



UNIVERSITI PUTRA MALAYSIA

***STANDBY MODE MINIMIZATION FOR EFFICIENT BUILDING
MANAGEMENT SYSTEM USING FUZZY LOGIC***

WAQAR TARIQ

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**STANDBY MODE MINIMIZATION FOR EFFICIENT BUILDING
MANAGEMENT SYSTEM USING FUZZY LOGIC**

By

WAQAR TARIQ

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

June 2015

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DEDICATION

After thanking to Allah Almighty and his last messenger Prophet Muhammad (PBUH). This thesis is especially dedicated to my parents and my younger sister. I would like to dedicate this project to my other beloved family members, all my supervisors and lecturers in the Department of Electrical and Electronic Engineering of University Putra Malaysia and friends. Their guidance, prayers and relentless support have been a great inspiration to the realization of this project.



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

STANDBY MODE MINIMIZATION FOR EFFICIENT BUILDING MANAGEMENT SYSTEM USING FUZZY LOGIC

By

WAQAR TARIQ

June 2015

Chairman : Mohammad Lutfi Othman, PhD, Ir
Faculty : Engineering

In regards of smart and efficient energy management, many think that standby mode purely the solution in reducing the electrical usage. However, the standby mode of electrical appliances is also among one of the main factors that contributes to the electrical wastage as the appliances still consumes electrical energy during the standby operation. This research mainly focuses on creating a FES with a combination of image processing that minimize the standby mode and to evaluate the performance of the created dummy load system based by real-time lecture room case studies. The problem statement on energy wastage is strongly upheld by all previous studies done on this respective issue. The outcome of this research can be used to enhance the existing Building Management System (BMS) with the addition of standby mode minimization automation system. With this research, the standby mode of the electrical appliances can be automatically and manually controlled or minimized based on the desired fuzzy rules set by the feedback system of image processing intact by the system. The role of image processing in this system is as same as of occupancy sensor, but the role of camera image processing filters makes it feedback more precise. The controlling of the electronic devices like TV, LCD, Gaming consoles or mobile and laptop chargers are totally dependent on the presence of the user in the premises or for charging and discharging phenomenon load detection circuit is used in this proposed research. Overall the proposed research can be explained as the system is comprised of fuzzy logics and rules which are monitoring and controlling the power consumption of electronic and electrical devices. Whereas controlling and monitoring is done through GUI developed in Matlab and controlling and monitoring is done with sets of fuzzy rules with the feedback of image processing with the use of filters to make the feedback more accurate and precise for this purpose GAIT reorganization system. It addresses the main point of concern that is the minimization of the standby operation of electrical appliances.

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

SIAP SEDIA PENGURANGAN MOD BAGI SISTEM PENGURUSAN BANGUNAN YANG CEKAP MENGGUNAKAN LOGIK KABUR

Oleh

WAQAR TARIQ

Jun 2015

Pengerusi : Mohammad Lutfi Othman, PhD, Ir
Fakulti : Kejuruteraan

Dalam hal pengurusan tenaga pintar dan cekap, ramai beranggapan bahawa mod siap sedia merupakan penyelesaian semata-mata dalam mengurangkan penggunaan elektrik. Walau bagaimanapun, mod siap sedia peralatan elektrik juga merupakan salah satu daripada faktor yang menyumbang kepada pembaziran elektrik kerana peralatan masih lagi menggunakan tenaga elektrik semasa operasi siap sedia. Kajian ini memberikan tumpuan utama dalam mewujudkan **FES** dengan gabungan pemprosesan imej yang meminimumkan mod siap sedia dan menilai prestasi model sistem beban semu berdasarkan kajian masa sebenar bilik kuliah. Kenyataan masalah pembaziran tenaga amat didukung oleh semua kajian yang dilakukan sebelum ini ke atas isu ini. Hasil daripada kajian ini boleh digunakan bagi meningkatkan *Building Management System (BMS)* yang sedia ada dengan penambahan mod siap sedia sistem meminimuman automasi. Dengan kajian ini, mod siap sedia peralatan elektrik boleh dikawal secara automatik dan secara manual atau boleh diminimumkan berdasarkan peraturan kabur yang telah ditetapkan oleh sistem maklumbalas daripada imej pemprosesan utuh oleh sistem. Peranan imej pemprosesan dalam sistem ini adalah sama seperti sensor penggunaan, tetapi peranan kamera penapisan pemprosesan imej ini menjadikan maklumbalas lebih tepat. Pengawalan alat-alat elektronik seperti TV, LCD, konsol permainan atau telefon mudah alih dan pengecas komputer riba adalah bergantung sepenuhnya kepada kehadiran pengguna di dalam premis atau fenomena untuk mengecaj dan menyahcaj litar pengesanan beban dalam kajian yang dicadangkan ini. Pada keseluruhannya, cadangan kajian boleh diterangkan sebagaimana sistem ini terdiri daripada logik kabur (*fuzzy logics*) dan peraturan yang memantau dan mengawal penggunaan kuasa alat-alat elektronik dan elektrik. Manakala pengawalan dan pemantauan telah dilakukan melalui GUI yang telah dibangunkan di Matlab dan kawalan dan pemantauan dilakukan dengan mengeset peraturan kabur dengan maklum balas daripada pemprosesan imej dengan menggunakan penapis untuk menjadikan maklum balas yang lebih tepat bagi tujuan sistem penyusunan semula GAIT. Ia menunjukkan titik utama yang menitikberatkan meminimuman operasi siap sedia peralatan elektrik.

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WAQAR TARIQ

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Mohammad Lutfi Othman, PhD

Senior Lecturer, Ir
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Norman Mariun ,PhD

Professor
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Noor Izzri B. Abd Wahab, PhD

Senior Lecturer
Faculty of Engineering
Universiti Putra Malaysia
(Member)

BUJANGBIN KIM HUAT, PhD

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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Signature: _____ Date: _____

Name and Matric No.: Waqar Tariq GS33625

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Signature: _____
Name of
Chairman of
Supervisory
Committee: Mohammad Lutfi Othman, PhD

Signature: _____
Name of
Member of
Supervisory
Committee: Norman Mariun ,PhD

Signature: _____
Name of
Member of
Supervisory
Committee: Noor Izzri B. Abd Wahab, PhD

TABLE OF CONTENTS

ABSTRACT	Page
ABSTRAK	i
ACKNOWLEDGEMENTS	iii
APPROVAL	v
DECLARATION	vi
LIST OF TABLES	viii
LIST OF FIGURES	xiv
LIST OF ABBREVIATIONS	xv

CHAPTER

1	INTRODUCTION	1
	1.1 Background	1
	1.2 Energy Saving System	1
	1.3 Problem Statement	2
	1.4 Objectives	2
	1.5 Scope of Work	2
	1.6 Thesis Layout	3
2	LITERATURE REVIEW	4
	2.1 Power Wastage	4
	2.2 Factors of Power Wastage	4
	2.3 Human Negligence	4
	2.3.1 Improper Installation	5
	2.3.2 Standby Mode or Phantom Load	5
	2.3.3 Wastage Perspective of Phantom Load Analysis	5
	2.4 Reviews on Standby mode in electronic appliances	7
	2.4.1 Standby mode operation of electrical appliances	7
	2.4.2 Standby Mode VS Hibernate Mode VS Sleep Mode	7
	2.4.3 The Standby Power Challenge	8
	2.5 How to deal with Phantom Load	8
	2.6 Consumer Training and Education	8
	2.6.1 Advantages and Disadvantage	8
	2.7 Power Monitoring Device	9
	2.7.1 Advantages and Disadvantages	10
	2.8 Energy Audit	10
	2.8.1 Electrical Energy Audit in a Malaysian University- A Case Study	10
	2.8.2 Energy Audit activity at UPM	11
	2.8.3 Energy Audit Project Work Flow	12
	2.9 Automatic Standby Power Management Using By Usage Profiling and Prediction	16
	2.9.1 Advantages and Disadvantages	16
	2.10 A Low Cost and Effective Implementation of Standby Mode Power Reduction	17
	2.11 Review on image processing role in BMS or Energy saving schemes	18

2.12	Building Management System Based on Image Sensor	18
2.13	Review on monitoring and controlling techniques	19
2.13.1	Design of Building Energy Monitoring and Management System	19
2.13.2	Energy Management and Control System of a Building by PC and Camera base	20
2.14	Fuzzy Logic	21
2.14.1	Fuzzy Logic – Based Supervisory Control of Household Appliances	22
2.14.2	Applying truth values	24
2.15	Review on different systems synchronization in BMS	25
2.15.1	Information Fusion Based Smart Home control System and its Application	25
2.15.2	Recent Applications of Fuzzy Logic to Home Appliances	27
2.15.3	Prototype Development of a Spatial Information Management System for Large-scale Buildings	27
2.16	Cost Feasibility Study	29
2.16.1	Installation cost	29
2.16.2	Operational Cost	30
2.17	Summary	30
3	RESEARCH METHODOLOGY AND DESIGN	31
3.1	Experimental Methodology	31
3.1.1	Work Flow	31
3.2	Monitoring system	33
3.3	Controlling Systems	34
3.4	Fuzzy Expert System (FES)	35
3.5	Real-Time Lecture Room Case Studies	39
3.6	Gait Recognition	40
3.7	Data Sets for Image processing and Fuzzy Logic	42
3.7.1	Data set	42
3.7.2	Data set B	42
3.7.3	Parameters	42
3.8.	Matlab Image Processing Toolbox	42
3.8.1	The output membership functions for image detection	44
3.8.2	Fuzzy Rules for Image detection	44
3.8.3	Person detection (based on Shape Metric) Fuzzy Logic Input Structure	45
3.8.4	Periodic determination on time fuzzy logic input structure	47
3.8.5	Input membership functions periodic determination	48
3.8.6	Fuzzy rules for periodic determination	49
3.9	Fuzzy Expert System (FES)	50
3.10	Fuzzy Set of Rules	56
3.11	BMS and standby minimization Hardware Design	56
3.12	Arduino R3 Mega 25	57
3.13	LCD Television	58
3.14	Web Camera	59
3.15	Summary	59

4	RESULTS AND DISCUSSION	60
4.1	Introduction	60
4.2	Operational Results of the System	60
4.3	Fuzzy Expert System (FES) Case Studies	62
4.3.1	Case 1: When both the Lights and Fan are OFF	64
4.3.2	Case 2: When Lights are ON, FAN is OFF	66
4.3.3	Case 3: When Lights are OFF, FAN is ON	67
4.3.4	Case 4: When both the Lights and FAN is ON	68
4.4	Fan Speed Determination Fuzzy Logic Input69Structure	71
4.4.1	Fuzzy rules for fan speed determination	73
4.5	Main GUI showing the system in operation	73
4.6	Quantitative Results and Discussion	75
4.7	Image Processed Controlling Measurements for Standby Mode of (LCD)	77
4.8	Summary	78
5	CONCLUSIONS AND RECOMMENDATION FOR FUTURE WORK	
5.0	Conclusion	79
5.1	Suggestions for future works	79
	REFERENCES	81
	BIODATA OFSTUDENT	83
	LIST OF PUBLICATIONS	84

LIST OF TABLES

Table	Page
1. Average Standby wastage and annual cost	6
2. Differences between Standby, Hibernate and Sleep mode	7
3. Example of the Energy Audit Table	13
4. Appliances Power Rating Table And Total Energy Usage Comparison	13
5. Real-Time Case Studies	38
6. Description of the Variables Used In the FES	51
7. Summary Of LCD Television Findings Obtained From The Survey	54
8. Current Summary Table For “TV current” Input Membership Function	55
9. Voltage Summary Table For “TV supply voltage	56
10. Arduino R3 Mega 2560 Specifications	58
11. Representation Of Input Variables With The Case Studies	63
12. Current Values Used To Indicate The TV Operation Mode	63
13. Resultant Output TV Operation Mode and The Graph Indication	64
14. Graph Indications of Input Variables during On And Off Mode	64
15. Summary of LCD Television Findings Obtained From The Survey	75
16. Tariff Peninsular Malaysia Year 2014	76
17. Consumer Base Phantom Load Loss Cost/Month	76
18. Standby Mode Power Saving With Respect To Time	78

LIST OF FIGURES

Figure	Page
1. Simple Power Meter	9
2. Power Monitoring System	9
3. Electricity Consumption Pie Chart	11
4. Project Work Stages	12
5. Energy Usage Distribution Pie Chart	14
6. Energy Usage Comparison between the Observed Energy Usage	15
7. Classification And Power Management Policy	16
8. The Block Diagram Of The Circuit	17
9. The Implementation Of The Circuit In A Socket Form	18
10. PC And Camera Based Energy Management & Control System	21
11. Fuzzy Logic Systems	22
12. Overview of Application Controller Technologies	22
13. Control System Architecture	23
14. Graphical Representation of Fuzzy Logic Truth Values	24
15. Information Synchronization Architecture	25
16. Controlling Architecture	26
17. Special Information Management System	28
18. System Input to Output Flow	28
19. Work Flow of the Research	32
20. Block Diagram of the Masters Research Hardware	33
21. Block Diagram between Dummy Load, DAQ Device and Computer	34
22. Experimental Set Up Of Building Energy Management System	34
23. Steps in Designing the FES	35
24. Main Components of Matlab Fuzzy Logic Toolbox	36
25. FIS Editor from Matlab Fuzzy Logic Toolbox	36
26. Membership Function Editor From Matlab Fuzzy Logic Toolbox	37
27. Rule Editor From Matlab Fuzzy Logic Toolbox	38

28.	Sample Of Fuzzy Rules Formed By the Rule Editor	38
29.	Rule Editor from Matlab Fuzzy Logic Toolbox	39
30.	Human Gait	41
31.	Contrast Enhanced Images in Gait Sequences	41
32.	Gait Cycle	41
33.	Fuzzy Logic Input Structure Head Size Detection	41
34.	Input Membership Function Plot	43
35.	Image Detection Output Membership Function	44
36.	Fuzzy Rules Image Detection	45
37.	Fuzzy Input Structure 19 Person Detection	46
38.	Input Membership Function	47
39.	Fuzzy Input Structures Periodic Determinations	48
40.	Membership Function Periodic Determination	48
41.	Fuzzy Rules Periodic Determination	49
42.	Fuzzy Logic Toolbox Fis Editor	52
43.	Input Variable “TVcurrent” Membership Function	53
44.	AC Adapter Power Rating Of LCD TV Load	54
45.	Output Variable “TV supplyvoltage” Membership Function	55
46.	Matlab Fuzzy Logic Rule Editor	56
47.	Arduino R3 Mega 2560 Description	57
48.	LCD Television	58
49.	Webcam	59
50.	Surface Viewer For “Bulbperiod”Out Period	60
51.	Surface Viewer For “Motorperiod”Out Time	61
52.	Surface Viewer For “TVcurrent	61
53.	Surface Viewer For “Bulb Period And Motor Period	62
54.	Surface Viewer For “Bulbperiod, Motorperiod And TVsupplyvoltage	62
55.	Case 1 Output Command When TV Status Is Off	65
56.	Case 1 Output Command When TV Status Is Standby	65
57.	Case 1 Output Command When TV Status Is ON	66
58.	Case 2 Output Command When TV Status Is OFF	67
59.	Case 3 Output Command When TV Status Is OFF	67

60.	Case 3 Output Command When TV Status Is Standby	68
61.	Case 3 Output Command When TV Status Is ON	68
62.	Case 4 Output Command When TV Status Is OFF	69
63.	Case 4 Output Command When TV Status Is OFF	70
64.	Case 4 Output Command When TV Status Is ON	70
65.	Fuzzy Logic Input Structure	71
66.	Input Membership Function	72
67.	Fuzzy Output Membership Function	72
68.	Fuzzy Rules Fan Speed Determination With Temperature Sensor	73
69.	Main (GUI) For Hardware Control	73
70.	Gait Detection	74

CHAPTER 1

INTRODUCTION

1.1 Background

Modern era is known as the age of energy efficient building either commercial or residential sector. Advanced engineering introduced many new technologies for this purpose as energy saving is a constant concern factor and a continuous work is done on this issue like Building management system (BMS), EBMS and many more technological setups which helps in saving energy to some extent. The purpose of a BMS is to automate and take control the energy related operations like electrical equipment's in the most efficient way. That makes it possible for the consumers to save energy and gets economical perks as well as can full fill their social responsibility.

1.2 Energy Saving Systems

As modernization goes on many newer systems of saving energy are introduced, which are quite successful till some extent, not only systems many campaigns are also supporting these systems by giving awareness and a sense of responsibility to both commercial and residential consumer to make sure minimum wastage of energy at their end.

Wastage of energy may occur of many factors, for example, distribution losses, human negligence, and one of the most important factor which is a hurdle in the way of zero energy buildings that is standby mode loss, also known as phantom load, vampire load or leakage current. So far many procedures and systems are present to overcome these factors, but a continuous development is always needed to attain maximum results.

One of the systems is BMS, which monitor and control services such as heating, ventilation, air-conditioning, lighting, security, and switching, ensuring that operation are at the maximum level of efficiency and economy. This is achieved by maintaining the optimum balance between environmental conditions, energy usage and operating requirements.

The BMS is a “standalone” computer system that can calculate the pre-set requirements of the building and controls the connected load to meet switching, monitoring and controlling needs. Its inputs, such as motion, temperature, light sensors and outputs, such as on/off signals are connected into the main system, server or controlling unit around the building. Programs in the respective system, server or controlling unit use the information to decide the necessary level of applied control.

The level of control via the BMS is dependent upon the information received from its sensors and the way in which its programmers tell it to respond to that information. As well as offering a precise degree of control to its environment, it can be made to alarm on conditions that can't meet specification or warn of individual items of load fail, the whole BMS process is divided floor to floor and load to load and then connected to main control and monitor panel.

Occupancy times for different areas are programmed into the BMS such that the plant is brought on and off to meet the occupational requirements. These times are often under optimum start control. This means that the heating plant is enabled, at a varying predetermined time, to ensure that the heated space is at the set desired temperature for the start of the day. The BMS therefore, based on the outside air temperature the space temperature and the building structure, determines the plant start time.

1.3 Problem Statement

To overcome the wastage factors such as phantom load or standby mode wastage automation is required. This is the era of computer networking, automation and optimization which make possible to solve any sort of troubleshooting remotely anywhere any time. There is a general thinking that standby mode in electronic devices is purely the solution for minimizing the electrical usage. However, in reality the standby mode of electrical appliances is also among one of the main factors that contributes to the electrical wastage as the appliances still consumes electrical energy during the standby operation. Roughly estimated 10 to 15% consumption of electricity is still there during the standby mode. This consumption is usually termed as phantom load, vampire load or leaking electricity (Tariq, Mustafa & Rasool, 2012).

As aforementioned, the power wastage factors, i.e. human negligence, and phantom load or standby wastage are the key concern toward the zero energy buildings. Zero energy cities are the real future and the final goal concerning energy in the building sector. To achieve such cities the highlighted wastage factors should be addressed.

1.4 Objective

This research will try to emphasize on limiting the use of electricity in a particular building by the mean of developing a prototype i.e. dummy load. An operational feature like Periodic controlling, automation of the devices/appliances will be the main target of the research will be the minimization of standby mode. The main target is to overcome the issue of human negligence in wasting electrical power. Elaborating it further objectives of the research can be laid as.

1. Developing a BMS prototype to test a monitoring and controlling system which may help to control switching of connected load in a periodic manner to avoid after use power wastage.
2. To develop a controlling program to minimize standby mode/ phantom load, by using the tool of image processing and fuzzy logic.
3. Synchronize the standby mode minimization program with the developed BMS prototype for monitoring and controlling.

1.5 Scope of Work

The research will be oriented on a dummy load which will be used to show the usage of particular equipments used in a building such as air conditioner, lighting system, and multimedia equipments which will be attached to a DAQ and then to a controlling and

monitoring unit on a computer, on which monitoring and controlling will be done by constructing a GUI on Matlab then by using fuzzy logic and image processing controlling will be done. The aim of this research is to develop a technique to ensure minimum use of standby mode and make sure that there is no power loss of devices after the particular time period of use.

1.6 Thesis Layout

This thesis is composed of five chapters.

The first chapter is the introductory chapter and it provides basic background of the study, problem statement, objectives, and scope of the work.

Chapter 2 provides the review and analysis of different type of power wastage, its factors and effect. This chapter also provides an explanation of several previous research works on BMS. It also discusses all the previous techniques used in BMS technology, i.e. controlling and monitoring methods. Discussion about different type of devices, equipment's used in setting up BMS. Standby minimization, phantom load factor and its prevention techniques and comparison with proposed technique also discussed in this chapter.

Chapter 3 presents the methodology and research design to achieve the objectives of the proposed research.

Chapter 4 presents the results and findings on voltage; current and power monitoring base .This chapter also presents comparative survey results in order to prove they obtained results satisfy the benchmark. Survey results consist of power consumption, power wastage and tariff.

Finally, Chapter 5 concludes this research. BMS Design using fuzzy logic is the most suitable technique, when to avoid energy losses occur in building power consumption also this technique is effective to reduce losses because of standby mode, fuzzy logic and image processing offer low power consumption and Design simplicity. The Contributions of this work are also stated and ideas for future development of the BMS Technology design are suggested for respective target oriented usage.

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