UNIVERSITI PUTRA MALAYSIA

TEMPERATURE AND HUMIDITY CONTROL SYSTEM USING FUZZY COGNITIVE MAP

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By

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Thesis Submitted to the Graduate School of studies, Universiti Putra Malaysia, In Fulfillment of the Requirement for the Degree of Master of Science

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TO

My Parents, Azar and Faramarz,

My lovely sister, Farnoosh and my younger brother Farshid

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement of the degree of Master of Science

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Intelligent Buildings have been more developed recently and tendency to be more intelligence is appeared. The intelligent buildings are the integration of four systems which are a Building Automation system (BAS), a Telecommunication of system (TS), an Office Automation system (OAS) and a computer aided facility management system (CAFMS). Building Automation system (BAS) is a main part of each intelligent building which is an integration of subsystems such as heating, ventilating and air-conditioning system (HVAC), lighting control, automatic fire alarm system and security system. HVAC system is energy consuming.

Increasing the nonlinearity and uncertainty in recent electrical and mechanical building's structures cause description of the system become more difficult or impossible

mathematically. The relationships among system's inputs and outputs govern on the mathematical model of the system. Due to the nonlinearity of time-variability and multivariability of the HVAC system by disturbances and uncertainties, to design and implement the proper control strategy is a challenge. Therefore, dynamical model of the HVAC system should be used to apply different control methods to minimise energy consumption.

This thesis is mainly focused on closed loop control of HVAC system to control the energy usage and synchronously balance with desired temperature and humidity ratio values. Hence, designing a nonlinear control procedure should be considered. The Fuzzy Cognitive Maps (FCMs) control method had been applied on the system. In order to reach the energy efficiency and desired temperature and humidity ratio values, the affecting and affected parameters are defined. The results of the FCM control shows that the controller stabilizes the outputs on the desired steady state with no overshoot and undershoots.

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

SYSTEM SUHU DAN KAWALAN KELEMBAPAN MENGGUNAKAN PETA KOGNITIF KABUR

Oleh

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April 2012

Pengerusi: Profesor Madya Abdul Rahman Ramli, PhD

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Bangunan Cerdas telah lebih maju baru-baru ini dan cenderung untuk menjadi lebih cerdas. Bangunan cerdas adalah merupakan gabungan empat sistem iaitu sistem automasi bangunan (BAS), sistem Telecommunikasi (TS), sistem automasi pejabat (OAS) dan sistem pengurusan kemudahan ter bantu komputer (CAFMS). Sistem Automasi Bangunan (BAS) adalah satu bahagian utama bagi setiap bangunan cerdas yang mana satu kesepaduan subsistem seperti pemanasan, menganginkan dan sistem penyaman udara (HVAC), kawalan pencahayaan, sistem penggera api automatik dan sistem keselamatan. Sistem HVAC adalah menggunakan tenaga.

Pertambahan ketaklelurusan dan ketakpastian dalam struktur bangunan dalam aspek elektrik dan mekanikal dalam bangunan menyebabkan pemerihalan sistem telah menjadi lebih susah atau mustahil secara matematik. Perhubungan antara input-input dan output

dalam sistem menentukan pada model matematik sesuatu sistem. Disebabkan ketaklelurus kebolehubahan-waktu dan kebolehubahan pelbagai pada sistem HVAC oleh gangguan-gangguan dan ketidakpastian, untuk mereka bentulo dan melaksanakan strategi kawalan yang sepatutnya merupakan satu cabaran. Maka model dinamik sistem HVAC perlu digunakan untuk mengguna kaedah kawalan yang berbeza untuk meminimakan penggunaan tenaga.

Tesis ini menumpukan kepada kawalan gelung tertutup sistem HVAC. Untuk mengawal penggunaan tenaga dan dalam masa yang sayna seimbang di kan dengan keselesaan terma. Maka, mereka bentuk prosedur kawalan tak lelurus adalah perlu dipertimbangkan. Peta-peta Kognitif Kabur (FCMs) kaedah mengawal telah digunakan dalam studio. Supaya mencapai kecekapan tenaga dan diingini nilai suhudan nisbah kelembapan, mempengaruhi dan terjejas parameter ditakrifkan. Keputusan-keputusan kawalan FCM menunjukkan yangpengawal mengukuhkan output di keadaan mantap teringin dengan tiadaterlaiak dan undershoots.

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I certify that a Thesis Examination Committee has met on April 30th. 2012 to conduct the final examination of Farinaz Behrooz on her thesis entitled "**Temperature and Humidity control using Fuzzy Cognitive Map**" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

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

FARINAZ BEHROOZ

Date: 30 April 2012

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