Science**

**Faculty of Mechanical Engineering**

June 2013

## AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student : Luthffi Idzhar Bin Ismail

Student I.D. No. : 2010367161

Programme : Master of Science in Mechanical Engineering

Faculty : Mechanical Engineering

Thesis Title : Initial Response Analysis of Robot-based  
Intervention Program (RBIP) for Children with  
Autism using Humanoid Robot

Signature of Student : .....

Date : June 2013

## ABSTRACT

In recent decade, robotics has become very significant in assisting the children with autism in the areas like social interaction, emotion recognition, interactive plays, joint attention and special education. Autism is a brain developmental disorder that affects an individual's social interaction, communication impairments and restricted stereotyped behaviour. Currently, research on the robotics for autism children shows suggestive finding in helping them to improve their quality of lifestyle and adapting themselves to their surroundings. Motivated by these emerging factors, the main objective of this research is to design and propose an interactive robot-based intervention modules using humanoid robot and analyze the initial response of autism children when they are expose to the module in an experimental program called Robot-based Intervention Program (RBIP). The methodology and outcome of this research are outlined in several stages that will be described in details in the Chapter 3. The initial response analysis is being done using modified Behaviour Score Sheet with reference to the Gilliam Autism Rating Scale (GARS) second edition. Based on the experiments that has been conducted in the RBIP and normal classroom, the results shows that 83.3% of the participated children response positively to the interaction in RBIP while another 16.7% response very good in normal classroom interaction for their stereotyped behaviour subscale and communications subscale. On the other hand, only 50% of the participated children with autism response positively in the social interaction subscale in the RBIP while 41.7% response optimistically to the normal classroom interaction while the remaining of 8.3% is not being able to be evaluated since the participants did not cooperate during the interaction in both RBIP and normal classroom experimental setting. Overall, most of the children are positively respond in RBIP which indicate that the robotic intervention program is an effective intervention program for them in improving their impairment in irregular repetitive stereotyped behaviour, communication skills and social interaction skills. Lower score in the three-subscale evaluation of Behaviour Score Sheet during RBIP is indicated that they exhibit less autism characteristic during RBIP compared to the normal classroom interaction.

# TABLE OF CONTENTS

	<b>Page</b>
<b>AUTHOR'S DECLARATION</b>	ii
<b>ABSTRACT</b>	iii
<b>ACKNOWLEDGEMENT</b>	iv
<b>TABLE OF CONTENTS</b>	v
<b>LIST OF TABLES</b>	viii
<b>LIST OF FIGURES</b>	ix
<b>LIST OF ABBREVIATIONS</b>	xii
<b>LIST OF CHAPTERS</b>	xiii
<b>LIST OF CHAPTER'S SUMMARY</b>	xiv
<b>CHAPTER ONE: INTRODUCTION</b>	
1.1 Research Background	1
1.2 Problem Statement	4
1.3 Objective	7
1.4 Scope and Limitation of the Research	7
1.5 Significance of Project	8
1.6 Originality	9
<b>CHAPTER TWO: LITERATURE REVIEW</b>	
2.1 Rehabilitation Robotics	11
2.2 Autism	14
2.2.1 Characteristic	15
2.2.2 Diagnosis	18
2.2.3 Early Intervention	19
2.3 Human Robot Interaction (HRI)	20
2.3.1 Definition	21

2.3.2	Safety in HRI	22
2.3.3	Application of HRI	22
2.4	Humanoid Robot	24
2.4.1	ASIMO	25
2.4.2	HRP-3	26
2.4.3	NAO	28
2.5	Robotic Assistive Therapy	40
2.6	Previous Related Work	43

### **CHAPTER THREE: METHODOLOGY**

3.1	Overview	49
3.2	Research Ethic	53
3.3	Design of Experiment (DOE)	54
	3.3.1 Demographic Details	54
	3.3.2 Experiment Setup	56
	3.3.3 Experiment Protocol	60

### **CHAPTER FOUR: ROBOT-BASED INTERVENTION PROGRAM**

4.1	Introduction	62
4.2	Interactive Modules in RBIP	64
	4.2.1 Module 1: Introductory Rapport	64
	4.2.2 Module 2: NAO Talks	66
	4.2.3 Module 3: NAO Hand Movement	68
	4.2.4 Module 4: NAO Song Play and Eyes Blink	70
	4.2.5 Module 5: NAO Song Play and Hand Movement	72
4.3	Justification of Interaction Module	74
4.4	Architecture of Interaction Module	76
	4.4.1 Architecture of Interaction Module 1	77
	4.4.2 Architecture of Interaction Module 2	78
	4.4.3 Architecture of Interaction Module 3	78
	4.4.4 Architecture of Interaction Module 4	79
	4.4.5 Architecture of Interaction Module 5	80