

CONTENTS

APPROVAL PAGE

SELF DECLARATION AGAINST PLAGIARISM

ABSTRACT iv

ACKNOWLEDGEMENTS v

PREFACE vi

CONTENTS vii

LIST OF FIGURES ix

LIST OF TABLES xi

1 INTRODUCTION 1

- 1.1 Background 1
- 1.2 Problem Identification 3
- 1.3 Research Purposes 3
- 1.4 Scope of Work 3
- 1.5 Research Methodology 4
- 1.6 Research Methods 5

2 BASIC CONCEPT 6

- 2.1 Airbag Triggering Methods from IMU Sensor 6
- 2.2 Sensor for Fall Detection 10
 - 2.2.1 Sensor Vision 10
 - 2.2.2 Pressure Sensors 11
 - 2.2.3 Sensor IMU 12
 - 2.2.4 Sensor Parameters Used for Fall Detection 15
- 2.3 Parameters in Fall Detection 16
 - 2.3.1 Signal Processing Algorithm for Fall Detection 16
- 2.4 Machine Learning Algorithms for Fall Detection 18
 - 2.4.1 Random Forest 18

2.4.2	Support Vector Machines (SVM)	20
2.4.3	Convolutional Neural Network (CNN)	21
2.4.4	Artificial Neural Network (ANN)	22
2.5	Airbag Sensing System	23
2.6	Time To Fall Calculation	24
3	SYSTEM MODEL AND THE PROPOSED DESIGN	26
3.1	System Design	26
3.2	Hardware Design used to help validate the results of the selected algorithm	27
3.3	Fall Detection Airbag System	28
3.4	IMU Sensor Data Retrieval	28
3.5	Machine Learning Data Processing	29
3.5.1	Training Process	29
3.5.2	Inference Process	30
3.6	Dataset Collection	31
3.7	Experimental Protocol and Participant Characteristics	32
3.7.1	Participant Characteristics	32
3.7.2	Not Fall Scenario	33
3.7.3	Fall Scenario	34
3.8	Confusion Matrix for Fall Detection Model	35
4	RESULT AND ANALYSIS	37
4.1	Model Training Result	37
4.1.1	Support Vector Machine (SVM)	37
4.1.2	Random Forest (RF)	39
4.1.3	Convolutional Neural Network (CNN)	41
4.1.4	Artificial Neural Network (ANN)	43
4.1.5	Model Comparison	44
4.2	Visualizing Dataset and Real-Time Fall Detection Results	45
4.2.1	Forward Fall Comparison	45
4.2.2	Backward Fall Comparison	46
4.2.3	Side Fall Comparison	47
4.2.4	Comparison Between Standing and Walking	47
4.3	Testing and Validation of the Algorithm	48
5	CONCLUSION	50
	REFERENCES	51