Vehicle Security System Using Zigbee

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***Abstract*-** The first car been stolen was reported in 1896. Since then, car safety tools and after that car security system faced a fast rapid development. The security system has become one of the key factors in car manufacturing as the demand from the buyer. The main objective of this project is to secure and monitor the car based on combination of Zigbee system, Peripheral Interface Controller (PIC) 16F877A microcontroller, vibration sensor, temperature sensor and micro switch. In order to develop a user friendly security system, it is used as a tool to send data or information to the Liquid Crystal Display (LCD) at the receiver for displaying the car situation. There are two programs used in this system which for the transmitter and the receiver. Proteus 7 Professional will be used in designing process of the circuit and to conduct simulation works. Meanwhile, PIC C Compiler software will be used to compile the C language code to Hexadecimal (HEX) code so that it is compatible to the PIC. The hardware and software issues of wireless monitoring system have been successfully developed by using Zigbee technology. This system is expected to enhance the capability of existing system and reduce cost of the system. With significant improved in range and reliable data accuracy in real time, this project promise a bright future with a high commercial value. In addition, with its compact and robust feature it attract future user in buying the product and the same time have good application value in future as well as reducing the statistic of stolen cars.

***Index Terms*-** Car Security, PIC16F877A Controller, Sensor, Zigbee

I. INTRODUCTION

The outer shell of automobiles impacts the people's life. It is becoming the needs and a symbol of modern society. Not only the demand on quality and performance of the vehicles increase rapidly, but there is also an issue increases day by day which is car stolen. Based on the official website of Polis Di Raja Malaysia (PDRM), the total numbers of vehicles that has been stolen for the year 2011 amounted to 17,474 cases. From the amount, 12,427 cases are the car theft and about 5,047 cases are for other vehicle which is includes van, lorry and etc. Although there some intelligent systems e.g. Vehicle Tracker by using Global Position System (GPS) can be used to retrieve vehicle, but people are still not using it due to the high cost purchase. By using Zigbee system network in this anti-theft system, the cost is expected to be lower compare to existing GPS anti-theft system. This project is provided a remote controlling security system for vehicle. This security system consists of vibration sensor (body), alarm, buzzer, micro switch (engine), temperature sensor, fan and magnetic sensor (door). User will be able to control the system remotely since the data in the system will be transmitted wirelessly via Zigbee module. They also can monitor the car status by using the Liquid Crystal Display (LCD) display which attached to the controller.

According to F.R. Rashidi, et al, [1]; Bluetooth is used as communication medium in this car safety monitoring system. The Bluetooth application was used on a mobile phone to send message to the users in the event of their vehicle intrusion. Passive Infra-Red (PIR) sensor founded in the system will send a message if there is any intrusion get into the car through Bluetooth to PIC microcontroller.

Based on the journal, Shihab A. Hameed, et al [2] reported that the proposed system focuses on using the Multimedia Messaging Service (MMS) and database technology. The picture of the intruder will be sent via local Global System for Mobile Communications (GSM) / General Packet Radio Service (GPRS) service provider to the user and/or police. This project is being recommended the integration between monitoring and tracking system. The system can send Short Messaging System (SMS) and MMS to the owner to have fast response while the car is still nearby the original location. This system cannot be used at the rural place without network coverage provided.

From the journal, S.Padmapriya and Esther Annlin KalaJames [3], skin color detection is first implemented on the input color image to reduce the computational complexity. This system used the Morphological operations that give a previous knowledge for face detection using the Adaboost algorithm. By using principal component analysis (PCA) algorithm, a specific face can be recognized by matching the principal components of the current face to those of the known persons in a facial database built in advance.

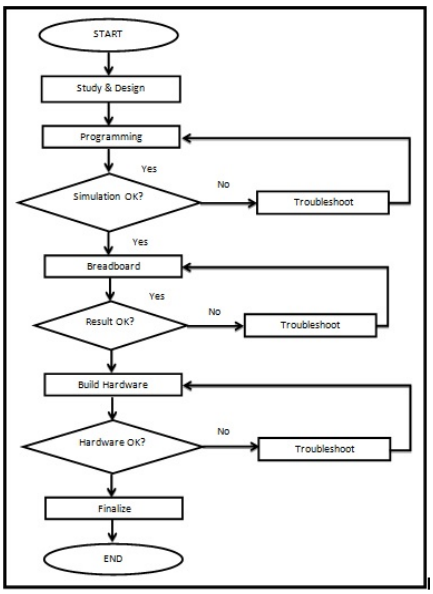
In the journal, K S Khangura, et al [4] said that his innovative system is based on a tamper-proof electronic link between the driver's key and the ignition system. This method used radio frequency technology with improves a new level of theft protection to vehicle security systems in a way that it does not require any effort from the drivers. In addition, this tactic removes the normal wear and replacement of keys common to contact based security systems.

According to Zhixiong Liu and Guiming He [5], their proposed security system are based on device vision technology acids that is a new level of theft protection to vehicle security systems in a way that does not interfering the drivers. When the case of an illegal driver drives the car, POLLUX will alarm and

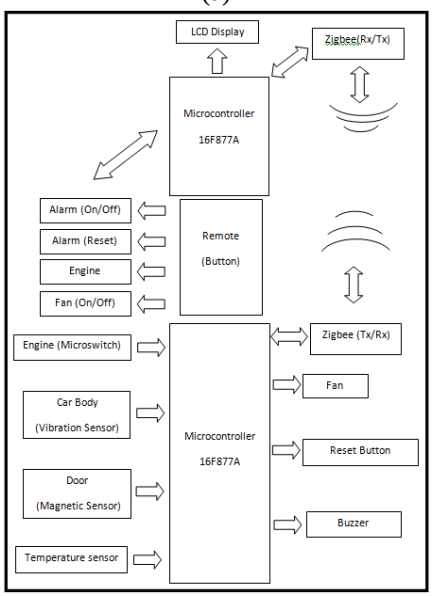
send the illegal driver's image to car owner or police through Code Division Multiple Access (CDMA) or General Packet Radio Service (GPRS) networks.

However, according to these papers, high performance of Zigbee technology together with ability to remain quiescent for long periods without communications and long power battery is required to obtain reliable experimental data. Such these high cost experimental devices will not be affordable if not supported by research fund. Thus, Zigbee communication is used as the communication medium due to the small size, good performance and acceptable price [13]. The aim of this project is to investigate and design one system that can help user easy to monitor their car by using Zigbee module with a user friendly security system.

II. MATERIALS AND METHODS



(a)



(b)

Figure 1 (a) Project Flow chart and (b) Car Security Block Diagram

This project is divided into two parts, first is hardware development and second is software development. C language is used to execute the program in PIC which would get signal from sensors and display the status on LCD display. PIC C compiler is used to assemble the C programming [6], [7], [8], [9] file into HEX file. Meanwhile, all the simulation processes are done with ISIS 7 Professional software. The hardware part is divided into two parts which are master control and slave control where the sensor circuit is located.

The first step is to study on the literature review on the basic operation of Zigbee technology and also related research journal to this project. Next, selection and suitability of sensors that will be used in the project is reviewed. There are magnetic sensor, temperature sensor (LM35), vibration sensor, micro switch, buzzer, alarm, fan, light emitting diode (LED). The designing process will be in the next step that will be in Proteus software. Then, the programming is constructed base on the desired output. The circuit is simulated and integrated with the selected sensors after the programming has been successful constructed. In case of the simulation failed, the programming process must be redone and reviewed again. For successful simulation, the next step is to implement it on to the breadboard to check whether the circuit functional or not. The circuit must be reconstructed if the circuit failed to operate as expected. A new functional circuit will be constructed in Printed Circuit Board (PCB) for the real application.

According to the block diagram, there are four sensors which is temperature, vibration, magnetic, and micro switch. These sensor works as input in the transmitter circuit and will be interfaced with the PIC 16F877A microcontroller [10], [11], [12]. The outputs of this system are alarm, fan, and buzzer. Xbee module works as the transmission medium for which the data will be transferred wirelessly to the receiving XBee in the transmitter circuit. The received data will then be displayed in the LCD display [13].

III. RESULTS/FINDINGS AND DISCUSSION

A. Zigbee Functionality Test Result

This process is for checking the functionality and testing how far the Zigbee transmitter can connect with Zigbee receiver. Before that, the Xbee module need to be configured before it can be used as serial communication medium.

The X-CTU software has several other functions beside configure the Xbee module. Each main tab has its own function to develop the communication by using the Xbee module. Below are the explanations of its function:

i. **Personal Computer (PC) Settings**
Allow user to choose the desired COM port and configure ports to fit the radio settings.

ii. **Range Test**
Allow user to achieve a range test between two radios.

iii. **Terminal**
Allow access to the computers COM port with a terminal emulation program.

iv. **Modem Configuration**
Allow the ability to program the firmware settings via a graphical user interface [14], [15].

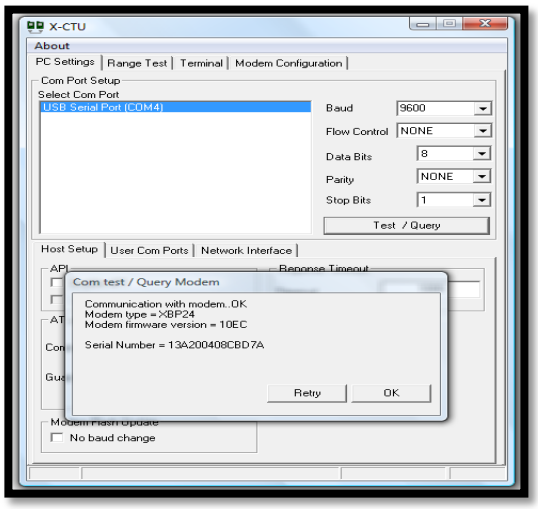


Figure 2 Port Setting

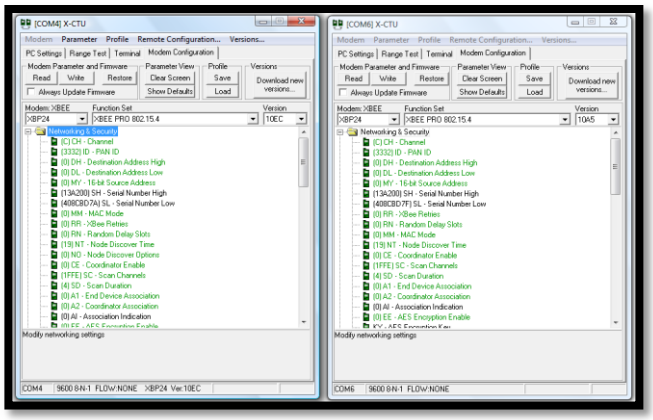


Figure 3 Configuration of Destination Address

After finished the setting both of the Zigbee [16], [17], [18] module using X-CTU software in the PC, both the Zigbee is tested whether it can communicate each other or not. It also to make sure the range of communication whether the Zigbee refer to its specification or not [19].

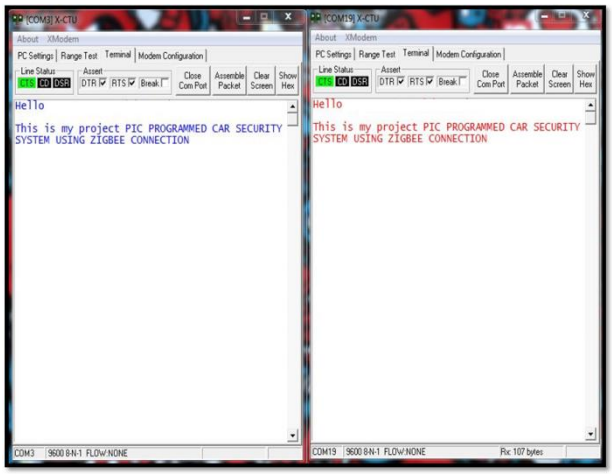


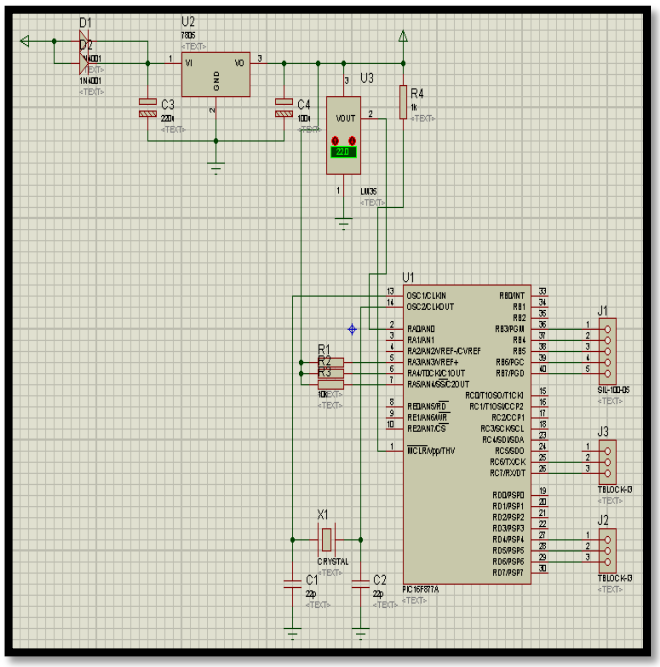
Figure 4 Data transmit (left) and receive (right)

Table 1 Collected Data Analysis

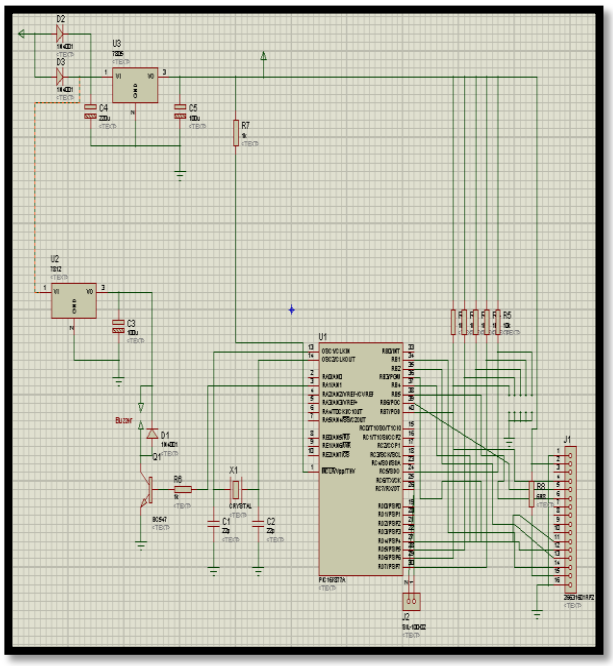
RANGE (M)	ZIGBEE ANALYSIS
Meter 0 to Meter 20	The Zigbee 2 received data from transmitter accurately and instantaneously.
Meter 0 to Meter 40	The Zigbee 2 received data from transmitter accurately
Meter 0 to Meter 60	The Zigbee 2 received data from transmitter accurately
Meter 0 to meter 80	The Zigbee 2 received data from transmitter accurately
Meter 0 to meter 100	The Zigbee 2 received data from transmitter accurately
Meter 0 to meter 120	The Zigbee 2 received data from transmitter accurately.
Meter 0 to meter 140	The Zigbee 2 received the data slowly the transmitter.
Meter 0 to meter 160	The Zigbee 2 received the data the transmitter.
Meter 0 to meter 180	The Zigbee 2 received the data from the transmitter.
Meter 0 to meter 200	The Zigbee 2 still able received the data from the transmitter.

Table 1 shows the range between Zigbee 1 and Zigbee 2 and also the result of data that received from the transmitter Zigbee. For this project, Zigbee is used as wireless communication tool. The Zigbee offers communication up to 200 meter and it can supported until the maximum range. It is due to the conducted test at the open field with able the line of sight occurs. The errors could be occurred due to surrounding factors.

B. Circuit Design Result



(a)



(b)

Figure 5 (a) Construction in ISIS for Receiver for Transmitter and (b) Receiver

i. Interfacing LCD Display with PIC Microcontroller

Based on this project, the LCD display was connected with PIC 16F877A microcontroller to display the entire situation inside the car such as temperature, key, door and part of the car whether safe or unsafe.

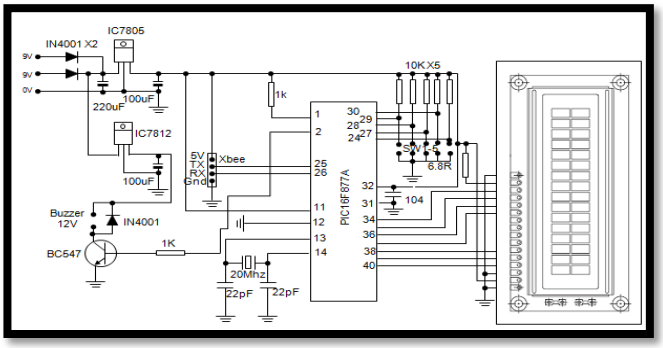


Figure 6 Schematic LCD Display Interface with PIC Microcontroller

ii. Interfacing Sensors with PIC Microcontroller

In this part, the sensors will interface with PIC 16F877A microcontroller to ensure that the PIC and sensors are successfully connected. If the connection between the sensors are perfect, the data can be sent and view at the LCD display. There are two partition in this system namely transmitter and receiver part. For the transmitter part, it will be embedded inside the car with four inputs and two outputs. The input of the system consists of temperature sensor [20], vibration sensor [21] (car body), magnetic sensor (door), micro switch (engine) [22] and LED [23] while the output part consists of buzzer and reset button. For the receiver part, it may be consider as a remote or handheld indicator and it have several element like LCD display, fan, buzzer and four push button for the alarm as to ON or OFF the system, reset button (OFF the both buzzer), engine (OFF the engine) and fan (ON / OFF the fan).

(a)

(b)

Figure 7(a) Temperature inside the Car and (b) Fan is ON

(a)

(b)

(c)

Figure 8(a) Vibration sensor is ON, (b) magnetic sensor is ON (c) and micro switch is ON

IV. Conclusions

In a nutshell the objectives of the project have been successfully achieved. A wireless monitoring system have been successfully developed using Zigbee technology and the result is satisfactory. With significant improved in range and reliable data accuracy in real time, this project promise a bright future with a high commercial value. In addition, with its compact and robust feature it attract future user in buying the product. Although this project has turn out to be a great success, more improvement can be done in order to create a more complete security system. Creating a more compact circuit and smaller in size is recommended in the future work. A smaller size remote controller helps user to carries it with ease. Another improvement to the project is to link it with another wireless communication system such as GSM. With this addition users can be notified through their cell phone in case the buzzer is not working properly. Further Research and Development (R&D) will ensure a complete security system with high commercialized value. This project also can be extended, not only for car security purposes but also with the right choice of sensors, this system can be implemented as home security system.

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