

# **HAND GESTURE RECOGNITION USING ARTIFICIAL NEURAL NETWORKS**

**By**

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**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,  
in Fulfilment of the Requirement for the Degree of Master of Science**

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in fulfilment of the requirement for the degree of Master of Science

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**Faculty: Engineering**

Hand gesture has been part of human communication, where, young children usually communicate by using gesture before they can talk. Adults may have to also gesture if they need to or they are indeed mute or deaf. Thus the idea of teaching a machine to also learn gestures is very appealing due to its unique mode of communications. A reliable hand gesture recognition system will make the remote control become obsolete. However, many of the new techniques proposed are complicated to be implemented in real time, especially as a human machine interface.

This thesis focuses on recognizing hand gesture in static posture. Since static hand postures not only can express some concepts, but also can act as special transition states in temporal gestures recognition, thus estimating static hand postures is in fact a big topics in gesture recognition. A database consists of 200 gesture images have been built, where five volunteers had help in the making of the database. The images were captured in a

controlled environment and the postures are free from occlusion where the background is uncluttered and the hand is assumed to have been localized.

A system was then built to recognize the hand gesture. The captured image will be first preprocessed in order to binarize the palm region, where Sobel edge detection technique has been employed, with later followed by morphological operation. A new feature extraction technique has been developed, based on horizontal and vertical states transition count, and the ratio of hand area with respect to the whole area of image. These set of features have been proven to have high intra class dissimilarity attributes.

In order to have a system that can be easily trained, artificial neural networks has been chosen in the classification stage. A multilayer perceptron with back-propagation algorithm has been developed, thus the system is actually in-built to be used as a human machine interface. The gesture recognition system has been built and tested in Matlab, where simulations have shown promising results. The performance of recognition rate in this research is 95% which shows a major improvement in comparison to the available methods.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagai memenuhi keperluan untuk Ijazah Master Sains

**PENGECAMAN PERGERAKAN TANGAN  
MENGUNAKAN RANGKAIAN NEURAL TIRUAN**

Oleh

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**Januari 2007**

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Pergerakan tangan merupakan sebahagian komunikasi di antara satu sama lain di mana kanak-kanak kecil pada kebiasaannya akan berkomunikasi dengan menggunakan pergerakan tangan sebelum mereka boleh bercakap. Bagi orang dewasa, mereka juga akan menggunakan pergerakan tangan sekiranya perlu ataupun bagi mereka yang pekak atau bisu. Idea dalam mengajar mesin untuk belajar tentang pergerakan sememangnya menarik disebabkan oleh komunikasi operasinya yang unik. Sistem pengecaman pergerakan tangan yang boleh diterima pakai akan membuatkan sistem kawalan jauh tidak lagi diperlukan. Walaubagaimanapun, banyak teknik-teknik baru yang telah dibentangkan begitu rumit untuk diaplikasikan dalam keadaan sebenar terutamanya sebagai perantaraanmuka mesin dan manusia.

Tesis ini memfokuskan ke arah pengecaman pergerakan bagi postur tangan statik. Postur tangan bukan sahaja dapat menggambarkan sesuatu konsep atau maksud tetapi juga

bertindak sebagai keadaan perubahan dalam pengecaman pergerakan dinamik, oleh yang demikian, postur tangan merupakan salah satu tajuk utama di dalam pengecaman pergerakan. Satu pangkalan data yang mengandungi 200 imej telah dibina di mana lima sukarelawan telah turut sama membantu dalam proses ini. Imej-imej tersebut diambil di dalam persekitraan terkawal dan postur yang tidak terlindung besertakan latar belakangnya yang tidak tercemar dan kedudukan tangannya yang telah ditentukan.

Satu sistem kemudiannya telah dibina untuk mengecam pergerakan tangan tersebut. Imej yang telah diambil terlebih dahulu melalui pra-proses bagi proses perduaan bahagian tapak tangan di mana teknik pengesanan pinggir 'sobel' telah digunakan dan diikuti dengan fungsi 'morphological'. Teknik penyarian elemen baru telah dibangunkan berdasarkan kiraan perubahan keadaan menegak dan melintang dan juga ukuran nisbah imej kawasan tangan terhadap saiz imej tersebut. Set-set elemen ini telah terbukti mempunyai sifat ketidaksamaan dalam kelas yang tinggi.

Bagi mendapat satu sistem yang senang untuk dilatih, rangkaian neural tiruan telah dipilih dalam proses pengklasifikasi. 'Perceptron' berbilang lapisan dengan algoritma aliran belakang telah dibangunkan, yang mana sistem terbina dalam telah digunakan sebagai perantaraanmuka di antara mesin dan manusia. Sistem pengecaman pergerakan telah dibangunkan dan diuji menggunakan perisian Matlab, di mana simulasi telah menunjukkan keputusan yang memberangsangkan. Kadar pengecaman bagi kajian ini adalah 95% dan ianya lebih tinggi berbanding dengan kaedah-kaedah yang sedia ada.

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I certify that an Examination Committee met on 11<sup>th</sup> Januari 2007 to conduct the final examination of Mohd Amrallah Mustafa on his Master of Science thesis entitled “Hand Gesture Recognition Using Artificial Neural Network’ in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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## **DECLARATION**

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

**MOHD AMRALLAH MUSTAFA**

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