

Hardware Design for an Embedded System
(Smart controller & automatic emergency system)

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Hardware Design for an Embedded System

Tajuk Projek : (Smart controller & automatic emergency system)

Sesi Pengajian :

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For my lovely father and mother

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ABSTRACT

An embedded system is an application-oriented special computer system which is scalable on both software and hardware. It can satisfy the strict requirement of functionality, reliability, cost, volume, and power consumption of the particular application. Embedded systems in many cases must be optimized for life-cycle and business-driven factors rather than for maximum computing throughput. In this project, a system with smart controlling and auto emergency features is proposed. In this system, the user can control the appliance at building, such as light and fan, which can reduce the energy wastage. On the other hand, the automatic emergency system has the features which the user can report the emergency situation in the building instantly to the authorities and contacts by using calling button and emergency message in the android application. Moreover, address location are also shown in the application on the android phone and the user can use the application to display the maps of the location. By knowing the location of the user, this could also help in locating the elderly people. In developing the smart controller and automatic emergency system, microcontroller Arduino-Uno has been used. MIT app Inventor 2 has been used as the designer application for developing the application for android mobile phone. Instead of hungry force WiFi association, the Bluetooth connection is utilized. The security of the communication is also guaranteed within the building. A prototype has been developed. The prototype demonstrates that the controlling system such as LED and fan can be turned on using the android mobile phone, the flame sensor can detect the flame in range of 100cm approximately, and the buzzer are ring when the flame is detected. On the other hand, in emergency situation, the

developed system demonstrates that with a single button, the user can make an instant calling or messaging with the information of current location in maps format and coordinate. In summary, this project shows a good feature for industrial needed, as there are lots of houses and building nowadays, which is hard to monitor and to control. The developed system is low-cost, easy to program, easy to assemble, and low power consumption which is also user friendly system, meeting the demands of the customer nowadays.

ABSTRAK

Satu sistem tertanam adalah sistem komputer khas yang berorientasikan perisian dan perkakasan. Ia boleh memenuhi keperluan teknologi masa kini, kebolehpercayaan, kos yang murah, jumlah, dan penjimatan penggunaan tenaga bagi sesuatu system. Banyak sistem tertanam, ianya mempunyai kekangan reka bentuk yang amat berbeza daripada aplikasi komputer yang sedia ada. Tiada pencirian tunggal yang tertumpu hanya kepada spektrum pelbagai sistem tertanam. sistem Terbenam dalam banyak kes perlu dioptimumkan bagi meningkatkan kitaran hayat produk dan faktor-faktor perniagaan yang didorong oleh sistem pemprosesan pengkomputeran yang maksimum. Dalam projek ini, pengawal pintar dan sistem keselamatan pantas dapat di hasilkan. Mikropengawal Arduino-Uno dan aplikasi android juga di gunakan dalam projek ini. Bluetooth juga di guna pakai sebagai alat komunikasi dalam sistem ini kerana ianya lebih murah berbanding modul komunikasi yang lain dan keselamatan lebih terjamin kerana ianya hanya dalam kawasan bangunan sahaja. Pengguna boleh mengawal peralatan dalam bangunan hanya dengan menggunakan aplikasi ini, sebagai contoh lampu dan kipas. Bagi sistem kecemasan pantas, pengguna boleh melaporkan situasi kecemasan dengan pantas melalui membuat panggilan atau pesanan ringkas kepada pihak berkuasa dan kenalan. Selain daripada itu, alamat juga akan di paparkan dalam aplikasi di telefon android dan pengguna boleh memaparkan peta kawasan melalui aplikasi ini. Pengguna boleh menjadikan alamat tersebut sebagai rujukan sebelum melaporkan situasi kecemasan kepada pihak berkuasa dan kenalan. Projek ini juga menunjukkan fungsi yang baik, sebagaimana industri perlukan dewasa kini. Dalam pengakhiran projek ini, ini menunjukkan

sistem di hasilkan mempunyai kos yang rendah, senang di program, senang di hasilkan dan mesra pengguna, di samping jimat tenaga sebagaimana pengguna perlukan dewasa kini.

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

The embedded system is a considerably a hot topic that has gain increased interest over the past few years. An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints [1]. There are some ways available for designing an embedded system. Android system is one the systems that can be established with hardware of an embedded system. Android is a mobile operating system (OS) based on the Linux kernel and currently developed by Google and it is designed primarily for touchscreen mobile devices such as smartphones and tablet computers, with specialized user interfaces for several devices [2]. MIT app inventor 2 Application used as the designer application for the software part for this project.

This application also used in the communication protocol between software and hardware part. This application is an open source application which is the user can easily edit the application based on the requirement. In this project, designing an embedded system which ARM processor as the core module and establish the communication of the hardware with the android application is the main purpose.

Nowadays, android system is the common thing to the entire phone user. Android system can be used as a controller to an embedded such as lamp as proposed in this project. In addition Arduino-Uno also involved as the main component for the hardware part which connected to LED as the lamp and several sensor such as fire sensor. Arduino-Uno is a single-board microcontroller, intended to make it easier to build interactive objects or environments. The hardware consists of an open-source hardware board designed around an 8-bit or a 32-bit Atmel ARM [4]. Hence, during the project development, coding for android and hardware part need to executed correctly, if there is an error occurs troubleshooting process need to be done. The Arduino integrated development environment (IDE) is a cross-platform application written in Java and derives from the IDE for the Processing programming language and the Wiring projects [4]. A program or code written for Arduino is called a sketch and the programs are written in C or C++. The design of the project will consider all the part involving such as android, Arduino, LED and sensor.

1.2 PROBLEM STATEMENT

- As controller for a lamp in the building which can reduce wasted power consumptions.
- To accelerate the process of notification for the emergency situation
- Act as automatic emergency system
- Sensor monitors the situation in the building
- If the fire detected by the sensor, the buzzer will ring, then the user can use the application to make a call or message to the authorities, owner and friends just click a single button in the application.

1.3 SCOPES OF PROJECT

This project will focus on:

1. Hardware Part.
 - Circuit designs using Arduino-Uno, LED, motor, and sensor.
 - Fabricate the circuit into PCB
 - Soldering the entire component to the main module for this project
2. Software part
 - Using MIT app Inventor 2 to design the android application
 - Execute programming language

1.4 OBJECTIVES

The aim of this project is:

- To design an embedded system which ARM processor as the core module
- To establish the connection between embedded system with android application
- To design a controller and notifies system using Arduino-Uno and MIT app inventor 2
- To develop a system which able to notify authorities about the emergency situation

1.5 THESIS STRUCTURE

This report will be divided into five main chapters. The first chapter will discuss the introduction to this project. The introduction includes the background of this project, problem statement, significant of project and objectives with the scope of the study. As the name implies, the introduction serves as an initial overview of the project will state a goal that will be worked on during the entire project.

A literature review is the second chapter of this report. In this section, matters regarding this project will be further discussed and elaborated based on the reference of previous study related to embedded system, android, and Arduino-Uno.

The third chapter will discuss the methodology. The methodology includes the elaboration of all the necessary steps and guidelines that is taken to implement this project. It will describe the process flow of the development of the smart controller and automatic emergency system.

Result and discussion will be on the fourth chapter of this report. The necessary output will be seen from both software and hardware to get the expected output as the purposed of this project.

The conclusion and recommendation will be at the final or fifth chapter of this report. It will conclude the overall results of the project and states either the initial goals or objectives are fulfilled.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, the proposed project has been compared to the nine previous projects. The features of the product are compared based on the application provided and module used. Section 2.2 shows comparison between previous work and section 2.3 shows the benchmarking of this project.

2.2 COMPARISON BETWEEN PREVIOUS RESEARCH WORKS

Generally, previous research work proposed a user friendly project, which means the project done is easy to use by people because of the simple system used in the project [7], [8], [10], [11], [12], [13], [14] and [15]. In addition, a remote access project also has been proposed from the entire past project, it means that the user can control the system remotely. [8] And [15] state that the cost of the project can be high if the component used is expensive because this journal [8] and [15] just makes suggestion

on which part and component that the user can use for the project. In the other hand, a low-cost project proposed by the other past project.

Research work in [7], [8], [10], [12], [13], [14] and [15] states that house is the main fitting places that can utilize their proposed framework. While [9] and [11] demonstrates that any spots can utilize their framework in the task. Bluetooth correspondence is the normal association utilized as a part of the task; this is on account of bunches of the past undertaking uses Bluetooth as the communication protocol, for example, [7], [8], [10], [11], [12], [14] and [15]. The other past venture utilized IP and GSM as the communication protocol for their task, such as [9] and [13]. Furthermore the majority of the past tasks are programmable venture which implies the user can program the framework as indicated by what yield that the client need, aside from [9] demonstrates that the application is non-programmable, which just the master individuals can utilize or alter the framework.

In addition, only [8], [13], [14] and [15] have the emergency system capability, because their project is not only focusing on the controlling system, but the emergency system also provided. The other past undertaking did not focusing the emergency system and just concentrating on the controlling framework.

The whole past project demonstrates that low power utilization is utilized for the undertaking. This is a result of the part utilized is a little segment that just need a low power with the exception of [9] that utilized segment or equipment that need high power utilization. This is additionally will influence the expense for the framework. The low the equipment required for the framework the low the expense for the task. What's more, the majority of the past activities that including in this project demonstrates that just the client or the proprietor of the framework will get the emergency notification, such as [7], [8], [10], [11], [12], [13], [14] and [15].

In summarize for the [7], [9], and [11], the system of their project used Arduino as the module. Mobile phone used as the controller for the system and the main objective for this project are to assist handicapped/old aged people. This project also based on the home automation which also using Zigbee as the module that involved in the communication protocol. Hence [13], Zigbee is involved in the communication protocol of the system, it is also using Raspberry-Pi as the main module in the project that based on the home automation and capable on monitoring and controlling. While for [9], this project using Arduino and WiFi system, that only capable to control the sound of the speaker. The distance covered also is limited, because it is only can control within the area of the speaker. This project also shows a high power consumption based on the connection of the hardware used, [9].

Research on [10] is using JAVA as the main module for the system that based on the home automation system, the main purpose of this project is to provide a user-friendly home automation and Security applications for the home. Moreover, [12] also using Raspberry-Pi and Bluetooth as the main module for the proposed project, it is also stated that the project is adaptive home system that provide domestic environment which also improves the quality of residents life. Bluetooth used as the communication protocol for the [12] and using Raspberry-pi as the main module for the project, but the emergency system is provided in the proposed project. While for the [13], it is using Zigbee as the main module that support a monitoring system based on the home automation system and android system is used as the controller for their project. Hence for both [14] and [15], they are using PIC as the main module for the proposed project and Bluetooth as the main communication protocol in the system. Both [14] and [15] also based on the home automation system.

Section 2.3 shows the features provided by this proposed project. The system has been compared to the nine journals involved the research.

2.3 BENCHMARKING

In light of the audits from the nine journals, it can reason that framework from this project is better contrasted with the past undertaking on the grounds that this framework can go about as controller for electrical machines, for example, light and fans in the building which can minimize the energy consumptions, it can quicken the procedure of reporting the emergency situation that otherwise called automatic emergency system. This automatic emergency system expressed that when the sensor detects the circumstance in the building, then if the fire recognized, the buzzer will ringing. Just by using the application on the android mobile phone that has been made for this project, the process of reporting the emergency situation at the building to the owner of the building, contacts and authorities such as police and fireman become faster and efficient. Table 2.1 shows the Comparison of features in previous research work with the proposed project.

2.4 CONCLUSION

This proposed project has been compared to the nine journals. The comparison between the projects is based on the features provided and module used to develop the system or project. Next chapter will show the development procedure to obtained the proposed features.