CAR POSITION BASED ON WIRELESS SYSTEM

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"I hereby declared that I've read through this report and found that it has comply the partial fulfillment for awarding the Degree of Bachelor of Electrical Engineering (Mechatronic)"

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Date : 11/5/09

ABSTRACT

This project is about an indoor parking system based on Zigbee technology. Beside that it's describe how Zigbee works as WSN in detect position of the car at indoor parking (multi-layered parking). Zigbee has been developing by the organization named as 'Zigbee Alliance' as a new wireless standard based upon the IEEE 802.15.4 Standard. When these wireless active, it will count automatically the total of the car in every floor by sending the collected data to the monitor. Then the users will informed that any vacant parking in this area. Thus, the driver spent less time in finding vacant parking. In this application, a design of GUI by using Visual Basic 6 will integrate with ZigBee (hardware). The GUI system will show number and location of the vacant lots. Zigbee will integrate with GUI to produce an excellent parking system.

ABSTRAK

Projek ini adalah tentang Sistem Tempat Letak Kenderaan Tertutup menggunakan teknologi Zigbee. Di samping itu,ia menerangkan bagaimana Zigbee berfungsi sebagai salah satu aplikasi daripada Rangkaian Pengesan Tanpa Wayar untuk mengesan kedudukan kenderaan di tempat letak kenderaan tertutup. Zigbee telah dihasilkan oleh satu organisasi yang dikenali sebagai 'Zigbee Alliance' di mana mereka cipta standard baru sistem tanpa wayar berdasarkan kepada IEEE 802.15.4.Apabila system ini dalam keadaan aktif, ia akan mengira jumlah kenderaan di mana secara automatiknya dapat mengenalpasti tempat letak kenderaan yang kosong. Ini akan dipaparkan pada monitor dan pengguna akan mendapat tahu kedudukan tempat letak kenderaan yang masih kosong. Oleh itu, ia akan menjimatkan masa bagi pengguna untuk meletak kenderaan tanpa merasa tertekan dan membuang masa. Dalam projek ini juga terdapat satu sistem yang dikenali sebagai GUI di mana digunakan sebagai monitor untuk memaparkan bilangan tempat letak kenderaan yang masih kosong. Akhir sekali, Zigbee akan digabungkan dengan GUI dan menghasilkan satu system tempat letak kenderaan yang baik.

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LIST OF ABBREVIATION

WSN	-	Wireless Sensor Network
IEEE	-	Institute of Electrical and Electronic Engineers
GUI	-	Graphical User Interface
FFD	-	Full Function Device
RFD	-	Reduce Function Device
WPAN	-	Wireless Personal Area Network
PAN	-	Personal Area Network
PHY	-	Physical
DSSS	-	Direct Sequence Spread Spectrum
OSI	-	Open System International
MAC	-	Media Access Controller
VB6	-	Visual Basic 6
PIC	-	Programmable Integrate Chip
USB	-	Universal Serial Bus
NPN	-	Negative Positive Negative

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 Background

Wireless technology is becoming more popular as it overcomes the disadvantages of having the user restricted in a particular location. Wireless communication can be deployed easily, decreasing the overall cost of the system.

Wireless sensor network is a part of the wireless communication.The main purpose of sensor networks is to monitor an area, including detecting, identifying, localizing and tracking one or more objects of interest. A wireless sensor network is a collection of nodes organized into cooperative network. Each node consists of processing capability, may contain multiple types of memory, have a transceiver, have power source and accommodate sensors and actuator. The nodes communicate wirelessly and self-organize.

There are many wireless monitoring and control applications in industrial and home environments which require longer battery life, lower data rates and less complexity than those from existing standards. For such wireless applications, a new standard called IEEE 802.15.4 has been developed by IEEE. The raw data rate will high enough for applications like sensors, alarms and etc.

In this project, Zigbee Technology based on wireless standard will be used as wireless sensor network that will detect the location of the objects or vehicles. Firstly th project starts with the study of the WSN (Zigbee) on such as how it works, specification and features of the technology, and its application.

This project also covers a GUI design and development for the monitoring system. The Zigbee technology based on WSN as hardware and the GUI as software then will be integrated to complete the whole monitoring system. Lastly, some analysis on the performance of the system also is included.

1.2 Problem Statement

Nowadays, a multi-layered parking system in a building is spread unsystematically over a wide area. For that, searching for a vacant lot in a multi-layered parking is not such a simple task. As a result, users have to spend lots of time to find the vacant parking in a wide area of parking lot. This situation will cause the drivers to get angry and frustrated in the case no parking lot can be found or wasting time to find back their vehicles.

It's also hard to find a vacant parking if the indicator at the entrance only show the parking lot is fully occupied without telling which area is vacant. For that, a car park positioning system based on wireless sensor network is proposed.

1.3 Project objectives

The aim of this project is to design and implement car park positioning application using the wireless sensor network that is based on Zigbee Technology. This application can detect the location of the car at indoor parking such as in the multi-layered and wide area parking. It also includes a design and development of a GUI for monitoring the parking system. Then, the GUI (software) and ZigBee Technology based Wireless Sensor Network (hardware) will be integrated to complete the car park system including some analysis on the system performance and reliability.

1.4 Scope of Project

The scopes of this project basically are to:

i) Study the Zigbee Technology based on wireless sensor network.

ii) Design and development of GUI to monitor the parking system.

iii) Apply the Zigbee Technology based on wireless sensor network for the parking system.

iv) Investigate the evaluation on the Coverage Performance of the Wireless Sensor Network based on Cirronet ZMN2405HP Zigbee module.

CHAPTER 2

LITERATURE REVIEW

Before focusing on the objectives of this project, all information related to the project must firstly be understood. This chapter explains the information related to this project.

2.1 Wireless Sensor Network

Wireless sensor network is a trend for the past few years, and it involves deploying a large number of small nodes in a target area. The nodes then sense environmental changes or phenomenon and report them to other nodes over flexible network architecture. Sensor nodes are great for deployment in hostile environments or over large geographical areas.

The applications for WSN are many and differ. They are used in commercial and industrial applications for data monitoring monitor data that is difficult or expensive to be monitored using the wired sensor. They could be built in uncultivated region, where they would remain for many years without the need to recharge/replace their power supplies.

Sensor networks have been useful in a variety of domains. The primary domains at which sensor networks are deployed are as follow:

- **Environmental observation**. Sensor networks can be used to monitor environmental changes. An example could be water pollution detection in a lake

that is located near a factory that uses chemical substances. Sensor nodes could be randomly deployed in unknown and hostile areas and relay the exact origin of a pollutant to a centralized authority to take appropriate measures to limit the spreading of pollution. Other examples include forest fire detection, air pollution and rainfall observation in agriculture.

- **Military monitoring**. Military uses sensor networks for battlefield surveillance; sensors could monitor vehicular traffic, track the position of the enemy or even safeguard the equipment of the side deploying sensors.
- **Building monitoring**. Sensor networks can also be used in large buildings or factories monitoring the climate changes. Thermostats and temperature sensor nodes are deployed all over the building's area. In addition, sensors could be used to monitor vibration that could damage the structure of a building.
- **Healthcare**. Sensors can be used in biomedical applications to improve the quality of the provided care. Sensors are implanted in the human body to monitor medical problems like cancer and help doctors monitoring their patients' health condition.

2.1.1 Features of Wireless Sensor Network

Some of the important features which are need to know concerning the understanding of the wireless sensor networks are:

i. Small battery requirements – important for a sensor node to save energy to stay alive for a longer life time. This is done by having a sleeping mode some times during its operation to conserve energy.

ii. Nodes are located to each other and communicating using a wireless medium in the multi-hop sensor networks.

iii. Encryption methods can be used to carry out the data security in the operations of these networks.

iv. Physical layer in the sensor network protocol stack is responsible for the detection of signal, modulation and generating carrier frequency.

v. Compared to the networks, built up using wires, it requires less maintenance for the WSN.

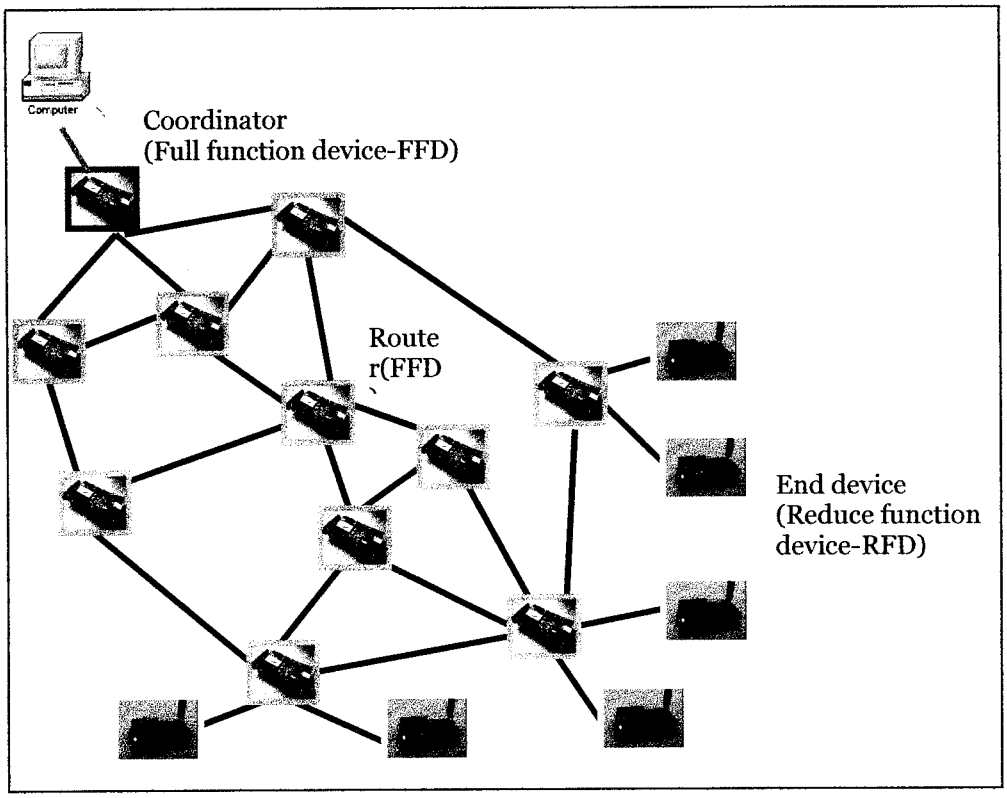
vi. Easy installation.

There are three types of devices:

i) The network coordinator maintains overall network knowledge. It is the most important and requires the most memory and computing power.

ii) The Full Function Device (FFD) supports all IEEE 802.15.4 functions and features specified by the standard. It also can function as a network coordinator. Additional memory and computing power make it ideal for network router functions or it could be used in network-edge devices.

iii) The Reduced Function Device (RFD) carries limited functionality to lower cost and complexity. The RFD can be used where extremely low power consumption is a necessity as Figure 2.0.



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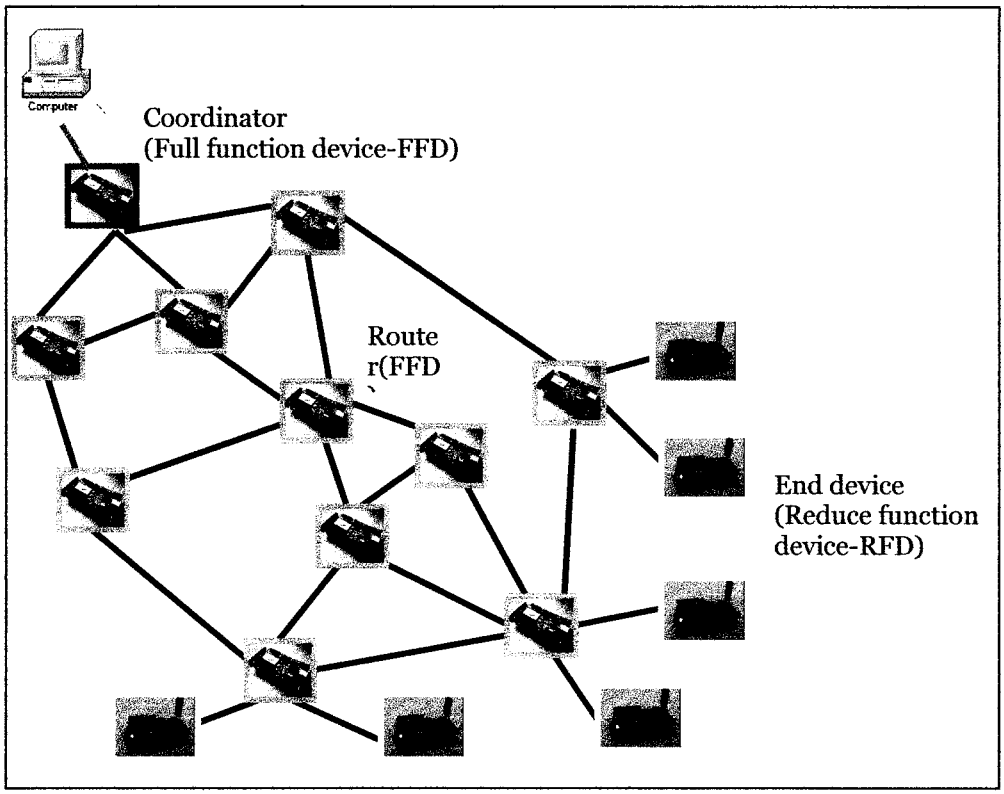

Figure 2.0: Components of IEEE 802.15.4 Standard

2.1.2 WSN Network Topologies

There are three classic network topologies (star network, cluster network, and mesh network), assess their strengths and weaknesses.

2.1.2.1 Star networks

Theoretically, these systems are the most reliable because there is only one single node of failure in the topology—the gateway itself as sees Figure 2.1. Each node connects directly to a gateway.

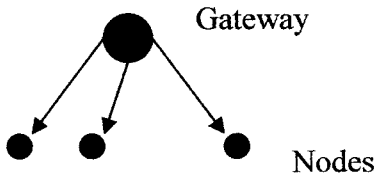

Figure 2.1: Star networks

In star network topologies, each sensor node requires a separate twisted shielded–pair wire connection. The cost is high, configuration management is difficult, and nearly all the information processing is done by the host. Complete wireless local area networks (LANs) were implemented using this technique. These were successful in the office environment but didn't fare as well in factories.

2.1.2.2 Cluster tree network

Cluster tree networks reduced the number of wires required to connect field devices to the gateway, but they also introduced another single node of failure—the cable (see Figure 2.2). Each node connects to a node higher in the tree and then to the gateway and data is routed from the lowest node on the tree to the gateway.

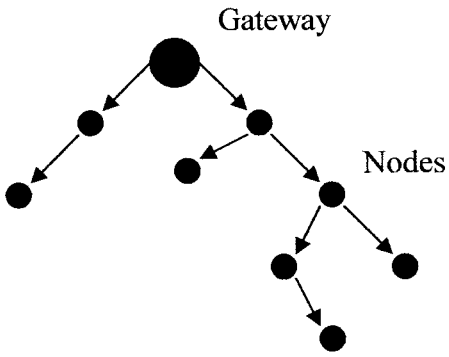

Figure 2.2: Cluster tree network

In a cluster tree network, each sensor node puts its information onto a common medium. This requires careful attention to protocols in hardware and software. The single-wire connection represents a potential single-point failure. But some vendors supply redundant connections to mitigate this potential problem. Wireless systems use the same types of protocols to implement cluster tree topologies, simulating hard-wired connections with RF links.

2.1.2.2 Mesh networks

The promise of the mesh topology (i.e., when all nodes are connected all the time) had to wait until vendors developed a way to interconnect nodes without the required wiring connections. A network of any appreciable size becomes infeasible if all wires must be connected specifically for the network as see Figure 2.3.

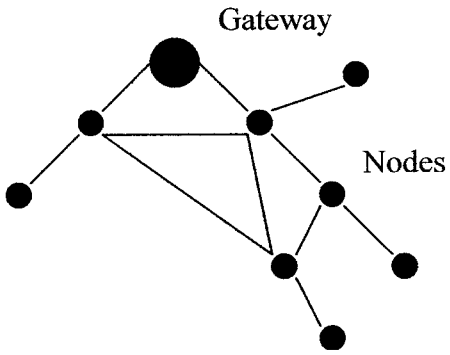

Figure 2.3: Mesh network