Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF PROGRAMMABLE CONTROLLER FOR BUILDING AUTOMATION SYSTEM

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Bachelor of Electronics Engineering Technology with Honours

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DEDICATION

This research is dedicated to my parents, Marta Singgak, Sitti Binti Kulah and to my beloved grandmother, Damaris Jumari Tasih, who always encourage me. They give me the discipline and motivation I need to approach a task with eagerness and dedication. Without they love and support, this project would not have been possible.

ABSTRACT

Most of small to medium building such as classroom or office did not equip with commercial "Building Automation System (BAS)" due to the cost required. Therefore, there are some buildings that have air conditioning and lights that automatically turn on within the time coordinated and will only turn off at a certain time. As a consequence, this has led to wastage of electricity if no activity is run at a certain time, but the air conditioner is still on. Hence, the purpose for this study is to develop a programmable controller focusing on how to regulate the building automation system. The goal of this project is to create a programmable controller for small scale building automation system on electrical appliance power consumption, to evaluate estimation total power consumption and energy saving for electrical appliance and to develop a data logging system using appropriate software to monitoring energy consumption on daily, weekly and monthly basis. Within this project, a micro- controller will act as a main controller to regulate the system in monitoring all of the parameters required. As a result, users will have an access to the particular building automation system through an application. Users are able to turn on the electrical appliances anytime and anywhere.

ABSTRAK

Sebilangan besar bangunan kecil hingga sederhana seperti bilik darjah atau pejabat tidak dilengkapi dengan "Building Automation System (BAS)" komersial kerana kos yang diperlukan. Oleh itu, terdapat beberapa bangunan yang mempunyai penyaman udara dan lampu yang secara automatik menyala dalam waktu yang diselaraskan dan hanya akan dimatikan pada waktu tertentu. Akibatnya, ini menyebabkan pembaziran elektrik jika tidak ada aktiviti yang dijalankan pada waktu tertentu, tetapi penghawa dingin masih aktif. Oleh itu, tujuan kajian ini adalah untuk mengembangkan pengawal yang dapat diprogramkan yang memfokuskan kepada bagaimana mengatur sistem automasi bangunan. Objektif projek ini adalah untuk mengembangkan pengawal yang dapat diprogram untuk sistem automasi bangunan berskala kecil pada penggunaan kuasa alat elektrik, untuk menilai anggaran jumlah penggunaan tenaga dan penjimatan tenaga untuk alat elektrik dan untuk mengembangkan sistem log data menggunakan perisian yang sesuai untuk memantau penggunaan tenaga pada harian, mingguan dan bulanan. Dalam projek ini, pengawal mikro akan bertindak sebagai pengawal utama untuk mengatur sistem dalam memantau semua parameter yang diperlukan. Akibatnya, pengguna akan memiliki akses ke sistem automasi bangunan tertentumelalui aplikasi. Pengguna dapat menghidupkan peralatan elektrik pada masa yang diinginkan dan di mana sahaja.

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CHAPTER 1

INTRODUCTION

1.1 Background

A distributed control systems, such as the Building Automation System (BAS), consists of a computerized and intelligent mesh network of electrical devices that communicate with each other. Its primary function is to monitor and regulate the mechanical and electrical equipment in a building's mechanical and electrical system. The system's primary purpose is to maintain a defined temperature range in the building and deliver lighting at certain brightness levels depending on occupancy and schedule. Additionally, it keeps track of system performance and device faults. If a device is facing a problem or malfunction is identified, the system will immediately send emails and SMS messages to the person in charge, or the building engineering personnel. When compared to a non-controlled structure, the capability of a Building Automation System (BAS) lowers the energy and maintenance expenses of the building, which is why it is often referred to as an intelligent building.

1.2 Problem Statement

Nowadays, it is hard to check a building’s power consumption or maintain a good energy saving among community, especially for offices due to it’s daily power usage such as air conditioning. Thus, increasing the power outage and the cost for the electrical appliances used.

1.3 Project Objective

The objective of this project are:

i. To develop a programmable controller for small scale building automation system focusing on electrical appliance power consumption

ii. To evaluate estimate total power consumption and energy saving for electrical appliances.

iii. To develop a data logging system using an appropriate software to monitoring energy consumption.

1.4 Scope of Project

The primary aim of this project is to use advanced intelligent technologies to decrease expenses and increase energy efficiency in a building environment. For example, the energy consumption in a building or office with air conditioning and ventilation is one of the most important contributors to the monthly electricity costdue to its high horse power. The goal of this project was to develop a programmable controller that could be used to operate a variety of electronic devices. The user wouldbe able to programmed the system to turn on and off at a certain times and also be able to set how long each phase would last. To make monitoring easy, the amount of energy used for each month will be recorded in a database-driven system. It is anticipated that a micro-controller, which will be combined with a real-time clock, will be the primary processor for this project. Furthermore, an update or configuration of the timing and duration for turning on the air conditioner will be possible for the user.

1.5 Expected Result

The expected result for this project is the air conditioner can be turned on or off within the time set by the user and all the air-conditioner will be connected by a relay switch to the timer. The air-conditioner will be set by the time the users want to be switched on. For example, it will be switched on 15 minutes before any activities started. This will help save the electrical bills and make the area more comfortable during any activity. In addition, the power consumption, whether it is daily, weekly, or/and monthly can be calculated and become our early expected result as it does not require hardware to obtain electricity consumption. Not only that the user can identify the appliances that consume more energy, but they can also log in into database to monitor the electrical usage.

1.6 Thesis Outline

The project is divided into five chapters, each of which is linked to the previously mentioned objectives and methods. Among the topics covered in the first chapter are content analysis, research problems, anticipated results, and project goals. In Chapter 2, the article will discuss the results of the literature review as well as previous studies that have been conducted on this topic. The methods for developing programmable logic controllers for building automation systems will be discussed in Chapter 3. While in Chapter 4, a case study will be conducted using a model that has already been developed. The last part will examine the project findings and accomplishments, and potential research subjects for the next phase of its development.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter primarily focuses on the researcher, the journal, the article knowledge and philosophy, previous analysis and comparisons between methods,preliminary analysis and comparisons between approaches. This chapter discusses the construction of an IoT based programmable controller for a building automationsystem. The PLC-based building automation framework aims to lower the cost of energy in commercial and residential buildings and houses.

2.2 Related Previous Work

2.2.1 "IOT Based Monitoring and Control System for Home Automation" by Dr.B.Prakash, M.Alekhya, G.Komala Reddy, A.Geethika, B.Santhosh Reddy (2018)

This article was authored by a group of scholars in the year 2018. An effective implementation of the IOT (Internet of Things) for tracking and managing household appliances over the Internet is proposed in this project. When using a home automation system, the user interface is provided via a portable computer. This device interfaces with a home automation network through the use of an Internet gateway as well as low-power networking protocols such as Zigbee and WiFi. In this project, the purpose is to monitor household appliances using a smartphone, with Wi-Fi serving as the communication protocol and the Raspberry Pi serving as the server device. A web-based interface enables

the user to interact with the item directly, whilst home appliances may be managed remotely through the use of a straightforward webpage. Its capacity to detect smoke, which allows it to send an alerting message and a screenshot to a smartphone in the case of a fire, is another feature that contributes to the increased security of fireplace flames. The server will be connected to relay hardware circuits that will supply electricity to the household's electrical appliances and devices. A result of the server communication, the user will be able to pick the most suitable computer. Because of the connection to the server, the user has the ability to select the most appropriate device. The server then establishes connections with the appropriate relays. The connection to the server enables the user to choose the most suited computer for his or her needs. Even if the network connection fails or the internet is unavailable, the embedded device board may still manage and operate the equipment on a local level provided it is connected to the relays designated to it. Because of this, it is able to provide a scalable and cost-effective Home Automation solution.[1].

2.2.2 " An Internet of Things Based Air Condition and Lighting Control System for Smart Home" by Mehmet Tastan and Hayrettin Gökozan (2018)

Using an example of a smart house, this article covers the gadgets that regulate the air conditioning and lights. The Android-based user interface makes it simple for the user to set and operate the devices, and it also provides energy savings and thermal comfort. The system structure, which includes the display of the system and the NodeMCU controller, interact with Blynk through Wi-Fi, and the DHT22 sends the humidity and temperature data to Blynk every 5 seconds, according to the manufacturer's specifications. The Arduino Pro Mini controller is used on the receiver side of the programmed air conditioning system, while the Arduino Pro Mini controller is used on the transmitter side of the programmed air conditioning system. To develop a controller for the Blynk

application, the analogue and digital pins are utilised in conjunction with each other as needed. When the SMART HOME application is downloaded and installed on an Android smartphone, the Blynk server system is accessed. As a result, data is exchanged in both directions between the Intelligent Home interface and the NodeMCU, and the process continues. Parameters include things like temperature, humidity, light intensity, and weekly programming, to name a few. The Android app provides access to the Blynk Home Automation software interface, which can be viewed and updated on demand. To manage the air conditioning systems, the software is used to detect the temperature and humidity levels, and then compare those measurements to the values recorded in the microcontroller. NodeMCU and PCs can communicate with each other via wireless communication provided by the RF modules. The relay module contacts that are linked to the digital outputs of the Arduino Pro Mini allow for the control of the air conditioner's on/off operation as well as the modification of its parameters. The timing may be customised for seven days a week, with four different time slots to choose from. Specifically, the NodeMCU is responsible for the digital PWM output in the lighting control system. The outcome is that the project now provides a nice and clever climate-lighting system.[2].

2.2.3 “IOT based application for monitoring electricity power consumption inhome appliances” by Korakot Luechaphonthara, Vijayalakshmi A (2019)

A proposed Internet of Things (IoT)-based application for monitoring energy power usage in household appliances is presented in this research. The two most important systems in this project are those for information collecting and information presentation. The current sensor ACS712 with full scale values of 5A, 20A, and 30A is used to measure the actual consumption power, and the information is transmitted to the information processing module via Wi-Fi. As a result, when the information processing module receives the power consumption data, it stores it in a database My SQL AWS Cloud server. The Data Processing module gets information on the power usage felt by each of the sensors installed in the appliances over a Wi-Fi communication interface, which is connected to the Internet. These details are maintained in the MySQL database and may be accessed in order to reply to customer inquiries. Following that, the information saved will be made available to consumers through smart energy usage monitoring services. The sensors provided the design for the data repository. The ESP8266 is used to operate the sensor, monitor it, and analyse its data. The Internet of Things (IoT) is connected through the embedded WI-Fi (IoT). An electricity metre attached to the following equipment will collect data on power use in an existing residence over a period of six weeks in the case of the study. Each day and night, the information obtained is separated into two groups, which are day and night, respectively. The hours of 6 a.m. to 6 p.m. are considered daytime, while the hours of 6 p.m. to 6 a.m. are considered nighttime[3].

2.2.4 "Towards the development of an energy-efficient smart home through IoT" by Mohammad Reduanul Haque1, Shifat Jaman1, Md Golam Saklayen1, Md. Mohsin Khondoker1, Abu Bakkar Siddik1, Umme Sara2 and Mohammad Shorif Uddin3 (2019)

This document describes a room automation system that was created with the help of Bluetooth and an Arduino board. Through a simple user interface, the Android application may simply control and manage household appliances connected through Bluetooth. While Bluetooth serves as the foundation for this project, there are two modules in it, one of which is software and the other of which is hardware, and its functions include turning on and off fans, lights, televisions, and locking and unlocking doors. When it comes to the software, designers construct an android-based mobile application that runs on the device's operating system, and the programme communicates with the hardware over the Bluetooth network. Apps for Android devices display the screen home for the room selection button as well as the side navigation bar on the left. When the room selection button is pressed, the three-button alternative layout for selecting the desired room will be displayed. Once each room button has been selected, the user will be directed to a new page where they will discover the Bluetooth link button as well as another button for managing household appliances such as lights, fans, televisions, and other similar devices, among other things. The hardware interfaces for the home automation system are controlled through Bluetooth, which allows for easy setup. To control the temperature in three different rooms, the following components are used: a Bluetooth module, an LM-35, an LDR sensor (for temperature detection), an electric bulb, an electric fan, a resistance, and a relay module. The GND and VCC pins on the Arduino were used to control the Bluetooth module. When the Bluetooth module's TX pin is linked to the Arduino board's RX pin, the device is considered to be operational. When the Bluetooth module provides