Internet of Things (IoT) Enabled For Door Access System

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Fakulti Kejururteraan Elektronik dan Kejuruteraan Komputer
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To my beloved father and mother

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ABSTRACT

Internet of Things (IoT) has become a phenomenon in many recent researches. A smart digital automated system based on IoT plays major role which helps in reducing human work by applying interaction technology in daily life. This thesis introduces the IoT enabled door access system project. This project is to design a prototype of a door access system that able to be automatically controlled and monitored remotely. The system is an integration of IoT technologies with sensor based on energy harvesting. Generally, the door system is connected to WiFi connection and the user can control and monitor the door status whether it is lock or unlock from their personel device such as smartphone in real time. For the sensor part, energy harvesting based sensor which is piezoelectric is used in order to have battery less prototype. The power source to activate the system can be harvested from surrounding. The main purpose on the design is to prevent the situation where the user is unable to unlock the door when the key is missing also to give a solution for users to monitor the door status when they forget whether the door has been locked or not. This system aims also to eliminate the use of keys to access the door, where the daily struggle faced to bring along a bunch of keys anywhere. The prototype of system is successfully done, and the procedure also the software and hardware requirement has been compiled in this thesis report. The result discussion and future improvement of the system are discussed in last two chapters.

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ABSTRAK

Objek Rangkaian Internet (IoT) telah menjadi satu fenomena dalam banyak kajian baru-baru ini. Sistem digital automatik pintar berdasarkan IoT memainkan peranan penting dalam membantu mengurangkan kerja manusia dengan mengaplikasikan interaksi teknologi dalam kehidupan seharian. Tesis ini memperkenalkan tentang sistem pengaktifan akses pintu IoT. Projek ini adalah untuk mereka bentuk prototaip sistem akses pintu yang dapat dikawal dan dipantau secara automatik dari jauh. Sistem ini adalah gabungan teknologi IoT dengan sensor berasakan penuaian tenaga. Secara umumnya, sistem pintu dihubungkan kepada sambungan Sistem Rangkaian Tanpa Wayar (WiFi) dan pengguna boleh mengawal dan memantau status pintu sama ada ia telah dikunci atau belum dengan hanya melalui telefon pintar dalam masa nyata. Bagi bahagian sensor, sensor penuaian tenaga iaitu piezoelektrik digunakan untuk menghasilkan prototaip bebas bateri. Sumber kuasa untuk mengaktifkan sistem boleh dituai dari persekitarannya. Tujuan utama dalam mereka bentuk prototaip ini adalah untuk mengelakkan keadaan di mana pengguna tidak dapat untuk membuka pintu apabila kunci hilang juga untuk memberi penyelesaian bagi pengguna untuk memantau status pintu apabila mereka terlupa sama ada pintu telah dikunci atau tidak. Di samping itu, salah satu tujuannya juga adalah untuk menghapuskan penggunaan kunci untuk mengakses pintu, di mana masalah harian yang selalu dihadapi adalah untuk membawa kunci dalam bilangan yang banyak untuk ke mana sahaja. Prototaip sistem berjaya dilakukan, dan prosedur juga keperluan perisian dan perkakasan yang diperlukan telah disusun dalam laporan tesis ini. Perbincangan hasil dan peningkatan masa hadapan sistem dibincangkan dalam dua bab yang terakhir.

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ABBREVIATIONS

3D	-	Three Dimension
AC	-	Alternate Current
APP	-	Application
AT	-	Attention
DC	-	Direct Current
FTDI	-	Future Technology Devices International
GSM	-	Global System for Mobile Communications
ICSP	-	In-Circuit Serial Programming
IDE	-	Integrated Development Environment
IoT	-	Internet of Things
iOS	-	iPhone Operating System
LCD	-	Liquid Crystal Displays
LED	-	Light Emitting Diode
MQTT	-	Message Queue Telemetry Transport
PCB	-	Printed Circuit Board
PWM	-	Pulse Width Modulation
PZT	-	Lead Zirconate Titanate
RFID	-	Radio Frequency Identification
SOC	-	System on Chip
TCP/IP	-	Transmission Control Protocol / Internet Protocol
USB	-	Universal Serial Bus
WiFi	-	Wireless Fidelity

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CHAPTER I

INTRODUCTION

1.1 Introduction

The Internet of Things (IoT) is a technology that aims to put the things around us on a network. The motivation of IoT is to provide a global infrastructure that can connect objects and intelligent services over a network. The intelligent services process the collected data from these objects to serve the desired purposes for which it is implemented for. The purpose here is used in wide sense that means the wide range of usefulness and applications these services will support depending on the domain and type of information collected and processed. Physical word or the objects and the information about the objects are two things. The IoT makes the objects talking to each other via information they exchange. Smart home is one such application where IoT oriented solutions is being implemented to make the secure and convenient living experience. Door lock system is an essential feature in this series of home appliances which can be remotely controlled.

1.2 Background

IoT Enable Door Access System is a prototype of door access system which able to be automatically controlled and monitored remotely. The prototype consists of a door lock which will be access by a servo motor and the system will be controlled

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by a smartphone application. The project is designed as an alternative method to lock and unlock the door for those who are forgetting to lock the door or whom always losing the key. The purpose of this project is to simplify the task of locking and unlocking the door. The locking mechanism in the door can be activated and deactivated by using smartphone from anywhere as long as there is accessible internet connection for the smartphone. The additional features are that the device will be supplied with power from a rechargeable battery which generated by energy harvesting sensor circuit.

Nowadays, people can get the access to internet from anywhere around the world. Plenty of device can have the access to the internet especially from the smartphone. As technology grows, smartphone becomes one of the platforms that people use not just to connect with others, also to monitor everything in surrounding in any aspects through internet connection. This project, which is based on the IoT integration, allow the smartphone to monitor and control door accessibility from anywhere through internet connection. The prototype which is connected to the IoT platform and allow the user be able to lock and unlock the door remotely. It does not limit to the same internet connection. The prototype will be able to operate even with different internet connection as the smartphone used.

For this project, the prototype is supplied by the rechargeable battery, which the rechargeable battery can get the power from an energy harvesting sensor namely piezo element sensor. The vibration from harvest from the piezo element sensor produces the power to charge the battery. The aim is to create an alternative power source to be used to power up the prototype system.

1.3 Problem Statement

Most people always in urgency situation or being careless sometime. This might be the cause of forgetting to lock the door of their home or premis. It has become a problem on how to lock or unlock the door from another place and how to make sure the door is secure if we are at somewhere else. Furthermore, taking a bunch of keys at a time will be a problem to store and bring around the entire time. It is also a problem

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to enter the room if we lost or misplace the keys, and what is the alternative way to unlock the door if the key is missing. Other than that, it might be hard for handicap person to approach the door to lock or unlock it if they need some privacy for themselves, and what if they can access the door without the need to move towards the door.

1.4 Objectives

The objectives of this project are:

- To develop IoT enabled door access system using Arduino platform and dedicated gateway.
- To design and construct a hybrid low power circuit using energy harvesting sensor.
- To integrate the constructed hybrid low power circuit with the door access device and IoT platform.

1.5 Scope of work

This project will be focus on the design of a door control system and Android based application used to control and monitor the door. The design of the Android application is based on Blynk cloud server where it is connected to the prototype of the door system. The project also focus on the design of energy harvesting circuit with piezoelectric as the sensor to supply power for the prototype. The work focus on the function of the application to control and monitor door status and the connection between application and hardware of the prototype.

1.5.1 Software

For the prototype to function as expected, the related software and IoT platform to be used is identified. For the Android platform, the Blynk application is used as the apps that allows to control microcontroller such as Arduino operation by using smartphone through internet connection. The Arduino Integrated Development

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Environment (IDE) software is used to create the Arduino program and to upload the program into the Arduino board. The other related software used in this project are Proteus for constructing the circuit of this project.

1.5.2 Hardware

For the hardware, the component that to be used for building the prototype need to be determined first. The Arduino board is used as the microcontroller platform for this proposed prototype. The Arduino UNO connect with ESP8266-01 Wireless Fidelity (WiFi) module in order to connect to the internet connection. For the hardware design, a door is required to design with the suitable lock attached to it such as the deadbolt lock. The servo motor which controlled by the Arduino is attached to the door lock in order to lock or unlock the door which is controlled by the smartphone application. Next, the piezo element sensor is used as the energy harvesting sensor, and the energy harvesting circuit is designed purposely to make the battery automatically charged, when there is vibration force act on the sensor.

1.6 Conclusion

This chapter discusses on IoT technology, which growth in this modern day for the sole purpose to provide with better lifestyle in daily life. The use of IoT led to the creation of smart home, which is an automated smart environment that improve the living experience. The design of IoT enabled door access prototype system is one of the related home appliances in a smart home. The project is to design an IoT based smartphone application that can connect to door system wirelessly. The application able to control to lock and unlock door also monitor the door status remotely in real time. The prototype system is implement with piezoelectric sensor to harvest waste energy produce in surrounding and convert it to supply to the prototype. The purpose of the design is to eliminate the use of key to lock and unlock the door, where a lots of keys usually need to bring along at all time. The system design purposely to avoid problem occur by carelessness to lock the door before leaving house, where the users can monitor the door status after they leaving the house. The project is focus on the

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connection and successfully data transmission between the application and the prototype system via dedicated gateway.

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CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter overview the project that has been conducted and shows the result obtained through of the previous researches. The project design considered some characteristic factor and include with the latest implementation of technology and the effectiveness of system based on the previous studies. The information becomes some source of references to gain the desired aims. Meanwhile, by reviewing the theories and related knowledge that are acquired to be implemented with choosing proper component to enlightened the reliable of project. Thus, the references such as books, journals and articles are the right sources as guidelines to determine the content of component, software, equipment and hardware part that is suitable to be used in this project.

2.2 Related Work

There are few researches which related to current work in progress. There are also several existing devices related to modern door access system. Furthermore, many research theories had been done related to the energy harvesting system. This part will be divided into IoT and door access system related researches and energy harvesting related researches.

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2.2.1 IoT Door Access System Related Researches

There are few journals or researches related to the IoT based door lock system that will be review in this section. The related researches entitle, IoT based door entry system, the digital locking and unlocking system based on Android for smartphone, security and usability improvement on a digital door lock system based on Internet of Things, and Internet of Things based door locking system – architecture.

2.2.2 IoT Based Door Entry System

From the research, the objective of this paper is to propose a remote access controlled door entry system for homes and office buildings. Based on the research methods and statistical analysis, the control system which can be remotely access with the help of internet can be used to control another devices and appliances at home or office which the person controlling it can be anywhere around the world as long as there is internet connection with it. The main controller used in the proposed system is Raspberry Pi. The Raspberry Pi board act as the platform for monitoring and controlling the door. The door entry system proposed in this paper installed with a switch for guest monitoring, camera for guess authentication, solenoid actuator which used to open the door, and a speaker set that used to make the system can response directly to the guest which all of the manipulators were mounted at appropriate places at the door [1].

The outcome of the research shows that the switch status can be monitored from the Raspberry Pi. The system act where the door entry system will allow the admin to easily monitor and control the entry of people into the house, when the switch is being pressed by the guests as they arrive in front of the door, and everything will be done through internet [1].

The advantage stated in this research is that the system is compatible to be used in home with unnecessary new software installation and configuration. The

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