DESIGN OF AUTOMATIC LOAD MONITORING SYSTEM

Final Year Project proposal Report Submitted to Kampala International University in Partial Fulfillment of the Requirement for the Award of the Degree

OF

BACHELOR OF SCIENCE

IN ELECTRICAL AND COMPUTER ENGINEERING

BY

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NOVEMBER 2016

DEDICATION

This project report is dedicated to the family friends to mention a few Mr. Isabirye Ali and Mr. Kat Richard whose consistent love and timely assistance helped to come up with this good project report.

DECLARATION

The fact that the work in the entire project proposal is based on original work except for citations and quotations which have been duly acknowledged and that it has never been previously and concurrently submitted for any other degree or award at KIU or other institutions.

Signature: …………………………

Student: Isabirye Sharifu

Date: …………………………….

APPROVAL

This is to certify that this project report entitled **"DESIGN OF AUTOMATIC LOAD MONITORING SYSTEM"** was proposed by **ISABIRYE SHARIFU** and has met the required standard for submission in partial fulfillment of the requirements for the award of Bachelor degree in electrical and computer engineering at Kampala international university

Approved by,

Signature: ………………………………..

College Supervisor: **Mr. Lugwire Ronald**

Date: ……………………………………

ACKNOWLEDGEMENT

Special thanks to all staff members whose close supervision, guidance, love and timely advice were instrumental to everyone in conceptualizing and writing this report up to its completion to mention a few prof. Jang, Mr. Lugwire Ronald, Mr. Adabala, and Madam Priscilla Ajiboye

Above all praises to ALLAH who blessed those people with the gift of knowledge, life and put them around with much love and care.

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NOMENCLATURE

Ω   Ohm

μ   Micro

AC   Alternating Current

DC   Direct Current

LED   Light Emitting Diode

MW   Mega watts

D   Diode

R   Resistor

C   Capacitor

EUL   Eskom Uganda Limited

UETCL   Uganda Electricity Transmission Company Limited

A   Ampere

KIU   Kampala International University

KV   Kilo-voltage

F   Faraday

EMI   Electromagnetic Interference

Q   Transistor

Hz   Frequency

SF6   Sulfur hexafluoride

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter consists of the background of the proposed project, problem statement, objectives, scope, definition of terms etc.

1.1 Background of the study

Industrial and Commercial building proprietors generally spend about 30% of their operating budget on energy (M.Donelly, 2012). According to the Energy Consumption Survey conducted in Uganda by the Energy Information Administration in 2008, every year 40 billion UGX is spent on energy bills for industrial and commercial buildings (Environmental Defense Fund, 2012). In many industrial and commercial buildings, most of the operations are not energy efficient and energy usage is not managed well, incurring unnecessary waste. In addition, every year, 56 billion UGX is lost to power outages during maintenance work and blackouts during power failure in Uganda. Also due to high costs of energy bills which include peak demand surcharge and power factor surcharge, just to name a few. Peak demand surcharge is the charge imposed on commercial or industrial buildings for their maximum energy demand, even though for a short period of time. Power factor surcharge is imposed on commercial and industrial buildings that have a low power factor of less than 0.85. Therefore low power factor supplied has registered an increasing number of cases on power outages and blackouts due to failure of machines to run the connected loads. Hence it's seen that costs of low power factor on the loads is not to be treated lightly and there must be means to reduce these costs

Besides high cost charges due to low power factor, poor quality of power on the grid will cause faults and imbalances of power to the loads thus instability on the grid. There must be a control over operation of loads in industries and this cannot be done without first monitoring the load.

In view of the problems faced by mainly in industries and electrical networks, the importance of the proposed project sets out to develop and study an automatic load monitoring system.

With that therefore Load monitoring system mainly focuses on how power is used by the connected loads. In practice, the monitoring is in different ways i.e. installation of energy meter to account for power usage, installing real time device for communication in case of power failure to the loads such that the load flow is easily catered for. Load monitoring technology improves on the life time of the devices.

Among the easy ways to monitor loads is looking at the power consumed by the loads, since power has many ways in which it is controlled thus controlling it eases its mitigation. (*Nicoline Saw Ying Jie power monitoring 1st edition text book© 2014*)

Power disturbance is a very big problem in industries and domestic application. It lends mainly to permanent damage of expensive equipment, prolonged repair rates, outages and blackouts which adds to high costs of energy consumed by the end users.
Thus researchers proposed an automatic Load monitoring System which will be aiming at reducing interruptions caused by power transients with in transmission lines as well as reducing on the costs involved in power systems maintenance by increasing the lifetime of the device.

It will be designed to have a time switching delay before switching on the loads after a blackout to reduce on those high burst of energy which most cases happen immediately after powering the connected loads, so this will provide good starting mode. The proposed design will help to immediately supply power from dc batteries to overcome blackout and power dc loads until power is back. The choice of the battery will depend

on the capacity of load it will supply and more importantly is that the batteries will be charged by the rectified DC voltage from Mains AC supply and cut off when fully charged, not to overcharge them avoiding reduction of their life span.

This project will be useful since it gives a solution to the existing problems happening in real life.

Since the required components are available at reasonable costs, researchers thought of as per the level of technology, making a load monitoring system operate like the current system though it will be implemented by low voltage electronic cheap components available on the local market. The proposed design will be cheap compared to the current system. Developing the proposed circuit will improve the researchers' skills which will in the long run enable them become better engineers.

The system will be accessed by everyone in the building where AC power is required. Hence, all the rooms with power, this system will save the entire infrastructure from power effects.

1.2 Problem Statement

Loads needs quality power supply to operate well considering their designed specifications like efficiency among others, poor quality of power supplied reduces the life time of the loads, permanent damage of the system and time to time break down of the system. The system mainly suffers from several transients and harmonics during that time when power comes back after a black out. This is because at that time power has not stabilized so high short bursts of energy are experienced on the line. In order to minimize such problems, a system which will first take a short period depending on the design before it supplies the connected load with power after a blackout has been proposed. This will help to supply stabilized power to the load. In practice, an alarm system is designed to detect the failure and the system automatically switches on the alternatives like a generator solar etc. The alarm if not acknowledged and reset, either

manually or remotely, cannot stop so the proposed system will allow the alarm for a shot time and stops without deactivating it but a flashing constant flash light will be on until power is back. This system will monitor power failure and automatically switches on the dc power from batteries to supply dc loads.

1.3 Significance of the project

With AC Power failure not being a new experience in today's world, especially in the third world countries, this circuit represents a very handy technology whose relevance can be justified with some of the following uses based on integration and application of theories in the engineering discipline. These uses include:

o This proposed project means a way you can improve on the life span of the loads being subjected to power which may cause permanent damage to the all system thus through monitoring load power it easy to minimize the problem which may occur in absence of power like blackout by providing an alternative DC supply

o The proposed project is to minimize on some problems caused by power damaging expensive equipment like high short burst of enegy on line therfore providing away of reducing on electical equipment maintanace costs.

With the above uses therefore, the above technology is relevant since it offers a solution to reduce on the problem of eventual or rampant power failures that are not new in today's world particularly in the third world countries.

1.4 Objectives of the project

1.4.1 General objective

To design an automatic load monitoring system that will monitor loads AC power supply at a reduced cost with ease of operation and maintainability

1.4.2 Specific objective

- o To design an electronic circuit using circuit wizard software and to be integrated with the existing electrical wiring connected to different electronic components.
- o To develop a circuit and understand the principle of operation of each components used through simulation software like circuit wizard.
- o To test and implement the design on the printed circuit board.

1.5 Scope of the project

1.5.1 Content scope

This project focuses on development of a load monitoring circuit that will use a 555 IC to monitor AC supply to loads and the system will switch on the loads after a delay time. This very system will supply alternative DC power from batteries to a few loads to avoid inconveniences.

1.5.2 Time scope

The entire development process of the system right from gathering the required information and equipment, system design, implementation and testing will be done in a period of three month.

1.5.3 Geographical scope

The study of the project will be taken within EUL involving staff and other colleagues at the workplace.

Project justification

Since power without control is useless, the presence of this proposed project will be of much help to reduce on the possible power problems to the loads otherwise loads will continue to be subjected to the above problems.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter briefly describes some of the systems designed by earlier scholars and , it will also includes the principle operation of the proposed system and including it's aspects like its strengths and weaknesses.

2.1. The Evolution of Power Monitoring Systems and the current development

By their nature, mission critical facilities such as Internet data centers are prime candidates for power monitoring systems. By employing monitoring systems to analyze system-wide historical and real-time power data, facility managers can reduce the cost of electricity and improve its quality and reliability.

Modern power monitoring systems look nothing like the basic electricity meters from which they evolved. Where high accuracy metering, disturbance recording, transient detection or harmonic analysis is needed, there is no substitute for power monitors therefore among the current systems are devices like OctoPlex A1770-CE AC Power monitor which notify people within the premises on power flow using LED indication and virtual touch screen for analyzing the power events. Additionally depending on the designed purpose for use, the device can be connected such that failure of power is indicated by alarm system through PLC configuration. Then depending on the system operation, it can be used like switching on AC generators remotely to supply power using SCADA system and locally using manual method.

Below is one of the recent power monitoring device used and briefly how it functions

Figure 1: Show octoplex A1770-CE AC Power Monitor

The OctoPlex A1770-CE AC Power Monitor allows the engineers to monitor the voltage, current, and frequency of up to 4 single phase AC inputs or 1 three phase input in one package that can be connected in a safe place. The AC Power Monitor utilizes four independent signal processing circuits that interface with a 16 bit microprocessor. The processed data is transmitted over the dual Bus interface to the flat panel where the user can view the information.

There are three LED's that are visible through the cover of the AC Power Monitor. The left and right LED's indicate that there is a primary and secondary connection. The LED in the center indicates whether the AC Power Monitor is receiving power from the input connectors. The standard AC Power Monitor page on the touch screen shows the AC voltage (RMS), current, and frequency of all four input lines. The internal temperature of the unit is also displayed. If one or more inputs are not used then the values displayed will be zero.

The enclosure of the AC Power Monitor is made from die cast aluminum and coated in a durable white powder coat finish that will provide years of protection in any environment.

2.1.1 Strengths of the existing technology

o It has an in built protection system and LCD monitor to display the events happening.

2.1.2 Weakness of the existing technology

o It uses four independent signal processing circuits that interface with 16bit microcontroller thus making it expensive due to many components .

o To operate the device it needs an expert, engineers, technicians or artisans thus limiting other users.

o If one or more inputs to the device are not used then the values displayed will be zero.

2.2 Architecture of the proposed design

Basically, looking a little bit more on the various weaknesses of the recent device, the proposed system will have a less complicated architecture, easily operated, cheap and in addition will reduce some power problems experienced by loads as the major reason for this project proposal, below is the theory of the proposed project
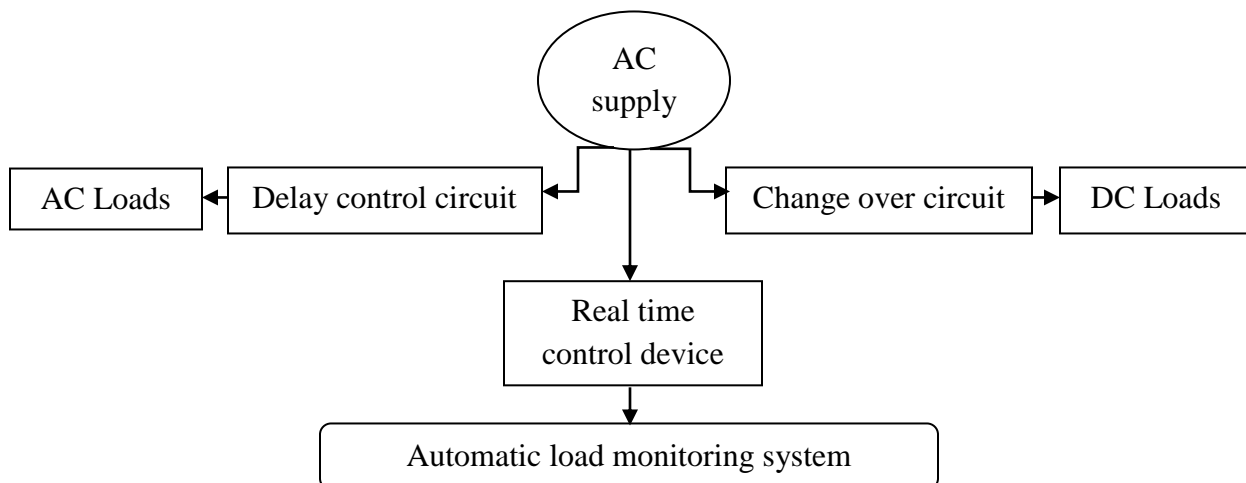
- Ac supply. It's the source for AC power.

- Change over circuit. It will change to DC power from the battery to supply DC loads, charges them and cuts off the current when fully charged.

- Delay control circuit. It controls the load AC power supply using a relay.

- Real-time control device. It will use rectified DC power to monitor the AC source and give asuitable command to the automatic system which is either ON or OFF.

- Automatic load monitoring system. It will mainly use 555 IC to produce the required signals when AC is off and running on alternative supply.

In general;

The automatic load monitoring system will use a 555 IC which will produce the required signal when switched on by a relay to activate the alarm with a flashing light. The system will use relay to charge the batteries and automatically will switch on this supply to supply the loads using the same relay. It will be composed of switching transistors and relay to control the power supplied to the AC loads by delaying to power the loads in case power is back after a blackout. Finally it will have LEDs for indicating the state of the all system

In the next chapter, we shall see the circuit and the general working principle of the whole system.

2.2.1. Strengths of the proposed system

- It will take a short period of time to power the AC loads when power is back to overcome high transients unlike in the current system which immediately power the AC loads.

o It will be user friendly since it will not require an expert to operate it to find out its state because everything will be seen like a reset switch will be provided.

o It will also automatically switch on the alternative supply to power the DC loads.

o It will be cheap and easily understood since it will use three circuits and its implementation will need simple electronic components.

o The alternative source (batteries) will be automatically charged by the system and cutoff in case are fully charged ready to be used to prevent overcharging which reduces their lifespan

o It will be built with a snubber circuit on addition to a fuse to provide more protection.

o It will be using a variety of loads both AC and DC to meet the required objective

o It will consume less power since the batteries after charging will be in off state waiting to be switched on.

o As long as there is an input to the device, it will monitor the load power unlike in the existing technology.

2.2.2. Weakness

This system mainly is suitable for three phase application like in commerical and industrial purposes excluding out residental application but however it can be used on single phase with less modification since single phase can easily be obtained from three phase supply.

2.2.3. Assumptions

o The Printed Circuit Board for this system will include simple add-ons and modifications, these may include small Voltimeter or Ammeter as additional power monitoring devices (these meters will be already made devices on

market). The project plan may improve as new information and issues are revealed, added or discarded.

2.3. Briefly on different proposed components to be used in the proposed design.

- o **Transforme**r. This is a device used for stepping down power to low voltage levels from 240VAC -12VAC.
- o **Diodes** . A diode is a single junction device made of p and n type materials.. Its main function is to rectify an ac signal although other special purpose diodes like zener and led's are used for other purposes. Majorly are used to allow flow of current in one direction when forward. Zener doide these are used for voltage regulation in power supplies. and have breakdown voltages which are very low
- o **Resistors.** Resistors can be of two types: fixed value resistors or variable resistors. These are used to limit current and variation of output power.
- o **Capacitors**. Capacitors are capable of storing charges. They are used for coupling ac signals from one circuit to another and for frequency selection etc. They are also used for filtering the output wave form in power supply circuit.
- o **Transistors.** Transistors are semiconductor devices used for applications like amplification of voltages, current and are also used in oscillator circuits and switches.
- o **Switches.** They are used for breaking and completing the circuit.
- o **LEDs.** Leds are pn junction devices which emit light radiation when biased in the forward direction
- o **Voltage Regulator**. They are used to produce a constant output direct voltage depending on the input voltage and its rating
- o **Timer.** This is an electronic device having 8pins mainly operated in three different modes thereby producing an oscillating signal depending on the mode is operated in. The modes include mono-stable, astable and bi-state. Among the types include NE555, NE556 and others

- o **Relays.** This an electromechanical device have a coil wound on a solenoid, movable contact, normally open contact and normally close contact such that when the power passes through the coil, magnetizes the solenoid and attract the move contact commanding to either open or close depending on the state of the device. It can be used both in AC and DC voltage to switch on load.

- o **Switches.** This an electro-mechanical devices that are used for breaking and completing the circuit on the loads. The choice depends on the purpose and the current conductor to switch on

- o **Batteries**. This is an electrochemical cell that has two terminals positive and negative that is used to store electrical charge and supply it when used as DC V.

- o **Buzzer.** This is an electronic device that transduce electrical signal into sound signal. They are different types depending on the power rating required to use.

- o **Fuse.** They are used to allow rated current to pass through and block high current by melting out to break the circuit thus protect the connected load

CHAPTER THREE

METHODOLOGY

3.0 Introduction

To achieve the objectives of the project there will be various methods that shall be followed. These methods will be used to gather information right from the initial stage of the project up to the final stage of its implementation. The following are the methods that will be taken to achieve the objectives of the project.

3.1 Generation of idea

Having spent some time at EUL as trainee, one of SF6 sectionised circuit breaker in 132KV switch yard was under maintenance, after completion the breaker was forgotten to be de-isolated leaving on the portable earth yet for normal operation of the SF6 the portable earth having to be removed. These portable earth are put to create safe working zone under the maintenance as is among the safety precaution you must first do before carrying out the work. When the line was energized the breaker tripped and the all Uganda went off because EUL being the largest power produce, it has spinning reservoir to cater for any break down on the national grid. This made the grid unstable and the other machines which were on acted as motoring thus the country was in total darkness for almost two hours. Because of the agreement made by UETCL, EUL to supply them with power and in any case of power failure without their concern, EUL pay for these lost mw if an agreed period exceeds while the problem is not rectified, so the Sift supervisor at that time had to rush and bring back power on the grid with the help of Kenya first energizing the line with voltage and frequency for synchronization of the units on grid. The all company was full of alarm sound which turned into noise until were manually switched them off. The standby diesel generator was already supplying

the lighting loads thereby helping in bringing back power on the grid. Some of the loads like pumps, lights, which were using older system of mitigation, on bringing back of power on the grid damaged these loads which were not manually switched off due to high transients. The excepted period for power to stabilize is 15seconds maximumally otherwise its over/under voltage and real time device in place switches off (***EUL hydropower plant manual).*** Now it's mainly from here that the researcher obtained the idea of reducing on the problems caused by power to the loads by coming up with the idea of improving on the system through designing a delay circuit to first delay powering the load to allow power stabilization and also allowing the alarm to stay on for a determined time instead of turning into noise. That is why the researchers came up with this idea, understanding of how much importance the system would be if implemented.

3.2 Consultation

The consultation will involve assessing the strengths and weaknesses of the project. After a go ahead will be made and consult the prospective engineers about the trend of the existing technology and also determine what makes the system better in the proposed technology of the project.

3.3 Observation

Observation will also be used to view what is taking place in the world of innovations in order to have knowledge of the data flow in this field of technology and find ways of how the system will make the work easier and better, after which the researchers will;

- o design and simulate the proposed project using softwares like circuit wizard.
- o Connect different electronic components on abread board using jumper wires.

- Finally solder the proposed circuit on the printed circuit board for implementation.

3.4 System design

The system design of the proposed system uses three architecture designs which involve the power supply, delay switching circuit, monitoring circuit and load changeover circuit. The proposed system involves diagrammatic illustrations showing the components arrangement and the power flow from one component to another component.

3.5 Generic block diagram of the proposed project design

| AC SOURCE | MONITORING SYSTEM DELAY CIRCUIT CHANGEOVER CIRCUIT | LOADS |
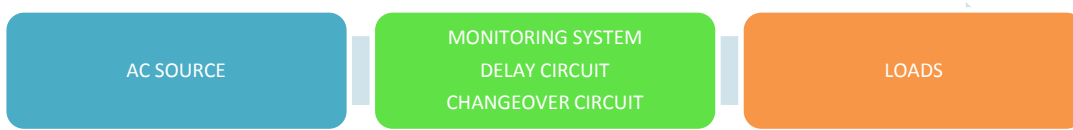
3.5.1 Power Supply

AC from V1 through an overload protection fuse F1, snubber circuit R5, C6,(without question, the best way to handle the problem of EMI is to minimize or reduce it at the source which are experienced like during switching), step-down by a transformer T1 to bridge rectifier (D1, D2, D3, and D4) for rectification. Then through filtered capacitor C1 and fed to voltage regulator RG1and finally to relay RL1. The power circuit will have a LED D6 for indicating the presence of power supplied to relay. Also AC power from source will directly power AC loads controlled by the relay RL1 as in fig 2. The relay RL1 will be operated on rectified DC power. (Briefly about C-R. By using ceramic capacitor

and carbon film resistor, when the source reduces in sourcing current, the capacitor will source enough current so that the di/dt rate of current fall through the inductor is not as fast also R-C damps out the ringing if the component values are appropriated selected. Finally reduce on spikes by droping the voltage across the resistor, capacitor charges and discharges and discharges allowing voltage with less spikes to inductor).

3.5.2 Monitoring system.

It will operate on DC power supply from a battery which will be charged through RL2 of fig 3 ready to power the monitoring system in the absence of power. The oscillatory connection of (R2, C5 and Q1) will help to produce a pulse at a frequency determined by period T of the 555 IC connected in mono-stable mode therefore the value of R2 and C5 are not of much concern. Transistor Q1 is connected in common emitter configuration to Vcc through R1 on base for limiting the current and R3 on emitter for C5 discharge. A signal sent to IC 555 from that oscillatory circuit will enable the IC 555 to produce a signal for the period T which will be sent to activate the alarm connected at output pin 3. Flash LED will be powered directly from battery to give out a continuous flash otherwise it will be also controlled through switch SW3. During normal operation, the monitoring system is in off position waiting for activation from the relay RL1, if it is not activated, no signal will be produced, buzzer and flash LED will be off. A SW1 for reset the timer to activate it to reproduce the signal will be used. It will be pressed to find the state of the system thus will be helpful in case of fault finding with system.
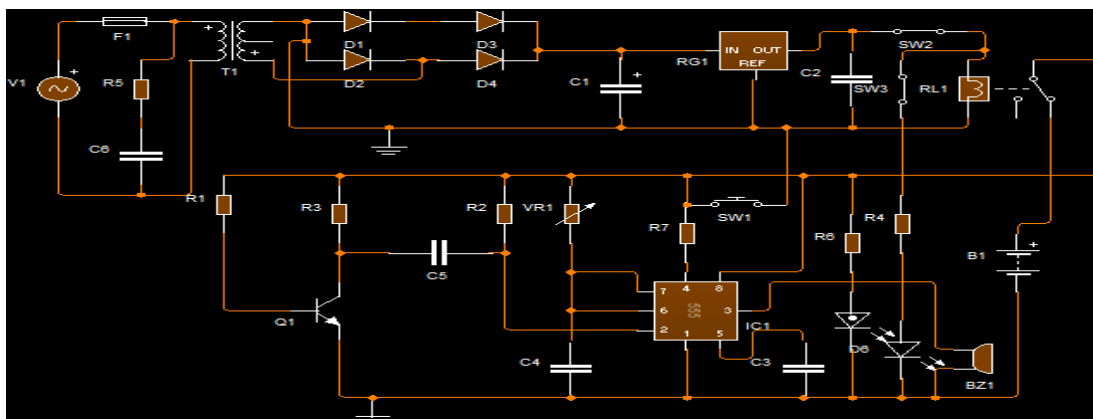
Figure 2: Show the power supply and proposed load monitoring circuit

3.5.3 Briefly on the load to be monitored.

The proposed design will monitor AC loads like lights, fun etc. Basically the loads which will use 240VAC power and will be automatically substituted by the alternative DC loads as the above explanation on the operation of the system.

How to choose the components.

Required to supply 240VAC such that our relay receives 5DCV. Power supply = 240VAC, transformer 240VAC at 13A to (12-15) VAC at (1-2) A. Considering f=100Hz since after converting 50Hz AC into DCV, through full wave bridge. As the negative part of the pulse is converted into positive, one pulse will be counted two. So period (T) = 1/100 = 10ms, V= peak voltage, ie voltage given to voltage regulator IC (2 more than rated). Using 12-0-12 the rms value of transformer so peak voltage is Vrms*√2, 12*√2 = 16.968V.

Now 1.4V will be droped on diodes (use 1N4007, have high PIV = 1000V datasheet) when forward biased. So 16.968V-1.4 = 15.568. For more information refer to datasheet of 7806. (I_o = 500mA-1A, Vi = 8.0V-21V, V_o = 5.70-6.3V).

When capacitor discharges into load circuit, it must provide (2+7.4). V=15.568-9.4 = 6.168. Then from C = I*T/ΔV; C = 1*10ms/6.168 = 1621.3µf. using a relay of 5V (nominal voltage VDC 5V, pick up voltage VDC max 3.5, drop out voltage VDC 0.5, Nominal current 72mA, nominal operating power 360mw, coil resistance 69.4Ω. Now using a battery of 6V at 20mA-1A for monitoring system

From datasheet, Rvr1 max = (Vcc-Vcapacitor)/I threshold, I threshold = 0.25µA, bypass capacitor 0.01µf be placed across pin 5 to Gnd. This will increase the noise immunity of the timmer to avoid causing timing errors.

Vcapacitor = 2/3vcc for monostable circuit of 555. Output pin 3 gives max 200mA when sourcing, for VCC 6v, v_o= 2.75V minimum, reset current of 0.25µA, pulse width (T) = 1.1VR1*C4. Using DC V source = 6V at 200mA, Vcap = 2/3*6 =4, Rvrl max = (6-4)/0.25µA=8mΩ. Control voltage=2/3*5=4V, if required T = 10seconds. Then C4= 10/1.1Rvrl max, 10/1.1*8MΩ = 1.1µf, buzzer will be 3-4V.

Since input voltage is small transistor Q1 will be a switching transistor, (IC =10mA, Ib = 0.5mA, VBE(sat) = 0.7, VCE= 5V). R3 = Vcc/IC, R3 =Vcc-Vce/Ic, R3 = 6-5/10mA, =100Ω, R1 = Vcc-4.3/Ib, R1 = 6-0.7/0.5 mA = 1060Ω, since the minimum voltage is 5V at pin 2, then R2 = Vcc-1/Ith, R2 = 6-1/0.25µA, = 2mΩ. C = I*T/V, C = 0.25µA*11/5 = 0.5µf. R6 = Vcc- 0.7/Imax, R6 = 6-0.7/20mA, = 265Ω. R4 = Vin RL1-0.7/Iin, R4 = 5-0.7/20mA, = 215Ω

3.5.4 Automatic change over circuit.

AC from V1 will be step-down by transformer T1, rectified by D1, D2, D3 and D4 to DC pulsating power, filtered to DC voltage by capacitor C11, fed to a relay RL2. A power transistor Q3 will provide the DC power to charge the batteries B1 and B2. A zener D5 diode will be connected to divert the charging current to ground in case the batteries are fully charged such that the batteries are not overcharged to reduce their efficiency. When power goes off, the relay will be deactivated and moving contact turned off in

normally closed position, this will automatically connect and power the DC loads with power from batteries. A LED D8 will be connected to indicate the state of the system
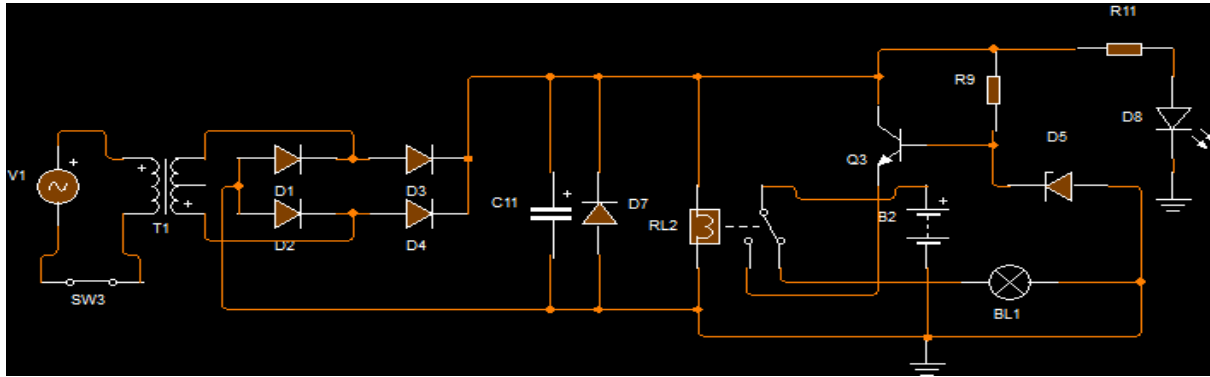

Figure 3: Show an automatic change over switch as the proposed

V1; 240VAC, T1= 240VAC at 13A to (12-15) VAC at (0.5-1)A. f =100Hz, T = 1/100 = 10ms, V= Vrms*√2, 12*√2 = 16.968V. Now 1.4V will be dropped on diodes (use 1N4007, have high PIV = 1000V datasheet) when forward biased. So 16.968V-1.4V = 15.568. C = I*T/ΔV; 0.8*10ms/9; C = 888.9μf.

For more information refer to datasheet of Relay 9V (nominal voltage VDC 9V, pick up voltage VDC max 6.3, drop out voltage VDC 0.9, Nominal current 40mA, nominal operating power 360mw, coil resistance 225Ω

For zener to be activated, voltage at its node has to be higher than its reverse bias voltage such that it deviate current to ground therefore at base of power transistor except 6.2V for a 6V zener to operate well.

Voltage drop will be = 14.168-6.2 = 7.968V. R9 = V drop/Iin; 7.968/0.041A = 194.34Ω, remember the design is 6V, 0.66A; output voltage of transistor will be Vb-0.7; then (6.8-0.7) V = 6.1V, current to battery; IE =Ic-Ib; 0.7A-0.041mA = 659mA. Value of R11

will be Vdrop on R11-Vdrop on D8 i.e. Iin = 59mA (blue/green data sheet forward current 30mA, peak forward current 100mA, power dissipation 120mw) R11 = 14.168-0.7/59mA =228.27Ω. Having got 6.1V, 0.659A, our load has to be with almost the same operating parameters.

3.5.5 Delay circuit.

AC from V1, will be step-down by T1, rectified by D1, D2, D3and D4 to DC power, smoothened by capacitor C1 to variable resistors R1 and resistor R2 making a voltage divider through capacitor C2 which will determine a delay time and power the switching transistors Q1 and Q2 connected in such a way to increase the current gain which will drive the relay RL1 to control the AC Load BL1 depending on the value of capacitor C2 and variable resistor R1. Additionally the circuit will have a LED D6for showing the state of the circuit if powered.
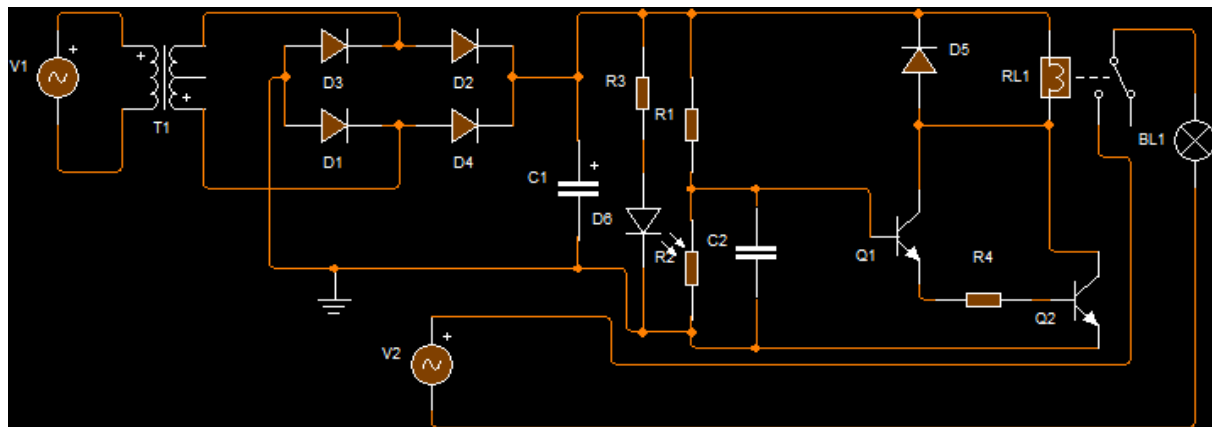

Figure 4: Show a delay circuit as the proposed

V1; 240VAC, T1= 240VAC at 13A to (12-15) VAC at (0.5 -1) A. f=100Hz, T = 1/100 = 10ms, V= Vrms*$\sqrt{2}$, 12*$\sqrt{2}$ = 16.968V. Now 1.4V will be droped on diodes (use 1N4007, have high PIV = 1000V datasheet) when forward biased.

So 16.968V-1.4V = 15.568V. V = 15.568-9.568 = 6V. Then from C = I*T/ΔV;C = 1*10ms/6V = 1666.7μf . using a relay of 6V (nominal voltage VDC 6V, pick up voltage VDC max 4.2, drop out voltage VDC 0.6, Nominal current 60mA, nominal operating power 360mw, coil resistance 100Ω, using Q1 and Q2 as switching transistor to increase on the current gain. Darlington pair of transistor we will use as specifications of the datasheet where IC = 1Adc, VCE = 4.0Vdc Ib = 16mA, hfe = 500min and 15000max).

1.4 Drops across the two transistors. R4 = (Vin at Q1-1.4)/Iin*Q1hfe; R4 = (4-1.4)/0.016*22.5, R4 = 7.2Ω. Iin= IRL1+Iin potential divider. Iin potential divider = (1-0.5)A , = 0.5A. Iin C2 = Ib = 16mA. Taking an assumption that 0.7V is needed to set Q1 in saturation, and then it will be the same voltage for capacitor and junction of potential divider. Therefore if relay takes 0.5A, the remaining current will balance the R1 = 15.568-0.7/0.5, R1 = 29.74Ω. then R2 = 0.7/(0.5-0.016) = 1.44Ω. C2 = 1*T/V, C = 16mA*10ms/0.7 = 228.6μf.

In this project researchers shall require the following electrical and electronic tools and equipment to aid in the implementation process.

Table 1: Show the proposed tools, materials and equipment

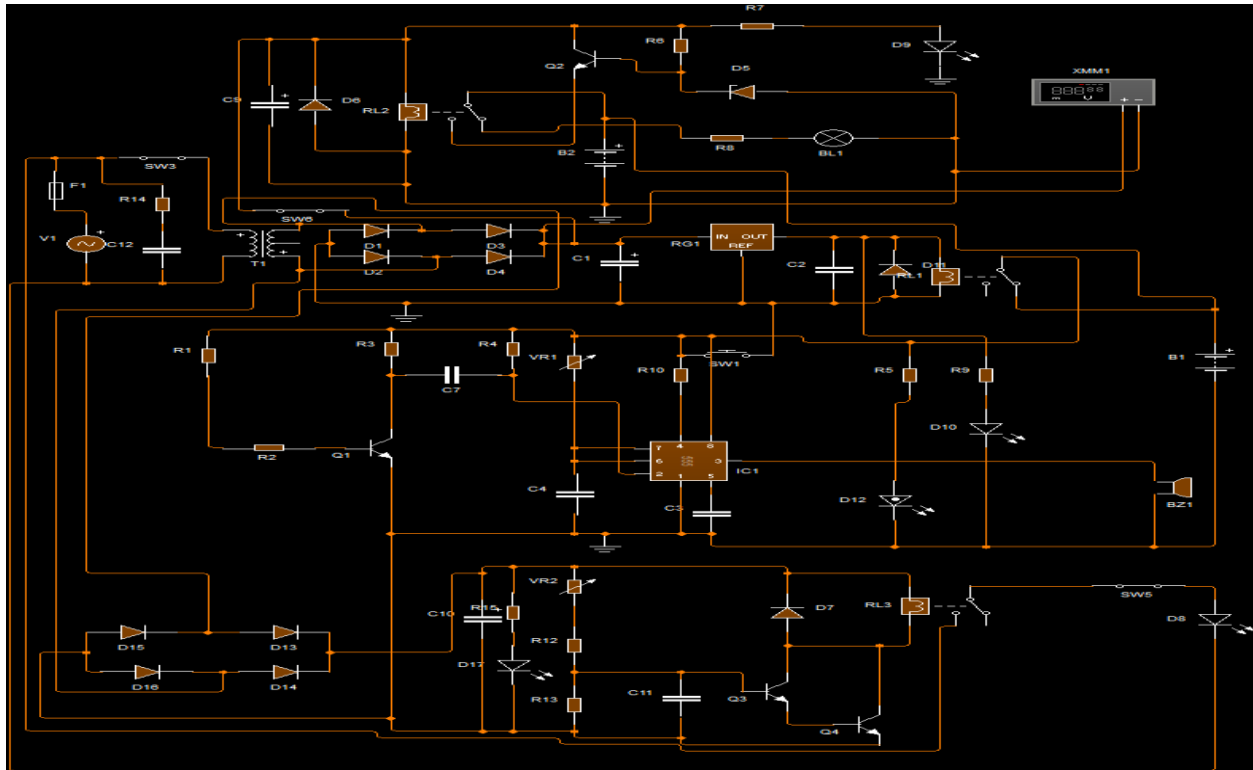| Tools	Materials	Equipment
o A pair of pliers o Wire cutter o Bread board & PCB board	o Cable (1.5mmsq & 2.5mmsq) o Jumper and Solder wire	o Soldering gun o Digital multimeter

Figure 5: Show the complete proposed circuit of the automatic load monitoring system

3.6 System implementation

Implementation of this work will involve the use of the mentioned hardware and software components which will be installed on a breadboard to complete the circuitry. A working system shall be presented for examination and may be tested for approval at the time of presentation.

 Any errors to be incurred during the installation of the components will be corrected to make the system better and results of this system shall be presented in a written project report which shall be presented in both hardcopy and softcopy.

3.7 System testing

Testing will involve setting and checking for continuity in the system circuit and the power supply that will be designed for the system. Connected load will be used to check if the system is working depending on different components used and in absence of AC power which should be able to respond by producing sound from the buzzer, constant flashing led and as well as connected the designed DC loads to DC power.

3.8 Time frame

Table 2: Show the proposed time frame of the project

No	Activity	Description	Duration
A	Consultation	Data will be gathered from prospective engineers	2 week
B	Observation	Collected data will be Analysed.	2 week
C	System design	Circuit will be designed	3 weeks
D	Implementation	The designed system will be connected as per the circuit on breadboard and tested.	1 week
E	Testing	Finally it will be tested to check for accuracy.	1 week
F	Report	Final report will be written	3 weeks

3.9 Conclusion

This proposal has clearly provided an introduction to the Project, the background against which it will be carried out, the project problem to be resolved, the objectives to be achieved in order to resolve the project problem and a clear significance for carrying out this project.

APPENDIX I: PROJECT BUDGET

Below is the estimated budget for successful completion of this project.

Table 3: Show the proposed budget for the project

Item	Quantity	cost per item (Ugx)	Estimated cost(Ugx)	Total
Research materials	_	-	100.000	
Laptops	01	900.000	900.000	
Electrical Tool box	01	150.000	150.000	
Electronic components	various	-	100.000	
Transport	-	-	120.000	
Documentation	-	-	30.000	
Miscellaneous	-	-	20.000	
Total	-	-	**1.420.000**	

APPENDIX II: REFERENCES

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