Power Outage Alert System (POAS) via SMS

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Faculty of Electronic and Computer Engineering
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DEDICATION

There are a number of people without whom this thesis might not have been written, and to whom I am greatly indebted.

To my mother, Phelomina, who continues to learn, grow and develop and who has been a source of encouragement and inspiration to me throughout my life, a very special thank you for providing a 'writing space' and for nurturing me through the months of writing. And also for the myriad of ways in which, throughout my life, you have actively supported me in my determination to find and realise my potential, and to make this contribution to our world.

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ABSTRAK

Sumber terbesar ditemui untuk kegunaan manusia adalah bekalan elektrik. Bekalan elektrik ialah satu kegunaan asa untuk semua orang di dunia ini tanpa mengira lokasi dan penggunaanya. Penggunaan bekalan elektrik adalah genting kepada industri-industri yang bergantung kepada bekalan elektrik yang terutamanya terlibat dalam bidang pemgeluaran. Tetapi secara praktikal, kegagalan tenaga elektrik adalah senario yang sangat biasa berlaku di bangunan-bangunan. Gangguan kuasa dari penyedia perkhidmatan elektrik ialah satu senario yang minimum berbanding dengan kegagalan kuasa rosak di Malaysia. Ia adalah satu standard penting untuk memasang satu pemutus litar yang direka bentuk untuk melindungi satu litar elektrik sari kerosakan disebabkan oleh beban lebih, litar pintas dan galangan tinggi bumikejutan. Bagaimanapun, kegagalan tenaga elektrik tidak dapat diperasan melainkan pemutus litar dikesan pada kedudukan tersadung. D alam sesuatu kawasan yang luas seperti industry-industri, kemudahan awam, stesen-stesen yang beroperasi dari kawasan yang jauh , kegagalan tenaga elektrik tidak dapat dilaporkan apabila insiden seperti itu berlaku. Dalam membantu senario sedemikian, Power Outage Alert System (POAS) melalui SMS direka bentuk yang menggunakan teknologi wayarles untuk memberi amaran kepada pengguna sekiranya acara kegagalan tenaga elektrik dikesan. Perantaran yang digunakan untuk menghantar amaran adalah melalui sistem pesanan ringkas atau SMS. Papan agihan POAS ialah satu sistem masa nyata pintar yang bukan sahaja mampu memberi amaran jika kegagaln tenaga elektrik berlaku, namun ia mampu mengspekifikasikan punca kegagalan di papap agihan.

ABSTRACT

The greatest resources found for mankind is electricity. Electricity is a basic utility for everyone around the globe regardless of location and usage. The utilization of electricity is crucial in industries which so lie depends on electricity when come to production. But in practical power failure is a very common scenario in buildings. The power interruption from the service provider is a minimal scenario comparing to the faulty power failures in Malaysia. It is a written standard in Malaysia to install a circuit breaker which is designed to protect an electrical circuit from damage caused by overload, short circuit and earth high impedance shock. However, the electric trip cannot be noticed unless the circuit breaker is detected at tripped position. In a large area such as industries, public facilities, remotely operated stations and not to be notified when there is a power failure. In assisting such scenario using wireless technology the Power Outage Alert System via SMS (POAS) is designed to alert the user on the event of power failure is detected. The medium used to alert the user is via short messaging system (SMS). The POAS distribution board is an intelligent real-time system which is not only capable of alerting the users on a typical power failure, but going a step advance by alerting the user on the specific fault of their distribution board. The POAS is able to identify the type of power failure and the faulty component in a distribution board.

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LIST OF ABBREVIATIONS

MS	–	Main Switch
MCB	–	Miniature Circuit Breaker
ELCB	–	Earth Leakage Circuit Breaker
LCD	–	Liquid Crystal Display
PIC	–	Programmable Integrated Circuit
SMS	–	Short Messaging System
GSM	–	Global System for Mobile Communication
RC	–	Radio Control
DB	–	Distribution Board
LED	–	Light Emitting Diode
AC	–	Alternating Current
RS-232	–	Recommended Standard 232
VSM	–	Virtual System Modeling
CCS	–	Custom Computer Services
HEX	–	Hex file

LIST OF APPENDICES

APPENDIX	TITLE
A	Source Code
B	SK40B User Manual
C	Liquid Crystal Display (LCD) User Manual
D	GSM Modem User Manual

CHAPTER 1

INTRODUCTION

Humans have an intimate relationship with electricity, to the point that it's virtually impossible to separate your life from it. Sure, you can flee from the world of crisscrossing power lines and live your life completely off the grid, but even at the loneliest corners of the world, electricity exists. When we consider electricity, we usually think of electric power, and that's how we'll use the term here. Electricity is energy, and energy can do work. Electric power, electricity, is used to do things for us, and no modern society exists without it. Electricity is generated at places where it is economical and advantageous to do so, and is transported to places of use through the power grid.

A power outage (also known as a power cut, power failure, power loss, or blackout) refers to the short- or long-term loss of the electric power to an area. There are many causes of power failures in an electricity network. Examples of these causes include, faults at power stations, damage to power lines, substations or other parts of the distribution system, a short circuit, or the overloading of electricity mains. Power outages are categorized into three different phenomena, relating to the duration and effect of the outage:

- A **dropout** is a momentary (milliseconds to seconds) loss of power typically caused by a temporary fault on a power line. Power is quickly (and sometimes automatically) restored once the fault is cleared.
- A **brownout** is a drop in voltage in an electrical power supply, so named because it typically causes lights to dim. Systems supplied with three-phase electric power also suffer brownouts if one or more phases are absent, at reduced voltage, or incorrectly phased. Such malfunctions are particularly damaging to electric motors.
- A **blackout** refers to the total loss of power to an area and is the most severe form of power outage that can occur. Blackouts which result from or result in power stations tripping are particularly difficult to recover from quickly. Outages may last from a few hours to a few weeks depending on the nature of the blackout and the configuration of the electrical network.

Power failures are particularly critical at sites where the environment and public safety are at risk. Institutions such as hospitals, sewage treatment plants, and mines would typically have backup power in the form of standby generators which automatically start up when electrical power is lost, which would allow them enough time to either complete their work or to initiate a controlled shutdown of their process and/or evacuation of personnel.

Other life-critical systems such as telecommunications are also required to have emergency power. Telephone exchange rooms usually have arrays of lead-acid batteries for backup and also a socket for connecting a generator during extended periods of outage [10].

A conventional main distribution board (or panel board) is a component of an electricity supply system which divides an electrical power feed into subsidiary circuits, while providing a protective fuse or circuit breaker for each circuit, in a common enclosure. Normally, a main switch, and in recent boards, one or more Earth Leakage Circuit Breaker (ELCB) or Miniature Current Breakers with Overcurrent protection

(MCB), will also be incorporated. The circuit breaker is defined as a mechanical switching device that capable to break currents under specified abnormal circuit conditions, such as those of a short circuit or lightning occurrence. The ELCB unit works by monitor s the amount of currents flowing through the Live (Phase) conductor and returning back down the Neutral conductor. The ELCB has rating of 30mA as allowable difference between the Live and Neutral. Should this difference of currents be exceeded, then the ELCB will trip. As well as a MCB unit which built with an electro mechanical relay technology function to supply power to each load independently and only that particular MCB unit connected with the appliances will be tripped when a short circuit occurred [5- 6].

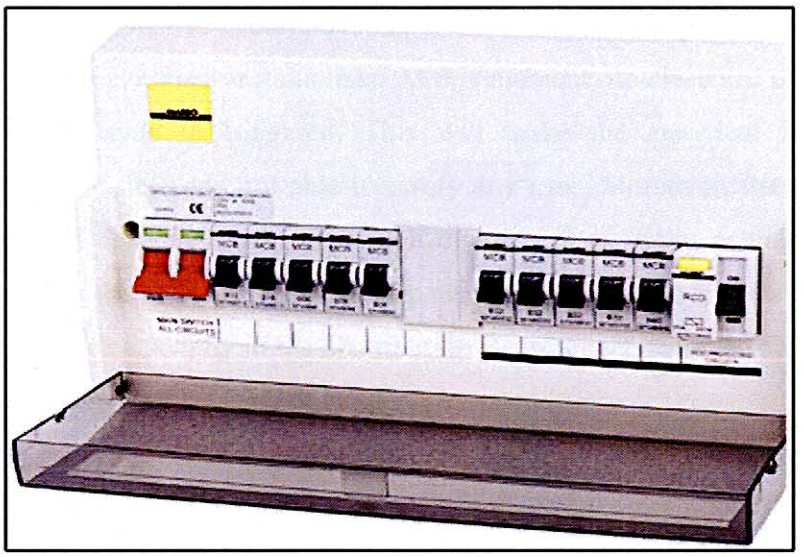

Figure 1.1: Conventional Distribution Board

Although continuous electricity is supplied to the premises, some errors due to technical problem may cause the supply of electricity to the users to be broken. One of the major technical problems that may aris is the power outage. A power outage refers to the short- or long-term loss of the electric power to an area. There are many causes of power failures in an electricity network. Examples of these causes include, faults at power stations, damage to power lines, substations or other parts of the distribution system, a short circuit, or the overloading of electricity mains. Power failures are

particularly critical at sites where the environment and public safety are at risk such as hospitals, sewage treatment plants, mines etc. In some places, normally in heavy industrial and remote location areas, electrical appliances need to operate for longer period (usually 24 hours). Electricity is needed to ensure the instruments (e.g. network servers) are fully operated for longer period. These areas usually are not monitored and if any electrical fault (power outage) occurred will not be noticed. The discontinuity of electricity due to power failure would cause operation of machines, equipment or devices to stop and delaying any work that going on. In computational industries, sudden power outage will cause any unsaved data on network to lose permanently.

So, if the electrical has been tripped or any electrical faulty occur, either ELCB or MCB will push down to avoid electrical shock to the electrical appliances or loads connected with the electrical installations. At this moment, no electrical trip or warning indication is displayed or triggered. This will make the electrical faulty or trip occurrence is not visible and not able to notify any user. Moreover, the electrical trip that has occurred does not notifying which component is faulty actually and which component causes the electrical trip. The trip also will be come to known if there is any person that saw for personally in the Distribution Board or sense for no electricity when electrical appliances stop working or suddenly stopped [1].

1.1 Objectives

The main objectives of this project are to develop an electrical fault or trip detection with LCD display and connected via a GSM modem for monitoring system. The monitoring system is designed by using the conventional Distribution Board and added with some extra components so it would be able to operate on the mission that has been targeted.

For this, a Programmable Integrated Circuit (PIC) is used to integrate with the distribution board to interface between those components acting as inputs and also

output. By using this monitoring system, it is able fasten the time taken to switch on back the ELCB or MCB that has been tripped due to electrical shock. Besides that, the main advantage of the Power Outage Alert System (POAS) project is able to send a notification of power failure to a client via Short Messaging System (SMS) through mobile phone [7]. This entire project will help to monitor certain areas which consuming electricity but are not or rarely checked for the electricity status on that particular areas. This project also can specify detailed the location and the component that has been failure or tripped.

1.2 Scope of Project

The scope of this project is to design a complete model of Distribution Board which will consist of Main Switch (MS), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), electrical wiring. An electronic circuit which will consist of PIC general purpose SK40B, AC Relays, Relay Base and GSM Modem will be designed to detect (circuit breaker trip) as the input for this system. The electronic components and wiring must be handled carefully because it will operate with a large amount of voltage (240V, 50 Hz). The distribution of power should be monitor and checked every time a process is done to test the POAS system. The input detector electronic circuit will consist of plenty of sensitive components such as Integrated Circuit (IC) and low resistance electronic components which need to prevent from the exposure to high voltage connectivity.

Moreover, some sort of programming has to be learned and understand such as C# language for PIC command instructions. The whole project will use the C #language type which is categorized under CMCS Compiler. This C# language programming also able to initiate the GSM Modem to work by sending a SMS when there is an input triggered [2]. For this, the AT Commands were used and translated directly to the C coding to be used with the GSM Modem [4].

The Proteus software is used to design the whole electronic circuit virtually before implementing on practical prototype project hardware. We can test the prototype in computer version before any mistakes and errors are corrected using the Proteus software. The PICkit 2 is used to download and "burn" the command coding into the PIC using the hexadecimal codes to interpret the C language programming [16].

1.3 Problem Statement

In some places, normally in heavy industrial areas, electrical appliances need to operate for longer period (usually 24 hours). Electricity is needed to ensure the instruments (e.g. network servers) are fully operated for longer period. These areas usually are not monitored and if any electrical fault (power outage) occurred will not be noticed. The discontinuity of electricity due to power failure would cause operation of machines, equipment or devices to stop and delaying any work that going on. In computational industries, sudden power outage will cause any unsaved data on network to lose permanently. Electric trip can occurs for a number of reasons:

- High winds blowing trees and branches onto power lines
- Vehicles striking and breaking utility poles
- High winds blowing lines into trees
- Animals such as birds, snakes and squirrels climbing poles and contacting both pole and the power line
- Snow and ice build-up that causes power lines to break or touch tree branches

So, if the electrical has been tripped or any electrical faulty occur, either ELCB or MCB will push down to avoid electrical shock to the electrical appliances or loads connected with the electrical installations. At this moment, no electrical trip or warning indication is displayed or triggered. This will make the electrical faulty or trip occurrence is not visible and not able to notify any user. This will delay if any production process is going on for an example such as in some companies, industrial and factories .

Moreover, the electrical trip that has occurred does not notifying which component is faulty actually and which component causes the electrical trip. The trip also will be come to known if there is any person that saw for personally in the Distribution Board or sense for no electricity when electrical appliances stop working or suddenly stopped [5 & 10].

1.4 Project Significant

So as a solution for the problem statements, Power Outage Alert System project is designed to help in monitoring and alert system. The monitoring part will consist of detection of all electrical trip component failure. The system is also able to identify exactly which component is faulty and causes the electrical trip [11]. So, the exact component name n faulty type will be displayed on the LCD Display and at the same time produce a SMS on notification of power failure to the client via mobile phone. The SMS will contain the details of exact location of the Distribution Board and power failure type. This will be very helpful if more than one distribution board is used in a same place.

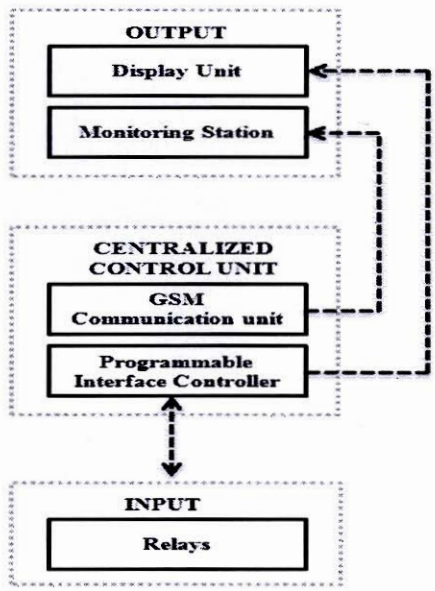

Figure 1.2: Structure of Power Outage Alert System

CHAPTER 2

LITERATURE REVIEW

2.1 Conventional System

Factors	Conventional System	POAS
Monitoring electrical component fault in DB	No	Automatic
Receive real-time electrical trip alerts	No	Automatic
Display instant electrical component status	No	Automatic
Identify specifically failure component	No	Automatic
Alert notification instantly via SMS	No	Automatic
Maintenance	Very costly	Cheap
Upgrading the system	Require professional	Easy & Cheap
Initial cost of installation	Daily basis	RM750

Table 2.1: Comparison between Conventional and POAS system