Shopping Trolley Tracking System via SMS using Ultra High Frequency Application

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Abstract: *This paper presents the function of Application Radio Frequency In Keeping Track Shopping Trolley Using GSM. The objective of develop this project is to create a solution that can help the shopping management that provide trolleys services for the costumers or users to reduce cost to their company arising from the missing trolleys and frequently considered stolen This system consists of receiver and transmitter, and technically this device uses radio frequency wave concept to operate. If one of the trolleys is out of range, turn on a buzzer and a red light at the same time at control room than using GSM will sent Short Message Service (SMS) to guard. This capability provides ease and safety to safety guard, to monitor the trolleys frequently used by costumers or users. The operating frequency used by the transmitter is about 100MHz to 2.45GHz which the receiver can detect accurately within 10 to 100 meters; even through a protective casing is covering the transmitters. This covering is also use to avoid the users damaging the transmitters and to provide protection to the assembly. This is to ensure the trolley always in range.*
Keywords: PIC Microcontroller, Proteus professional 7, RF transmitter and receiver, GSM.

1. INTRODUCTION

Nowadays, shopping cart in one of the item that usually use at the supermarket or shopping mart. A shopping cart (trolley, carriage) is a cart supplied by a shop, especially supermarkets, for use by customers inside the shop for transport of merchandise to the check-out counter during shopping. Customers can then also use the cart to transport their purchased goods to their cars.

In some places, customers are allowed to leave the carts in the parking lot, and store personnel will return the carts to the storage area. In most Malaysian premises however, coin (or token) operated locking mechanisms are provided to encourage shoppers to return the carts to the correct location after use. In many countries, the customer has to pay a small deposit by inserting a coin, token or card, which is returned if and when the customer returns the cart to a designated cart parking point. The motivation behind the deposit systems is not theft deterrent (the trolley is worth significantly more than the deposit) but to reduce the expense of employees having to gather carts that are not returned, and to avoid damage done by runaway trolleys.

From the history, the invention of Sylvan Goldman, owner of the Piggly Wiggly supermarket chain in Oklahoma City is one of the first shopping carts was introduced on June 1937. He found a wooden folding chair and put a basket on the seat and wheels on the legs. Goldman and one of his employees, Fred Young, a mechanic, began tinkering. Their first shopping cart was a metal frame that held two wire baskets. Since they were inspired by the folding chair, Goldman called his carts "folding basket carriers". [1]

The shopping cart has undergone many more changes as time has progressed. The shape has changed as ergonomic considerations were taken into account. For the most part, carts are bigger to hold more merchandise, thus enabling more sales. Although basic design hasn't changed much in the last 50 years, the next generation of carts is still evolving, with even bigger upper and lower baskets. Some stores are starting to get cart accessories that hold two kindergarten-size kids.

Practically all modern shopping carts are made of metal or a combination of metal and plastic and have been designed to nest within each other in a line to facilitate collecting and moving many at one time and also to save on storage space. The carts can come in many sizes, with larger ones able to carry a child. There are also specialized carts designed for two children, and electric mobility scooters with baskets designed for disabled customers.

Shopping trolleys also present tremendous logistic problem to the management. The result that, trolleys being misplaced or stolen and this project aims at developing a solution to provide theft prevention. Most supermarket or hypermarkets in Malaysia share the same problem of keeping track of their trolleys when users use it. The main problem is, trolleys are always out of range from the supermarket because the users do not know where they should leave the trolleys and this causes lot of trouble to the supermarket management, and often most trolleys are considered stolen when this happened.

The main objective of this project is to design and develop

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a device that detects the shopping trolleys when the trolleys are out of the market range, making use of wireless system concept. There are various types of wireless systems. This project uses the Radio Frequency for communication. This project is also implements the transmitter and receiver concept. The main goal of developing this device is to alert the safety guard when the trolleys are out of range and to prevent shopping trolley from theft and lost.

2. PROJECT DESCRIPTION

There was a two ways association between the model and the implementation. The basic features of the model were used to drive the implementation, while the lessons learned during the implementation were used to refine the model. It is therefore expected that there is a direct mapping between the model and the system.
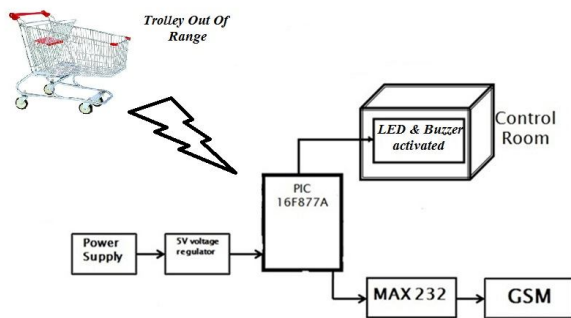

Figure 1. Basic model of project

The circuit of this project is divided into 3 main circuit which are Main Board that contained PIC 16F877A, transmitter circuit and receiver circuit. Another main part is GSM Device. The circuit is design using Proteus 7 Professional, the circuit is design and successfully simulated before transfer to PCB layout.

i. Main Board

This is the main circuit of the system. This circuit contains PIC 16F877A and MAX232.Firgure 2 show the Main Board Schematic Circuit.
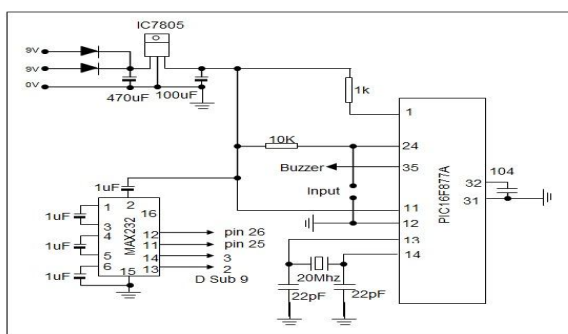

Figure 2. Main Board Schematic Circuit.

ii. Transmitter

For this system, the development of Signal Detector using Radio Frequency (RF) system used Transmitter. There are two type of RF Transmitter that used in this project. One is use 315MHz and another one is use 433MHz. This module is small in dimension. In addition it has a wide operating voltage, which is from 3 volt to 12 volt. It is a low cost RF transmitter. According to the data sheets, the maximum distance for transmission is 100 meters. The transmit distance is seriously affected by the antenna design (length). It is good for a short distance transmission. It could be used as an industrial remote control, telemetry, remote sensing, alarm systems, wireless transmission for various types of low-rate digital signal, remote control for various types of household appliances and electronics projects.[2]   Figure 3 shows that the Transmitter Schematic Circuit.
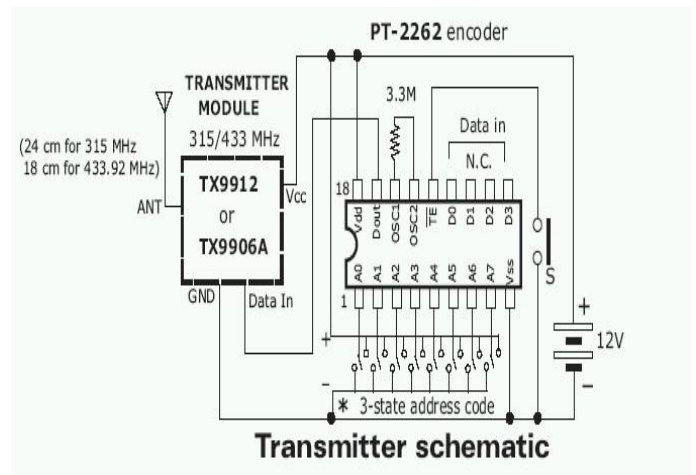

Figure 3. Transmitter Schematic Circuit
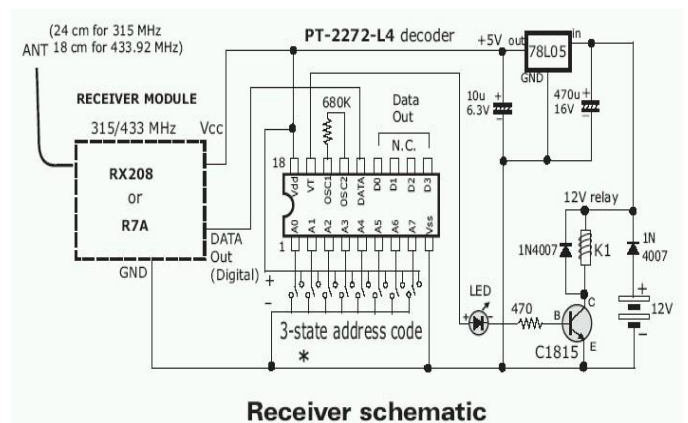
iii. Receiver

Figure 4. Receiver Schematic Circuit

For this system, the development of Signal Detector using Radio Frequency (RF) system used Receiver. There are two type of RF Receiver that used in this project. One is use 315MHz and another one is use 433MHz. Similar to

the RF transmitter, the RF Receiver module is also small in dimension. The receiver has a small range of operating voltage. It just can support the operating voltage from 4.5 volt to 5.5 volt. The RF Receiver has a super regeneration design to ensure it is sensitive to weak signal. Figure 4 shows that the Receiver Schematic Circuit.[3]

iv. GSM Device

Global System for Mobile Communication (GSM) is world's most famous mobile platform. Mobile phones with SIM cards use GSM technology to help communicate with family, friends and business associates. Other applications of GSM include access control devices, transaction terminals and supply chain management. For access control devices, it enables communication with servers and security staff through SMS messaging. GSM/ GPRS modem can be connected directly to the computer serial port for wireless GSM communications including sending and receiving text messages. It can also be connected to the remote RS232 serial equipment which allowing us to dial up the system for remote management. [4] .

3. RESULTS AND DISCUSSIONS

3.3   Title and authors

The final result of the project is to create an application radio frequency in keeping track of shopping trolley by using Transmitter Module and Receiver module using radio frequency. When detect the trolley is out of range it will activated the warning buzzer and red LED in the main board at control room, in the same time GSM will send warning message to the guard hand phone that the trolley is out of range. The expected result for Application Radio Frequency In Keeping Track Shopping Trolley Using GSM as below:

- To fabricate microcontroller circuit
- To fabricate Transmitter circuit
- To design the prototype of project
- To fabricate receiver circuit

A) Software Implementation

Software implementation is the most important part in this project. It involved the development of C language using software CCS Compiler. Before implementing the hardware the simulation is done using Proteus in order to better understand before implementing the hardware development.

i. Algorithm And Programming In CCS Compiler

Microcontroller is the CPU (central processing unit) of the system. It receives data and process it based on the program C language. An algorithm has to be developed to make the microcontroller to read the input and respond accordingly. This source code is using C language and compiled by CCS Compiler. There are two parts of the program, which are the main program and the interrupt program. The microcontroller is always run the main program until there is an interrupt occurred. When microcontroller receives an interrupt flag, then it will jump to interrupt process.

Interrupt process is the most important part in PIC operation. Without interrupt, there a many functions and features inside of the PIC cannot be used. Interrupt is a process that can stops a microcontroller from what it is doing currently, so that something else can be serviced first. The general process of interrupt can be explained as when the main program is running, it performing as usual, but when an interrupt occurs, the main program halts while another routine is carried out. When this routine finishes, the processor goes back to the main routine again.

ii. PICkit2 Software

PICkit2 is software used to load the program to the microcontroller. The circuit is interface with ICSP programmer first before loading the hex file into the PIC16F877A. The important icon such as open, write and verified has been explained in detail as below:

    i. After connecting the circuit with the ICSP programmer, the icon 'Verified' was pressed to detect the PIC.
    ii. Then the .hex file was attached from icon 'open'
    iii. To load the file into the microcontroller, button 'Write' was selected.

Successful message will appear if the loading was finish and success.

iii. Proteus 7 Professional.

Proteus 7 Professional is circuitry software that helps user to simulate schematic circuits. The software consists of two parts; the board editor is to create the circuitry and PCB board editor for designing PCB boards. This software provides a library for variety used components with its own specific size and radius of pin holes which can minimize the user's burden in determining the component size.

Basis step start using Proteus 7 Professional:
i.   Click component icons. Chose the related component that will be used in the circuit.
ii. Click pick device icon. The device selector dialogue will appear and now select the device from the various devices library. Then select object from the object selector.

iii. Complete the circuit and loading the HEX file to simulate. Double click at the PIC16F977A to load the HEX file that has been created in the CCS Compiler.
iv. Click the start button to run the electrical schematic. Figure 4.5.1 show the basic step in using Proteus 7 Professional.

Receive SMS Messages through a Mobile Phone using GSM Modem.

Receiving SMS messages through a mobile phone or GSM modem has a major advantage over the other two ways .Wireless carriers usually do not charge any fee for receiving incoming SMS messages with their SIM cards. The disadvantage of receiving SMS messages this way is that a mobile phone or GSM modem cannot handle a large amount of SMS traffic. One way to overcome this is to load balance the SMS traffic with a pool of mobile phones or GSM modems. Each mobile phone or GSM modem will have its own SIM card and mobile phone number.

In terms of programming, sending and receiving SMS messages through a mobile phone or GSM modem is similar need to send instructions (in the form of AT commands) to the mobile phone or GSM modem. In Table 1, list of AT commands that are related to the receiving and reading of SMS:

TABLE 1. AT Commands for Sending and Receiving SMS

AT command	Meaning
+CMGF	New message indications
+CMGL	List messages
+CMGS	Read messages
+CNMA	New message acknowledgement

To enable an application to receive SMS messages, have to write the source code for connecting to and sending AT commands to the mobile phone or GSM modem, just like what a hyper terminal program does. Write the source code in C, C++, Java, Visual Basic, or other programming. Figure 5 shows the Short Message Service (SMS) that receive at mobile phone.

Generally, the methodologies are divided into three parts; there are planning, implementing and analysis. In planning phase there are including with reading activity and some job of requirements of hardware and software to be used.

In reading activity, have do a research through several sources such as text books, journal, paper references, the Internet and more sources due to get the information about the project related. While in the requirements of hardware and software to be use that was study and find out the functional and operational of the hardware and software related.

Next step is implementing phase where in this part has produce the project circuit board. When the PCB was ready to mount the electronic components, the process of construction circuit is followed. The process of checking, testing and tuning are followed due to complete a part of implementing.

At the end of the project, the circuit module, mechanical structure and source code for the Application Radio Frequency in Keeping Track Of Shopping Trolley using GSM has been successfully constructed and demonstrated. Generally, the objective of this project has been archived. The main board, transmitter and receiver circuit have been successfully designed, developed, constructed and tested. The result presented in the previous chapter revealed that intended shopping trolley tracking system can successfully detect when a shopping trolley is within or out of range of the shopping complex permitted area.

Figure 5: Short Message Service (SMS) that receive at mobile phone.

From the project testing and demonstration, RF transmitter module and RF receiver module are commonly used for Alarm systems and wireless reception for various types of low-rate digital signal. These RF Transmitter Modules are very small in dimension and have a wide operating voltage range (3V-12V). The low cost RF Transmitter can be used to transmit signal up to 100 meters (the antenna design, working environment and supply voltage will seriously impact the effective distance). It is good for short distance, battery power device development. For RF receiver modules are very small in dimension. The low cost RF Receiver can be used to receive RF signal from transmitter at the specific frequency which determined by the product specifications.

4. CONCLUSION AND FUTURE WORKS

In conclusion, the objective of the project has been achieved and in completing the project a lot of knowledge and experience has been gained. Finally, in analysis phase, the project was come out with the operations of Receiver and transmitter circuit. The functions and the operations of the circuits related are very important to be analyzed. With appropriate steps and methodology, any process of completing the project can be managed wisely and will be make a good result.

There are recommendation of the future work are suggested to improve on the performance of this project. In order to achieve the objective of the Application Radio Frequency in Keeping Track Of Shopping Trolley using GSM, good programming is suggested to overcome the problem of the microcontroller. To make the system more sophisticated, for the power supply for receiver and transmitter circuit, maybe can use solar panel to reduce of cost of maintaining if use a battery. Other than that, maybe at the trolley circuit will add alarm and LED to customer also know that they have use trolley out of range. . By this additional featured, this system functioned can give assurance for shopping complex to protect their trolley from thieves and criminals and will make the Application Radio Frequency in Keeping Track Of Shopping Trolley using GSM more friendly to users.

ACKNOWLEDGMENT

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