UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE DEVELOPMENT OF A SMART PLANT MONITORING SYSTEM USING IOT: THE PLANT WHISPERER

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

by

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I hereby, declared this report entitled THE DEVELOPMENT OF A SMART PLANT MONITORING SYSTEM USING IOT: THE PLANT WHISPERER is the results of my own research except as cited in references.

Signature: ……

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APPROVAL

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

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ABSTRAK

Berkebun di dalam bangunan adalah satu aktiviti dimana seseorang individu menanam tumbuhan di dalam sebuah kawasan tertutup. Dalam era pemodenan ini, ramai individu mengisi masa lapang mereka dengan berkebun di dalam bangunan. Tetapi, satu masalah besar telah timbul. Sebagai pekebun baru, mereka perlu meluangkan masa yang secukupnya untuk berkebun untuk memastikan tumbuhan mereka membesar dengan sihat kerana terdapat banyak faktor persekitaran yang mampu memberi kesan terhadap tumbesaran dan kesihatan tumbuhan mereka. Masa yang mereka perlukan telah dikekang dek kerana pekerjaan dan komitmen mereka. Oleh itu, projek 'Plant Whisperer: A Smart Indoor Gardening System' telah dicadangkan bersama beberapa alat sebagai solusinya. Melalui projek ini, satu sistem pemantauan tumbuhan akan direka untuk membantu mengekalkan kesihatan tumbuhan yang sedang membesar. Keadaan tumbuhan yang sihat juga akan dianalisi dan diuji. Beberapa sensor akan disambungkan pada sistem ini dimana sensor-sensor tersebut akan menghantar isyarat input kepada mikropengawal manakala mikropengawal pula akan menghantar data kepada pengguna menerusi aplikasi dengan menggunakan konsep 'IOT'. Seterusnya, beberapa penggerak juga akan dibenamkan ke dalam projek ini dimana penggerak-penggerak tersebut akan diaktifkan mengikut keadaan sensor-sensor yang terbabit. Konklusinya, projek ini mampu membantu mengekalkan kesihatan dan tumbesaran sihat tumbuhan tersebut.

ABSTRACT

Indoor gardening is an activity where people grow plants but inside enclosed compounds. In this modernization time, many individuals have found indoor gardening as an interesting activity to be spent during their free time. But a big problem has come to existence. As a beginner gardener, they need to spend a good amount of time with their growing plant in order to make sure the plants grow healthily since there are many environmental factors that can affect the plant's health and growth. All the time they need have been limited by their working hours and commitments. As every cloud has a silver lining, the 'Plant Whisperer' project is proposed along with certain tools to provide the solution. Through this project, a plant monitoring system will be designed to help maintaining growing plant health. Then, by doing this project, plant's healthy condition will be analysed and tested. Several sensors are embedded to this system that will send input signals to the microcontroller that will send data to the user through an application by using the IOT concept. Then, several actuators also are embedded into this project, where they will be actuated according to their own sensors. In a nutshell, it is known that the 'Plant Whisperer' will help in maintaining the plant's health and growth.

DEDICATION

This dedication is sincerely meant for my beloved family, respected lecturers and dear friends. Their loves, affections, guides, helps and encouragements are the things that urge me to advance across the finishing line. There are no words that have the ability to represent my appreciation to these beautiful souls.

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LIST OF SYMBOLS

v	-	Volts
A	-	Ampere
W	-	Watt
°C	-	Degree Celsius

LIST OF ABBREVIATIONS

LED	Light Emitting Diode
IoT	Internet of Things
LDR	Light Dependant Resistor
DC	Direct Current
SOC	System on Chip
IDE	Integrated Development Environment
GSM	Global System for Mobile
SMS	Short Message Service
LCD	Liquid Crystal Display
MCU	Microcontroller Unit
Hex	Hexadecimal
IC	Integrated Circuit
I2C	Inter-Integrated Circuit

CHAPTER 1

INTRODUCTION

1.1 Background

Indoor gardening is basically growing a plant indoor. Specifically, indoor gardening can be said as an act of growing plant inside an enclosed place, most often a residential home. Many types of plants can be grown indoor such as herbs and decorative plants. Many residents of flats, apartments, condominiums have taken a liking on this type of gardening because the lack of garden spaces at their places.

Apparently, in this era of globalization, almost everyone has a job. This statement portrays that their time to garden will become shorter and shorter thus, jeopardizing their plant's health. In order to help with maintaining their plant's growth and health, 'Plant Whisperer: A smart indoor gardening system' has been proposed.

Specifically, a plant need water, light and warmth in order to grow healthily. Thus, parameters such as soil moisture, light intensity, temperature and humidity needed to be monitored meticulously.

Water or specifically soil moisture, is a very important aspect in plant's growth. This is because water is crucial for photosynthesis as it is a reagent in this process. It is also important for cell enlargement and growth. Then, it also acts as solvent for minerals. But, if the soil is overhydrated or underhydrated, the root will rot and cause the plant to grow poorly and eventually leading to death.

Plants make their own food through the photosynthesis process. Sunlight is the source of energy for this crucial process to happen. Thus, plant's growth can be affected by the quality, duration and intensity of light energy.

Temperature also plays an important role in helping plants growth. Firstly, it can affect the metabolic process of a plant. Too high temperature can damage the plant's cell while too low temperature can make the cells become dormant. This certainly will affect the plant's health.

In order to monitor the plant's health and growth effectively, several sensors such as light intensity sensor, temperature sensor, soil moisture sensor and air humidity sensor have been integrated into the 'Plant Whisperer'.

Monitoring alone is insufficient to maintaining the plant's health and growth effectively. Thus, several actuators such as water pump, exhaust fan, mister and artificial sunlight also have been integrated into the 'Plant Whisperer'.

The water pump will activate when the soil moisture is too low in order to maintain an enough water supply for the plant. Then, the exhaust fan is used whenever the temperature is too high for the plant to bring out all the hot wave. On the other hand, the mister will be turn on whenever there is a decrease in air humidity in order to provide good humidity for the plant. Finally, the artificial sunlight in connected to the light intensity sensor, so whenever there is insufficient supply of light energy, it will turn on.

Then, in order to applying the Internet of Things concept, the microcontroller of the 'Plant Whisperer' will process the raw data from the sensors and send it to the android application through the Wi-Fi module. The android application will nudge the user if dangerous level of certain parameter has been reached so that the user can take a countermeasure.

1.2 Problem Statement

Plants need water, light and warmth to maintain a good health and grow healthily. Water are needed since they are the solvent for minerals, reagent in photosynthesis process and important for cell enlargement and growth.

On the other hand, light is also a crucial element as it is the source of energy for the plant to make their own food through the photosynthesis process. Temperature can affect the plant's metabolic process. Too high will kill the cells and too low will make the cells dormant.

Thus, it is important to monitor all these parameters and act on it. But the gardeners nowadays may have only a little time to take care of their plants because of their commitment at workplaces. Thus, the 'Plant Whisperer' are proposed to help the gardeners to:

1. Monitor the Light intensity, temperature, soil moisture and air humidity.
2. Actuate some actuators according to the sensors.
3. Grow plant healthily
4. Maintaining the plant's health.

1.3 Objective

There are three main aims for this project:

1. To develop a plant monitoring system to help maintaining growing plant health
2. To develop an application to monitor the plant's health or condition.
3. To analyze 'Plant Whisperer' performance.

1.4 Scope

The scope of this project is:

1. Using NodeMCU (ESP8266) as a microcontroller for the ‘Plant Whisperer’.
2. Using an Android Application to monitor the system.
3. Using soil moisture sensor, temperature and humidity sensor and light intensity sensor.
4. The processed data will be transmitted wirelessly from the microcontroller to the application.
5. This design is meant for indoor gardening only.

1.5 Report Outline

This project report includes five chapters. An overview of this project, ‘Plant Whisperer: A smart indoor gardening system’ has been enlighten in Chapter 1. Chapter 2 is a Literature review which portrays an overview of design and development of ‘Plant Whisperer: A smart indoor gardening system’. Then, in Chapter 3, the methodology of this project is presented including the process to build its hardware and software. On the other hand, Chapter 4 is focused on the results of this project. Finally, in Chapter 5, the conclusions and recommendations for future work are displayed.

CHAPTER 2

LITERATURE REVIEW

2.1 Indoor Gardening

Growing plant indoors is a technique called indoor gardening. It can be said that this technique can be used for decorative purposes. This is shown at shopping malls, trailing vines, restaurant, office buildings and even residential home. The reasons are to provide a sense of serenity and privacy and to improve indoor air quality that has long been proven affected by growing plants indoor. On the other hand, indoor gardening also can be defined specifically as an act of growing herbs or vegetable inside an enclosed compound such as residential home. Container gardening can be said as the simplest way of indoor gardening. Any type of container that have the ability to hold plant, soil and moisture are eligible. The most used technique is always potting using pot, but there are always individuals tend to recycle waste by using any medium such as used cans, egg cartons and so on as a container for their plants. Apart from that, the most important principle is the same as outdoor plants, indoor plants also need light, water and warmth in order to grow healthily (Maximum Yield Inc., 2019).

2.2 Indoor Gardening Issues

Recent article on indoor gardening issues (Saha, 2019) has shown that like common gardening, indoor gardening also has its own issues or problems. Firstly, the lack of sunlight. (Shipunov, 2018) states that every plant has it owns requirement of light in order to go