DEVELOPMENT OF AN INTERNET–BASED SYSTEM TO MEASURE THERMAL COMFORT IN INDOOR ENVIRONMENTS

By

SIVASANKAR SAMBASIVAM

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

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DEDICATION

To my family

Thank you for your continued support and understanding

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in partial fulfilment of the requirement for the degree of Master of Science

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February 2006

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Faculty : Engineering

The aim of the research is develop an internet-based system that would act as an advisor to determine and predict comfort level in indoor environment based on fundamental indoor parameters, with the goal that development of a system that determines the desirable comfort level in buildings that will enable the saving of energy and ultimately result in saving of costs for cooling of buildings and yet at the same time provide optimum comfort for the occupants.

Air-conditioning temperatures are often set between 23°C to 25°C based on American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) requirements, but it is not suitable for Malaysians. With this system, room temperatures can potentially be increased by at least 0.5°C. In the long term, the system has a potential to reduce energy consumption without sacrificing Thermal Comfort for occupants.

The technology system used in the development of Thermal Comfort System for Malaysia (TCSM) is based on Active Server Pages (ASP) server technology written in Visual Basic Script (VBScript) using Macromedia Dreamweaver MX as the web-authoring program of choice. Fanger's equations for predicting Thermal Comfort were converted into specific sets of rules using the backward chaining method. The system is designed to follow three main sections mainly the Start TC Helper, TC Predictor and Thermal Comfort Information. The major input variables required by the system from the user are (1) air temperature of the room, (2) mean radiant temperature of the room, (3) air velocity of the room, (4) relative humidity of the room, (5) clothing thermal resistance of the user and (6) the metabolic rate of the user.

As a means of validation of the system, studies were carried out in the Mid-Valley shopping centre, KBP001 Engineering lab and BKB 107A room from the Faculty of Engineering. As a means of verification, interviews were also carried with various experts in the field of thermal comfort in Malaysia and as a result of the interviews Humphreys' adaptive thermal comfort equation was added to the internet-based system. With the use of the system, there is a potential savings in energy bills when the system is used to offer the user the comfortable temperature of the room.

Abstrak tess ini dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi sebahagian keperluan untuk ijazah Master Sains

PEMBANGUAN SISTEM BERASASKAN INTERNET UNTUK MERAMAL KESELESAAN TERMA BAGI PERSEKITARAN DALAMAN

Oleh

SIVASANKAR SAMBASIVAM

Februari 2006

Pengerusi : Professor Madya Ir. Nor Mariah Adam, PhD

Fakulti : Kejuruteraan

Objektif kajian ini adalah untuk membangunkan satu sistem berasakan internet yang berperanan sebagai penasihat untuk menentukan dan meramal tahap keselesaan sesuatu persekitaran dalaman berasakan parameter dalaman asas. Matlamat projek ini adalah untuk membangunkan satu sistem yang akan menentukan tahap keselesaan yang optimum dalam bangunan yang bakal membolehkan penjimatan tenaga dan memberikan penjimatan kos untuk penyejukan bangunan dan pada masa sama memberikan keselesaan optimum untuk penghuni bangunan.

Suhu penghawa dinging biasanya diletakkan antara 23°C ke 25°C berdasarkan keperluan ASHRAE, yang selalunya adalah terlalu sejuk untuk rakyat Malaysia. Dengan sistem ini, suhu bilik boleh dinaikkan sekurang-kurangnya 0.5°C. Bagi jangka masa panjang, sistem ini mempunyai potensi untuk memberikan penjimatan bil tenaga tanpa pengurangan keselesaan terma bagi penghuni.

Sistem teknologi yang digunakan untuk membangunkan Sistem Internet untuk Keselesaan Terma di Malaysia berdasarkan teknologi ASP yang ditulis dalam bahasa VBScript menggunnakan Macromedia Dreamweaver MX. Persamaan yang ditulis oleh Fanger untuk meramal Keselesaan Terma ditukarkan kepada rangkaian kod computer menggunnakan kaedah rangkaian belakang. Sistem ini direka untuk mengikut tiga bahagian utama iaitu Mula Pembantu Keselesaan Terma, Peramal Keselesaan Terma dan Informasi Keselesaan Terma. Data pembolehubah yang diperlukan oleh sistem ini ialah (1) suhu udara bilik, (2) suhu radiasi min bilik, (3) kelajuan udara dan (4) kelembapan bandingan untuk bilik, (5) nilai rintangan terma pakaian dan (6) kadar metabolik penghuni bilik.

Untuk menyahkan sistem ini beberapa kajian dilakukan di pusat membeli belah Mid-Valley dan di makmal kejuruteraan KBP001. Untuk memeriksa kesahihan system ni, bebrapa temuduga dilakukan dengan pakar dalam bidang keselesaan terma di Malaysia dan hasilnya persamaan keselesaan terma Humpreys ditambahkan kepada sistem ini.

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Sivasankar Sambasivam

I certify that an Examination Committee has met on 28th February 2006 to conduct the final examination of Sivasankar Sambasivam on his Master of Science thesis entitled "Development of an Internet-Based System To Measure Thermal Comfort In Indoor Environments" 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 degree at UPM or any other institutions.

_____

SIVASANKAR SAMBASIVAM

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