UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY THE EFFECT OF CAPACITOR ON HOME APPLIANCE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electrical Engineering Technology (Industrial Power) (Hons.)

by

SITI HAJAR BINTI RAZLAN
B071210332
911125-10-5314

FACULTY OF ENGINEERING TECHNOLOGY
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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Industrial Power) (Hons.). The member of the supervisory is as follow:

…….

(Mohd Firdaus bin Mohd Ab Halim)

ABSTRACT

Recently, a global market related to energy efficiency technology and energy saving is extended quickly with the growth case major concern on extreme climate change. Especially, in home networking environment where only the scope of work have been concentrating regardless of energy consumption, it is important developing new energy efficient technologies specialist in home networking environment. The concept of this project are to build capacitor system and analyze the effect on energy saving through kilowatt hour (kwh) reading after implement the effect of capacitor system in consumer appliance, also to perform the data collection on energy saving. From the analysis made of the data will be taken using equipment called (power quality analyze). Power quality analyzes used was to prove the effect given after using the capacitor system.

ABSTRAK

Pada masa kini, kebimbangan utama kepada perubahan iklim yang terlampau pada teknologi kecekapan tenaga dan penjimatan tenaga di beri tumpuan pada pasaran global sekarang. Terutamanya, di persekitaran rumah di mana hanya bidang tugas di beri tumpuan tanpa mengira penggunaan tenaganya, pakar cekap tenaga yang baru di persekitaran rumah adalah penting bagi membangunkan teknologi – teknologi cekap tenaga. Tujuan utama projek ini adalah untuk membina suatu sistem pemuat (capacitor) dan menganalisis kesan selepas penggunaan sistem pemuat (capacitor) pada penjimatan tenaga melalui bacaan kilowatt jam (kwh). Daripada analisis yang dibuat data akan di ambil dengan menggunakan peralatan yang dipanggil (power quality analyze). Power quality analyzes ini digunakan bertujuan untuk membuktikan kesan yang diberikan selepas menggunakan sistem pemuat ini.

DEDICATIONS

To my beloved parent thank you for your support with my studies. I am honoured to have you as my parents and thank again for giving me a chance to prove and improve myself through all my flows of life. Thank you to my litter sisters, Sara whose never left me alone.

I also dedicate this to my good friend and my entire friend in the class of BETI seconds cohort FTK for helping me through the process of completing this thesis. Mohd Riduan Mohd and Noor Ashikin, thank you and I am will always appreciate all what you're all for helping me develop my software and hardware skill. Not forgotten to Nor Su'aidah Hamdam for the many word of support.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLE

LIST OF SYMBOLS AND ABBREVIATIONS

AC	Alternating current
DC	Direct current
DR	Demand response
Ec	Energy consumption
Et	Target energy
ESP	Energy service provides
HAN	Home area network
HEMS	Home energy management system
HESS	Home energy saving system
IC	Integrated circuit
LC	Inductor capacitor
LED	Light emitter diod
KWH	Kilowatt hour
PAR	Peak to average ratio
RTR	Real
SP	Smart plugs
AC	Alternating current
DC	Direct current

CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter briefly discussed about the project background and the problem of this project. The objective and scope of this project are also will be explained briefly through this chapter and should be achieved at the end of the project.

1.1 Background project

The capacitors are common phenomena of electronic structure that can be to stores electric charge. It is known as the capacitor has two terminal electrical element types of terminal is has polarity (positive and negative) and seconds is no polarity. Most capacitor are used in electric circuit for blocking direct current while alternating current pass and in electric power transmission system, capacitor are stabilizes voltage and power flow. In practical, capacitor are vary widely and consists of two conductor separated by a non-conductive dielectric. The dielectric means electrical insulator. The conductor can be thin films, foils or sintered beads of metal or conductive electrolyte and non-conductor acts to increase the capacitor charge capacity.

A capacitor is same as a battery, but it has a different job to do and come in all shapes and sizes, but they usually have the same basic components. A different between battery and capacitor are the battery uses chemicals to store electrical energy and release it very slowly through a circuit. A capacitor generally releases its energy much more quickly often in seconds or less. There are has two different condition capacitor are charging and discharging. When capacitor charging, electrical energy are adding and when capacitor discharging, electrical energy are releasing.

Table 1.1 The different type of capacitor

No	Type	characteristic
1	Variable capacitor	Has changeable capacitance
2	Electrolytic capacitor	Used when high capacitance is needed Most are polarized
3	Spherical capacitor	Has sphere shape
4	Power capacitor	Used in high voltage power system
5	Ceramic capacitor	Has high voltage function
6	Tantalum capacitor	Has high voltage capacitance
7	Mica capacitor	High accuracy capacitor
8	Paper capacitor	Paper dielectric material

Capacitances are known as capability to hold an electric charge. Generally, this is found in electromagnetic field, that use of specific kind of physical force on particles. To make force makes the particles to display movement with the outcome of an electric charge. In electrical circuit, the word capacitance is typically short form for the "mutual capacitor" and "self capacitor" between two nearby conductor, which is the quality of electrical charge that needs to be added to an isolate conductor to increase its electrical potential by one voltage.

1.2 Problem statement

Generally, the energy saving uses the capacitor in the system. As known, the capacitor system gives the effect on home appliance for the consumer. The appliances use the electrical energy in home for cooking, heating, TV and etc. By using less energy the consumer will have a lot of benefits such as save money and help the environment. To increase the available supply energy, the consumer has to use the less energy there is less pressure. To overcome with this system because the high energy bills on home and the energy can cause pollution. However, after the consumer install the system automatically can changing consumer behaviour and improving the efficiency of energy use lies in how energy is sold in these countries.

1.3 Objective of the project

The objective of this project are :

1) To build the capacitor system.

2) To perform the data collection on capacitor system.

3) To provide an efficient energy for consumer benefit on capacitor system.

1.4 Scope of the project

This project focuses on the design capacitor system and analyzes the effect on energy saving through kilowatt hour (kwh) reading after implement the effect of capacitor system in consumer appliance. The Multisims software and power quality analyze meter are used to make the performance of capacitor systems.

1.5 Expected project outcome

The expected outcome of this project is to design capacitor system and to analyze the effect of the energy after using capacitor system. Firstly, modelling of the capacitor system will be performing. The capacitor system will be design and analyzed using Multisim software. The power quality analyze meter is use to take the data collected from the performance capacitor systems. At the end of this project, the systems will develop a new way to decreases the usage of energy for every home appliances. This project will encourage people to learn more on efficiency energy and how to save energy consumption.

1.6 Conclusion

This chapter describes whole understanding about the project. It is basically a guideline platform in order to achieve the objectives. It is important as much a checklist at every point in this topic. Next in Chapter 2, focus on literature review where more information details phase by phase.

CHAPTER 2
LITERATURE REVIEW

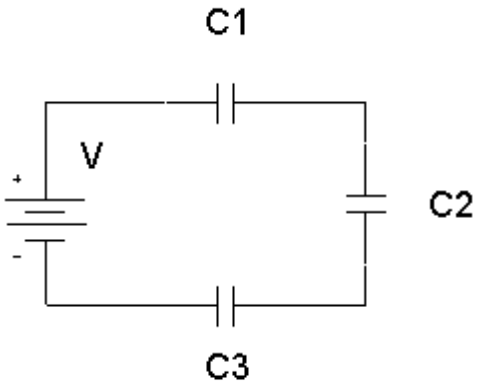
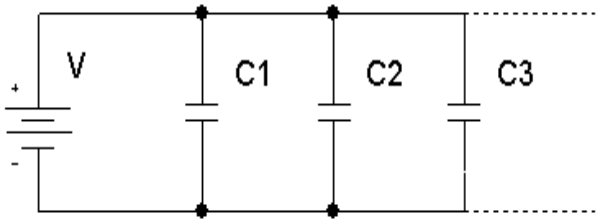
2.0 Introduction

The literature on capacitor is large and several textbook are available on describing the technical periodicals and also the published papers. In this chapter, may elaborate on method to design and to analyze the data of capacitor systems.

2.1 Basic principle of capacitor

Capacitor can simply defined as the store electrical energy when it is connected to its charging circuit. The charging circuit is disconnected, it's can eliminate that stored energy. In electronic device, capacitors are commonly used to maintain power supply. While batteries are being changed, the electronic device will maintain the power supply by (en.wikipedia.org). The dielectric of a capacitor in non-conductive and basically an insulator, when used in direct current circuit (DC), the voltage supply depend on the capacitor charges but blocks the flow of current through it. However, when a capacitor is connected to an alternating current circuit (AC), the flow of current appears to pass straight through the capacitor with little no resistance. Table 2.1 shows the example of circuit and the formula for series and parallel capacitor circuit.

Table 2.1 Example circuit and formula

Circuit	Formula
	$\frac{1}{C_{total}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
	$C_{total} = C_1 + C_2 + C_3 + \cdots$

2.1.1 The dielectric of a capacitor

The dielectrics of a capacitor are known as the non-conducting insulating material. The dielectric is the higher the permittivity of the dielectric which greater the capacitance. The various insulating materials used as the dielectric in a capacitor differ in their ability to block or pass an electrical charge. The dielectric material used is always an insulator, the conductive plates of a capacitor are generally made of a metal foil or a metal film allowing for the flow of electrons and charge. Dielectric Leakage is another factor which affects the operation of a capacitor. Dielectric leakage occurs in a capacitor as the result of an unwanted leakage current which flows through the dielectric material. Generally, it is assumed that the resistance of the dielectric is extremely high and a good insulator blocking the flow of DC current through the capacitor (as in a perfect capacitor) from one plate to the other. However, if the dielectric material becomes damaged due excessive voltage or over temperature.

2.1.2 The characteristics and properties of insulating dielectric

There are a classified according to the characteristics and properties of insulating dielectric:

1) Low loss, high stability – Mica, low-k ceramic and polystyrene.

2)Medium loss, medium stability – Paper, plastic film, high-k ceramic.

3) Polarized capacitor – Electrolyte's, tantalums.

2.1.3 The advantages of dielectric

There are a few advantages of dielectric:

1) Permittivity of the dielectric increases the capacitance.

2) The dielectric increases the maximum operating voltage.

3) The dielectric constant – the factor of *k,* the property of dielectric material and varies from one material to another increases the capacitance.

4) The dielectric provides mechanical support – the two plates allowing the plate to be closer together without touching.

2.2 Literature review

This part reviews of the previous related work in term of capacitor system design.

2.2.1 Historical introduction to capacitor technology

The beginning of capacitor is generally attributed to the invention according to (Ho and Jow, 2010). The first type of capacitor is ceramics. Since the earliest studies of electricity, the ceramic have been used as electrical insulation. The originally constructed, the narrow neck jar partially filled with water with electrical steer brought through a cork in the neck of the bottle to the water. In the experiment, the hands holding the jar formed the outer electrode and charging the jar with an electrostatic generator connected to the water. The experiments give the effect to the hand a painful shock by touching the lead.

Figure 2.2.1 The example of early ceramic capacitor

Source: Ho and Jow

2.2.2 Analysis of home appliance usage preference for energy saving

These projects are presents to develop the system which can automatically control appliance according to user preference (Teruhisa Miura, 2013). The analyzed home appliance usage logs and attempt to extract user preference for appliances are found possibilities of estimating user preference.

The analyze usage logs to extract user preference by appliance only without any models. However, for saving energy at home, the residents have to compare electricity consumption of each appliance. The steps of project for household energy saving will follow:

1) Develop the unified control system and record appliance usage logs.
2) Extracted user preference for appliance usage logs.
3) Prompt or automate energy saving activities based on extracted preferences.

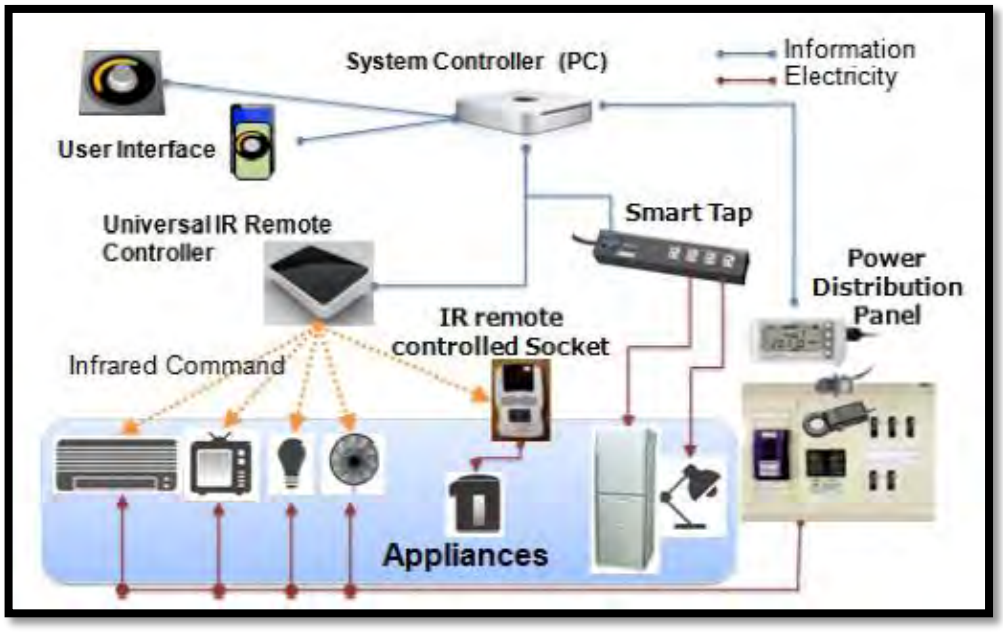


Figure 2.2.2 The system architecture user preferences appliance without models

Source: Teruhisa Miura

2.2.3 The new evaluation system for energy saving effect

According to (Huan *et al*, 2012), the energy consumption and energy efficiency in this project put forward the concept of target energy consumption and extended energy consumption. The new evaluation system established for overall energy saving effect more scientifically and actually. The most evaluation and comparisons of the effect of energy saving measures are based on indicators of work efficiency or energy conversion efficiency. The concepts are reasonable recognized, and the limited to current working process of energy saving equipment, while ignoring the energy consumption beyond the working process. Figure 2.2.3 shows the relationship between target energy and energy consumption.

Figure 2.2.3 The relationship between target energy and energy consumption

Source: Huan *et al*

The energy consumption refers to the total energy consumed in order to complete the target work donated by energy consumption.

These project aims to the energy consumption of working process of an energy saving equipment rather than the energy consumption of the whole process of implementation of energy saving measure. The energy consumption can be defined as:

1) Working energy consumption – the working process denoted by extended energy consumption.
2) Extended energy consumption – the sum of working energy consumption and early energy consumption.