UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF PUBLIC TRANSPORTATION (BUS) NOTIFICATION USING PIC MICROCONTROLLER

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

by:

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ABSTRACT

Locating a public transport bus and to transfer it location to the knowledge of people using Global Positioning System (GPS), Radio Frequency Identification (RFID) tags and General Packet Radio Services (GPRS) are all useful, but the main objective is its not yielded with this where the people receives information with many delay and thus people get misguide with different bus in the crowed metro city, In this project a bus location monitoring using Zigbee is used. The passenger in the bus stops is provided with a Zigbee Trans receiver which gets the data from the Zigbee Trans receiver of the incoming bus. The PIC controller makes the Zigbee displays the data in the bus stops and also it takes the data from the Zigbee and sends it to target bus stops. Thus, the passengers in the bus stops can be aware of the buses coming so they can board their respective buses. The bus stops details are displayed inside the bus along with LCD display using programming. The controllers used here is PICF877A. This idea also helps the passengers and the bus driver about information of bus unavailability and also unaware of the passengers at the bus stop due to incoming bus.

ABSTRACT

Mencari pengangkutan awam(bas) dan menghantar maklumat lokasi kepada pengetahuan orang menggunakan gps, tag id rf dan gprs semuanya berguna tetapi matlamat utama tidak diberikan, dengan ini di mana penumpang telah menerima maklumat tentang banyak kelewatan bas dan oleh itu orang mendapat salah arah dengan menaiki bas yang berlainan di bandar metro. Dalam projek ini pemantauan lokasi bas menggunakan zigbee digunakan. Penumpang di perhentian bas disediakan dengan penerima Transmit zigbee yang mendapat data dari penerima Zigbee Trans pada bas masuk Pengawal PIC menjadikan Zigbee memaparkan data di perhentian bas dan juga mengambil data dari Zigbee dan menghantarnya ke sasaran hentian bas .itu penumpang di perhentian bas boleh menyedari bus yang datang supaya mereka dapat menaiki bas yang betul. Butiran perhentian bas dipaparkan di dalam bas bersama dengan paparan LCD menggunakan pengaturcaraan. Pengawal yang digunakan di sini ialah PIC11F877A.Idea ini juga membantu pemandu bas mengenai maklumat setiap hentian bas serta lokasi penumpang dan juga penumpang juga menyedari bus yang akan datang.

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CHAPTER 1

INTRODUCTION

This section gives an overview about the project such as the idea of the project and the project's background. In this part, the objectives and the scope of the project are explained as well as the background of the study. This discussion is based on the problem statement of the project. The project title is "Development Of Public Transportation (BUS) Notification Using PIC Microcontroller". This project is want to help alert the passenger about the bus is arriving and also alert the driver bus by building the project that used Radio Frequency (RF) transmitter, receiver as the medium to pass and propagate the signal wave when trigger the button on the transmitter circuit while PIC16F877A as a microcontroller.

1.0 Project Background

With enormous bus stations and plenty of passengers the bus transportation system gets more complex, as well as the possibility of passengers will having problem by losing their direction and missed their bus. Sometime people inside the bus miss the destination that they desire due to the too much crowd in the bus. It's going to gives lot of trouble to the bus driver and passenger itself.

In order to overcome this problem local government may use GPS system to locate the bus and thus they can inform the people in the bus stop about the bus location and the people inside the bus also get information about the bus location inside the bus using GPS system. The GPS location can also be sent to the control section of

transportation using gprs thus they can monitor the bus location. But the problem is not reduced in this system it has been increased. The GPS usage may get delay in locating the moving bus and also the usage of internet may cost local government high thus this system may create a major trouble of giving wrong information to the people and may also mislead them to different bus stop.

Bus monitoring and alert system using Zigbee and microcontroller (PIC11F877A) is been proposed to overcome this difficulty. Zigbee is used in the bus stop to send the information to the bus and PIC is also connected with Zigbee to send the data received as a message. The driver bus will be alert about the passenger and their direction. At the same time at the bus stop the passenger itself will be notify that bus is near. Thus, this project is build with automatic alert and it easy to use. Plus, it's also a low cost and using low power consumption.

The amount of population increases and their need for more transportation systems increase as well.(Koga, 1999)[1] .Not all people are being able to process their own transport and travel individually, but the main objective is not yielded with this where the people receives information with many delay and thus people get misguide with different bus in the crowed metro city, In this project a bus location monitoring using Zigbee is used. The passengers in the bus stops are provided with a Zigbee Trans and receiver which gets the data from the Zigbee Trans receiver of the incoming bus. The PIC controller displays the data in the bus stops and also it takes the data from the Zigbee and sends it to the control section of transportation and also to other target bus stops. Thus the passengers in the bus stops can be aware of the buses coming so they can board their respective buses. The bus stops details are displayed inside the bus along with buzzer using

programming. The controllers used here is an PIC controller (PIC16F877A). This idea also reduces traffic and overloading of public in buses.

The collective transport means are essential to enable people to move around cheaply and reduce the traffic jam on roads. (Koga, 1999)[1]. Bus transportation is a capable system that allows people to travel to a variety of destinations at low cost. Developed countries have implemented assorted modernized bus transportation systems that enable passengers to freely travel to any desired locations. However, there are some obstacles that encountered by passengers who using bus transportation(Koga, 1999)[1].

One of them is the possibility of passengers missing a bus due to the deficiency of the bus transportation system(Me, 2013)[3]. Another thing is that, it would be a waste of time and cost in which, when the bus is coming into a bus station that no passengers waiting. A modernized bus transportation system can be implemented in order to reduce these deficiencies.

1.2 Problem statements

Nowadays the need for traveling from place to place is becoming a routine that people almost do every day. There are various transportation systems, in which people can travel from one place to another. Bus transportation is the people's common choice to use due to its availability at low cost and simple traveling methods to the user’s destination.

The disadvantages of using the bus transportation is when there are many passengers want to use it, they could be missing the bus and this makes them unable to reach a destination punctually(Me, 2013)[3]. Moreover, the drivers and

transportation vendors waste time and cost by driving a bus to an empty bus station(Koga, 1999)[1]. All these obstacles exist due to the olden and inefficient systems and technologies of bus transportation.

However, these bus transportation system's deficiencies can be reduced by developing a technology system that can significantly contribute to managing, improving, and modernizing the bus transportation systems. The system utilizes a microcontroller that controls the Zigbee wireless communication module that acts as a communication tool between the bus stations and the buses.

The systems working principle include PIC16F877A microcontroller, Zigbee, LCD, and sound buzzer where the bus drivers will receive an indicating signal through Zigbee(Ke, Ruiqiang, & Cuixia, 2008)[2]. The signal will show that the passengers are waiting in specified destinations. In addition, a signal will be send to the bus station that will sound a buzzer that notifies the passengers that a bus is coming to their station. Passengers can also see which bus is coming to their station through an LCD. This will be reduced the time and cost wasted, and improves the effectiveness of the bus scheduling systems.

1.3 Objectives

The objectives of Public Transportation (BUS) Commuter Notification system are:

1) To design a notification system for bus transportation by using the Zigbee wireless module.
2) To develop a program for the notification system by using the PIC Microcontroller.
3) To build the project, which implements a system that can help alerted, noticed and warned the passenger and driver with low cost and low power consumption.

1.4 Scope

The scope of this project includes designing bus transportation systems utilizing a Zigbee, PIC16F877A microcontroller, buzzer, and LCD. The Zigbee wireless module is the communication device between the buses and the bus stations. Furthermore, the PIC microcontroller acts as the controlling and processing device that drives the entire system. A programming code will be developed and uploaded into the PIC.

Then, it will be interfaced with the Zigbee module for communication purposes. Signals will be sent from bus stations to the buses and from buses to the bus stations. It provides a two-way communication. Upon receiving the signals, it will be notified by the sound of the buzzers and visualization of texts on LCDs. Moreover, after the passengers ride the bus, the driver can reset the notified messages on the bus by pressing a reset switch.

1.5 Project Contribution

This project will notify the bus drivers by sending signals from Zigbee that there are passengers waiting at the specified destinations. In addition, the passengers will know that the bus is available and the message will be shown at their bus stop via LCD screen. For the driver also receive the signal which shown the destination of passenger and sound from buzzer. This project improves the bus transportation system and reduces the time and cost wasted as it is in the current bus transportation system. This system also aids the passengers who sometimes miss their bus due to their carelessness. Moreover, passengers can spend their waiting time by reading books or using gadgets without worrying about missing the bus. Indirectly, this project also saves cost for the bus transportation vendors.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

Travelling is the process in which people would spend days and even months to reach the desired destination. People started using boats that made of wood to travel across the sea. Now, travelling becomes easy with the availability of several transportation means ranging from simple motorcycle to huge airplane. The present-day consumers should be able to ride any vehicle, and easy to get the transportation to the destination with desired time and speed. Among the various transportation system currently used is the bus transportation systems, which is a collectively transport mean. Bus transportation is widely developed in most countries. It is utilized to provide a collective transport for people who are not affordable to have own transport(Koga, 1999)[1] .Then, bus transportation would reduce the traffic jam occurred due to the plenty of individual transport moving on the roads. The developed countries implement an organized system, including station and booking tickets are implemented just like any other transportation system such as airlines transport systems(Gardner, Souza, & London, 2009)[4]. The most important is implementing the system for bus transportation, since it enables passengers to move around in convenience and arranged way. As a tourist may not possess an individual transport, bus transportation would make it easier for them to travel to a desired

destination. Apart from that, energy consumption could be reduced by utilizing bus transportation where passengers will take collectively transport instead of using individual transport. Hence bus transportation not only convenience to passengers, but also contributes in reducing energy consumption and travelling costs as well.

2.2 Theory and basic principle

Many theories have been proposed to explain what are Zigbee wireless and PIC microcontroller. Although the literature covers a wide variety of such theories, this review will focus on the basics of Zigbee and PIC microcontroller method of analysis and a gap in literature. However, other information from past, researchers will also be included in this chapter for readers to understand more about this project.

2.2.1 Zigbee Wireless

Zigbee is a specification for a suite of high-level communication protocols used to create personal area networks with a small, low-power for digital radios. The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in home displays, traffic management systems, and other consumer and industrial equipment that require a short-range low rate wireless data transfer(Ke, Ruiqiang, & Cuixia, 2008)[2].

Low power consumption will limit the transmission distances to 10–100 meters depending on power output and environmental characteristics. Zigbee uses very low

data rate and has a long battery life, which makes it widely useful in monitoring and control applications(A.Mounica & G.V.,2017). Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more than the distance. Zigbee is typically used in low data rate applications that require long battery life and secure networking (Zigbee networks are secured by 128 bit symmetric encryption keys.) Zigbee has a defined rate of 250 Kbit/s, is best suited for intermittent data transmissions from a sensor or input device.

Figure 2.1: Zigbee symbol

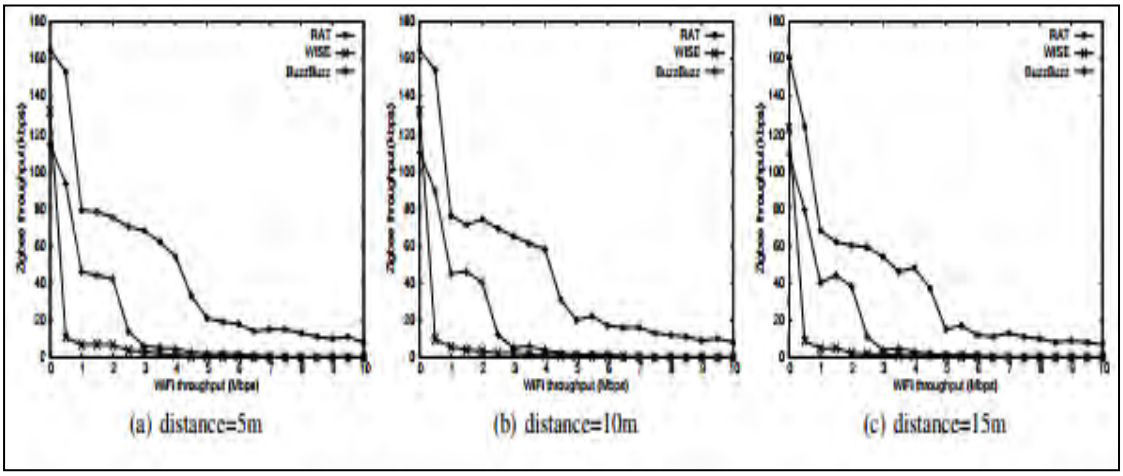

Figure 2.2: Zigbee throughput vs Wifi throughput

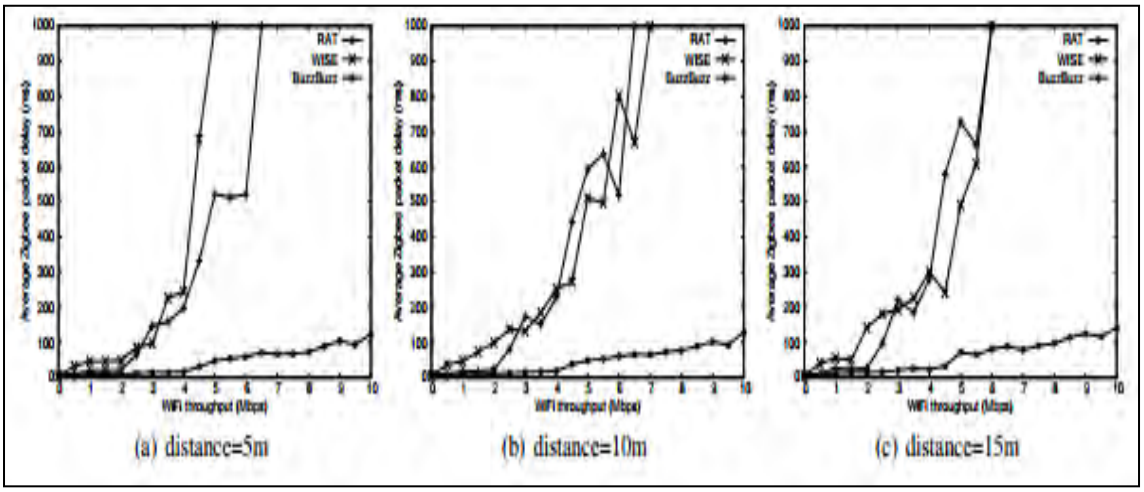

Figure 2.3: Zigbee packet delivery delay vs wifi throughput

2.2.1. History

Zigbee was created in 1998 and standardized in 2003, and revised in 2006. The Zigbee standard has evolved since its original release in 2004 and it is a new low cost, low power wireless networking standard for sensors and control devices.

Zigbee provides network speeds of up to 250kbps and is expected to be largely used in wireless sensor network applications where high data rates are not required. Zigbee uses the media access to control the layer and physical layer for communication between devices. Zigbee also offers a short-range wireless networking capability with low cost, low data rate and low power consumption.(Kobayashi, 2016)[5]

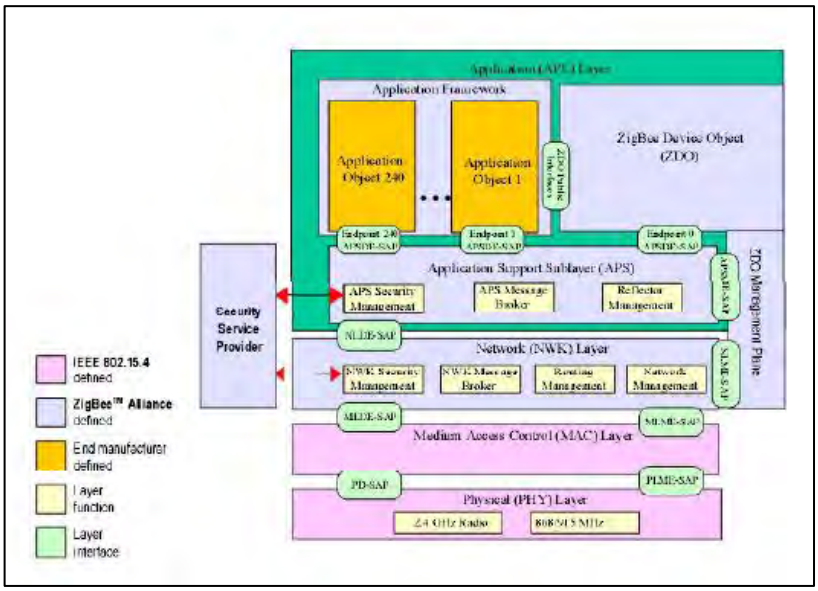

Figure 2.4: Zigbee stacks architecture, which is made up of blocks called layers.

Each layer will perform a specific function in the Zigbee protocol architecture. The data will entity provides the data transmission service and a management entity provides the all other services. Each service entity exposes an interface to the upper layer through a service access point (SAP) and each SAP supports a number of service primitives to achieve the required functionality .The Zigbee protocol will be built upon on this foundation by providing the network layer (NWK) and the framework for the application layer. The application layer framework consists of the application support sub-layer (APS) and the Zigbee device objects (ZDO).

The lower frequency PHY layer covers both of the 868MHz European bands and the 915 MHz band that are used in the United States and Australia. The higher the frequency the more layers are used on virtually worldwide.

The responsibilities may also include transmitting frames, synchronization and providing a reliable transmission mechanism. The Zigbee network layer supports star, tree, and mesh network topologies. The Zigbee coordinator is responsible for initiating and maintaining the devices on the star network topology.

Star network topology will control the coordinator and all the devices and directly communicate to the coordinator. The Zigbee will coordinates for starting the network and choosing the key network of parameters.The routers move data will control messages through the network by using the hierarchical routing strategy and Zigbee is employed by carrier sense multiple access (CSMA)

The advantages of Zigbee is that it will get through the CSMA is will be reduced the current drain and having longer battery life elimination of waiting time for polling. Zigbee also be developing the sensor and control the application for wireless personal area network (WPAN) applications that cover short distance communication and control requiring low data rates(Nugroho & Sahroni, 2014)[6]. The contributions of the paper are summarized as follows:

1) Conduct extensive statistical analysis of data traces captured in real-life WiFi networks. We show that, in a channel shared by a group of WiFi devices, the size of WiFi frame clusters well satisfy the power law distribution.

2) Test the encoding/decoding time of a series of light-weight coding techniques on Zigbee devices. Based on the results and the WiFi traffic

model, we derive the transmission efficiency for each coding technique, and present the optimal encoding strategy for different WiFi traffic load.

3) Observe that there is distinct duration gap between encoding time and decoding time on Zigbee devices, which can be effectively exploited for channel sampling. Hence, Zigbee devices can keep updating the WiFi traffic model while delivering packets, without frequently suspending their transmissions for channel sampling(P. Guo& J. Cao,2014).

The factors of prime propelling will be caused the significant of reduction in the power consumption and will provide the wireless stand, which the facilitators will improve the battery life from hours to months. Therefore Zigbee technology will innovate the proprietary solution by creating numerous interoperability issues. The implementation will combine with the very low power consumption and limited cost of implementation. The active development of Zigbee Chipsets and complete solution development by various companies globally stand witness to the expected boom of the Zigbee Standard in the very near future in several applications including ITS.

Table 2.1: Comparison Of Characteristic For Different Wireless Protocol

Protocols	**Bluetooth** [2], [14], [17], [18]	**UWB** [14], [19]	**ZigBee/IP** [2], [14], [17-23]	**Wi-Fi** [1], [2], [14], [24], [25]	**Wi-Max** [17], [25-28]	**GSM/GPRS** [29-33]
Frequency band	2.4 GHz	3.1-10.6 GHz	868/915 MHz; 2.4 GHz	2.4; 5 GHz	2.4; 5.1- 66 GHz	850/900; 1800/1900 MHz
Max signal rate	720 Kb/s	110 Mb/s	250 Kb/s	54 Mb/s	35-70 Mb/s	168 Kb/s
Nominal range	10 m	10-102 m	10 - 1000 m	10-100 m	0.3-49 Km	2-35 Km

Nominal TX power	0 - 10 dBm	-41.3 dBm/MHz	-25 - 0 dBm	15 - 20 dBm	23 dBm	0-39 dBm
Number of RF channels	79	(1-15)	1/10; 16	14 (2.4 GHz) 64 (5 GHz)	4;8 10;20	124
Channel bandwidth	1 MHz	0.5- 7.5 GHz	0.3/0.6 MHz; 2 MHz	25-20 MHz	20;10 MHz	200 kHz
Modulation type	GFSK, CPFSK, 8-DPSK,π/4-DQPSK	BPSK, PPM, PAM, OOK, PWM	BPSK QPSK, O-QPSK	BPSK, QPSK, OFDM, M-QAM	QAM16/64, QPSK, BPSK, OFDM	GMSK, 8PSK
Spreading	FHSS	DS-UWB, MB-OFDM	DSSS	MC-DSSS, CCK, OFDM	OFDM, OFDMA	TDMA, DSSS
Basic cell	Piconet	Piconet	Star	BSS	Single-cell	Single-cell
Extension of the basic cell	Scatternet	Peer-to-Peer	Cluster tree, Mesh	ESS	PTMP, PTCM, Mesh	Cellular system
Max number of cell nodes	8	236	> 65000	2007	1600	1000
Encryption	E_0 stream cipher	AES block cipher (CTR, counter mode)	AES block cipher (CTR, counter mode)	RC4 stream cipher (WEP), AES block cipher	AES-CCM cipher	GEA, MS-SGSN, MS-host