UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF ADD-ON SMART HOME SYSTEM USING INTERNET OF THINGS (IoT)

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

by

LEE SIN HUI

B071510240

950426-10-5328

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I hereby, declared this report entitled DEVELOPMENT OF ADD-ON SMART HOME SYSTEM USING INTERNET OF THINGS (IoT) 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 Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

……

Supervisor: MADAM WAN HASZERILA BINTI WAN HASSAN

……

Co-supervisor: SIR MOHD FAIZAL BIN ZULKIFLI

ABSTRAK

Sistem rumah pinter jenis tambahan lebih jimat dan senang daari segi pemasangan. Akan tetapi, jarang terdapat system rumah pintar dalam aplikasi berkenaan haiwan peliharaan di rumah. Meskipun ramai orang yang mempunyai haiwan peliharaan di rumah, pemilik-pemilik haiwan selalu menghadapi masalah tidak cukup masa untuk memberi makanan kepada haiwan peliharaan disebabkan oleh jadual seharian yang padat. Tujuan projek ini adalah untuk mencipta sebuah sistem rumah pintar jenis tambahan berasaskan Internet of Things (IoT) untuk menyelesaikan masalah tersebut, iaitu pemberi makanan haiwan pintar yang akan mengedarkan makanan kering haiwan peliharaan secara automatik walaupun pemilik haiwan tiada di rumah. Pemilik haiwan boleh mengawal pemberi makanan haiwan pintar melalui telefon pintar. Pasa masa pemberian makanan, pemilik haiwan akan memberi isyarat daripada aplikasi Blynk atas telefon pintar. Pembesar suara akan menarik perhatian haiwan peliharaan dengan mengeluarkan suara. Apabila haiwan peliharaan mendekati pemberi makanan haiwan pintar tersebut, pengesan ultrasonic akan mengesan pergerakan haiwan lalu mengaktifkan Arduino Mega. Servomotor akan memusing sehingga sudut darjah yang tertentu dan menyebabkan makanan kering haiwan untuk diedarkan ke dalam mangkuk di atas lantai. Pada sama yang sama, data masa sebenar akan dihantar ke platform IoT melalui modul Wi-Fi ESP8266. Sebagai kesimpulan, pemilik haiwan tidah perlu manghadapi kerisauan masalah diet haiwan.

ABSTRACT

Add-on smart home system is relatively cheaper and easier to be installed compared to the pre-installed type. However, there are very limited applications of smart home system involving pet care. Even though there are a lot of pet lovers who owns pets at home, many of them do not have the spare time to feed their pets due to hectic schedule. This project is designed to establish an add-on smart home system based on Internet of Things (IoT) which is the wireless smart pet feeder that can automatically dispense dry pet foods without the physical presence of the owner. The user is able to control the smart pet feeder directly from mobile phones. At feeding time, the user prompts the system from the Blynk application on smart phone or tablet. Then, the speaker produces sound to attract the pet and activates the Arduino Mega. Besides, when the pet approaches the smart pet feeder, the ultrasonic sensor detects it and activates the Arduino Mega. The servomotor then rotates to a specific degree, whereby the pet food drops into the serving bowl placed on the floor. At the same time, the real-time data is sent to the IoT platform via the ESP8266 Wi-Fi Module. As a conclusion, the problem of underfeeding and overfeeding are prevented with the design of this project. With the use of smart pet feeders, pet owners have one less chore to worry about at home while the healthcare of their pets are being taken care of.

DEDICATION

This research paper is solely dedicated to:

Lee Eng Ho, my beloved father;

Ng Pack Soon, my lovely mother;

and my adorable siblings,

who have been my constant source of inspiration.

This project would not have been made possible without their

continuous moral support and encouragements.

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LIST OF ABREVIATIONS, SYMBOLS AND NOMENCLATURES

AI	-	Artificial Intelligence
BLE	-	Bluetooth Low Energy
BoM	-	Bill of Materials
CPS	-	Cyber Physical Systems
GPRS	-	General Packet Radio Service
GSM	-	Global System for Mobile communication
H2H	-	Human-to-Human
H2M	-	Human-to-Machine
HVAC	-	Heating, Ventilation, and Air Conditioning
IEEE	-	Institute of Electrical and Electronics Engineer
I/O	-	Input/Output
IDE	-	Integrated Development Environment
IoT	-	Internet of Things
IP	-	Internet Protocol
IR	-	Infrared
LAN	-	Local Area Network
LED	-	Light Emitting Diode
M2M	-	Machine-to-Machine
PAN	-	Personal Area Network
PCB	-	Printed Circuit Board
PET	-	Polyethylene Terephthalate
PLC	-	Programmable Logic Controller

RF	-	Radio Frequency
RFID	-	Radio Frequency Identification
RM	-	Ringgit Malaysia
SIM	-	Subscriber Identification Module
SMS	-	Short Messaging Service
TCP/IP	-	Transmission Control Protocol/Internet Protocol
USD	-	United States Dollar
VoIP	-	Voice over Internet Protocol
Wi-Fi	-	Wireless Fidelity
WLAN	-	Wireless Local Area Network
WSN	-	Wireless Sensor Network

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter includes the background study on the project, problem statements, objectives, scope of project, summary and organization of the thesis.

1.1 Background

There are two types of smart homes, which are pre-installed smart homes, where the smart system has already been installed when the house was built and plug-in smart homes, where only the add-on smart application parts are inserted afterwards. For instance, smart meters and networked Heating, Ventilation and Air Conditioning (HVAC) systems are some of the existing examples. Pre-installed smart homes are high-cost. thus, the add-on types of smart homes have been lauded by the public in terms of cost and accessibility.

Some of the smart home systems commonly available are lighting control system, household appliances control system and security system. While there are already a vast number of smart home systems available in the market, there is minimal smart home system application that involves pet care. Much commitments are required to keep a pet, especially in this state-of-the-art era where spare time is a luxury for most of us. One of the main investments needed are companionship, which includes feeding the pets on time.

Smart pet feeder is one of the add-on smart home systems using Internet of Things (IoT). It is to help the pet owners to take care of the diet of their pets without the stress of forgetting the pets' diet due to hectic daily schedule. The smart pet feeder allows the pet owner to have the ease of controlling the dispensation of the pet food on smart phones, regardless of time and location constraints. A Wireless Fidelity (Wi-Fi) connected smart pet feeder automatically dispenses food when the pet approaches it, or when prompted by the pet owners on the smart phones. With the use of smart pet feeders, pet owners have one less chore to worry about at home.

1.2 Problem Statement

People are interested to incorporate smart home systems into their daily lives. However, the high installation cost might not be in favor by everyone. Add-on smart home systems are relatively cheaper and easier to be installed, compared to the pre-installed type. This makes the smart home systems easier to be accepted by more users. Besides, there are very limited applications of smart home systems involving pet care, even though smart home system is widely adopted globally. Since pets are considered as one of the members at home, pet care smart home system should be taken into account when designing a smart home system. Even though there are a lot of pet lovers who owns pets at home, often, these pet owners do not have the spare time to feed their pets due to the hectic daily schedule. This results in the pets to suffer from diet related health problems.

In order to overcome all the stated problems, an add-on smart home system using IoT based on pet care is proposed. The smart pet feeder enables the pet owner to have the ability of controlling the dispensation of the pet food on smart phones, regardless of time

and location constraints. With the use of smart pet feeders, pet owners are able to take care of the pet's diet without worries.

1.3 Objectives

This project embarked based on the following objectives:

(i) To establish an add-on smart home system based on Internet of Things (IoT).

(ii) To create a wireless smart device that can automatically dispense pet foods without the physical presence of the owner.

(iii) To allow users to control the smart pet feeder directly from mobile phones.

1.4 Scope of Project

The scope of this study is to design a smart pet feeder for cats or dogs. Besides, the smart pet feeder is meant to dispense dry foods, which in this case, it is the dry kibble. The smart pet feeder is developed by using Arduino Mega and is connected to the internet with the aid of a Wi-Fi serial module, ESP8266. Pet owners are able to control the smart pet feeder remotely and smartly, by using mobile phones. During the implementation of the project, both software and hardware are used.

1.5 Summary

This chapter explains the background study of add-on smart home system using IoT. The problem statements are stated in this chapter. There are three objectives to be achieved at the end of the project. Last but not least, the scope of the project is clearly defined.

1.6 Organization of the Thesis

This thesis comprises of three chapters as stated below:

- Chapter 1 – Introduction: This chapter includes the background study on the project, problem statements, objectives, scope of project, summary and organization of the thesis.

- Chapter 2 – Literature Review: This chapter is about the reviews done on previous researches and studies by others about smart home system using IoT through various sources such as journals, papers, articles or final year projects.

- Chapter 3 – Methodology: This chapter describes the method used in conducting this project and the elaboration on the process flow. The flowchart and block diagram of the add-on smart home system are included in this chapter.

- Chapter 4 – Results and Discussion: This chapter includes the tabulation of data from the project and analysis of the results obtained. Relevant results are presented in tables, graphs and photos.

- Chapter 5 – Conclusion and Recommendation: This chapter concludes the achievement of the project in compliance with the objectives as well as recommendation for future work.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

There are a handful of researches and studies about Smart Home System using IoT because of its vast advantages to the human. Although there are numerous related literatures accessible, this review focuses on specific scope. This chapter includes discussion on a few features standpoint that covers both software and hardware fields, which are:

(i) Internet of Things

(ii) Mode of Transmission

(iii) Intentions, Challenges and Solutions

(iv) Real Life Applications

2.1 Internet of Things (IoT)

This phrase 'Internet of Things' (IoT) was introduced back in 1999 by Ashton during the presentation of the Radio Frequency Identification (RFID). Following the life-changing emergence of this internet extension, several technologies such as the Wireless Sensor Networks (WSNs), Machine-to-Machine (M2M) topologies, Artificial Intelligence (AI) as well as the smart technology have adopted it into their operation to ensure a better performance. In accordance with Cisco's prediction, there will be as much as 50 billion of things being connected to the internet by the year of 2020, which is approximately 7 times more than the global population (Evans, 2011).

As mentioned by Weiser (1999), the IoT is an add-on system to the current internet where the everyday information transmission is focused mainly on Human-to-Human (H2H) interaction. Some of the common H2H instances are text messaging, voice calls, video calls as well as social networking. When the Artificial Intelligence (AI) is introduced, machines are starting to get more intelligent and this is when the Human-to-Machine (H2M) interaction gains a stand. A computer server incorporated with AI is able to customize the webpage content to cater the preferences of the different users by referring to their internet browser's history. In accordance to Moore's Law, the miniaturized electronic components allow microcircuit to be installed into any items. This is the reason why things in our daily lives are becoming more human-like, smarter and at the same time connected to the internet. Ubiquitous Computing is no longer just an idea, where computers are connected to almost everything around us. In order words, we humans are living with the internet-connected computers in our daily lives. The main idea of IoT is to get things around us to connect to the internet and can be widely applied in any scales. Figure 2.1 below illustrates the progression timeline of the industrial revolutions from the 1800s to present.

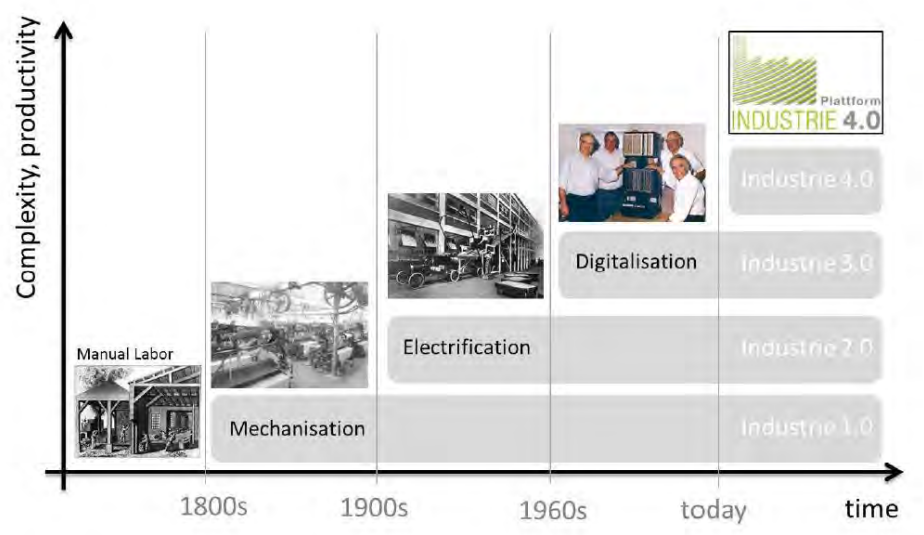

Figure 2.1: The timeline of Industry 1.0 – Industry 4.0 (Drath and Horch, 2014)

As eloquently stated by Drath and Horch (2014), the term 'Industry 4.0' which was originated from Germany is the most discussed topic right now on majority industrial forums. It refers to the fourth industrial revolution, where the previous three industrial revolutions have lasted for nearly 200 years. In Industry 1.0, the revolution started with the use of machines to replace manual labour back in 1800s. As a result, the relatively high productivity and efficiency boosted the fabrics yield. A hundred years later, the Industry 2.0 was introduced in the slaughterhouses with the main focus on electrification. Another extreme boost in productivity happened on the production line after the conveyor belts have been introduced to the industry. Then, the Industry 3.0 happened in 1969 with the introduction of the first Programmable Logic Controller (PLC) which marked the beginning of digital programming in the industry. Until today, the Industry 3.0 is still a great revolution in state-of-the-art smart systems. In Industry 4.0, people aim to incorporate the internet technologies into industrial operations. As indicated by Lee (2008), after the IoT technology is embedded into the Cyber Physical Systems (CPS), electronic hardware is integrated flawlessly with the internet with the aid of avant-garde computer and network technologies. This is illustrated in Figure 2.2.

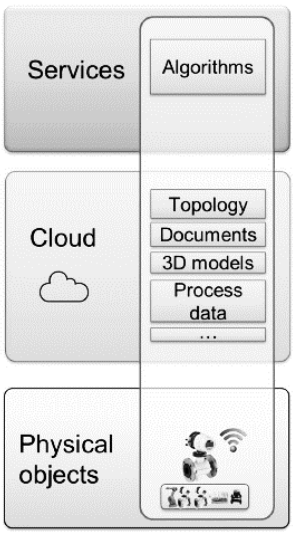

Figure 2.2: Cyber Physical Systems (CPS) in Industry 4.0 (Drath and Horch, 2014)

The CPS is made up of three levels, which are the physical objects, data models of the said physical objects and the services based on the algorithms. Some of the common CPS applications are smart home systems and Ambient Intelligence, where sensors and actuators are used to monitor, control and automate household appliances.

The Smart Grid targets solely on energy savings for houses and organizations, significant reduction in power consumption is made possible with the aid of the power grid to record the electricity consumption information for each of the household appliances (Hui et. al., 2017). The IoT technology is compatible with the algorithms for counterbalancing the electricity from the energy plant and the internal energy source such as solar panels. This allows the consumers to be smarter in power usage and make the best decision in electricity consumption. The Figure 2.3 shows the architecture of an IoT centric smart environment. All the smart technologies are incorporated with the aim of delivering the right data at the right time, regardless of location constraints.

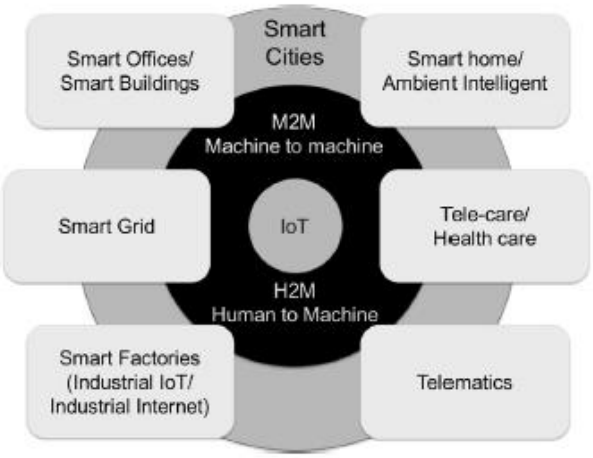

Figure 2.3: The architecture of IoT based smart environment (Hui et. al., 2017)