Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF AUTO RECLOSURE CIRCUIT BREAKER AT DISTRIBUITION BOX USING MICROCONTROLLER ESP32

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Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

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I declare that this project report entitled "DEVELOPMENT OF AUTO RECLOSURE CIRCUIT BREAKER AT DISTRIBUTION BOARD USING MICROCONTROLLER ESP32" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology with Honours.

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DEDICATION

To my beloved mother, Julia Zafarina Binti Othman Jalaluddin

and

my beloved father, Baharudin Bin Ismail.

ABSTRACT

Distribution board forms an integral part of a domestic electric supply system, whereby its main function is to divide an electric power feed into subsidiary circuits throughout the building whilst providing protection for each circuit via protective fuses. For security reasons, the distribution board is commonly placed at a high ceiling or were put on the high side of a wall. However, this type of placement creates a problem, which is accessibility. To be precise, due to the distribution board be commonly placed at a high place, users often having trouble accessing the distribution board should it become faulty. This is especially true in situations whereby the users are required to replace any faulty fuses, switches, or to reset any tripped switches due to circuit overload.

This project aims to address such problem using several simple inventions. By using servo motors which will be put beside each switch inside the distribution box, it will automatically reset any tripped switches, thus eliminating the need for the user to physically reset those tripped switches. In addition, the implementation of sensors inside the distribution box will allow for the users to be notified of any faulty switches or fuses via their mobile phones. This will save the users' time as they are not required to go through the hassle in identifying which switch or fuse that is faulty inside the distribution box themselves.

It is hoped that this project can assist the users with the problem as mentioned using the solution as proposed.

ABSTRAK

Papan agihan membentuk bahagian penting dalam system bekalan elektrik domestic, di mana fungsi utamanya adalah untuk membahagikan suapan kuasa elektrik kepada litar subsidiary di seluruh bangunan sambil memberikan perlindungan untuk setiap litar melalui fius perlindung. Atas sebab keselamatan, papan agihan biasanya diletakkan di siling tinggi atau diletakkan di bahagian atas dinding. Walau bagaimanapun, jenis peletakan ini menimbulkan masalah, iaitu keboleh-aksesan. Oleh itu, disebabkan papan agihan biasanya diletakkan di tempat yang tinggi, pengguna sering menghadapi masalah untuk mencapai papan pengedaran sekiranya ia rosak. Ini adalah benar terutamanya dalam situasi dimana pengguna dikehendaki menggatikan mana – mana fius atau suis yang rosak atau menetapkansemula mana – mana suis yang arus berlebihan.

Projek ini bertujuan untuk menangani masalah tersebut menggunakan beberapa ciptaan mudah. Dengan menggunakan motor servo yang akan diletakkan di sebelah suis MCB di dalam kotak pengedaran, ia akan secara automatik menetapkan semula mana – mana suis tersandung, sekali gus menghapuskan keperluan pengguna untuk menetapkan semula suis tersandung tersebut secara fizikal. Selain itu, perlaksanaan sensor di dalam papan agihan akan membolehkan pengguna dimaklumkan tentang sebarang suis atau fius yang rosak melalui telefon mudah alih mereka. Ini akan menjimatkan masa pengguna kerana mereka tidak perlu melalui kerumitan dalam mengenal pasti suis atau fius mana yang rosak di dalam kotak pengedaran itu sendiri. Diharapkan projek ini dapat membantu pengguna dengan masalah seperti yang dinyatakan iaitu menggunakan penyelesaian seperti yang dicadangkan.

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CHAPTER 1

INTRODUCTION

1.1 Background

The project starts with ESP32 which is like the brain of the whole project, when we apply the coding into the ESP32 then it will detect the codes and began the process. If the RCCB switch is nuisance tripped, the limit switch will detect and servo motor will push it back ON and if the event happens three times, but the RCCB still tripped, it will stop pushing the RCCB ON and send out notification to the consumer saying that the RCCB is malfunction. The project can also measure the power consumption by using the voltage and current sensor to measure the value of voltage and current flow through the RCCB and the value will be display by LCD.

1.2 Problem Statement

A normal distribution board is usually placed at a higher place which can be a burden to those who want to access it such as maintenance people to perform their work. Without the technology, the usual distribution board cannot inform the consumer if there is any problemoccurs. Users need to diagnose the problem themselves if there is an event of a blackout.

Common distribution boards do not have technology capable of overcoming nuisance tripping. When lightning strikes close to the distribution board, it will produce an electromagnetic wave that will cause overvoltage. Overvoltage can easily damage electronic items at home such as TVs and refrigerators. Next, when there is no one in the house and a nuisance trip occurs, it will be difficult for the user because he is not at home to turn ON the RCCB.

1.3 Project Objective

The objective of the project is to rectify problems due to lightning nuisance tripping. This project is also convenience because it can be control anywhere inside our house or a factoryand collect data by using the IOT technology that is link to our smartphone such as:

a) To develop microcontroller ESP32 program on auto reclosure circuit breakernotification to user.
b) To develop and built the prototype hardware of the auto reclosure circuit breaker.
c) To monitor the power consumption of the house.

1.4 Scope of Project

The scopes of this project are as listed below:

a) To use Microcontroller ESP32 and link with smartphone applications to identifytripping & notifications.
b) To use servo motor to turn ON back RCCB which in fault condition which sense bylimit switch sensor due to nuisance tripping.
c) Use voltage sensor and current sensor to send signal to ESP32 for power consumption usage.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In a shared enclosure, a distribution board divides an electrical power input into subsidiary circuits and provides a protection fuse or circuit breaker for each circuit. On more modern boards, one or more residual-current devices (RCDs) or residual current breakers with overcurrent protection (RCBOs) are generally included, as well as a main switch. It is commonly use everywhere that needed electricity such as house, factory, store etc. Usually during high loads, sometimes tripping will happen, and this will affect the productivity of a factory or effect the work at home for those who are working online at their house. By the new technology available nowadays, we can overcome if situation happens.

By the new technology available in this new era, this project can be controlled and monitored just by using a smartphone that is link to IOT. By using this system, we can identify if the MCB is broken because it will notify the user which MCB is broken. Then, if there is a nuisance trip happen, the servo motor can push back the MCB to ON state so that we can continue our work without having to find which MCB has trip. Finally, with the help of the current and voltage sensor, we can monitor the power consumption of the MCB, and it will be display at the LCD near the distribution box.

2.2 Internet of Things (IoT)

Internet of Things (IoT) systems are exposed to a wide range of risks due to the integration of different devices with various owners and producers. IoT applications commonly contain cloudand fog components, as well as being part of larger cyber-physical systems; in other words, thesesystems are exceedingly sophisticated, which exacerbates security concerns. Because of their abstraction capacity, patterns are a good method for this goal [1]. The design of IoT-based appsmust be able to handle this complexity and heterogeneity, and patterns are a good approach for this purpose. The Internet of Objects (IoT) is a network of things (items) with unique identifiersthat may communicate and collaborate to achieve common goals, such as sensors, actuators, andsmart phones. By allowing centralized control of a large range of devices, IoT systems have extended the spectrum of applications.

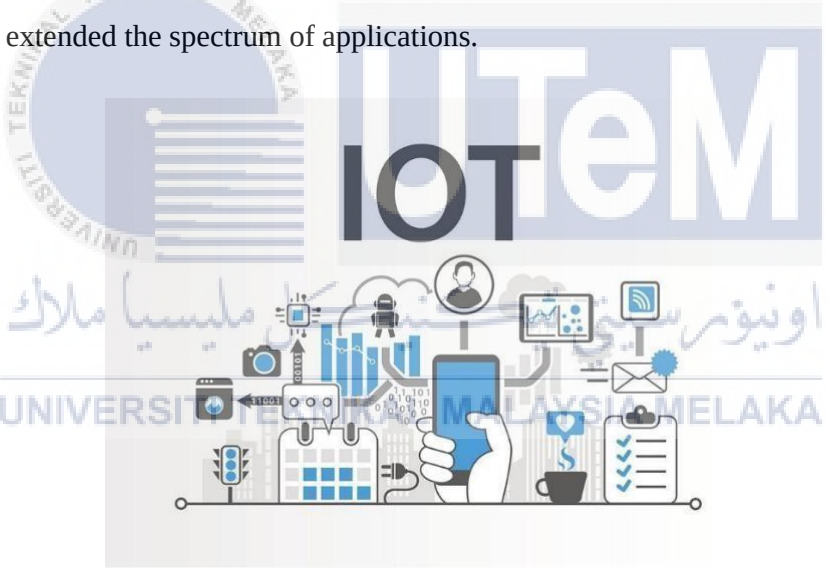

Figure 2.1 Internet of Things

2.3 Microcontroller (ESP32)

IoT, smart home automation, and embedded technologies are all fast evolving at the moment. This has a lot to do with the evolution of hardware modules and CPUs. On development boards, a communication interface, and peripherals, as well as the main CPU processor, areincorporated [2]. The ESP32 chip is getting increasingly popular, and there are already several hardware modifications and software development streams for it. A large communityof developers, as well as researchers, are working on using the ESP32 chip as the successorto the ESP8266 microcontroller. A microcontroller may be used with a variety of environmental monitoring sensors, whether they are used to monitor air pollution or to directly detect LPG leaks.

Smart home applications, automation, wearables, audio applications, cloud based IoT applications, and more may all benefit from ESP32 prototype boards. A specific development kit or a custom embedded system based on the ESP32 microcontroller can be created [3]. The Arduino platform is the simplest method to get started writing code for the ESP32 platform. This is an open-source platform based on Atmel microcontrollers for rapid prototyping.

Figure 2.2 Microcontroller (ESP32)

2.4 Microcontroller (ARDUINO)

Arduino provides a user-friendly development environment as well as a variety of hardware andsoftware tools for developing microcontroller-based projects quickly. Students, on the other hand, were losing the capacity to develop their own prototypes because of the large amount of knowledge accessible. Arduino is a widely used platform for developing projects. The hardware that can be added to the main board, the code libraries, and the knowledge accessible in the form of books, tutorials, videos, do-it-yourself projects, and the e-community are the reasons for this [4]. There are also lot of types of Arduinos which is, Arduino Uno, Arduino Mega, Arduino Shields and many more.

The Arduino microcontroller should be used in conjunction with low-cost sensors. This method has several advantages, including ease of installation and a cheap total cost of the apparatus [5]. A low-cost Arduino-based wire strain-gauge for earth flow/landslide monitoring is presented, with a prototype made with an Arduino Uno board, a data logging RTC, and an operational temperature sensor, and field testing demonstrating the experimental apparatus's great dependability.

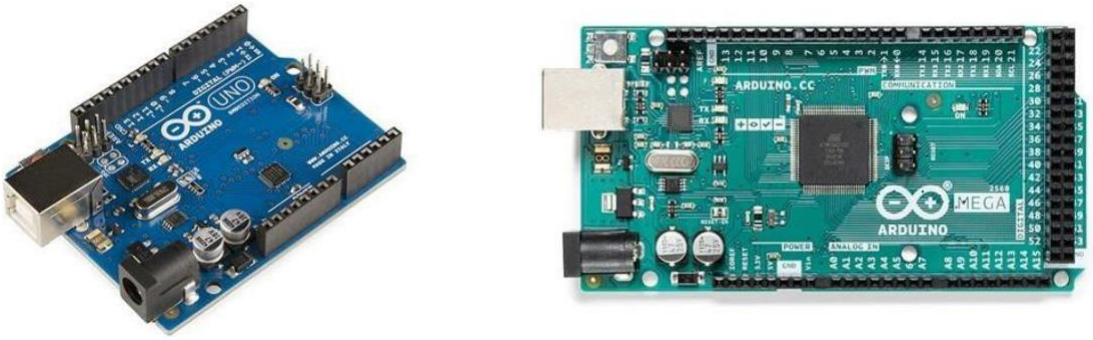

Figure 2.3 Arduino UNO and Arduino MEGA

2.5 Servo motor

Servo motors are frequently used in industrial applications that need precise control of acceleration, speed, and position. They may be found in a variety of places, including industrial robots, rolling machines, and printers [6]. Servo motors must have a high dynamic performance. Several servo motors can be used to do this. Permanent magnet synchronous motors (PMSMs) are the most prevalent form of servo motor because of their great power density and efficiency. Continuous operating servo cycles are used in applications that demand continual precise position and speed control, such as rolling machines, aluminum foil production machines, and painting robots, and they last longer than point-to-point cycles, which are often measured in minutes.

Even though novel control theories for high accuracy servo system control are frequently investigated, the PID-type controller continues to dominate in practice due to its simplicity,fault tolerant structure, and acceptable performance [7]. In servo motors, ripple and coggingtorque levels are kept to a minimum.

Figure 2.4 Servo Motor

2.6 Limit Switch

A limit switch is frequently used to regulate machinery, as a safety interlock, or to count objects passing past a point. When a moving component collides with a limit switch, the limit switch shuts. The controller can detect the voltage change of the associated I/ O port atthe same time. The controller might then perform the necessary follow-up actions [8]. Whena moving object collides with the limit switch's roller, the limit switch's lever drives the roller, causing the cam to revolve. The plunger then slides down, pushed by the cam, and thetypically closed contact opens due to the tension of the moveable spring. The coil spring andthe moveable spring in the bottom of the limit switch restore the lever, the cam, the plunger,and the movable contact to their normal states if the moving item loses contact with the roller. Limit switch failures can occur for a variety of reasons, including long-term usage, improper maintenance, or poor quality, as mentioned below:

a. The area of the contact point is very tiny, and the contact of the switch is inadequate due to low quality. Because of the high temperature, the contact point of the limit switch may burn, resulting in a short usable life.
b. The limit switch's springs would be in a state of material fatigue after operating many hours. As a result, as compared to the action of the moving item, the state transition of the moveable contact might be delayed.

Figure 2.5 Pin Limit Switch

2.7 Liquid Crystal Display (LCD)

The ongoing advancement of technology and the spread of the Internet are two major reasonsthat have led to the fall of print media consumption and the emergence of display readers. This has resulted in the development of high-resolution screens, particularly liquid crystal displays (LCD), which are among the most widely used [9]. The distances are shown on theLiquid Crystal Display according to the instructions in the Arduino microcontroller. It showsdistances in meters or millimeters, depending on the study's requirements [10]. Pin 12 to Pin2, Pin 11 to Pin 3, Pin 5 to Pin 4, Pin 4 to Pin 5, Pin 3 to Pin 9, Pin 2 to Pin 10 are the 14 terminals on the LCD that were connected to the ESP32. The function of the LCD is to display the data according to what we have coded such as the power consumption, password, and the temperature of the room and many more.

Figure 2.6 Liquid Crystal Display