Development of Transmitter and Receiver Circuit for Automatic Announcement in LRT Train

Mohd Nazrul Fazli bin Mohd Foudzi
Faculty of Electrical Engineering
University Teknologi Mara Malaysia (UiTM)
Shah Alam, 40450 Selangor
Malaysia
nazrulfazli@yahoo.com

Abstract – **Remote control system using radio frequency increasingly popular compared to infrared. The advantage of radio is the ability of the signal to pass through objects and walls. Its range is also impressive about 100 meters and more (in free space) being typical. This paper presents a solution for LRT train announcement problem by using wireless radio frequency transmitter and receiver circuit to energize the automatic announcement circuit. The circuit described generates ultrasonic sound of frequency between 315 Mhz to 350 Mhz. Transmitter which is placed at the station platform will generates ultrasonic sound and the receiver which is placed at the LRT train will senses ultrasonic sound from transmitter and switches "on" a relay. The relay is used to control the public address equipment.**

This project is one of the major part of the automatic announcement system which consists of complete block of automatic announcement system. The proposed project has two different circuit which is a transmitter that transmit the wireless radio frequency and a receiver to receive the signal transmitted. Then, the receiver output will connect to the automatic announcement circuit and activate it. To develop this circuit there are many software can be used such as p-spice and Multisim ver7 to design and simulate the circuit and Protel software to design the PCB board.

Keyword : LOS, LRT, Radio Frequency, Radio Frequency, Receiver, Station Platform Transmitter.

I. INTRODUCTION

RF is short for *radio frequency*, any frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space. Many wireless technologies are based on RF field propagation.

Radio frequency (RF) is a frequency or rate of oscillation within the range of about 3 Hz to 300 GHz. This range corresponds to frequency of alternating current electrical signals used to produce and detect radio waves. Since most of this range is beyond the vibration rate that most mechanical systems can respond to, RF usually refers to oscillations in electrical circuits or electromagnetic radiation

Low frequency systems generally have an operating range of between 1 and 3 meters, however low power levels can be used and therefore LF systems are more easy for licensing. Low frequency systems are also more appropriate for use in hazardous atmospheres due to the low power levels. Another advantage of LF systems is that unlike many other automatic identification systems, including RFID systems operating at the top end of the frequency spectrum, they do not require line of sight between the transponder and the reader antenna. High frequency systems are available with operating ranges of 30 meters or more. However, to obtain this range, high power levels must be used. Fast data rate Less able to penetrate solids high power levels. High frequency systems are less acceptable internationally due to licensing difficulties. Furthermore, the ability of these systems to read transponders through solids is limited, in addition those systems operating at the top end of the frequency spectrum require line of sight the transponder and the reader unit. The simplest link type is the point-to-point system. There, the transmitter and receiver must be pointed at each other to establish a link. The line-of-sight (LOS) path from the transmitter to the receiver must be clear of obstructions, and most of the transmitted light is directed toward the receiver. Hence, point-to-point systems are also called directed LOS systems.

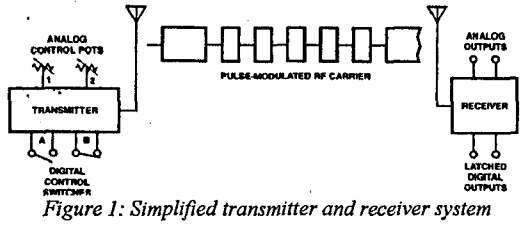


Figure 1: Simplified transmitter and receiver system

To design the transmitter and receiver circuit, there are many aspects to consider. The main problem is to find the best circuit for transmitter and receiver which is suitable to the application, because when to put the circuit at the LRT train, the equipment at the train itself have its own frequency which is came from signaling equipment. When the best circuit had been choose, the next process is to design the circuit using suitable software and application. From here, all knowledge about electronic and communication is very helpful to make the circuit function.

After all the circuit had been test and function, the next process is to put the transmitter and receiver circuit in the suitable case with the good design. The transmitter is house in a case which has two push switch buttons to select the channels. The pcb is fixed in the case with the screw. For the receiver case, it has a main switch for the power input control. The LED which is situated at the rear of the case will indicates power on and the channels selection.

The train announcement problem was encountered by the beginning of the service of LRT but the high cost to produce an effective automatic announcement and "birokrasi" has drag the project until now. Today the STAR LRT destination announcement is doing manually the train drivers.

The problem facing with the manual announcement is

- wrong destination announcement by the train drivers because the train driver always must alert which platform they arrived but sometimes they not focus and loose where they are.
- Slow announcement by the train drivers and not consistent voice in announcement because the situation is not same all the time.
- For the customer is when the train window is not clear or dark outside the train, difficult for them to identifies what station they had arrived.

This project is designed to resolve these problems as started before. When the train arrived near to the station (platform), the transmitter at the station will detect the signal from the receiver which is located at the train. Then the output from the receiver circuit will connected to the automatic announcement circuit.

II. METHODOLOGY

The methodology applied in this entire proposal is to develop the transmitter and receiver circuit. For the circuit drawing design, the software that use is the Multisim version 7. This software will detect when an error occur. For the PCB development, Protel software is used to determined the best location of the components on the PCB. With this software, it can determine which track is the best path. In the hardware design, there are some factors that had consider such as user friendly, easy to operate, easy to maintain and have a good looking.

Receivers and Transmitters

The transmitter modulates the RF carrier with a unique series of pulses, and the receiver decodes these pulses, and generates appropriate analog and digital signals for the devices being controlled. Analog signals are represented by pulses of varying duration. Digital signals are encoded and decoded by pulse counting techniques, i.e., the states of the digital channels are determined by the number of pulses in the transmitted signal .

A transmitter or source converts an electrical signal to a radio frequency. The most appropriate types of device is the antenna. The transmitter IC contains all of the active circuitry necessary to encode potentiometer positions and switch states into a pulse-modulated RF output . The IC also contains an internal voltage regulator which keeps radiated power constant even if the supply voltage changes . The receiver contains all of the active circuitry required to receive and decode the signals generated by the companion transmitter. Included are two latched outputs for connect to the others circuit. This outputs may be used to drive a automatic train announcement circuit.

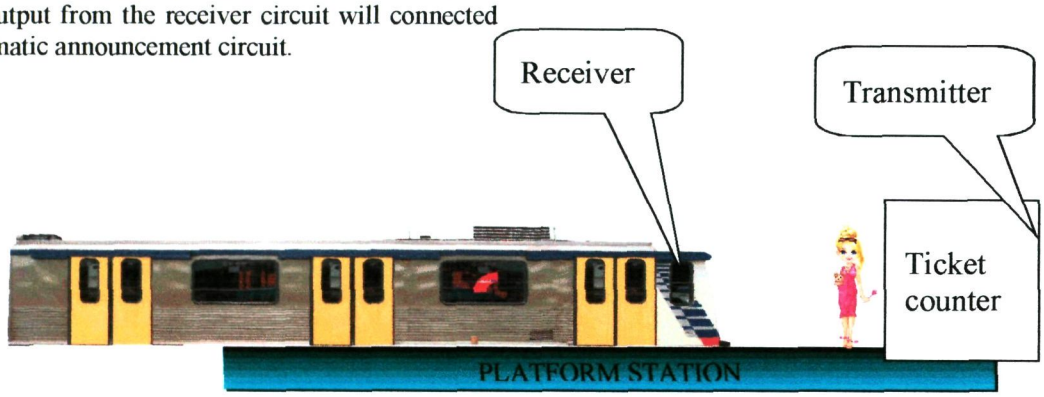
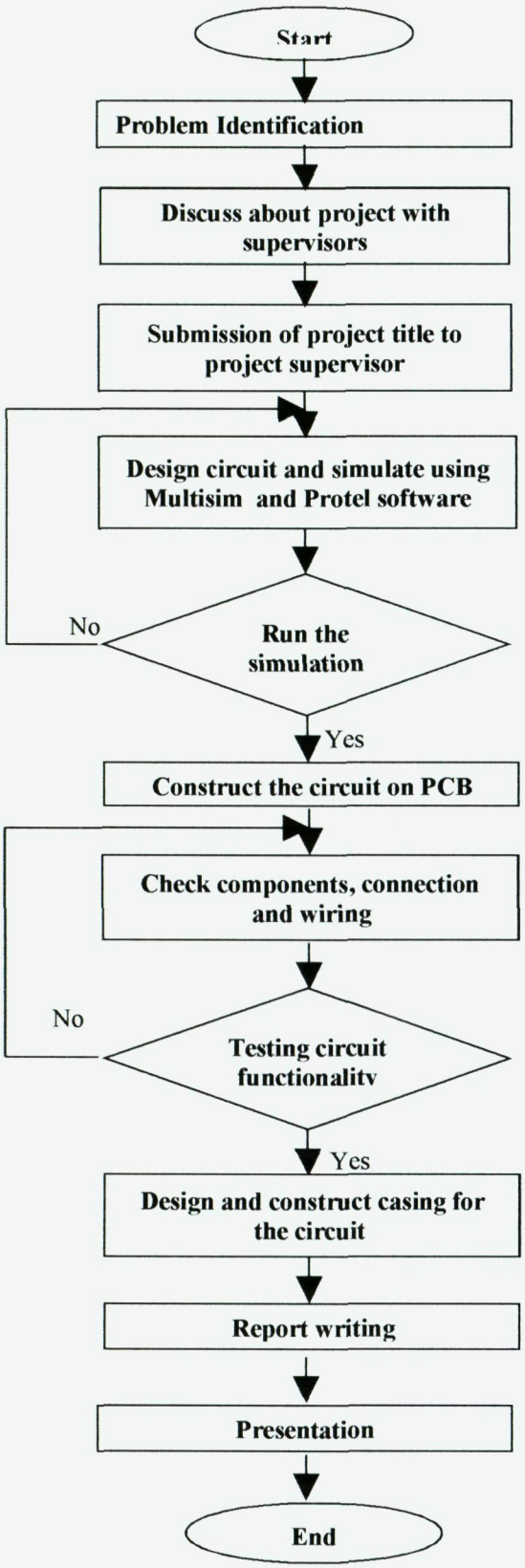


Figure 2: Basic illustration of transmitter and receiver of the automatic announcement system

Flow Chart



III. RESULTS AND DISCUSSION

After all the circuit had be tested and function in the lab, the next procedure is to test the circuit at the real environment. Two test are involved.

1. Output frequency compared to the distance
2. Voltage output compared to the distance.

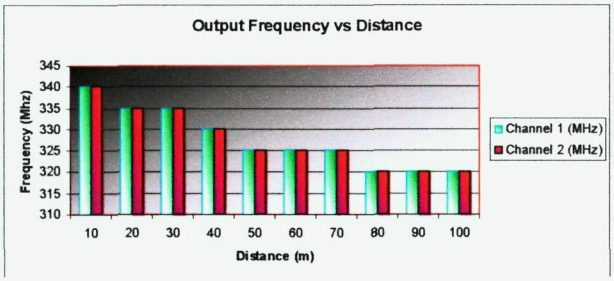


Figure 3: Output Frequency versus Distance

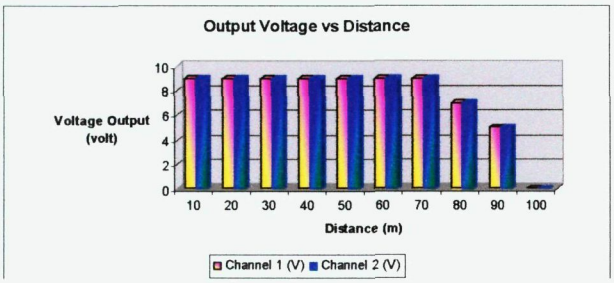


Figure 4: Output Voltage versus Distance

From the results, the data represent the output frequency and voltage output compared to the distance. For the output frequency, it is said that when the distance is far from the transmitter, the output frequency become lower and lower. When the distance is more than 90 meter, the output frequency is going to 0Hz. It is because the receiver cannot receive the signal from the transmitter because of distance barrier. Output voltage for the receiver also affected when the distance between transmitter and receiver is far. At distance more than 90 meter, the voltage output at the receiver is 0 volt. Same situation with the frequency, it is because of the distance of the receiver and transmitter.

Distance(m)	10	20	30	40	50	60	70	80	90	100
Channel 1 (MHz)	340	335	335	330	325	325	325	320	320	0
Channel 2 (MHz)	340	335	335	330	325	325	325	320	320	0

Table 1: Output Frequency vs Distance

Distance(m)	10	20	30	40	50	60	70	80	90	100
Channel 1 (V)	9	9	9	9	9	9	9	7	5	0
Channel 2 (V)	9	9	9	9	9	9	9	7	5	0

Table 2: Voltage Output vs Distance

IV. CONCLUSION

From this project, when use automatic announcement, we can solve the problem that was stated before in page 2. When customers are in the train, they will be acknowledging on the upcoming station automatically from the loud and clear announcement. This proposed system will also benefit the blind. Thus the LRT service will be improved tremendously and will increase the number of customers resulting high profits for the LRT Company .

Wireless radio frequency communication systems provide a useful complement to radio-based systems, particularly for systems requiring low cost, light weight, moderate data rates, and requiring long ranges up to 100 meter. When LOS paths can be assured, range can be dramatically improved to provide longer links. Radio frequency wireless networks are poised for tremendous market growth in the next decade, and wireless communications systems will compete in a number of arenas. Radio frequency systems have already proven their effectiveness for short-range temporary communications and in high data rate longer range point-to-point systems. It remains an open question whether radio frequency will successfully compete in the market for general-purpose indoor wireless access.

For the future work, some improvements can be done such as

1. to improve on the distance between transmitter and receiver.
2. to increase the number of channels
3. signal strength on the receiver.

REFERENCES

[1] Wimborne Publishing Ltd, Everyday Practical Electronic, May 1999

[2] J. M. Kahn and J. R. Barry, Wireless communications, Proceedings of the IEEE, vol. 85, Feb. 1997.

[3] Armstrong, M. (2002a) "The theory of access pricing and interconnection," in M. Cave, S. Majumdar, and I. Vogelsang (eds.), *Handbook of Telecommunications Economics*, North-Holland.

[4] Cramton, P. (2002), "Spectrum Auctions," in M. Cave, S. Majumdar, and I. Vogelsang (eds.), *Handbook of Telecommunications Economics*, North-Holland.

[5] F. R. Gfeller and U. H. Bapst, Wireless in-house data communication via diffuse radio frequency radiation," Proceed- ings of the IEEE, vol. 67,

[6] D. Heatley, D. Wisely, I. Neild, and P. Cochrane, Optical wireless: The story so far," IEEE Communications Magazine

[7] J. M. Kahn, W. J. Krause, and J. B. Carruthers, Experimental characterization of non-directed indoor radio frequency channels," IEEE Transactions on Communications, vol. 43

[8] En Mahadzir Abdul Ghani
Assistant manager, Electronic LAB Rapid KL

[9] Che Mohammad Said and Mohd Rozi Ahmad, Findings of Young Researchers, vol. 1 June 2006