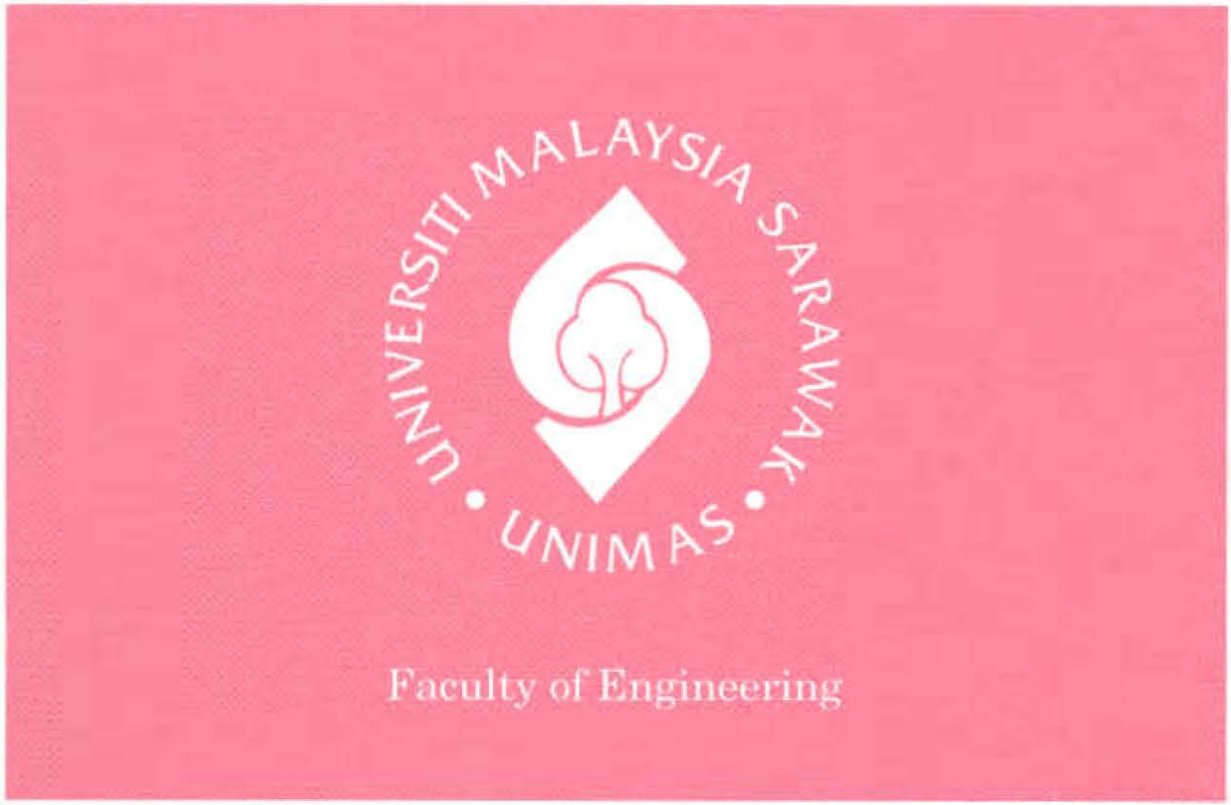

FACIAL EXPRESSION CLASSIFICATION

Chong Yung Fook

Bachelor of Engineering with Honours
(Electronics and Computer Engineering)
2010

UNIVERSITI MALAYSIA SARAWAK

R13a

BORANG PENGESAHAN STATUS TESIS

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SESI PENGAJIAN: 2009/2010

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Author : Chong Yung Fook

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Has been read and certified by:

p/p

Mdm. Annie Joseph
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17/5/2010

Date

Facial Expressions Classification

CHONG YUNG FOOK

This project is submitted as partial fulfillment of
The requirements for the Bachelor's Degree of Engineering with Honors
(Electronics and Computer Engineering)

Faculty of Engineering
UNIVERSITI MALAYSIA SARAWAK
2009/2010

Dedicated to my beloved family and friends

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ABSTRAK

Masa kini, semakin banyak applikasi elektronik dan alat jentera telah dicipta agar masyarakat kita ada gaya hidup yang lebih baik. Dengan itu, pengolongan ekspresi wajah menjadi penting sebab ianya dapat membantu applikasi elektronik berkomunikasi dengan manusia menggunakan cara yang lebih mesra. Justeru itu, system pengolongan ekspresi wajah menggunakan rangkaian neural telah dibentangkan. Sebagai pemulaan untuk penyelidikan dalam pengolongan ekspresi wajah, projek ini dibuat berdasarkan bentuk mulut. Pada mulanya, mulut akan diproses dengan menggunakan pemprosesan gambar untuk mendapatkan bentuk mulut dan vektor. Vektor diperlukan untuk pemprosesan rangkaian neural dan dilatih untuk mengolongkan ekspresi wajah. Rangkaian neural model Radial Basis Function (RBF) telah digunakan dalam projek ini disebabkan kelebihan model ini dalam mengenali hentuk. Beberapa tatarajah bagi rangkaian neural telah disimulasikan dan keputusannya telah dibandingkan. Keputusan menunjukkan peratusan pengolongan yang betul adalah sangat tinggi walaupun bentuk mulut sahaja dipakai dalam pengolongan. Peratusan pengolongan yang betul dapat mencapai lingkungan antara 60% sehingga ke 100%. Di akhir projek ini, cara perbaikan telah disarankan untuk meningkatkan pretasi dan fungsi dalam pengolongan ekspresi wajah di masa hadapan.

ABSTRACT

Nowadays, more and more advance electronic and machinery applications were invented to provide a better lifestyle to the society. Because of that reason, facial expression classification application also become important as it can help the electronic applications to interact with users in a more user-friendly method. Thus, a facial expression classification system using RBF neural network implementation is presented. As a beginning of the research in the facial expression classification, this project is done based on the shapes of the mouths. The mouths will be first undergone image preprocessing to obtain its shape and vectors. The vectors are needed for the neural network to process and learn to classify facial expressions. Radial Basis Function (RBF) neural network is used in this project as it provides advantages in pattern recognition. Networks are simulated for a few configurations and compared the result of testing. The results show that the percentages of correct matching are very high even though it is just based on the shape of the mouth. The percentage of correct matching can achieve in the range of 60% until 100%. Future improvements for facial expressions classification are suggested at the end of the project to improve the performance and functionality of facial expression classification in the future.

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ANNS	-	Artificial Neural Networks
DCT	-	Discrete Cosine Transform
IEEE	-	International Electronic and Electrical Engineering
MLP	-	MultiIayer Perceptron
MSE	-	Mean Square Error
PCA	-	Principle Component Analysis
SOFM	-	Self Organizing Feature Map
RBF	-	Radial Basis Function
RGB	-	Red, Green, Blue
TFEID	-	Taiwanese Facial Expression Images Database

CHAPTER 1

INTRODUCTION

1.1 Introduction to Neural Network

In the past, the term neural network had been used to describe the network of biological neurons, which performing the nervous system of living organism, such as human and animal. However in modern usage, it is more often to be referring as Artificial Neural Networks (ANNS), a programmable system created using computer instruction set that perform tasks and properties similarly to biological neurons. ANNS are made up by interconnected artificial neurons to process the task with the provided algorithm.

In ANNS, usually there will be three layers as shown in Figure 1. The first layer is the input layer, the layer that receives the input data and sends it to the hidden layer. The second layer is the hidden layer, the layer that will process the input data with the provided method and algorithm. The third layer is the output layer, the layer that will show the result of the hidden layer.

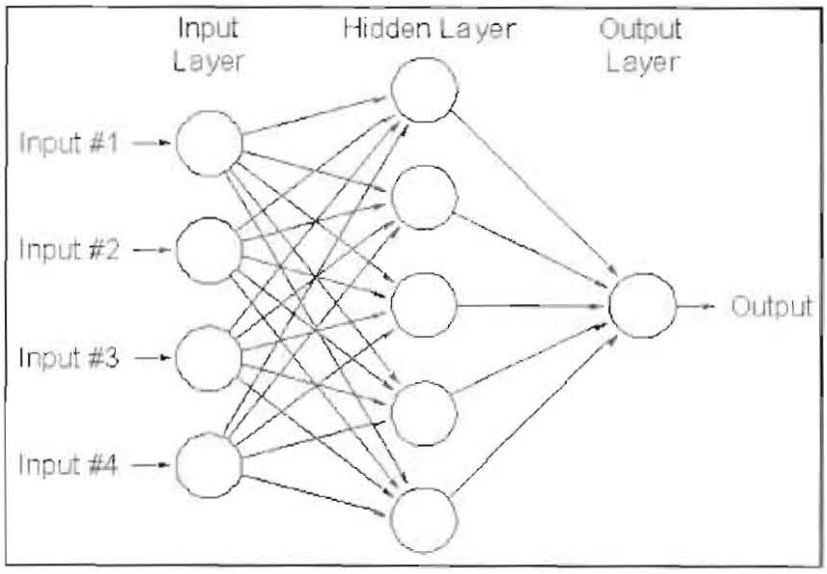

Figure 1: Layers of Artificial Neural Networks

1.2 History of Neural Network

ANNS has been largely been researched and undergoes simulation to simulate properties similar to biological neural network. The biological neuron has been tried to be simulated using computer programming. The brief histories of the neural network are listed below [1]:

1938 Rashevsky initiated studies of neurodynamics, also known as neural field theory, representing activation and propagation in neural networks in terms of differential equations.

1943 McCulloch and Pitts invented the first artificial model for biological neurons using simple binary threshold functions and it was discovered that many arithmetic and logical operations could be implemented.

1949	Donald Hebb comes out with Hebbian Learning, a neural network learning mechanism by reinforcement and association.
1954	Gabor invented the "learning filter" that uses gradient descent to obtain "optimal" weights that minimize the mean squared error between the observed output signal and a signal generated based upon the past information.
1958	Rosenblatt invented the "perceptron", introducing a learning method for the McCulloch and Pitts neuron model.
1969	Minsky and Papert demonstrated the limitation of perceptron.
1982	Hopfield's network was introduced for bi-directional flow of inputs between neurons or nodes.
1986	The backpropagation algorithm introduced in year 1974 became very popular and brought out the development of new training algorithms for multilayer perceptrons.

1.3 Applications of Neural Network

ANNS is applicable not only to biological processes, but also to technology application and mathematical arithmetic calculation. The applications can range from computer science or engineering field until marketing field. Some of the neural network applications' examples are as listed below:

I. Classification of human facial expression,

II. Real time target identification for security applications,

III. Industrial process controlling,

IV. Robotic for directing manipulator,

V. Investment analysis for marketing purposes,

VI. Artificial intelligent games development,

VII. Speech-reading.

1.4 Future of Neural Network

The development of ANNS and the application of ANNS are to be believed will be increase in the future. Researchers continuing to develop a new type of ANNS and implement the neural network in varieties of application, ANNS might develop in certain area such as:

I. More user-friendly human and computer interaction application,

II. Robot that can feel, think and act like human,

III. Organization Sales forecasting,

IV. Fully automated smart home or smart vehicles.

1.5 Introduction to Facial Expression Classification

The approach of ANNS in technology has been focused in developing a more user-friendly application that allowed the computer to communicate with human. The development of the more user-friendly application begins with the idea where the computer can interact with the users. Hence, researches have been done on human detection by technology to develop the computer system that can respond to human. The human detection that has been researched includes human movement detection, human facial recognition, human facial expression classification, voice recognition and etc. In this project, research and development will focus on facial expression classification using ANNS.

The facial expression is defined as the basic mode of nonverbal communication among people. The facial expression of a person is often being used to form the significant impression of such characteristics as friendliness, trustworthiness and status. Facial expression also always implies the changes of visual pattern over time, meaning showing the feeling or mood of the person at the moment of time [2].

Facial expression classification will be meaning to classify the expression showed by the human face at the moment of time. The expressions can either be classified into happy, sad, normal, angry or etc. Facial expression is important to identify the feeling or mood at the moment of time. The ability to classify facial expression can make the communication and interaction among people more effectively [3].

1.6 Project Objective

Facial expression classification is one of the main criteria for user-friendly application's development. The ability to classify facial expressions allowed the computer to respond to the user according to user's feeling at the moment of time, making the system more user-friendly.

Hence, the objectives of the project are:

I. To train the Radial Basis Function network for facial expression classification.

II. To implement the ANNS algorithm in order to classify the human faces.

III. To classify the human facial expression using ANNS.

IV. To simulate the result of ANNS for human facial expression classification.

1.7 Scope of Project

The scopes of this project are to study the method to apply ANNS into image processing and study about facial expression classification and Radial Basis Function (RBF).

Besides that, this project is done to study the method to process the image into input data that the ANNS can accept and study the method to classify human facial expression using RBF. Moreover, this project is to develop a RBF system that can classify human facial expression.

1.8 Chapter Outline

The outline for each chapter is listed as below:

Chapter 1 - Introduces about neural network and facial expression. Besides that, it also explains the objectives of the project and scopes of the project.

Chapter 2 - Summarizes the studies and researches done for this project.

Chapter 3 - Describes the methodology of this project and shows flow of the techniques. Besides that, it also explains the facial expression classification using MATLAB software.

Chapter 4 - Performing the results of the project and analysis of the project. Besides that, discussions will also be made to evaluate the performance of the developed system. The limitation of this project will also be discussed in this part.

Chapter 5 - Discuss about the conclusion of this project and make suggestions for further works of facial expression classification.

CHAPTER 2

LITERATURE REVIEW

2.1 Origin of Neural Network

The roots of ANNS studies started with the neurobiological studies that dated back about a century ago. For decades, biologists have been speculated on exactly how the nervous system works. William James was the first person who has come out the hypotheses for how the biological neural network system works in 1890s and lead to the development of ANNS. The concept at that time was mainly to describe how the human nervous system and mind performed.

The nervous system consists of the biological neurons as shown in Figure 2. In the biological neurons, the dendrite of one neuron receives electrical signals from the axons of the other neurons. At the synapses between the dendrite and axons, various amounts of electrical signals will be modulated. The neuron fires an output signal only when the total strength of the input signals exceeds a certain threshold. Then the signal will be sent to the brain for interpretation [4].

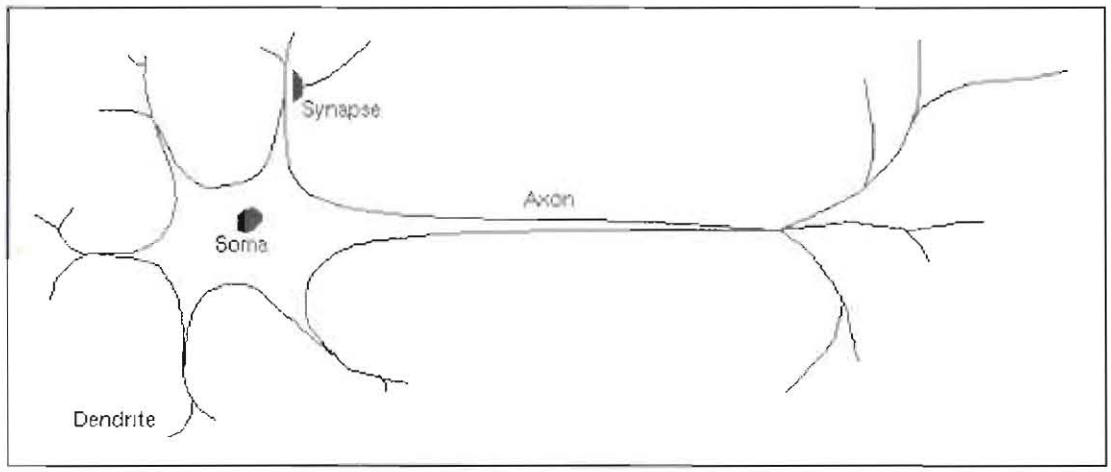

Figure 2: Biological Neuron

The concept of ANNS was developed using the hypotheses obtained from biological neural networks and it was first implemented into the Turing's B-type machines and the Perceptron. [1, 4, 5] Perceptron was the mathematical model representation for the biological neuron. In the Perceptron model, numerical values have represented the electrical signals in the biological nervous system. The weighted sum of the inputs represented the total strength of the input signals of the biological nervous system, and an activation function represented the threshold value is applied on the sum to determine its output [1].

The implementation of neural network concept into the Perceptron caused more and more types of ANNS been simulated. The ANNS have different architectures, different properties and serve for different purposes. It applies widely in our daily application, from simple washing machine automated controlling system until stock market forecasting, making the life of human easier and processing of data faster.