

PREDICTION BLOOD PRESSURE PARAMETER BY USING NEURO-FUZZY
MODEL

MOHD FAIZZ FAHMI BIN ARIAFF

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To my beloved wife and son

To my parents, brother and sisters

To my kind family in-law

And not forgetting to all friends

For their

Love, Sacrifice, Encouragements, and Best Wishes

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ABSTRACT

Blood pressure is the most often measured and intensively studied in medical and physiological practice because it is the valuable diagnostic aid to access the vascular condition of certain illnesses. As known that high blood pressure is the biggest known cause of disability and premature death through stroke, heart attack and heart disease. In this case, accurate blood pressure measurement and prediction need to be conducted. This project is mainly concerned on designing a model that can predict the Mean Arterial Pressure. By this project development, SPSS software used to decide the parameter that correlate with the blood pressure parameter based on Mean Arterial Pressure. Then utilizes the Neuro-Fuzzy model using MATLAB as the mainframe. This project is based on certain age and a number of subjects patient.

ABSTRAK

Tekanan darah paling sering diukur dan dipelajari secara intensif dalam perubatan dan praktis fisiologi kerana ia adalah cara menganalisis paling berguna untuk mengukur tahap keadaan salur darah bagi sesuatu penyakit. Sebagaimana yang diketahui tekanan darah tinggi adalah penyebab utama kepada hilang upaya, kematian mengejut oleh strok, serangan jantung dan penyakit jantung. Dalam kes ini, ketepatan pengukuran tekanan darah dan peramalannya perlu di buat. Prrojek ini paling utama adalah menekankan pada perekaan pada model yang boleh meramal purata tekanan arteri. Dalam membangunkan projek ini, ia menggunakan perisian SPSS untuk menentukan parameter yang berhubungkait dengan parameter tekanan darah iaitu purata tekanan arteri. Kemudian, menggunakan Neuro-Fuzzy model pada MATLAB sebagai model utama. Kajian berdasarkan kepada beberapa sela had umur dan bilangan subjek pesakit.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	x
	LIST OF FIGURES	xi
	LIST OF ABBREVIATIONS	xii
	LIST OF APPENDIX	xiii
1	INTRODUCTION	
	1.1 Project background	1
	1.2 Problem Statement	4
	1.3 Research Objectives	5
	1.4 Research Scope	5
	1.5 Thesis Outline	6
2	LITERATURE REVIEW	
	2.1 Introduction	7
	2.2 Blood Pressure Measurement Techniques	11
	2.2.1 Direct Invasive Technique	11
	2.2.2 Indirect Non-invasive Technique	12
	2.3 Fuzzy Blood Pressure Classification	18
	2.4 Adaptive Neuro-Fuzzy Inference System (ANFIS)	21
	2.4.1 ANFIS Model Structure	23

2.4.2	Model Validation	25
2.5	IBM SPSS Statistic	26
2.6	Summary	29
3	RESEARCH METHODOLOGY	
3.1	Introduction	30
3.2	SPSS Statistic Analysis	31
3.3	Neuro-Fuzzy Model	38
3.4	Summary	46
4	RESULTS AND DISCUSSION	
4.1	Introduction	47
4.2	SPSS Statistic Analysis Result	48
4.2.1	Result SPSS Statistical Analysis for 10 subjects	49
4.2.2	Result SPSS Statistical Analysis for 30 subjects	52
4.2.3	Result SPSS Statistical Analysis for 60 subjects	54
4.2.4	Comparative Analysis	55
4.3	ANFIS Results	57
4.3.1	Result ANFIS for 10 subjects	58
4.3.2	Result ANFIS for 30 subjects	65
4.3.3	Result ANFIS for 60 subjects	70
4.3.4	Comparative Analysis	75
4.5	Summary	76
5	CONCLUSION AND FUTURE WORKS	
5.1	Conclusion	79
5.2	Future works	80
	REFERENCES	81
	Appendix A	84

LIST OF TABLES

TABLE NO.	TITLE	PAGE
1.1	Characteristic of respondents' population of Malaysia age 20 or older	3
2.1	Classification of blood pressure for adults (Isik, 2006)	9
4.1	ANOVA Table	48
4.2	Coefficient Table	49
4.3	SPSS Regression Result for the 10 subjects	50
4.4	Coefficient Table shows the predictor variable from the SPSS	51
4.5	SPSS Regression Result for the 30 subjects	52
4.6	Coefficient Table shows the predictor variable from the SPSS	53
4.7	SPSS Regression Result for the 60 subjects	54
4.8	Coefficient Table shows the predictor variable from the SPSS	55
4.9	Coefficient Table shows the predictor variable for 10, 30 and 60 subjects from the SPSS's result	56
4.10	Symbol for training data and testing data	57
4.11	Training Error for the 10 subjects	60
4.12	Train Data FIS Output for the 10 subjects.	62
4.13	Test Data FIS Output for the 10 subjects	64
4.14	Training Error for the 30 subjects	67
4.15	Test Data FIS Output for the 30 subjects	69
4.16	Training Error for the 60 subjects	72
4.17	Test Data FIS Output for the 60 subjects	74
4.18	Error Comparison among the Three Samples	75

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
2.1	Von Basch's sphygmomanometer invented about 1881	9
2.2	Mercury and aneroid blood pressure gauges	10
2.3	10Digital blood pressure meter	10
2.4	Typical setup of a pressure measuring system by direct method	12
2.5	Principal of blood pressure measurement based on Korotkoff sounds	14
2.6	Illustration of the auscultatory measurement technique	15
2.7	Oscillations in cuff pressure	16
2.8	A typical organization of algorithms components of oscillatory blood pressure measurement	17
2.9	Type-1 fuzzy sets to represent input values of HR	18
2.10	Type-2 fuzzy sets to represent output values of mean blood pressure	19
2.11	ANFIS Model Structure	23
2.12	Training Error	24
2.13	Output of ANFIS	25
2.14	The Data Editor	27
2.15	The Output Navigator	28
3.1	The value in database for 60 subjects	31
3.1	SPSS ver21.0 for windows	32
3.1	Open Excel file in the SPSS ver21.	32
3.4	Select desired data from specific sheet in the Excel File	33
3.1	Result for input variable to be taken in the SPSS	34
3.1	Inserting the value into SPSS database	34

3.7	Choosing the Dependent and the Independent variables	35
3.8	Analyzing the database	36
3.9	The result of the SPSS	37
3.10	MATLAB command window	40
3.11	Graphic User Interface for ANFIS	41
3.12	FIS Editor with input sex, systolic, diastolic, HR	42
3.13	Fuzzy logic Rule Viewer after implemented into ANFIS	43
3.14	ANFIS Structure	45
4.4	Membership function after training using ANFIS	58
4.5	Data training error using ANFIS.	59
4.6	Data Training Error for Output FIS using ANFIS	61
4.7	Data Testing Error for Output FIS using ANFIS	63
4.8	Membership function after training using ANFIS	65
4.9	Data training error using ANFIS	66
4.10	Data Testing Error for Output FIS using ANFIS	68
4.11	Membership function after training using ANFIS	70
4.12	Data training error using ANFIS	71
4.13	Data Testing Error for Output FIS using ANFIS	73

LIST OF ABBREVIATIONS

SBP	-	Systolic Blood Pressure
DBP	-	Diastolic Blood Pressure
NN	-	Neural Network
BMI	-	Body Mass Index
FIS	-	Fuzzy Inference System
ANFIS	-	Adaptive Neuro Fuzzy Inference System
GUI	-	Graphical User Interface
SPSS	-	Statistical Package for the Social Sciences
MAP	-	Mean Arterial Pressure
T2FLS	-	Type 2 Fuzzy Logic System
MFs	-	Membership Function
FLS	-	Fuzzy Logic System
AI	-	Artificial Intelligent
FES	-	Fuzzy Expert System
BP	-	Blood Pressure
NIBP	-	Non- Invasive Blood Pressure

LIST OF APPENDIX

Appendix	TITLE	PAGE
A	Source Code for ANFIS	84 - 85

CHAPTER 1

INTRODUCTION

1.1 Project Background

Blood pressure is the most often measured and the most intensively studied parameter in medical and physiological practice. The blood pressure signal is important to determine the functional integrity of the cardiovascular system. Normal blood pressure gives right functional of cardiovascular system. But to be remembered blood pressure varies with age, state of health, and other individual conditions.

Typically, normal blood pressure for infant blood pressure is 80/50mmHg. For young adult, the normal blood pressure increases gradually and reaches 120/80. This is because blood pressure in the cardiovascular system varies at different point along the circulatory system. It is also due to different resistance occurring at different regions of the circulatory system.

Blood pressure signal take from the measurement of the force pushing on the arterial walls as the blood pumps out of the heart and into the circulatory system. It is expressed in millimeters of mercury, or mm Hg. The systolic blood pressure is the top number of a blood pressure reading. This shows the maximum pressure in the blood vessels as the heart contracts and circulates blood throughout the body. The diastolic blood pressure is the bottom number of a blood pressure reading. It shows the lowest pressure in the blood vessels between heartbeats, when the heart is at rest. These signal also one of the principal vital signs. Supplemented by information about other physiological parameters, the blood pressure is the most valuable diagnostic aid to access the vascular condition of certain illnesses (Kahndpur, 2005 and Isik, 2006).

The classical method of blood pressure measurement is by using a cuff over arm containing the artery. This indirect technique is non-invasive, that improved patient comfort and safety. The disadvantage indirect technique is cannot get high level accuracy and reading continuously (Shantanu, 2005; Isik, 2006). This technique was introduced by Riva-Rocci, who is Italian Physician during 1896. He determines the systolic and diastolic pressures using the devices that are ease of application, rapidity in action, precision, and harmlessness to patient (Jeremy, 1977; Gareth et al., 2001).

The current available method is non-invasive measurement that uses auscultatory techniques and semiautomatic devices which is oscillatory techniques that uses automatic devices Non-Invasive Blood Pressure (NIBP) Machine. In auscultatory techniques there two types of manometers are used in this facility, Aneroid and Mercury. Aneroids require annual checks to insure that mechanical wear or shocks haven't affected readings. Mercury is the "Gold Standard" of NIBP but needs accuracy checks as well. Most doctors and medical practitioner will use these method even it is a classical method but the accuracy is more reliable and assured.

The distribution of blood pressure (BP) in a representative national sample of Malaysian adults has not previously been described. High levels of BP are associated with increased risk of cardiovascular morbidity. While prevalence estimates of hypertension are convenient and simple to interpret, it suffers from dependence on choice of arbitrary cut-off level on a continuous distribution to define hypertension. Thus, fully understanding the classification or clustering in blood pressure prediction is essential to the developments of neuro-fuzzy systems model particularly in medical-related problems. Furthermore, fuzzy set theory plays an important role in dealing with uncertainty when making decisions in medical applications. Kuncheva and Steimann, 1999). The information on the population distribution of BP is useful for prediction and can describe BP related health burden as well as for prevention strategy.

From National Health and Morbidity survey in 1996 for Malaysian population, by this survey for blood pressure data can estimate the burden of illness due to BP related cardiovascular morbidity in the population. And some of results from the survey in the population BP distribution in Table 1.1, 2.1 million (30%) adult Malaysians can be expected to have BP above such a level 140/90. This means 30% of Malaysian`s population is older than 20 in 1996 have the hypertension stage 1 in blood pressure categories.

Table 1.1 Characteristic of respondents' population of Malaysia age 20 or older

	% respondents (unweighted) n=21391 No. (%)	% Malaysia population aged 30 or older n=7.84 million %
Sex		
Male	10004 (47%)	50%
Female	11387 (53%)	50%
Age		
30-34	4252 (20%)	21%
35-39	3944 (18%)	19%
40-44	3344 (16%)	16%
45-49	2638 (12%)	12%
50-54	1935 (9%)	9%
55-59	1651 (8%)	7%
60-64	1360 (6%)	6%
65-69	951 (4%)	4%
>=70	1316 (6%)	6%
Ethnic		
Malay	9656 (45%)	43%
Chinese	5978 (28%)	31%
Indian	1467 (7%)	8%
Other indigenous	3194 (15%)	9%
Others	1096 (5%)	10%

1.2 Problem Statement

Most of blood pressure (BP) measuring devices nowadays rely on a common concept of inflatable cuff to the arm which applied auscultatory or oscillometry principle. Current methods have a limitation to get blood pressure. Some of the problem and limitation is:-

- i. Patient physical condition. Need arm or leg to wrap the cuff. Not suitable for patient with the stumped or crippled condition. Or patient with burn effect all over their body or the patient with the orthopedic injuries where their born fractured. This makes the patient in the painful condition.
- ii. For the Newborn, the cuff sized is always not available. A cuff too large can cause reading to be lower than actual.
- iii. Movement from patient, muscle tremors and abnormal heart rhythms, a very weak pulse or pressure can cause difficulty to obtain a reading.

Accurate diagnosis of blood pressure is look likes easy to get in normal condition. But in some extreme scenario, like patient in scorched and blackened by fire that can be critical case to get the blood pressure value.

Artificial intelligent techniques can be used by this case for doctors' estimate instantly, neural networks, and fuzzy logic, neuro-fuzzy has shown great potential in this field. With the involvement of soft computing, the classification and prediction of algorithms which have direct applications in many medical problems have become much easier to be implemented and diagnosed.

Hence, this project tries to find out how the neuro fuzzy system or the hybrid combination of neural network and fuzzy logic techniques can be applied in the classification and prediction purposes, particularly on the medical field. So blood pressure can be estimated or predicted by using these artificial intelligent techniques

1.3 Research Objective

This research is intended to estimate mean arterial pressure blood pressure parameter. Therefore, the objectives of this research are:

- i. To predict the mean arterial pressure by using Neuro-Fuzzy Model in MATLAB Software.
- ii. To analyze the correlation between human physiology signal parameter (weight, height, BMI) to blood pressure parameter by using IBM SPSS Statistic Software Tool.

1.4 Research Scope

In order to archive the objectives, this project research is done guided by the following scope:

- i. Designing Neuro-Fuzzy model by using Adaptive Neuro Fuzzy Inference System (ANFIS). ANFIS train the Fuzzy Logic to predict the mean arterial pressure`s subjects by using the previous data from the real patients as the guideline to predict the outcome variable (mean arterial pressure).
- ii. The subject number up to 60 peoples and between 18 to 50 years old. Subject sampled by 10 subjects, 30 subjects and 60 subjects.
- iii. The acceptable error less than 10% because it is to prevent the model from making large mistake. For this project it can be accepted for development to predict the blood pressure parameter. But in medical problem it is very crucial to determine the accuracy and precision of the output of the analysis.

1.5 Thesis Outline

This thesis consists of five chapters. Each chapter elaborates different stage development of this project until to conclusion.

The first chapter presents the background of the project problem statements. This part presents the current method problem to measure blood pressure value, limitation of current method in practically condition and propose solution by using this project model as suitable frame to solve the problem. Objective and scope present the limitation subject and error in this model. Next is project methodology that will present the step by step of the work.

The second chapter is the literature review to explain the overview blood pressure in terms of unit in measure blood pressure millimeter Mercury (mmHg), classification of blood pressure. Next is measurement technique. Elaborate about invasive and non-invasive technique.

The third chapter describes the methodology for explanation of the project. Present every step in each stage to run this project. How to use Statistical Package for the Social Sciences (SPSS) and how to use Adaptive Neuro-Fuzzy Inference System (ANFIS) with its Graphical User Interface (GUI).

The forth chapter presents the result and discussion of the project by using ANFIS with it graphic user interface. Correlation result from the SPSS for 10, 30 and 60 subject. Then the result will be analyzed in the ANFIS to train and testing the data result.

The last chapter presents the conclusion from the project. Discuss the conclusion. Recommendation for future works of the project. Further development can be made the prediction more available.

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