DEVELOPMENT OF IOT BASED SMART BUILDING PREVENTIVE MAINTENANCE SYSTEM

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

by

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I hereby, declared this report entitled DEVELOPMENT OF IOT BASED SMART BUILDING PREVENTIVE MAINTENANCE SYSTEM is the results of my own research except as cited in references.

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APPROVAL

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

Signature: 

Supervisor: Ts AHMAD NIZAM BIN MOHD JAHARI @ MOHD JOHARI

ABSTRAK

Di kawasan perumahan seperti kondominium atau pangsapuri atau bangunan mana pun, mesti ada jabatan penyelenggaraan yang bertanggungjawab untuk penyelenggaraan bangunan. Penyelenggaraan bangunan perlu dijaga untuk kemudahan penduduk. Terdapat beberapa kemudahan tertentu yang biasa dikendalikan seperti tangki air bangunan, elektrik bangunan, saluran penyaman udara, kolam renang, lampu di dalam bangunan dan lain-lain. Sistem Pemeliharaan Pencegahan Bangunan Pintar berasaskan IoT dikembangkan untuk memantau nilai turun naik air tangki aras, arus elektrik dan kualiti air kolam renang. Tujuan utama projek ini untuk menyediakan pemantauan tanpa wayar terhadap nilai turun naik yang membantu membuat pengesanan awal untuk penyelenggaraan. Pengesanan awal dapat mengelakkan kerosakan pada kemudahan tertentu. Parameter turun naik akan ditentukan sama ada menjalankan penyelenggaraan atau tidak. Sistem ini terdiri daripada tiga sensor pengaktifan yaitu sensor ultrasonik, sensor modul saat ini, sensor pH dan sensor ORP (Potensi Pengurangan Pengoksidaan).

ABSTRACT

In a residential area such as condominium or apartment or any building, there must be a maintenance department which are responsible for the maintenance of building. Maintenance of building need to be maintained for the convenience of residents. There are certain facilities that common been sustained such building water tank, electricity of the building, air conditioning duct, swimming pool, lamp inside the building etc. IoT-based Smart Building Preventive Maintenance System was developed in order to monitor the fluctuation values of water level tank, electricity current and swimming pool water quality. The main purpose of this project to provides wireless monitoring of the fluctuation values that helps to make early detection for the maintenance. Early detection could prevent bigger damage of certain facilities. The fluctuation parameters will be determined whether it should be performing maintenance or not. The system consists three enable sensor which is ultrasonic sensor, current module sensor, pH sensor and ORP (Oxidation Reduction Potential) sensor.

DEDICATION

Thank you, my beloved parents, Asri Bin Yaacob, Rohaya Binti Omar, my supervisor En Ahmad Nizam Bin Mohd Jahari @ Mohd Johari, my lecturers and my friends.

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First and foremost, I praise and thank the Almighty God for His showers of blessings during my research work in order to successfully complete the study.

I wanted to express my deep and sincere gratitude to my supervisor, Ts. Ahmad Nizam Bin Mohd Jahari @ Mohd Johari, lecturer of Electrical and Electronic Engineering Technology, Universiti Teknikal Malaysia, Melaka, for giving me the opportunity to conduct final year project and providing valuable guidance during this research. He taught me the methods of doing the research and of explaining the research results as simply as possible. Through his guidance it was a great pleasure and honor to work and learn. I am extremely grateful for the opportunity he gave me. I do want to thank him for his support, his empathy and his wonderful sense of humor. I am incredibly thankful to my parents for their love, their prayers, their care and their sacrifices to educate and prepare me for my future. Next, to my beloved parents and siblings which always supported and encouraged me to do this project. Finally, specially thanks to my helpful lecturer and friends.

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LIST OF ABBREVIATIONS

IoT	Internet of Things
WSN	Wireless Sensor Network
ORP	Oxidation Reduction Potential
API	Application Programming Interface
DAQ	Data Acquisition
ICSP	In Circuit Serial Programming
GPS	Global Positioning System
GSM	Global System for Mobile
ALMONTD	Alert, Monitoring and Tracking Device
URL	Uniform Resource Locator
OS	Operating System
pH	Potential for Hydrogen
MCU	Micro Controller Unit
RFID	Radio Frequency Identification
AC	Alternating Current
DC	Direct Current
USB	Universal Serial Bus

CHAPTER 1

INTRODUCTION

1.1 Background

Building maintenance in Malaysia started in year 1971. It is gotten more dynamic in year 2007 when the public authority has demanded the upkeep the maintenance management as another country culture(Olanrewaju & Abdul-Aziz, 2015). Maintenance of buildings involves cleaning common areas, periodically removing garbage and fixing defected objects. This can incorporate inspection, fix and upkeep of electrical hardware, heating and air-conditioning equipment and other utilities. The maintenance of the building is important to keep up the properties and to secure the inhabitants of the building. Appropriate upkeep of the building guarantees that the building and the community stay secure, clean and a protected spot for work or residence.

(Zakiyudin et al., 2015) highlight that the lack of maintenance mastery with respect to building management in Malaysia and deficient building inspection could prompt issues in the execution of maintenance works, which could prompt shortcomings decision-making of maintenance costs. Therefore, preventive maintenance should be done properly. In a residential building area such as condominium or apartment or any building, there will be a maintenance department which are responsible for the maintenance of building. Maintenance of building should be kept up for the accommodation of occupants.

Based on (Olanrewaju & Abdul-Aziz, 2015) researched, from the time – cost model of maintenance, it is shown that the lower amount required to do the maintenance work is introduced from the earlier maintenance. In other words, as it moves from the value to the corrective maintenance paradigm, the maintenance costs increase.

1.2 Problem Statement

The maintenance of a building is a crucial part in order to keep any facilities in a good condition. The maintenance teams must constantly fix any small problems that arise according to the building. Basically, maintenance teams of the building using conventional method to detect any fluctuation values which they went to the scene to check up any unusual condition to perform maintenance. However, this conventional method may take times which could lead to larger damage. The problems that arise must be notify early in order to avoid larger problem. Therefore, in this work, a smart building preventive maintenance system with IoT based supported with an enable sensors is used to make early detection of fluctuation through internet which could immediately perform maintenance. The research provided three common facilities monitoring for preventive maintenance including water level monitoring, safety devices monitoring and swimming pool water quality.

1.3 Objective

The objective of this project will focus on issues arise based on the problem statement:

a) To develop IoT based smart building preventive maintenance system

b) To monitor the water level tank, electricity current flow through safety equipment/devices and swimming pool water quality.

1.4 Project Scope

The scope will inform all the component and features that need to be use in the project. Arduino Uno module is used as a controller or brain for the system. Besides, there are 4 enables sensor which used to monitor the fluctuation value at the scene area. The sensors are including Ultrasonic sensor (HC-SR04), Current module sensor (ACS712), pH sensor and Oxidation Reduction Potential sensor (ORP Redox Electrode). In addition, Wi-fi module (Node- MCU ESP 8277) is used to communicate the system from Arduino Uno module to Blynk App. Finally, a smartphone which is enable the user to receive notification from the scene area. Other than hardware components, software components are also important in order to successfully completing this project. Arduino Software (IDE) is used to create the source code of the project inside the Arduino Uno module. Besides, Blynk App software is used to configure the project in order to communicate with the microcontroller.

1.5 Expected Outcome

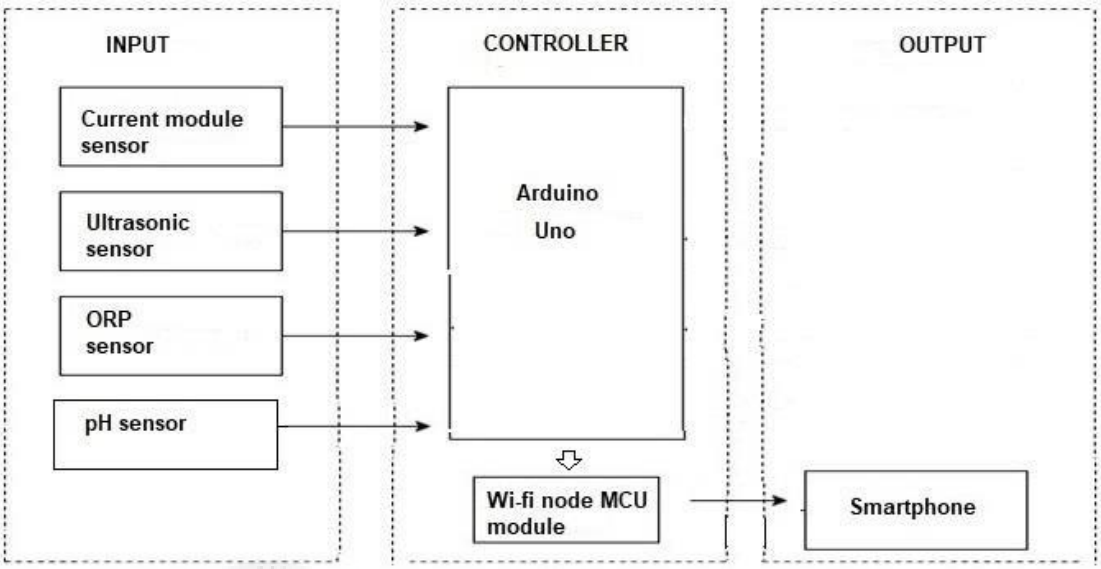

Figure 1.1 Project Block Diagram

Figure 1.1 above shows the project block diagram of the Smart Building Preventive Maintenance System. This system can display or notify fluctuation parameters of water level, current values, pH values and amount of chlorine inside the swimming pool. All the parameters are collected from 4 enables sensor which is current module sensor, Ultrasonic sensor, ORP sensor and pH sensor. Then, it will send all the parameters to controller which is Arduino Uno module. The controller will process the data and send the data to the user. Wi-fi module node MCU module act as the component to communicate the Arduino Uno module to Smartphone.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, it will review some fundamental ideas from the previous research according to the related project. The study is significant to complete this project. This review will particularly refer to previous ideas that is related to water level monitoring, water quality monitoring and current flow monitoring. Besides, it will review on some system that using IoT based which is relevant to the project.

2.2 Method to monitoring water level

There are several methods that has been used to monitoring the water level in the previous related work such as using water level sensor, capacitive water level and ultrasonic sensor. Traditionally, water level monitoring relies on human senses or using electromechanical technique in order to maintain the water level inside tank at the desired value. However, (Sachio, et al., 2018) said, when it comes to filling water inside the container, people tends to forgot to closed back the pump or valve which leads to water overflowing consequently water being wasted. Besides, (Jeswin, et al., 2017) said that conventional fluid level sensors depend on electromechanical technique which lead to security gave in the hazardous environmental factors. This refer to the oil and gas storage tank that could explode when there is exceeding or shortage of liquid level.

2.2.1 IoT based water level monitoring system using water level sensor

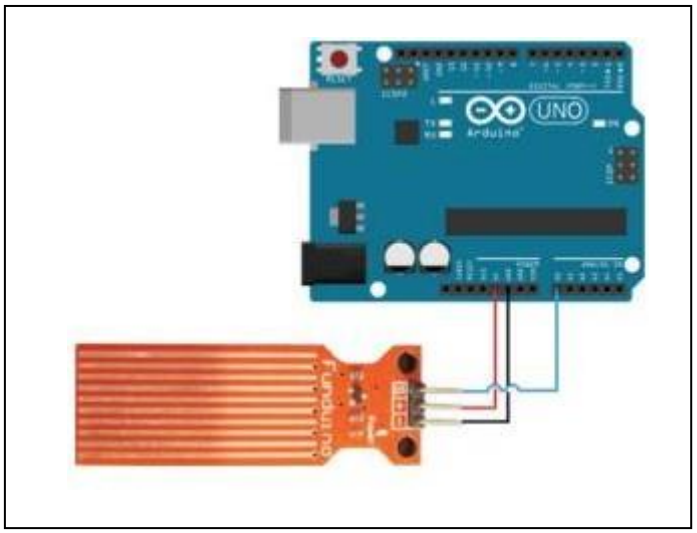

Figure 2.1 Circuit Diagram of Arduino Uni with water level sensor

Based on (Malche & Maheshwary, 2017) researched, it used liquid level sensor as shown in Figure 2.1 to monitor the water level. It is an analogue sensor that has working current beneath than 20mA and it works at 40 mm times 16 mm for a detection area. It needs about 5 V to power up. It has 3 pins which are Signal pin, positive pin and negative pin. Signal pin is associated with a analogue pin A0, positive pin associated with pin 5 V on the Arduino Uno module, and negative pin connected to GND respectively. Liquid Sensor is associated with Arduino Uno module likewise with an Ethernet shield that has a similar pin description Ethernet shield only connects Arduino Uno to the Internet through wired availability. This model additionally incorporates a Carriots library and an account on Carriots and freeboard. The API key will be provided after creating the Carriots account. Carriots offer a very accessible interface which new user can easily register to a new Carriots. The newly developed computer will show up on the Carriots control panel in the device list. The system must be registered, as it provides Device ID. Arduino firmware code requires the Device ID and the API Key

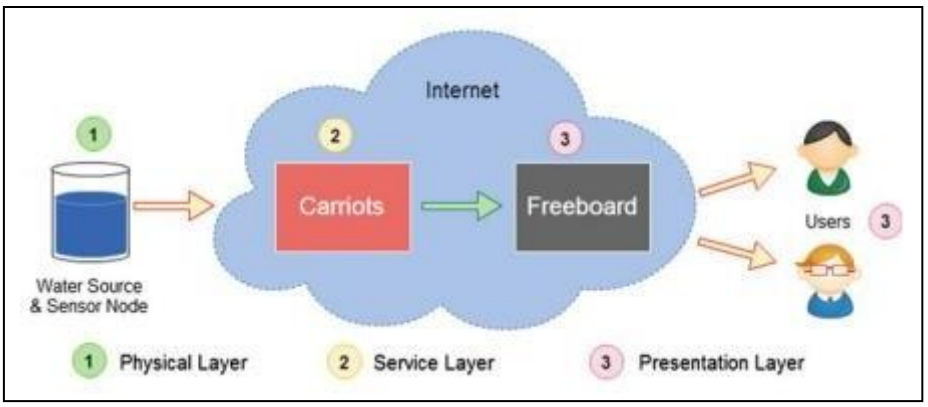

Figure 2.2 Interaction of three layer for the water level system

Basically, there are various models in order to communicate through IoT which are Wireless sensor network (WSN), distributed computing and other various advancements. Based on research studied, (Malche & Maheshwary, 2017) mentioned that, wireless sensor network (WSN) used for sensing the level of water in a water source through network availability. At that point, the sensor information is communicated to Carriots. The Carriots is used for IoT. Carriots offer a lot of advantages. It receives real-time data stream from WSN, which is utilized to store and analyze information streams. The user of the program is the vital subject at the presentation layer. The user can interact with system via this layer by used on the display layer of the freeboard design architecture to show the data.