Developing Prototype for Easy and Low-Cost Walkie Talkie for Long Range Communication

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Abstract: *The basic idea behind this prototype system project is to enhance and elevate the opportunities present in the earlier and current communication methods. This includes many things like areas where mobile towers' range is unreachable, operators are illiterate or have less technical knowledge, unable to operate complex machines or mobiles due to ageing or dementia like diseases, at the construction site use, for public servants' use, security guard's usage, confidentiality and security of transferring message is needed.*
  In this prototype walkie talkie system, audio communication takes place through the wireless transceiver, accessed by the external antenna. This whole system operates with the power source and takes decision of transmission or reception of audio, with the help of Push-To-Talk (PTT) button. Microphones and Speakers are used as input and output devices respectively. Simplified design and placement of components, low-cost and lightweight are some of the special things of this system.

Keywords: Walkie Talkie, Two Way Communication, Wireless Communication, Push-To-Talk Communication, PTT Communication, Radio Communication, Full Duplex, Half Duplex, ISM Band, nRF24L01+PA+LNA, Transceiver

I. INTRODUCTION

In simple words, Walkie talkies are handheld portable radio devices, that utilizes radio waves to intercommunicate wirelessly on a single frequency band, through open air medium. Walkie talkie is a kind of communication system which provides services one-to-one (single node to single node or single device to single device) and one-to-many (single device to many devices). It was firstly developed in 1937 by a Canadian inventor named Donald Higgs, calling the system as packset. Walkie Talkie was also developed quite independently, in between 1938 and 1941, by an American radio engineer named Alfred J. Gross. They were originally called two way radios, but the thing that made them really unique from telephones were the fact that, we could both 'walk and talk' at the same time, thus they became popularly known as walkie talkies.

Each battery-powered handset is equipped with a transmitter (which also acts as a receiver), an antenna for sending/transmitting and receiving radio waves, a speaker/loudspeaker that also often occasionally functions as a microphone, and a 'Push-To-Talk (PTT)' button that, means you push/press button to talk.

A walkie talkie is a half-duplex communication device. That means, many walkie talkies utilizes a single radio channel, where only one radio can transmit signal over the channel, even though any number can receive/listen, at the same time. Normally, the transceiver of walkie talkie is in receive mode. That means, when the user wants to communicate, he just presses the 'Push-To-Talk (PTT)' button, that temporarily turns off the receiving mode and immediately turns on the transmitting mode. Walkie talkies, when modified, can also works in full-duplex mode, which means walkie talkies interchangeably can work as both transmitter and receiver, at the same time. They communicate with each other using pre-defined specific wireless frequency band. Typical walkie talkies closely resembles with a cellular phone, which is slightly larger, when compared. But is still a single unit/device, with an antenna attached, most of the time, on the top side of the unit/device. Where a phone's earpiece/speaker is only loud enough to be heard by the user, a walkie talkies' built-in speaker can be heard by the user and those in the user's immediate neighbouring. Walkie talkie transceivers can used to communicate between other devices, or to vehicle mounted stations or with base stations, as per need and usage.

In our system, we try to Develop Prototype of Easy & Low-Cost Walkie Talkies, with trying to increase the communication range between two devices.

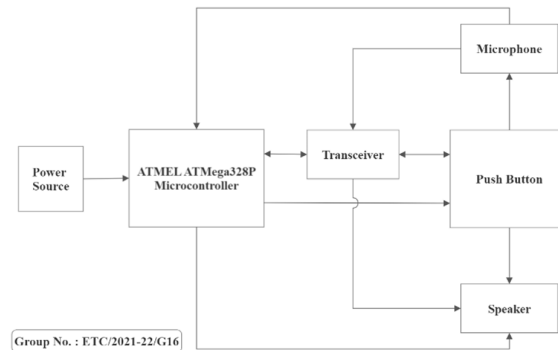## II. MATERIALS AND METHODS

2.1 Block Diagram

Figure 1: Proposed Block Diagram design consists of how the hardware components should be interconnected.

Description

Implementing Hardware consists of following Components

1. Power Source/ Battery – Used to Power the Circuitry
2. ATMEL ATMega328P Microcontroller – Used to Process Information
3. Transceiver, Antenna – Used for Wirelessly Transmitting and/or Reception
4. PTT Button – Used for Getaway to Decide Transmission or Reception Audio
5. Microphone – Used for Audio Signals Transmission
6. Speaker – Used for Audio Signals Reception which is Digital to Analog Signals' converter

Hardware
Components –
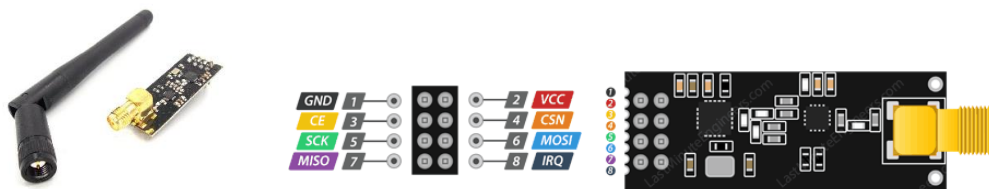**nRF24L01+PA+LNA Transceiver –**

Fig. 2 – nRF24L01+PA+LNA Single Chip Wireless Transceiver module with External Signal Booster Antenna
Fig. 3 - nRF24L01+PA+LNA Single Chip Wireless Transceiver module's Pinout

The NRF24L01+PA+LNA single chip wireless transceiver module with external signal booster antenna, uses the 2.4GHz transceiver from Nordic Semiconductor, the NRF24L01+. This transceiver IC operates in the Globally license free ISM 2.4GHz frequency band. This module have features like, an auto-retransmit feature (if signals lost and acknowledgements didn't received), ability to add extra pipelines (for adding more receiver devices), a reverse polarized SMA connector (for achieving maximum RF range). Also, it is designed with the on boarded Power Amplifier (PA) and Low Noise Amplifier (LNA) circuit, which when used with the external antenna, signals can reach an extra-long distance than the one without these parts.

In other words, this module comes with the Globally license free ISM 2.4GHz frequency antenna, having 250Kbps transmission rate, which, when used in open-air medium and without any obstacles or barriers, it can reach upto the 800 meters to 1 km communication distance.

Only precaution is to take, to prevent burning, is that input supply Vcc should provide with only +3.3 Volts.
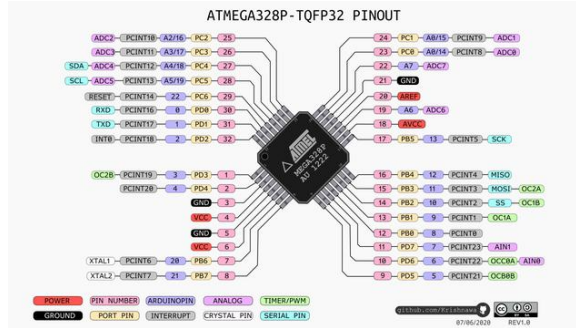
ATMEL ATMega328P Development Board -

Fig. 4 - ATMEL ATMega328P Development Board Pinout Diagram

The Atmel 8-bit AVR RISC-based ATMega328P microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general-purpose I/O lines, 32 general-purpose working registers, 3 flexible timers/counters with compare modes, serial programmable USART, internal and external interrupts, SPI port, one byte-oriented 2-wire serial interface, 6-channel 10-bit A/D converter, internal oscillator with programmable watchdog timer and 5 software-selectable power-saving modes. Its operating range is in between +1.8 and +5.5 Volts. [Ref. 4]. This same microcontroller is mounted on both Arduino Uno and Arduino Nano.

MAX4466 Microphone Amplifier module –

Fig. 5 - MAX4466 Electret Microphone Amplifier module

MAX4466 Electret Microphone Amplifier with Adjustable Gain Module is fully assembled module, that comes with a 20Hz-20KHz electret microphone soldered on. For the amplification, Maxim MAX4466, an op-amp is used onboard. This MAX4466 amplifier has an excellent power supply noise rejection (PSNR) capability, so this amplifier outputs good sound and isn't nearly as scratchy as other normals. On the obverse side, this module is included with a small trimmer potentiometer to adjust the gain, which is variable from 25x to 125x.

Blue Key Push Button Module -

Fig. 6 - Blue Key Push Button Module

Works to decide whether system should receive audio or transfer audio. When you press the push button, it will output a high level and it will turn to be LOW when you release it. Thus, making system to work as PTT (Push-To-Talk).

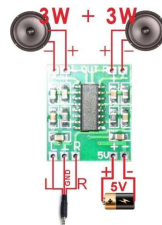**PAM8403 5V Two-channel Class-D Stereo Audio Amplifier –**

Fig. 7 - PAM8403 5V Two-channel Class-D Stereo Audio Amplifier

The PAM8403 5V Two-channel Class-D Stereo is an Audio Amplifier. This allows our system to achieve reproduction of high quality sound. One-channel can also be used separately, as per need. The new filterless architecture allows the device to drive the speaker directly, means requiring no low-pass output filters, thus reducing PCB area and system cost. Also can extend the battery life, which results in making it well suitable for portable system/applications.

Speaker –

Fig. 8 - Speaker

Oval shaped magnetic speaker is used into our system to convert received digital signals into human audible analog signals.
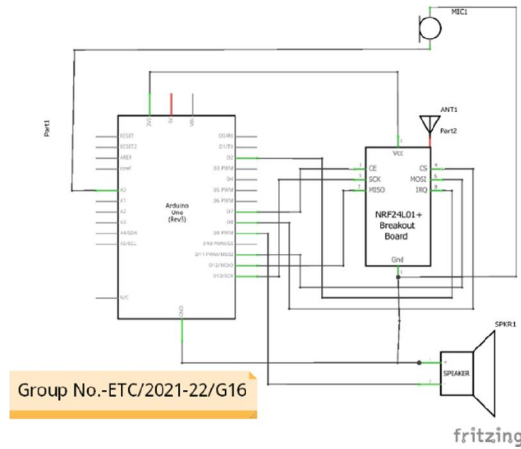
Circuit Diagram

Fig. 9 – Circuit Diagram
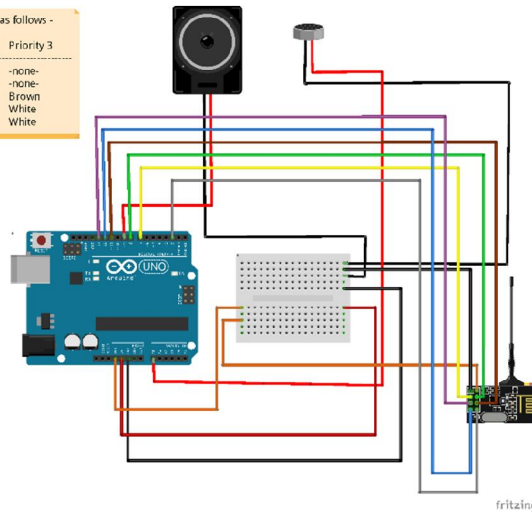
Connection Diagram

Fig. 10 – Connection Diagram

Hardware Components are interconnected as per the Connection Diagram. For one unit, Arduino UNO is used and for another unit, Arduino NANO is used reduce the overall size and weight. One may question that, will UNO and NANO intercommunicate? Answer is YES. They well Communicate and transfer audio.

Software

Software used for designing, compiling, and uploading this project and its code is open sourced ARDUINO IDE. The Arduino Integrated Development Environment (IDE) is a freely available cross-platform desktop application for Windows, macOS, Linux Operating Systems, that is written in the Java programming language. It is used to write, rectify, compile and upload code programs to Arduino boards and also other vendors' compatible boards, with the help of built-in and/or imported third-party software libraries, for wiring the project, which provides many common input and output procedures. Uploading code's programming Language used is, C++ based Dialect, known as Arduino Language. Code is uploaded on both ATMega328P Development Board, without any change.

Software Flow Chart-
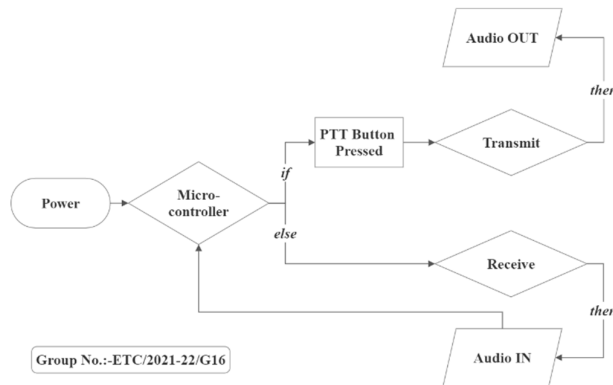
III. DESIGNING AND IMPLEMENTATION

IV. RESULT AND DISCUSSION

4.1 Result

As per uploaded program code, audio is transmitted through Transceiver, when the PTT (Push-To-Talk) button is pressed. When the same PTT (Push-To-Talk) button is not pressed or is in released state, transmitted audio is received continuously, if is transmitting. Audio have noise due to interference present, but is well audible and understandable.

4.2 Advantages and Disadvantages

A. Advantages

- In the emergency situations where network isn't available, we can communicate with authorative persons, in the golden time of need of help.
- Thus, we can use Walkie Talkie in that emergency situations to save loss of valuable lives or valuable financial loss.
- For Elders, who have movement problems due to aging, they can use Walkie Talkie to communicate with the family, when they need any help.
- In Short, "Help is Just A Button Away !"

B. Disadvantages

- Weight is comparatively extra, when compared to modern smartphones.
- Noise is every time present, because system uses Globally license free ISM 2.4GHz frequency band. This band is utilised by many Industrial, Medical, Scientific instruments. Because this band is open to freely available for usage without any government authority permission. Thus, these system creates unavoidable noise and interference.

4.3 Future Scope

1. System can be upgraded with the proper permission and allocation of spectrum by taking license from the government authority.
2. System can be made extra lighter by weight.
3. System can be made able to communicate at large distance by changing Transceiver component with the appropriate one.

V. CONCLUSION

As per uploaded program code, audio is transmitted through Transceiver, when the PTT (Push-To-Talk) button is pressed. When the same PTT (Push-To-Talk) button is not pressed or is in released state, transmitted audio is received continuously, if is transmitting. Audio have noise due to interference present, but is well audible and understandable.

REFERENCES

[1]. RF24Audio: RF24Audio – Arduino Library for Realtime Audio Streaming, http://nrf24.github.io/RF24Audio/
[2]. Arduino UNO_R3CH340G-1 Development Board's Manual, https://robu.in/wp-content/uploads/2017/10/2Fds2Fpdf2FU2FUNO_R3CH340G-1.pdf
[3]. Arduino Nano 2.3 Development Board's Manual, https://www.arduino.cc/en/uploads/Main/ArduinoNanoManual23.pdf
[4]. Datasheet1 - nRF24L01+PA+LNA Single Chip 2.4 GHz Wireless Transceiver module with External Signal Booster Antenna - Product Spec. Duchess.fm, https://www.sparkfun.com/datasheets/Components/SMD/nRF24L01Pluss_Preliminary_Product_Specification_v1_0.pdf
[5]. Datasheet2 – ATMEL ATmega328P Microcontroller (same for both Uno and Nano), https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7810-Automotive-Microcontrollers-ATmega328P_Datasheet.pdf
[6]. Datasheet3 - PAM8403_R1 5V Two-channel Class-D Stereo Audio Amplifier, https://www.mouser.com/datasheet/2/115/PAM8403-247318.pdf

[7]. Datasheet4 - MAX4466 Electret Microphone Amplifier, https://robu.in/wp-content/uploads/2019/06/MAX4466-Electret-Microphone-Amplifier-with-Adjustable-Gain-Module-1.pdf

[8]. Software1 - Arduino IDE, https://arduino.cc/en/Main/Software

[9]. Software2 - Fritzing, https://fritzing.org

[10]. Paper1 - V.S.P.Vamsi, "The Modern Communication Systems – Radio, Tape Recorder, Television, Movies, Walkie-Talkie, Smart Phones, Computer & Internet etc.,", International Journal of Engineering Development and Research (IJEDR), ISSN:2321-9939, Volume 7, Issue 4, pp. 561-591, December 2019, Available at : https://www.ijedr.org/papers/IJEDR1904100.pdf

[11]. Paper2 - Kakad Pallavi Changdeo, Sawai Priti Kakasaheb, Handore Kanchan Gorakh, Pansare Pooja Khandu, and Dr. K T V Reddy, "A SURVEY PAPER ON HALF DUPLEX COMMUNICATION DEVICE," International Journal of Advance Research and Innovative Ideas in Education (IJARIIE), Vol. 5, No. 1, pp. 135-138, Jan-Feb 2019. [Online] https://ijariie.com/AdminUploadPdf/A_SURVEY_PAPER_ON_HALF_DUPLEX_COMMUNICATION_DEVICE_ijariie9411.pdf

[12]. Website1 - https://en.wikipedia.org/wiki/Walkie-talkie

[13]. Website2 - https://en.wikipedia.org/wiki/ATmega328