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Smart Intercommunication System

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Abstract: A Smart Intercommunication System is an effective system implemented at low cost and readily available components. A wireless voice data communication between the FM transmitter and receiver is established by enabling a key press in the system. Switches are used for enabling and disabling the receiver load. Two arduino boards are used for controlling the operation. It is bidirectional communication, where the connection will be automatically discarded when the room is not specified by the users. In the transmitter part the mic is used to fetch the message or voice information to receiver part. A display unit is connected for displaying the message, when the room is enabled or disabled. The transmitter portions comprises of RF and FM transmitter for transmission of data and voice information. The data given is the enable and disable commands of load 1 and load 2. The receiver comprises of RF and FM receivers for responding to the data and voice information from transmitters.

Keywords: Arduino, Frequency modulation, Proteus, RF Transmitter and Receiver.

I. INTRODUCTION

An embedded system is designed to perform one or many dedicated functions with real time constrains. It consists of components that are designed to meet the customer requirements. The main core component is the microcontroller. The design engineer could optimize the design as per his requirements. It is the combination of both Hardware and software. The Intercommunication system is a voice communication system which can be used with in a building or between the buildings by means of telephone network. A wireless intercommunication system eliminates the use of copper wires between the stations, by making use of Radio waves allotted by government.

Amit Jaykumar Chinchawade (2016) proposed a survey on Li-Fi based audio transmission with home automation system. He described the importance of LI-FI Technology in the audio transmission and to monitor and control the house or office appliances. The Wi-Fi is replaced by Li-Fi in many applications due the high data transmission rate. It is a visible light communication that uses LEDs for audio and data transfer. Use of Li-Fi in audio transmission and device automation can improve the speed of communication and speed of device automation in various fields. Li-Fi can be used in various areas where few frequency ranges are restricted. It provides secured audio and data transmission [1].

Moumita Acharya (2015) described about the design and implementation of frequency modulated transmission and reception of speech signal and FPGA based enhancement. Here a speech enhancement filtering technique using FPGA is implemented and is played via headphone. The frequency modulation scheme has been used. The modulated signal is received through the receiving antenna from the medium and then applied to the FM receiver where the signal frequency is demodulated [2].

Received data is not steady and both transmission distance and environment will be affected by noise and interference. The data transmission system could be implemented by using RF transmitter receiver pair and voice data could be transmitted and received by frequency modulation transmitters and receivers.

II. HARDWARE AND SOFTWARE REQUIREMENTS

The ultimate aim of the work is to transmit the reliable voice data transmission from sender to multiple destinations by enabling a key press. It is a bidirectional communication, where the connection is automatically discarded when the room is not specified by the user. The work is divided into two phases as Transmission phase and Reception Phase. The Hardware components required for the implementation are, 433 MHz RF Transmitter Receiver Module, FM Transmitter, FM Receiver and Arduino UNO R3 Board. The software implementation is carried out with Arduino and Proteus 7.0 Design suite.

2.1 RF Transmitter Receiver

This hybrid RF Transceiver Module provides a complete RF transmitter and receiver module solution which can be used to transmit data up to 3 KHz from any standard CMOS/TTL source. The transmitter module is very simple to operate and offers low current consumption. Data can be supplied directly from a microprocessor, controller or encoding device, thus keeping the component count down and ensuring a low hardware cost. The RX – ASK is an ASK Hybrid receiver module. The RF Transmitter Receiver Module is an effective low-cost solution for using 433 MHz. The TX-ASK is an ASK hybrid transmitter module. TX-ASK are designed by the saw resonator, with an effective low cost, small size and simple to use for designing [3].

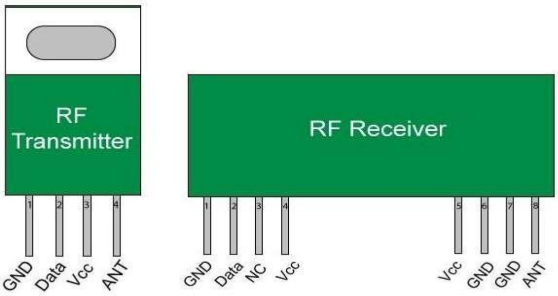

Figure 2.1 RF Transmitter and receiver module

The pin connections are represented as shown in the figure 2.1. The data is connected to 8th pin and 11th pin of transmitter and receiver Arduino controller respectively.

2.2 Push Button Switch

A push button is a momentary or non-latching switch which causes a temporary change in the state of an electrical circuit only while the switch is physically actuated. An automatic mechanism returns the switch to its default position immediately afterwards, restoring the initial circuit condition. There are two types: A push to make switch allows electricity to flow between its two contacts when held in. When the button is released, the circuit is broken. This type of switch is also known as a Normally Open (NO) Switch. (Examples: doorbell, computer case power switch, calculator buttons, individual keys on a keyboard). A push to break switch does the opposite, i.e. when the button is not pressed, electricity can flow, but when it is pressed the circuit is broken. This type of switch is also known as a Normally Closed (NC) Switch. (Examples: Fridge Light Switch, Alarm Switches in Fail-Safe circuits) [6]

2.3 FM Transmitter and Receiver

The circuit of FM Transmitter consists of 2 NPN transistors to amplify the audio input. To generate the radio frequency carrier waves, the FM transmitter circuit requires an oscillator. The tank circuit is to store the energy for oscillations. The input audio signal from the microphone penetrated to the base of the transistor, which modulates the LC tank circuit carrier frequency in FM format. The variable capacitor is used to change the resonant frequency for fine modification to the FM frequency band. The modulated signal from the antenna is radiated as radio waves at the FM frequency band. The FM Receiver consists of 24 SWG closely winded copper coil which is used for better data reception from the transmitter. The circuit comprises of trimmer (variable capacitor) for adjusting frequency bands from 88Mhz-108Mhz.It also consists of an antenna for improved quality of audio reception. FM radio IC is programmed to control the entire operation of the experimental setup. It assists the FM receiver in accurate channel reception, volume adjustment, bass and vocal adjustment. The board is powered by DC or AC power supply units.[7]

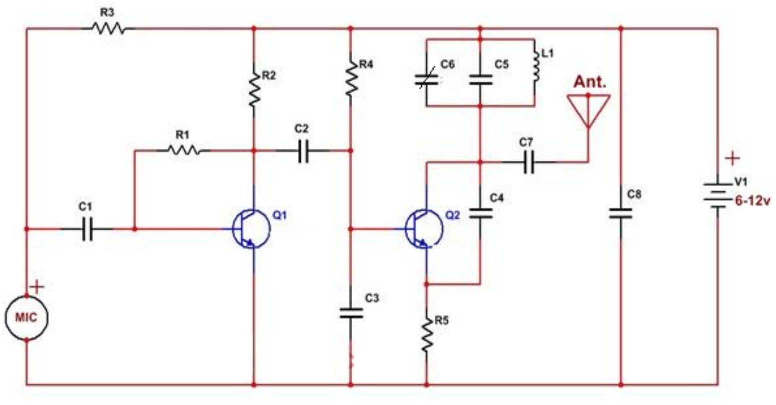

Figure 2.2 circuit diagram of fm transmitter

The FM transmitters are easy to use and the price is low. The efficiency of the transmitter is very high. It has a large operating range. This transmitter will reject the noise signal from an amplitude variation.

2.4 Arduino and Proteus 7.0 Design Suite

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. This software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. It was developed in Yorkshire, England by Labcenter Electronics Ltd and is available in English, French, Spanish and Chinese languages. Arduino is an open-source electronics platform based on easy-to-use hardware and software[4].

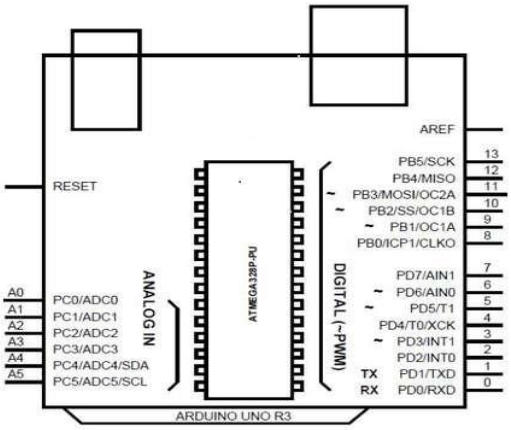

Figure 2.3 Arduino Uno R3 Board

Arduino boards as shown in Figure 2.3 are able to read inputs like light on a sensor, a finger on a button, or a Twitter message - and turn it into an output like activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so, you use the Arduino programming language and the Arduino Software (IDE), based on processing. Over the years, Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. [5].

III. IMPLEMENTATION

The Transmitter portion of the smart intercommunication system comprises of FM Transmitter, Arduino Controller, switch unit and RF transmitter. The voice data can be transmitted with the desired range in the frequency of 88 to 108 MHz with the help of FM Transmitter. The controls of the switching different FM Receivers are decided with the help of the push button switches 1, 2, 3 and 4. The switch 1 and 2 controls the load 1 FM receiver connected at the Receiver. The switch 3 and 4 controls the load 2 FM receiver connected at the Receiver. The Data are encoded and transmitted via RF Transmitter.

The FM Receiver is synchronized with the FM Transmitter by tuning the set up with the corresponding frequency. The Receiver unit consists of FM Receiver, Arduino controller and RF Receiver. The Transmitted data is received by the RF Receiver and it is decoded for interpreting the load 1 and load 2. The display could be connected for verification purpose.

IV. RESULT AND DISCUSSION

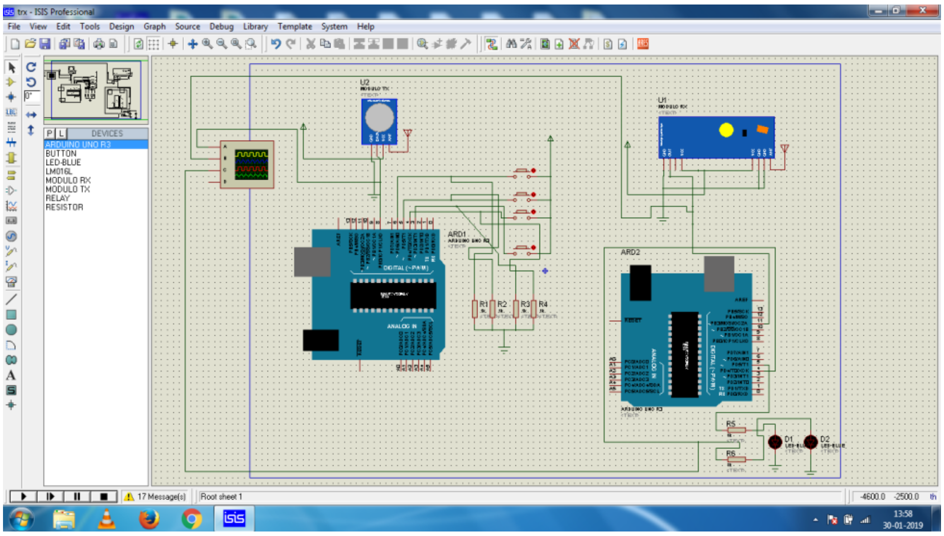

Figure 4.1 Testing of RF transmitter receiver

The figure 4.1 shows the circuit connection to test the RF transmitter and receiver module. Here, there are four switches to encode and transmit 4 input data to perform 2 operations in receiver side. The key 1, 2 in the transmitter controls LED 1 and key 3, 4 controls the LED2. The operation table 4.1 is mentioned below. At the transmitter section, the Arduino continuously monitors the status of the switches. Whenever a switch is pressed, a logic HIGH is detected at that particular I/O pin. As a result, the Arduino transmits a suitable message corresponding to the switch pressed.

Table 4.1 Operation Table

S. No / Key No.	Encoded Data	Decoded Data	Operation
1.	@ABC$	ABC	LED 1: ON FM Receiver 1
2.	@BOFF$	BOFF	LED 1: OFF FM Receiver 1
3.	@FON$	FON	LED 1: ON FM Receiver 2
4.	@FOFF$	FOFF	LED 1: OFF FM Receiver 2

For example, if LOAD1_ON switch, which is connected to pin 6, is pressed, Arduino detects logic HIGH at pin 6. Hence, Arduino sends a message as "@ABC$" via the RF transmitter. At the receiver end, the RF receiver receives this message and transmits the same to Arduino for decoding. When the Arduino at the receiver end decodes the message and understands that the transmitter characters are "@ABC$", it then writes a HIGH signal on the digital I/O pin 4. As a result, the load is turned on. Similar actions are performed when other switches are pushed.

If there is any error in the data transmission, the desired data is not transmitted, the Arduino at the receiver section lights up the error LED which is connected to the thirteenth pin. A data transmission successful LED and an error buzzer can also be implemented to indicate those actions more efficiently. Oscilloscope is used to verify the transmitted signal variations as shown in figure 4.2. The oscilloscope consists of 4 pin connections A, B, C, D. Pin A is connected to data of RF transmitter and pin B is connected to data of RF receiver and pin C is connected to pin 4 of RF receiver. Pin 4 and 5 are connected to resistor and then connected with LED.

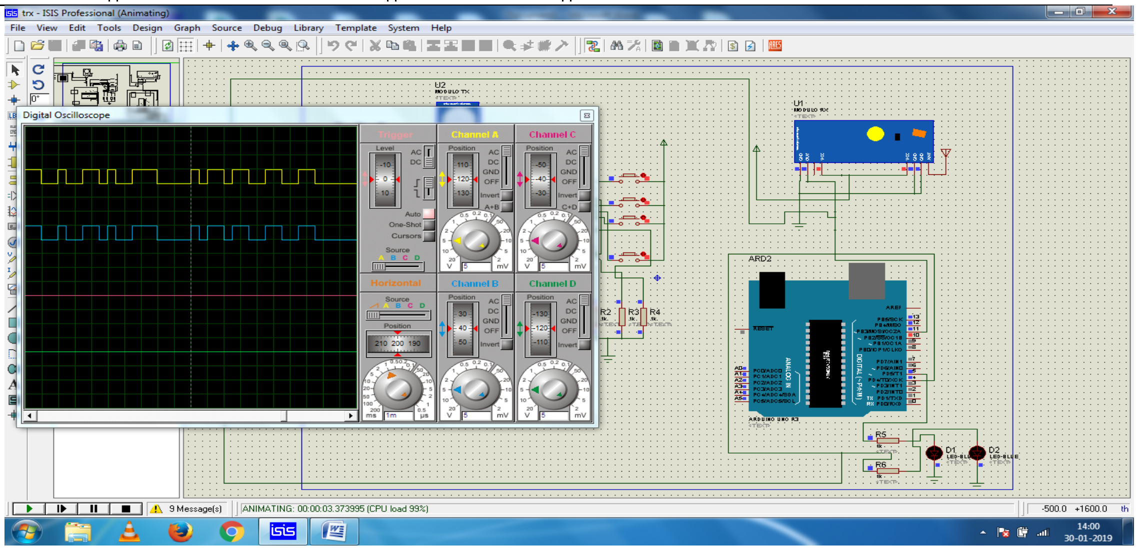

Figure 4.2 Oscilloscope connections for Data Verification

The Figure 4.2 shows the transmitted signal from RF transmitter to receiver when first switch is closed which is connected to the Arduino of transmitter side. The loads at the receiver side are connected with the FM Receivers.The figures indicate the Room 1 Enabled for the corresponding key press.

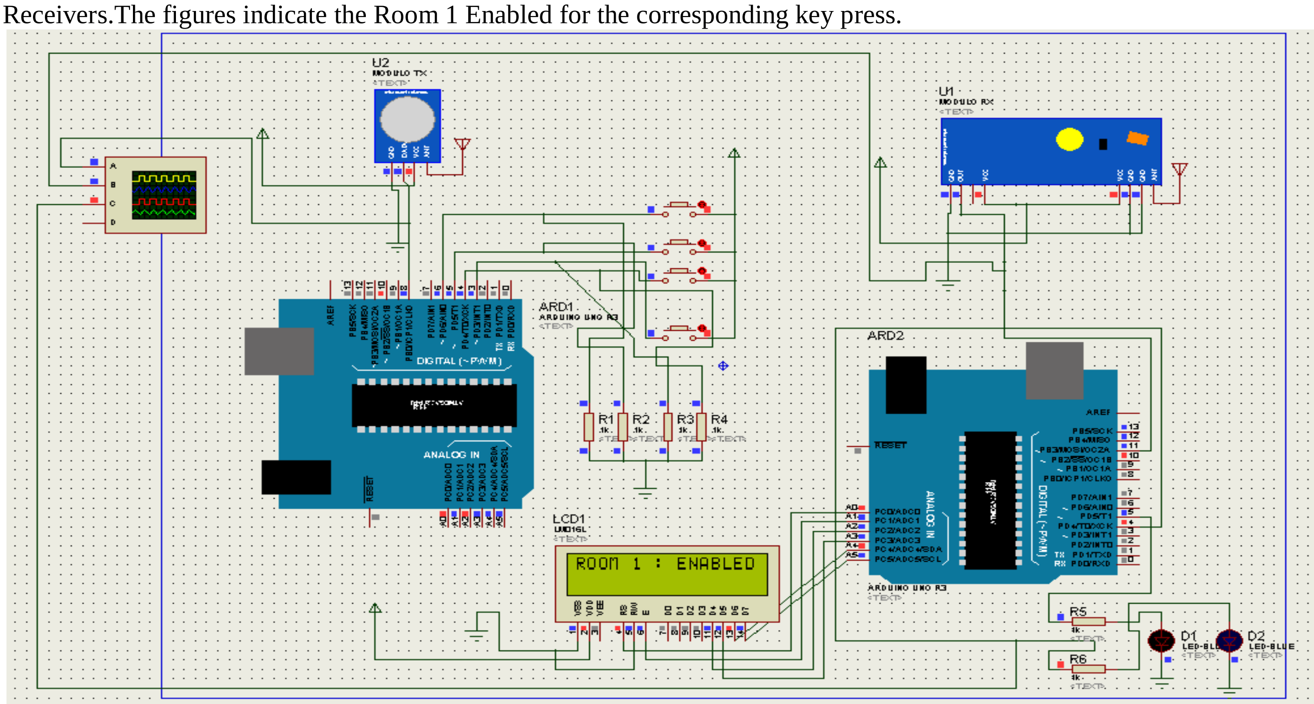

Figure 4.3 Enabling Room 1

Hardware Implementation

The connections are made as per circuit diagrams shown above. The hardware implementation is successfully done as shown in Figure 4.4, Figure 4.5. It comprises of transmitter module with FM transmitter and the receiver module with FM Receiver.

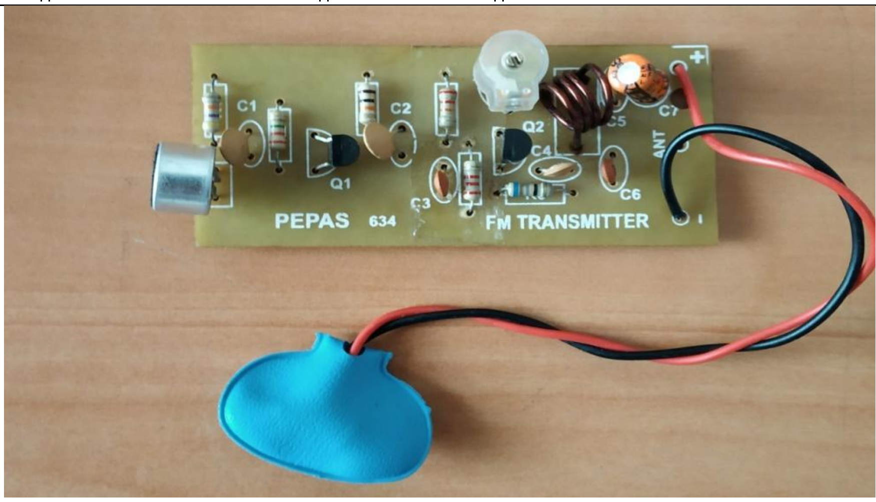

Figure 4.4 FM transmitter

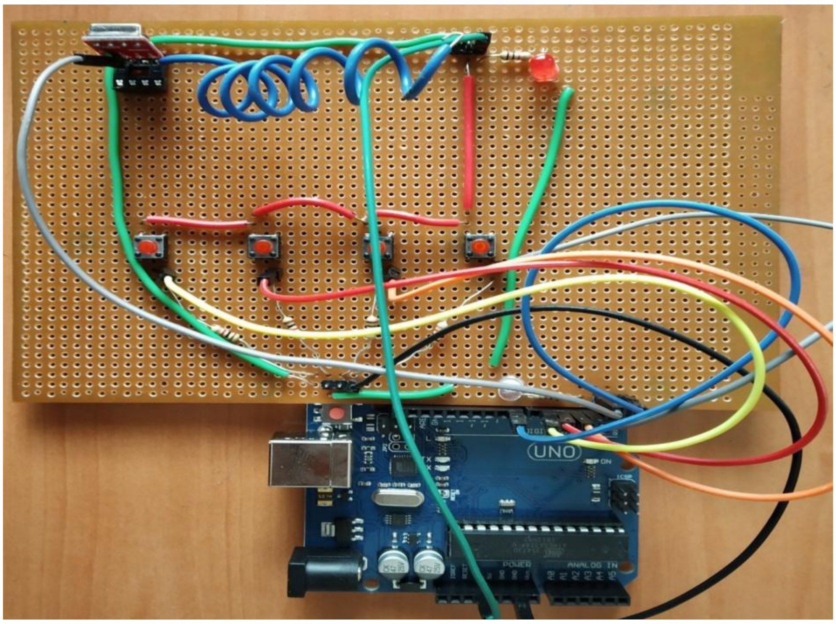

Figure 4.5 Hardware Implementation of Transmitter

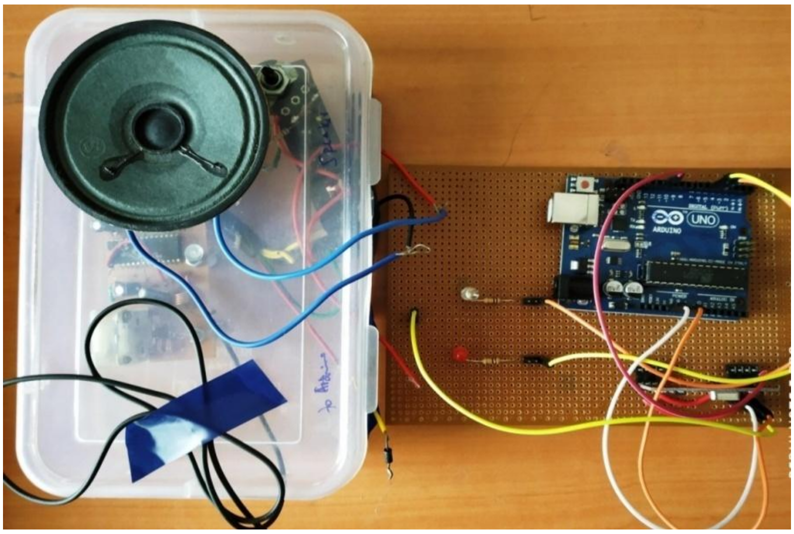

Figure 4.6 Hardware Implementation of Receiver

The operator takes the control over the receiver by enabling the transmitter. The implementation is simpler as it makes use of readily available components and trash or reusable components. Complexity of conventional system is reduced.

V. CONCLUSION

From the experimental results, it is evident that the software or the simulation result synchronizes perfectly with the hardware implementation. The transmission of the encoded data is exactly recovered and decoded at the receiver end with good accuracy within the range. The voice data transmission is good at low noise or less interference region. The reception is accurate by the FM receiver. The design and implementation are less complex and cost effective. The system acts like the base work for forth coming smarter inter communication systems. The advancements can be introduced by interfacing the authentication or security modules with the present systems. The range could be increased and noise can also be suppressed. Number of receivers can also be increased as per the requirements of the domestic usage.

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