Design of a Non-ionizing and Viable RF Based Attendant Calling System

Saif Hannan, Md. Jashim Uddin, Md. Razu Ahmed

Abstract*: This paper describes to build and demonstrate an RF based Attendant Calling System with HT12E Encoder, HT12D Decoder and 434 MHz RF transmitter and RF Receiver modules which can be used to request instantaneous services where calling to attendant is required like home, offices, universities, restaurants, hospitals, aviation industry, aged care centers and so on. This Attendant Calling System can be used for a place without any line of sight (LOS) around the area. The main objective of this work is to build the transmitter and receiver circuit with less components and to create multiple channels without any programming. The operating frequency is 434 MHz (non-ionizing) which is configured for RF transmitter and RF Receiver modules. A pair of encoder and decoder has also been used in this system in which the number of encoder pins should be matched with the same number of decoder pins. Amplitude Shift Keying (ASK) modulation technique is used for transmission.

***Index Terms*: ASK, Flight Attendant Communication, IC HT12E, IC HT12D, Nurse Call System.**

I. INTRODUCTION

Now-a-days RF transmitters and receivers have a variety of applications and become very much popular for wireless communication system. By operating them manually, life can be so simple and fast .It can be used for many applications such as flight attendant calling, nurse call system and efficient waiter services at restaurants.

The main objective of this work is to build many transmitter circuits and a receiver circuit and to demonstrate a working communication system between them. This system has one transmitting end and a receiving end. If any individual at transmitting end wants to call the attendant at receiving end at any time within finite range, he/she can call simply by pressing the button. Then the respective LED will glow and a buzzer will buzz. It will reduce manual work and waste of time. Normally the range of the system may cover around 100 meters.

The basic components of the system are HT12E Encoder, HT12D Decoder, RF transmitter and RF Receiver modules. The RF module comprises of a RF transmitter and a RF receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. A RF transmitter receives serial data and transmits it wirelessly as RF through its antenna connected at pin 4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder. The RF transmitter module uses a digital modulation technique called ASK (Amplitude Shift Keying) or on-off keying [14], [17]. HT12E and HT12D is a 2^{12} series encoder and decoder IC widely used in remote control system applications [13], [4]. HT12E IC is capable of converting 12 bit parallel data inputs into serial outputs and HT12D IC is capable of converting 12 bit serial data inputs into parallel outputs with operating voltage from 2.4V to 12V [5] & [6].One of the main advantages of RF based remote device is that it can operate the appliances without the requirement of line of sight within its specified range efficiently [13]. A coil loaded antenna is used to cover around 100 meters.

II. LITERATURE REVIEW

This work was concentrated on personal communication systems which are essential to ensure security, emergency contact and to avoid redundancy of expensive and heavy communicating materials. In aviation industry, the flight attendant calling system is now an essential part for best customer services. In the survey conducted by Lori J Brown, 87% of the commercial flight attendant preferred that a wireless communication device would improve communications and enhance safety [9]. The study also reports that 72% of the attendants would be willing to wear a device to achieve wireless communication in-flight. The "Pilot/Flight Attendant Communication and Joint Training" study [10]; investigated the gaps that obstruct the feasible communication in a post-9/11 environment and recommended the discrete communication between flight attendants and pilots. From the final reports of Federal Aviation Administration (FAA) it was observed that flight attendant fatigue can be precisely overcome by providing them personal or portable communicating devices to enhance on-board customer services [8]. Such devices may cause interference in flight communication system. But Jay J. Ely at NASA Langley Research Center found that portable electronic devices will not affect in flight navigation and communication system [7]. According to the decision taken in "Aviation frequency spectrum and ITU World Radio Communication Conference" held on 2011 [1], the Aeronautical Frequency Management showed that among spectrum allocation for aeronautical services utilized by civil aviation, the bandwidth (400-900) MHz was not used and is free to allocate for required services like this project work.

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This project will be operated at 434 MHz.

Antoni Morey I Pasqual in his M.Sc. thesis work examined that, the wireless nurse call system is the most effective alternative communication in Healthcare [2]. Soheila Mojdeh *et al.* [15] suggested that, the nurse call system caused patient's satisfaction as well as resolved many problems of them. We are also proposing our project for a viable nurse call system for general wards, elderly people and for disabled patients in a hospital or clinic where people would need such a communicating device. This device will be operated at 434 MHz, which is *non-ionizing* as observer by [3] & [11], hence *it will not affect the patients as well as sensitive healthcare equipments*. Nagaveni B. Birader *et al.* [12] have proposed a touch screen based nurse or attendant calling system, which will cost much money than our project as well as their GSM network for communication will be ionizing as remarked by [3] & [11].

For Restaurants, instantaneous customer service is essential. To ensure it, they must have a handy, cheap and reliable communicating system which will ensure customer-waiter interaction instantaneously and satisfy the customers. Android based touch-screen device was proposed by Sushmita Sarker *et al.* [16]; which was costly and dependent on Wi-Fi network that has no assurance of availability and hence is not a viable solution. But our project can be a best alternative in this regard and will cost less money.

III. CIRCUIT IMPLEMENTATION

The system has two parts i.e. transmitter and receiver. The detail description of the system is as follows.

A. Transmitter

The block diagram of transmitter is shown in fig .1.

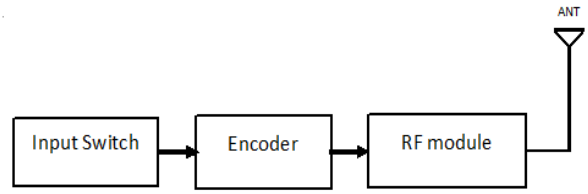

Figure1: **Block Diagram of Transmitter**

The transmitter circuit is built with a RF transmitter module which works on frequency 433.92MHz and Encoder ICHT12E which will encode the signal and gives it to the RF module when the TE (transmission enable) switch is turned ON.

Here VCC and ground pins of the encoder are connected to VCC and ground of RF transmitter module. All the address pins A0-A7 and AD8-AD11 can be connected with a switch to ground for channel transmission. By changing address, different information can be transmitted. 680k ohm resistor is inserted between oscillator pins. TE pin is also connected to ground. It is operated on 5V DC power supply. If a transmission-enable signal is applied, the encoder transmits the 12 bits of address/data serially in the order of A0 to AD11 for the HT12E encoder. It may be 000000000111 for the circuit as shown in fig.2. So, 8-bit address and 4-bit of data are together transmitted over 434 MHz carrier frequencies.

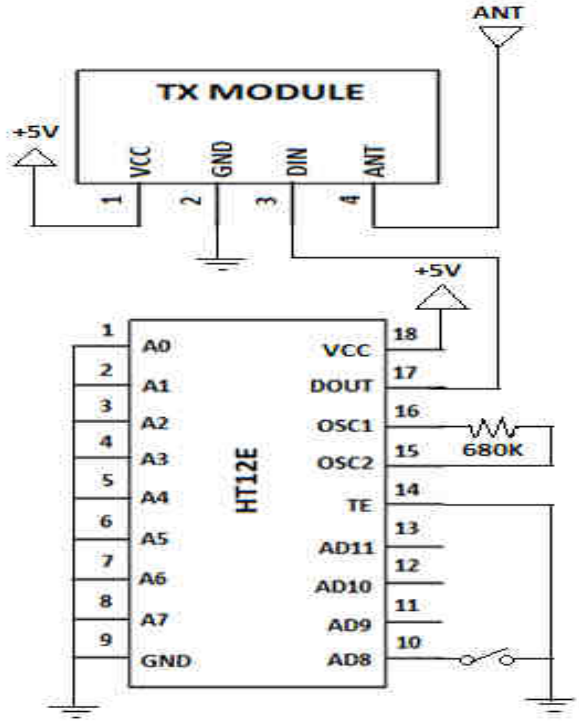

Figure 2: Circuit Diagram of Transmitter

B. Receiver

In fig.3, the block diagram of the receiver is shown.

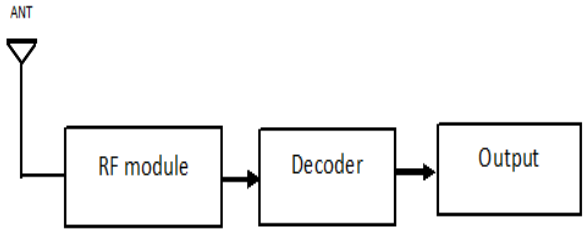

Figure 3: Block Diagram of Receiver

The receiver works exactly inversely of the transmitter. It is built with a decoder IC HT12D to decode signal encoded by encoder IC HT12E and RF receiver module which also works on frequency 433.92MHz. HT12D gives high output when any of the buttons is pressed on transmitter.

The number of decoder pins should be matched with the same number of encoder pins and the circuit connections should be same. A 33k ohm resistor is shorted between oscillator pins. Receiver will receive the data and give the address & data to IC HT12D. IC HT12D first compares the address few times. If it matches it gives high pulse on output. It will be 000000000111 for the circuit as shown in fig.4. LED is used to show the reception of data at output and the buzzer is used to buzz when the signal is received by receiver. To buzz, a buzzer output is triggered to the base of a transistor. Whenever the switch is pressed on the transmitter, the particular LED on the receiver glows and the buzzer buzzes.

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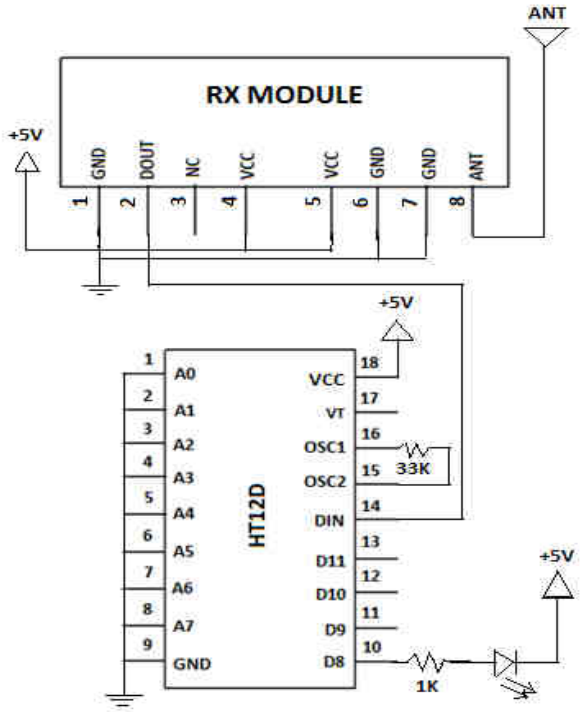

Figure 4: Circuit Diagram of Receiver

The total process was successfully tested on a breadboard. The following Fig. 5 & 6 of the built prototype was taken for reference.

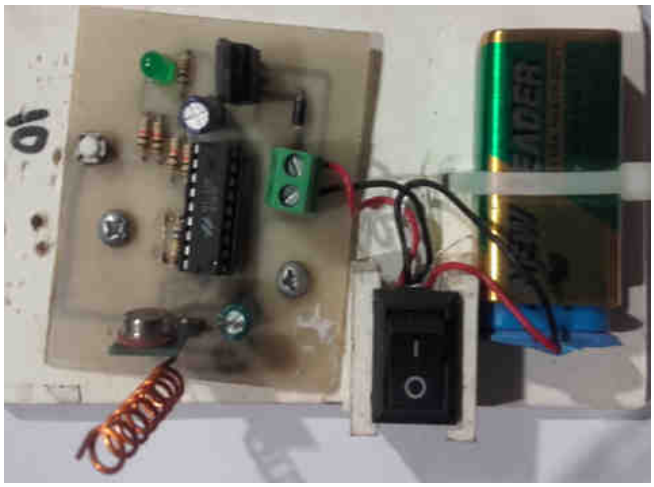

Figure 5: RF Transmitter

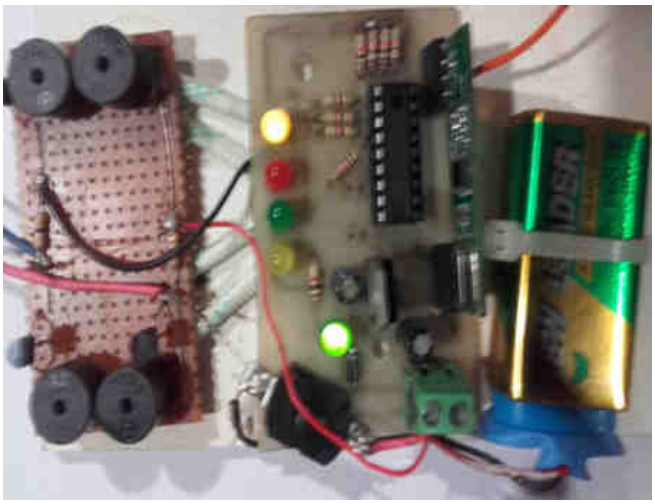

Figure 6: RF Receiver for 4:4 Channels

IV. CONCLUSION

Our RF based Attendant Calling System is implemented with HT12E Encoder, HT12D Decoder and 434 MHz paired RF modules. No programming is needed in this system. The equipments used in the circuits are easily available and cost effective. The system is too easy to operate. Its main advantage is that it can be operated without the requirement of line of sight within its specified range. It will save time and reduce manual work. Also, our calling system is non-ionizing due to allowed frequency range [3] & [11], which is essential for safe and hygienic communication for any people and it has no effect on aircraft communicating system [1]. So, it can be easily used for personal communication at hospitals, aircrafts and restaurants, where calling an attendant instantaneously is essential for ensuring better customer service. Our model is capable for maximum of twelve channels for transmission to the single receiver.

V. THE PROJECT IN PERSPECTIVE OF BANGLADESH

The total cost required for the overall project was estimated for four transmitters and one receiver unit. The estimated cost is shown in Table 1.

Table 1: Total Cost of Overall Project Implementation

Component Name	Number (Pieces)	Cost in BDT.
IC HT12E/HT12D paired	4	960/-
Tx-Rx Modules paired (433 MHz)	4	2,600/-
Resistors	30	15/-
Capacitors	10	15/-
PNP Transistors	4	10/-
Voltage regulators (LM7805)	5	40/-
Diodes	5	10/-
Switches	4	20/-
LEDs	9	20/-
Buzzers	4	20/-
Coil loaded antennas	5	10/-
Batteries (9V)	5	400/-
Printed Circuit Board	5	150/-
Total cost		=4,270/- =USD 54.74 (approx.)

This cost was estimated for making an impression of the project to be reasonable. There was no such work done in past and hence no cost comparison was possible.

VI. FUTURE WORK

An encoder and a decoder are used here for the project. If a *transceiver* is used for this project, the system will be more effective. Also antenna coverage can be increased. *Frequency Shift Keying (FSK)* modulation technique can be used for better performance.

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