GREENHOUSE MONITORING USING WIRELESS SENSOR NETWORK

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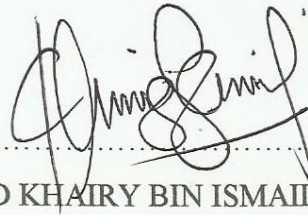(COP DAN TANDATANGAN PENYELIA)

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Dedicated to my parents, my siblings and also my colleagues and friend who had been supporting me through thick and thin.

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ABSTRACT

A greenhouse is a building where plants are grown. Greenhouses are often used for growing flowers, vegetables, fruits, and tobacco plant. Most greenhouse system still uses the manual system in monitoring the temperature and humidity in the greenhouse, a lot of problem can occurred not for worker but also affected production rate because the temperature and humidity of greenhouse must be constantly monitored to ensure optimal conditions. The wireless sensor network can be used to gather the data from point to point to trace down the local climate parameters in different parts of the big greenhouse to make the greenhouse automation system work properly. The aim project is developing a greenhouse monitoring system to monitor a greenhouse temperature and humidity parameters by applying the Zigbee a wireless device as the wireless sensor network system. In this project, Zigbee will be used as a wireless device and the temperature and humidity sensor will be used to collect data of temperature and humidity in the greenhouse. This project is combination of hardware such as PIC Microcontroller, LCD Display and Zigbee as the main hardware components and C Compiler and MP Lab IDE for the main of software elements that could support up to 100 meters. The data from the greenhouse will be measured by the sensor and the data that are collected will be sending to the receiver. The data that has been read will be displayed on the LCD screen. By using this system, the process of monitoring is easier and it is also cheaper for installation and maintenance process.

ABSTRAK

Rumah hijau adalah bangunan di mana tumbuhan ditanam. Rumah hijau sering digunakan untuk menanam bunga, sayur-sayuran, buah-buahan dan tumbuhan tembakau. Kebanyakan sistem rumah hijau masih menggunakan sistem manual untuk memantau suhu dan kelembapan dalam rumah hijau di mana banyak masalah boleh berlaku bukan sahaja untuk pekerja tetapi juga kadar pengeluaran terjejas kerana suhu dan kelembapan rumah hijau mesti sentiasa dipantau untuk memastikan keadaan yang optimum. Rangkaian pengesan tanpa wayar boleh digunakan untuk mengumpul data dari titik ke titik untuk mengesan di bawah parameter iklim tempatan di bahagian yang berlainan rumah hijau yang besar untuk membuat sistem automasi rumah hijau berfungsi dengan baik. Tujuan projek adalah pembangunan sistem pemantauan rumah hijau untuk memantau suhu dan kelembapan rumah hijau dengan menggunakan ZigBee peranti wayarles sebagai pengesan tanpa wayar. Dalam projek ini, ZigBee akan digunakan sebagai peranti wayarles manakala pengesan suhu dan kelembapan akan digunakan untuk mengumpul data suhu dan kelembapan di dalam rumah hijau itu. Projek ini adalah gabungan perkakasan seperti PIC Microcontroller, LCD Paparan dan ZigBee sebagai komponen utama dan C Compiler dan MP Lab IDE untuk elemen perisian yang boleh menyokong jarak sehingga 100 meter. Data dari rumah hijau itu akan diukur oleh pengesan dan data yang dikumpul akan menghantar kepada penerima. Data-data yang telah dibaca akan dipaparkan pada skrin LCD. Dengan menggunakan sistem ini, proses pemantauan adalah lebih mudah dan ia juga lebih murah untuk pemasangan dan penyelenggaraan proses.

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List of Abbreviation

DSP   -   Digital Signal Processor

WSN   -   Wireless Sensor Network

HID   -   Human Interfacing Device

CMOS -   Complementary Metal-Oxide Semiconductor

OTP   -   One Time-Programmable

WPAN -   Wide Personal Area Network

RFID   -   Radio-frequency identification

UART -   Universal Asynchronous Receiver/Transmitter

ADC   -   Analog to Digital Converter

CHAPTER I

INTRODUCTION

This chapter will discuss briefly the background of the system have been chosen to develop. The greenhouse monitoring will also discuss the problem statement, main objective and the scope of the project.

A greenhouse is a building where plants are grown. Greenhouse protects crops from too much heat or cold, shield plants from dust storms and blizzards, and help to keep out pests. Light and temperature control allows greenhouse to turn in arable land into arable land, thereby improving food production in marginal environments. Because greenhouse allow certain crops to be grown throughout the year, greenhouses are increasingly important in the food supply of high latitude countries. Greenhouses are often used for growing flowers, vegetables, fruits and tobacco plants.

1.1   Project Background

The closed environment of the greenhouses has its own unique requirements, compared with outdoor production. Pets and diseases, and extremes of the heat and humidity, have to be controlled, and irrigation is necessary to provide water.

Significant inputs of the heat and light may be required, particularly with the winter production of warm weather vegetables. Because the temperature and humidity of greenhouses must be constantly monitored to ensure optimal conditions, a wireless sensor network can be used to gather data remotely. The data is transmitted to a control location and used to control heating, cooling, and irrigation systems.

1.1.1   Wireless Sensor Network Concept

Wireless sensor network is a new research field. It can be used in some special situation for signal collection, processing and transmitting. Wireless technologies have been rapidly developed during recent years. Its advantages include the liability, simplicity, and low cost in both installation and maintenance. Wireless sensor network can form a useful part of the automation system architecture in modern greenhouse. Wireless communication can be used to collect the measurement and to communicate between the centralized control and the actuators located to the different parts of the greenhouse.

Zigbee is a new wireless sensor network technology characteristic of less distance and low speed. It is a new wireless sensor protocol stack of IEEE 802.15.4. Generally modern greenhouse has hundreds of square meters and they may plant variety of plants depending on different seasons. Based on wireless sensor network technology for greenhouse, Zigbee offers flexibility and mobility to save cost and energy spent on wiring.

This project is innovation from the technology that we have in now days. In modern greenhouse, several measurement points are required to trace down the local climate parameters in different parts of the big greenhouse to make the greenhouse automation system work properly. Cabling would make the measurement system expensive and vulnerable. Moreover, the cabled measurement points are difficult to relocate once they are installed.

1.1.2   Factors of the Greenhouse Network

Thus, a wireless sensor network consist small size wireless sensor nodes equipped with radio and one or several sensors in an attractive and cost efficient option to build the required measurement system. Wireless technologies have been rapidly developed during recent years. Starting from the military and industrial controls, it is now being widely applied in environmental monitoring and agriculture.

There are a few type of wireless communication technologies which is Zigbee, Wi-Fi and Bluetooth. Wi-Fi, Bluetooth and Zigbee work at similar RF frequencies, and their application sometimes overlap. There are five main factors of the greenhouse network to be comparing which are [1]:

i)   **Cost** – Zigbee chip is the lowest compare to Bluetooth and Wi-Fi. The overall system cost can be significantly reduced by the employment of Zigbee chip.

ii)   **Data Rate** – Zigbee is 250 kbps, while Wi-Fi and Bluetooth are 54 Mbps and 1-2 Mbps, respectively. Despite the lowest data rate, Zigbee is sufficient foe a greenhouse. Low data rate helps to prolong the battery life.

iii)   **Number of Nodes** – The capacity of the network is determined by the number of nodes, and Zigbee has up to 254 nodes, the largest among the three. It meets the application demand of more and more sensors and actuators in a greenhouse.

iv)   **Current Consumption** – Zigbee has the lowest current consumption, 30 mA, while Wi-Fi, 350 mA, and the Bluetooth, 60-170 mA. It also greatly helps to prolong the battery life.

v)   **Battery Life** – Zigbee chip has the longest battery life, which is a few months or even years.

As a whole, Zigbee technology offers long battery life, small size, high reliability, automatic or semi-automatic installation, and particularly, a low system cost. Therefore, it is a better choice for greenhouse monitoring and control than other wireless protocols.

Zigbee is a new technology now being deployed for wireless sensor networks. A sensor network is an infrastructure comprised of sensing; computing and a communication element that allows the administrators to instrument observe and react to event and phenomena in a specified environment. Lately, traditional system to collect parameters for greenhouse is widely used in agriculture. The traditional system adopts wired way wiring, which makes the system complex and expensive.

Zigbee's mission is to cut the traditional wires between sensors, wired slaves devices, and the microcontrollers and microprocessors they serve. Compared to the cabled system, the installation of wireless sensor network is fast, cheap and easy. Moreover, it is easy to relocate the measurement points when needed by just moving sensor nodes from one location to another within a communication range of the coordinator device. Wireless sensor network maintenance is also relatively cheap and easy. The only additional costs occur when the sensor nodes run out of batteries and the batteries need to be charged or replaced, but the lifespan of the battery can be several years if an efficient power saving algorithm is applied.

1.2 Problem Statement

Nowadays, most greenhouse system still uses the manual system in monitoring the temperature and humidity in the greenhouse. By using the manual system, a lot of problem can occurred not for worker but also affected production system. This all has changed in the modern greenhouses because size of the greenhouse itself is become bigger than before in order to support the need in market and the greenhouse facilities provide several options to make local adjustments to the lights, ventilation, heating and other greenhouse support systems.

However, more measurement data is also needed to make this kind of automation system work properly. Increased number of measurement points should not dramatically increase the automation system cost[2].

The first problem is if the greenhouse is far away from the maintenance office, worker or engineer must go on the site to check manually every hour to check if there are any problem occurs. Then, the reading of the temperature and humidity must be checking manually to make sure the greenhouse is in a normal condition. This project therefore mainly designs to minimize the risk for workers to avoid from hazard in the greenhouse. Monitoring the temperature and humidity in greenhouse on the LCD screen can reduce time and problem easier.

The second problem is many greenhouse system still use the cable to send data from sensor level to monitoring. It is difficult to install the system if the greenhouse is far away from maintenance office. The data cable are easy to damage if lay in high temperature and danger condition. These projects were upgrade from wired to wireless sensor network to send data from greenhouse to monitoring on the LCD screen in the maintenance office.

1.3   **Objective of Project**

The purposes of greenhouse monitoring using wireless sensor network prototype that is targeted at transmitting and receiving data within the greenhouse infrastructure. It was used to as the target for the amount of data that useful for an analysis of the factors that enable proper functioning greenhouse. So, at the beginning of this project, by focusing on the production of prototype models to help people in understanding about monitor the greenhouse by using wireless sensor network. The main objective of this project can be summarized as follows is to develop a greenhouse monitoring system to monitor a greenhouse temperature and humidity parameters by applying the Zigbee a wireless device as the wireless sensor network system.

1.4   **Scope of Project**

Development the Greenhouse Monitoring Using Wireless Sensor Network is a best project have chosen after doing research from books, internet, electronic magazine and other resources and discussion between the experience in communication fields. Greenhouse Monitoring Using Wireless Sensor Network is an innovation of monitoring the temperature and humidity in the greenhouse.

The scope of this project consists of hardware and software. The basic idea is to monitor software and the main part of the hardware is the circuit :

i)   Implement Zigbee wireless and sensor system to transmit and receive data wirelessly that could support by using 9V battery.

ii)   The two level sensor components consist to transmit data through monitor system.

iii)   The main processor that controls the whole system is PIC16F877A. Upon this project to be monitor, the data will be transmit and receive through Zigbee to the next processor.

iv)   The data will then be process to monitor the temperature and humidity and the reading will be displayed into the LCD screen.

v)   MPLAB is the software used to interface the software with the hardware.