UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF A MICROCONTROLLER-BASED AUTOMATED ELECTRICAL FAULT DETECTION SYSTEM WITH GSM MODULE

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

by

JUNAINAH BINTI ROSLAN

B071710240

950725-02-6128

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

TECHNOLOGY

2020

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DEVELOPMENT OF A MICROCONTROLLER-BASED AUTOMATED ELECTRICAL FAULT DETECTION SYSTEM WITH GSM MODULE

Sesi Pengajian: 2020/2021

Saya **JUNAINAH BINTI ROSLAN** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

☐ SULIT* Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

☐ TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

☒ TIDAK TERHAD

Yang benar,

.....

JUNAINAH BINTI ROSLAN

Alamat Tetap:

LOT 7

KAMPUNG PONDOK KUAK LUAR

33100 PENGKALAN HULU

PERAK DARUL RIDZUAN

Tarikh: 14/01/2021

Disahkan oleh penyelia:

.....

Ts. MASLAN BIN ZAINON
Pensyarah Kanan (Senior Lecturer)
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
Universiti Teknikal Malaysia Melaka

Cop Rasmi Penyelia

Tarikh:14/01/2021

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

DECLARATION

I hereby, declared this report entitled DEVELOPMENT OF A MICROCONTROLLER-BASED AUTOMATED ELECTRICAL FAULT DETECTION SYSTEM WITH GSM MODULE is the results of my own research except as cited in references.

Signature: 

Author : JUNAINAH BINTI ROSLAN

Date: 14/01/2021

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

Signature: ……

Supervisor : Ts. MASLAN BIN ZAINON
Pensyarah Kanan (Senior Lecturer)
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
Universiti Teknikal Malaysia Melaka

ABSTRAK

Kerosakan adalah ketidaksempurnaan yang berlaku pada saluran elektrik yang boleh menyebabkan kegagalan sistem pendawaian elektrik seperti kebakaran api dan memberi kesan maut kepada tubuh badan. Kaedah konvensional akan memerlukan pekerja elektrik untuk mengesan kerosakan yang berlaku. Kaedah ini akan membuang masa dan menyebabkan sebahagian besar bahaya kerana memerlukan pekerja elektrik untuk mengesan lokasi kerosakan. Namun begitu, untuk mengatasi masalah ini, pengesanan automatik kerosakan elektrik dirancang dan dikembangkan. Protaip ini dikembangkan dengan menggunakan Arduino MEGA2560 sebagai pengawal utama yang dihubungkan untuk mengawal proses masukan dan keluaran. Bekalan kuasa, pengesan arus, pengesan voltan, potensiometer, pengatur voltan, dan LCD dipasang ke dalam litar untuk menganalisis prestasi sistem dari segi keberkesanan pengesanan dan lokasi kerosakan elektrik dalam sistem pendawaian domestik. Kerosakan yang berlaku akan dipaparkan pada skrin LCD dan modul GSM digunakan untuk menghantar mesej amaran kepada orang yang bertanggungjawab. Pada akhir projek, protoip yang dikembangkan berjaya menghantar pesanan amaran kepada pekerja elektrik dan kerosakan dapat dikesan. Oleh itu, masa dan tenaga pekerja dapat dijimatkan dan kerosakan dapat dikesan dengan lebih berkesan.

ABSTRACT

Fault is an imperfection that occurs on electrical lines that can lead to failure in an electrical wiring system such as fire burning and a fatal effect to the human body. A conventional method will use electrical workers to detect the fault occurs. This method is wasted time and most dangerous part due to require electrical workers to check the location of the fault. However, to overcome these problems, automated electrical fault detection is designed and developed. The prototype is developed by using Arduino MEGA2560 as the main controller interfaced to control both the process of input and output. A power supply, current sensor, voltage sensor, potentiometer, voltage regulator, and LCD are installed into the circuit to analyze the system performance in terms of the detection effectiveness and location of electrical faults in domestic wiring systems. The faults that have been occurs will be displayed on the LCD screen and GSM module used to transmit an alert message to a person in charge. At the end of the project, the developed prototype is successfully able to send alert messages to electrical workers and the fault can be detected. Subsequently, time and manpower can be saved and the fault can be detected more efficiently.

DEDICATION

This project and thesis are wholeheartedly dedicated to my beloved parents, who have been my source of inspiration and gave me strength also continually provide their moral, spiritual, emotional, and financial support.

To our brothers, sisters, relatives, supervisor, lecturer, and who shared their words of advice and encouragement to finish this study. For my close friends, Hafiz Bin Adnan, thank you for helping out throughout complete this project.

And lastly, we dedicated this study to ALLAH SWT, thank you for the guidance, strength, power of the mind, protection, and skills and for giving us healthy.

ACKNOWLEDGEMENTS

Alhamdulillah, thanks to Allah SWT, with His wiling for giving me the opportunity to complete this Final Year Project which is title Development of a Microcontroller-Based Automated Electrical Faults Detection System with GSM Module. This final year was prepared for Faculty of Electrical and Electronic Engineering Technology, University Teknikal Malaysia Melaka (UTeM).

Firstly, I would like to express my deepest thanks to, Ts. Maslan Bin Zainon, as my supervisor who had guided been a lot of tasks during two semester session 2020/2021. Deepest thanks and appreciation to my parent and family for their cooperation, encouragement, constructive suggestion and full of support for the report completion, from the beginning till the end.

Last but not least, thanks to all my friends and everyone that has been contributed supporting my work and help me during the final year project progress till is fully completed.

Thank you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF SYMBOLS

m	-	Ampere
KB	-	Kilobyte
KV	-	kilovoltage
mA	-	miliampere
MHz	-	Megahertz
mm	-	millimeter
ms	-	millisecond
sec	-	second
V	-	Voltage
w	-	Angular velocity
x	-	Displacement
z	-	Height
q	-	Angle

LIST OF ABBREVIATIONS

AC	Alternating Current
BDP	Bachelor Degree Project
DC	Direct Current
ELCB	Earth Leakage Circuit Breaker
GPRS	General Pocket Radio Service
GSM	Global System Mobile
IDE	Integrated Development Environment
IoT	Internet of Thing
LCD	Liquid Crystal Display
MCB	Miniature Circuit Breaker
PCD	Printed Circuit Board
PWM	Pulse Width Modulation
RCD	Residual Current Device
RMS	Root Mean Square
USB	Universal Serial Bus
VDR	Voltage Divider Rule

CHAPTER 1

INTRODUCTION

1.1 Background

Fault can be described as an imperfection on electrical lines which can cause the electrical system failure like a fatal effect on humans and fire burning (Nandi, Toliyat and Li, 2005). In Malaysia, 405 accidents due to electrical failure occurred between 2005 and 2011, and 191 people died due to accidents (Bonari, 2015). Therefore, by instead making the public aware of electrical safety and hazard, it is also necessary to consider proper protection devices as part of safety. While the single-phase system has had its own safety protection such as earth conductor, that is not necessarily a hundred percent efficient instantly (Abd Azzis, Mohd Nor and Ibrahim, 2013).

Every day, a lot of people are injured in electrical incidents at home. Whether an old or new home, bad wiring can put in safety risks like shock and house fires can become a reality. Faulty wiring is the most common cause of fires in houses and buildings. The faults that may occur in a domestic building are short circuit fault, over-current fault and lightning fault. For industrial or domestic electrical, the protection system is the most important to avoid harm to the equipment. By installing Residual Current Device (RCD), many of these injuries could be prevented. Protection against RCD can save lives and families from fatal electrical shocks and can even provide some fire protection. Having an RCD modem consumer unit gives us better protection since it usually covers all cables, sockets and home appliances (Mohd Anuar Bin Mohamed Ayub, 2013).

1.2 Problem Statement

A conventional method for electrical faults troubleshooting is commonly used daily for electrical installations workers. Most of this method has its weakness as an example; In order to solve the electrical fault, the location of the fault is required checked by manpower. This method is waste a time. In this context, it will take some time for the person in charge to find the correct location of the fault, depending on the difficulty of the electrical wiring. The more complicated the electrical wiring, the more complex it is to troubleshoot the problem occurs. On the other side, coping with high-risk situations also a weakness of conventional methods (Albert and Hallowell, 2013). This was the riskiest part due to unpredictable circuit events while troubleshooting. Even the Standard Operation Procedure (SOP) has been established by Suruhanjaya Tenaga Malaysia, however, still a risk of sudden unexpected occurrence due to the surrounding factor. The absence of real-time detection and monitoring was seen as a problem of conventional methods inefficient (Demirci et al., 2011).

1.3 Objective

The purposes of this project are as follows:

a) To design and develop a microcontroller-based circuits and hardware for an automated electrical faults detection system.
b) To apply a GSM network system for update control and monitoring for the electrical faults detection system.
c) To analyze the system performance in terms of the detection effectiveness and location of electrical faults in domestic and industrial's single-phase wiring systems.

1.4 Scope

This project focusses on the development of an automated electrical faults detection system with GSM module and considered for single-phase wiring system in domestic and industrials. The purpose of the microcontroller is to controller of the overall system for the automated electrical fault detection and the location fault occurs. The GSM network system is applied in this project to update control and monitoring the electrical fault detection system by sending a message. Other components of this project are power supply, current sensor, voltage sensor, voltage regulator, potentiometer and LCD are installed to analyse the system performance in terms of detection effectiveness and location of electrical fault. Thus, there will be a hardware part of this project. To program the board, Arduino Integrated Development Environment (IDE) software will be used in the software program section of the application.

CHAPTER 2

LITERATURE REVIEW

2.1 Electrical Faults

In electrical systems, the fault is the abnormal condition which damages the electrical failure of the equipment and disturbs the normal flow of the electric current. Faulty wiring is the most prevalent factor in the house and buildings such as faulty appliance, loose electrical connection, overloading of a circuit and circuit breaker tripping. The type of faults in electrical wiring is explained below:

2.1.1 Over-current fault

The National Electrical Code describes over-current as any current that exceeds the rated current of equipment or the amp city of the conductor. The current flow of the conductor always generates heat. The higher the current flow, the hotter the conductor. Excess heat is harmful to people and electrical components. An over-current protection device is used to prevent unnecessary current flow to the conductors. This protection device ate intended to maintain the current flow in a circuit in a safe condition to avoid overheating the circuit conductor. The fuse or wire may melt or damage the other elements of the circuit when the current that designed to carry greater than which a circuit or fuse (Tenaga, 2007). It could be due to short fault, ground fault, or overload.

2.1.2 Short-Circuit Fault

The short circuit is required that allows the current to move along an unwanted path without or very low impedance. It is an abnormal low-resistance connection between two electrical circuit nodes, which is supposed to be at different voltages. Accidental short-circuits, particularly between the high and low voltages of a power supply may allow very strong current to flow, potentially cause circuit damage, overheating, explosion or fire. While typically the result of a fault, there are situations where short-circuit are intentionally caused, for example, voltage-sensing of crowbar circuit protectors.

Short circuit fault current can be thousands of times larger than the normal operating current of the system within one millisecond (Bhatia, A, 2019). Short circuit damage can be avoided or reduced through the use of fuses, circuit breakers or another overload protection that disconnects the power in reaction to unnecessary current. Figure 1.1 shows the short circuit incidence within the residential electrical wiring.

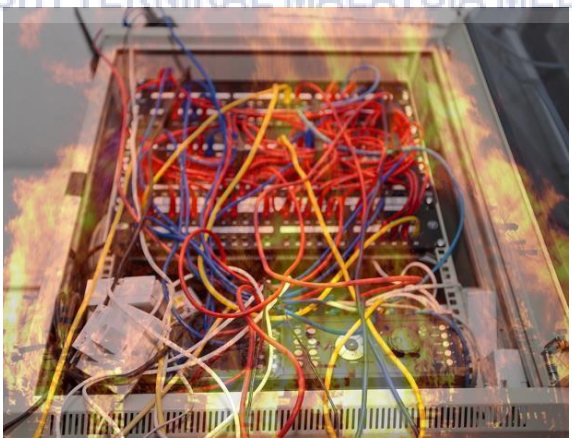

Figure 2.1: Short circuit

2.1.3 Over-voltage Fault

In an electrical circuit, when the voltage exceeds the maximum value of the operational voltage, this is known as overvoltage. The over-voltage can cause an excessive voltage stress and excess acurrent flow. The most harmful over-voltage is triggered by an oversupply in electricity such as lighting strikes. The high-voltage power range can burst fuses, the power can be in hundreds of kilovolts (kV) and destroy more sensitive electrical devices when overvoltage is triggered by lightning strikes. The internal overvoltage caused by the switching operation occurs under normal conditions or when network fault occurs. The output voltage increased dramatically when an unloaded long line is activated, resulting in over-voltage in the system due to the Ferranti effect.

2.1.4 Ground Fault

A ground fault is an abnormal flow of electricity that can experience a number of different types of faults. It is one type of fault which the unintended path of the electric current is flowing directly to the earth. An electrician, a ground fault occurs when a hot wire makes contact with either grounding wire or a grounded part of the system, such as a metal electrical box. Uncontrolled flow allows the circuit breaker to trip due to the ground fault. The main danger of ground faults is the possibility of shock when a person comes in contact with the path of least ground resistance and standing on the ground or in a damp location. In the installation, fault protection devices are used to protect the equipment and for the safety of people.