

A Review on Wireless Audio Transmission System for Real-Time Applications

¹Deepshika Kuhite; ²Mangala S. Madankar

¹Department of Computer Science & Engineering,
G. H. Raisoni College of Engineering, Rashtrasant Tukadoji Maharaj Nagpur Univesity, India

² Assistant Professor, Department of Computer Science & Engineering,
G. H. Raisoni College of Engineering, Rashtrasant Tukadoji Maharaj Nagpur Univesity, India

Abstract - Since from past few years it has been observed that the technology has been changed very rapidly. Most of the devices that we are using at present are operating wirelessly. So in this paper we are proposing a method to transmit the audio signals wirelessly using Bluetooth and control the signal using CC2500 trans-receiver. Here we will use an audio device as an input to the voice signal to the controller that is Arduino Nano Atmega 328. The controller is used to down sample/ up sample the data and finally a wireless device Bluetooth is used for wireless communication.

Keywords - *Bluetooth, Arduino Nano ATmega 328, CC2500*

1. Introduction

In today's world wireless communication is the fastest growing technology. As wireless communication is very interesting area of research for researchers in electronics world. Wireless communication involves transmission and receiver of data without use of cables or wires.

Wireless Sensor Network (WSN) is a network which works same as that of internet. As we know that the internet is a network in which various networks are connected to a central network called as hub. Similarly in a WSN network there are number of distributed sensors which collect data from various distributed locations and transfer it to a central location through the network.

In traditional WSN we mainly focused on monitoring various parameters such as temperature, humidity, gas, pressure, etc. Now-a-days WSN are gaining more response in emergency applications. As there may be many uncertain parameters that need to support Voice transmission over WSN. [1] So there has been a tremendous surge in Voice over Internet Protocol (VoIP) in various sectors. People have started experiencing the advantages of VoIP in various sectors some of which include mobile, Wi-Fi etc. The advantage of using wireless network is it has low cost and it consumes low power as compared to wired networks [2-3].

Due to various benefits of wireless communications it has grown rapidly. The wireless approach shows many advantages but also has some disadvantages with respect to cabled networks. Mobility is clearly one of the major advantages of wireless with respect to cabled devices, which require plugging [2]. Another advantage lies in the way new wireless users can dynamically join or leave the network, move among different environments, create ad hoc networks for a limited time and then leave. The technological challenges involved in wireless networks are not trivial, leading to disadvantages with respect to cabled networks, such as lower reliability due to interference, higher power consumption, data security threats due to the inherent broadcast properties of the radio medium, worries about user safety due to continued exposition to radio frequency, and lower data rates[3]. With better wireless network, transmission of real time media in everyday life is now possible.

2. Literature Survey

From the past few years, technology has been growing at a very high speed. As now human beings are becoming much more dependent on electronic gadgets and their applications for their comfort. Thus, [1] Bluetooth and IEEE 802.11 (Wi-Fi) are two communication protocol standards which define a physical layer and a MAC layer for wireless communications within a short range (from a few meters up

to 100 meters) with low power consumption (from less than 1 mW up to 100 mW). Bluetooth is oriented to connecting close devices, serving as a substitute for cables, while Wi-Fi is oriented towards computer-to-computer connections, as an extension of or substitution for cabled LANs. In this paper there is an overview of these popular wireless communication standards, comparing their main features and behaviours in terms of various metrics, including capacity, network topology, security, quality of service support, and power consumption. Paper [2] conveys more information about communication modules like RF, Bluetooth and Zigbee in industrial applications. In this paper, an overall comparison of these modules on the basis of their industrial applications and characteristics such as standard, bandwidth, battery life, data rate, and maximum transmission range etc. Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor [3]. The most common wireless technologies use radio. The different types of wireless communication mainly include IR wireless communication, satellite communication, broadcast radio, Microwave radio, Bluetooth, Zig-bee etc. In paper [3] we discuss the wireless communication using the HC-05 Bluetooth module, the bluetooth network topology and interfacing Bluetooth with arduino. Real-time audio-visual communication has become the need of this era [4]. Video conferencing may be one solution to saving both time and money. In fact, video conferencing may be a more effective way of communicating to clients and customers. Integrated Network Systems can install video conferencing that will allow you to share anything that is on your computer monitor and meet people face to face. In last few years, work is being done for real time transmission of audio and video.

This paper presents detailed study of audio and video transmission through various channels. Most popular is using wireless LAN or Wi-Fi. Though some authors have tried audio and video transmission through visible light communication using LEDs, some have used WiMax which means broadband wireless network with high speed [4]. Arduino ATMEGA-328 microcontroller has been programmed for various applications [5]. By using the power jack cable, arduino microcontroller has been programmed so that the execution of the program may takes place. Various kinds of arduino board are present in the market. In this paper, Arduino UNO ATMEGA-328 microcontroller is described in a detailed manner. Arduino software is installed in the computer and so that we can edit and upload the program according to the applications. Mainly these arduino software supports c and c++ programming languages. Various inputs and outputs are present in the arduino board and therefore simultaneously 8 input and output ports can be used for various applications.

Some of the applications used by using arduino boards are rotating general motor, stepper motor, control valve open, etc.,

3. Theory of Techniques

3.1 Arduino Nano ATmega 328

The Arduino Nano is a small and user-friendly board based on the ATmega328 (Arduino Nano 3.0). It lacks only a DC power jack and works with a Mini-B USB cable instead of a standard one. The Nano was designed by Gravitech. The Arduino Nano can communicate with a computer or with other microcontrollers. The ATmega328 provide UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An FTDI FT232RL on the board channels has serial communication over USB. The FTDI drivers provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent. The Receiver and Transmitter LEDs on the board will flash when data is being transmitted via the FTDI chip and USB connection to the computer.

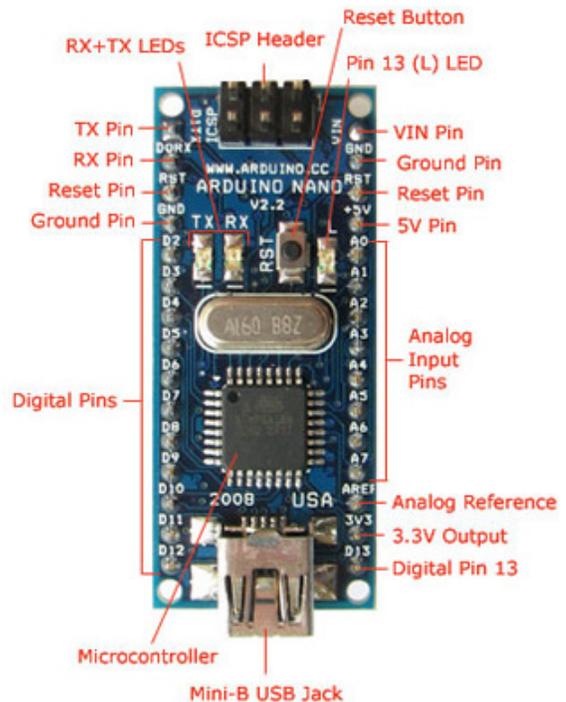


Fig 1: Arduino Nano ATmega 328

3.1.1 Power supply in Arduino Nano ATmega 328

There is an additional power supply source present in Arduino microcontroller. Power supply port is present at

the corner of the arduino microcontroller. Either we can use this power supply port by connecting with external power supply (i.e, ac power supply), or by connecting a dc power supply through input pins. These power supplies produce an active form to the arduino microcontroller. These arduino microcontrollers can accept a range of power supply. When the power supply voltage range exceeds, the microcontroller gets damaged.

3.1.2 Working Principle of ATmega 328

The working of arduino microcontroller is where the proper connection is made. The output of the pins can be connected with the external devices according to their applications. The program to be executed for the applications can be done by using arduino software. From this arduino software, we can edit according to the applications. This software can works on c and c++ programming language. It is fully a high level language. By using the conditions of working, we can create a program to proceed for the applications. Then after, these programs can be uploaded through the arduino microcontroller by using the power jack cable. The program can be uploaded to the microcontroller and ready for further process. ATMEGA-328 microcontroller can saves a program and these IC can acts as a processor to do the process without any error [12]. After by giving an analog or digital input to the system, we can do the process according to the applications. We can control the process of the application by editing the program in the arduino software and again can be uploaded to the arduino microcontroller via power jack cable. There is an option of reset button. The purpose of reset button is to reset the program which means the previous programs are deleted and we can use the arduino for the other application purposes. Likewise, these arduino ATMEGA-328 microcontrollers can be used for n number of applications.

3.2 OVC 3860 Bluetooth Module

Bluetooth is a wireless communication technology used for exchange of data over short distances. It is found in many devices ranging from mobile phones and computers. Bluetooth has a combination of both technologies that is of hardware and software. It is intended to create a personal area networks (PAN) over a short range. It operates in the unlicensed industrial, scientific and medical band at 2.4 GHz. User can use the UART serial port to communicate with OVC3860. It will implement Bluetooth headset and stereo headset functions through sending AT command. The UART serial port use-slow signal wires: Transmitter and Receiver, supporting 1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200, 230400, 460800 and 921600bps baud rate. The default baud rate is 115200bps.

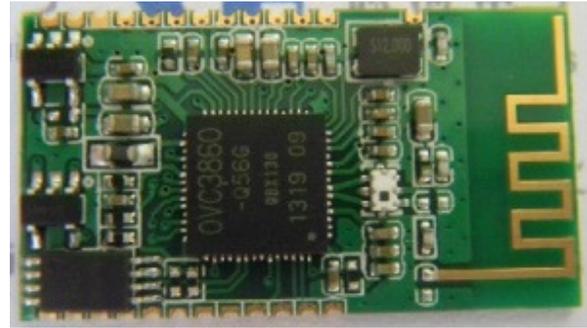


Fig 2: OVC3860 Bluetooth module

3.2.1 Pairing & Connections of OVR 3860 Bluetooth Module:

1) Enter Pairing Mode #CA

AT#CA: This command puts the module in the pairing mode. By response of information indication of command success or failure will be seen. Entering in pairing mode indication or failure indication will be sent to the host.

Table 1: Enter pairing mode

Command	Current Status(s)	Possible Indication(s)	Indication Description
#CA	Any	II	Enter Pairing Mode Indication

2) Cancel Pairing Mode #CB

AT#CB: When the module is in pairing mode, this command causes the module to exit the pairing mode. This command makes the module in idle state. By response of information indication of command success or failure will be seen.

Table 2: Cancel pairing mode

Command	Current Status(s)	Possible Indication(s)	Indication Description
#CB	Pairing	IJ2	Exit Pairing Mode Indication



Fig 4: CP2102 USB to serial Converter

3.4.1 USB Function Controller and Transceiver

The Universal Serial Bus function controller in the CP2102 is a USB 2.0 compliant full-speed device with integrated transceiver and on-chip matching and pull-up resistors. The USB function controller manages all data transfers between

the USB and the UART. It also manages command requests generated by the USB host controller and commands for controlling the function of the UART. The USB suspend and resume signals which are supported for power management. The CP2102 will enter in the Suspend mode when Suspend signaling is detected on the bus. On entering Suspend mode, the CP2102 declare the SUSPEND mode and SUSPEND the signals. SUSPEND is also asserted after a CP2102 reset until device configuration during USB Enumeration is complete. The CP2102 exits from the Suspended mode when Signalling is detected or generated, USB Reset signal is detected, or when device reset occurs. On exit of Suspend mode, the SUSPEND signals are de-asserted. Both the commands i.e. SUSPEND temporarily float high during a CP2102 reset. If this behaviour is undesirable, a strong pull-down (10 kΩ) can be used to ensure SUSPEND remains low during reset. See Figure 6 for other recommended options.

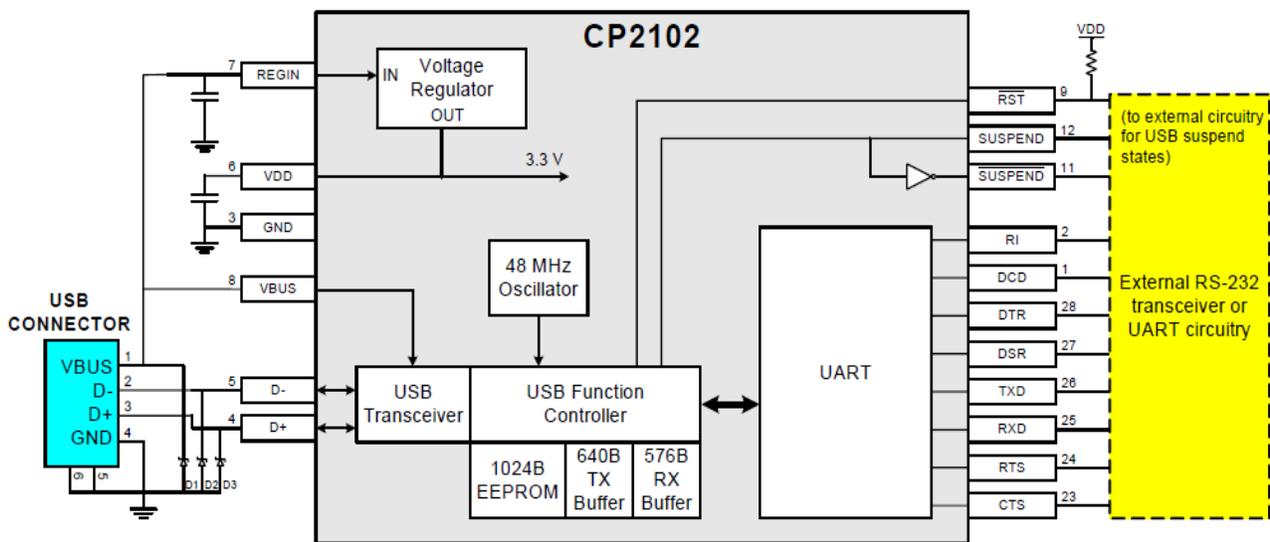


Fig 5: CP2102 Connection Diagram

3.5 Switches

Switch is the most important part of most electronic circuits. Most of the circuits contain an on/off switch for controlling the device or activate different features of the circuit. Switches are mechanically used. They contain two or more terminals that are internally connected to metal contacts. These terminals can be opened or closed by the person operating the switch. When the switch is in the “On” position, the contacts are brought together to complete the circuit so that current can flow. When the contacts are

together, the switch is closed and when they are apart, the switch is open and current cannot flow.



Fig 6: Switch

4. Proposed Work

Fig. 7 shows the block diagram of transmitter section of Wireless Audio Transmission System. As shown in figure it consists of a Bluetooth device i.e. Laptop, USB to serial convertor and Trans-receiver.

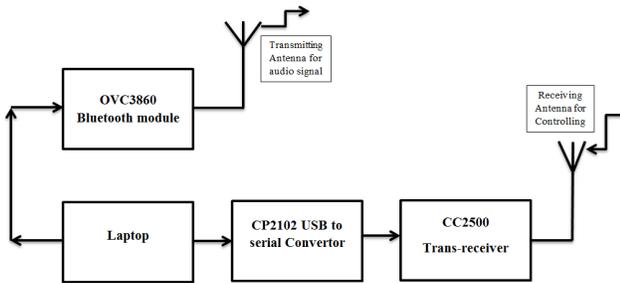


Fig 7: Transmitter section of Wireless Audio Transmission System

Here we are using Laptop which contains Bluetooth used as an input device to the circuit. The Bluetooth device can directly paired with OVC3860 Bluetooth module for transmission of data. From the fig we can see that we are using CP2102 USB to serial convertor which is highly integrated and use minimum PCB space. The CC2500 trans-receiver is used for controlling the device by using matlab programming. Here we are using matlab programming for controlling the signal. The controlling of signal is done by using switches and they are transmitted and receive by trans-receiver. This is shown in fig. 8. Switch contains five pins they are play, next, stop, previous and folder. The signal for controlling is transmitted from receiver side to transmitter side by using CC2500. If at transmitter side CC2500 trans-receiver get the signals of “PLAY” then device start transmitting the audio signal using Bluetooth to receiver side. If “STOP” is received transmitter stop the signal for transmission. If “NEXT”

signal is received the next song is played. If “PREVIOUS” signal is received previous song is being played. If “FOLDER” signal is received then next folder song is played. In this way the controlling of signal is done.

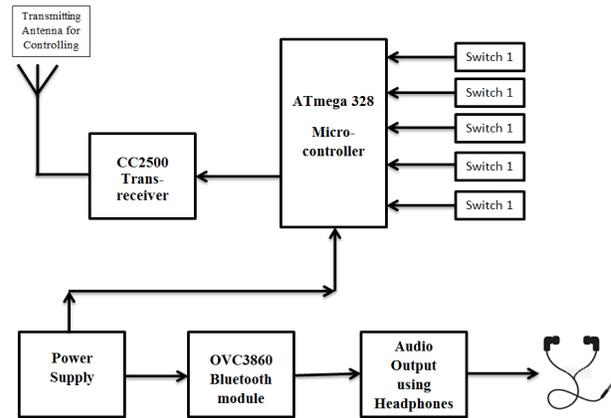


Fig 8: Receiver section

Fig. 8 shows the block diagram of receiver section. Here the transmitted signal is transmitted by using Bluetooth is received by the receiver and this signal is then applied serially to the micro-controller unit through UART for processing. Externally battery is connected with the arduino microcontroller for the power supply. After processing the signal is to be applied to OVR3860 Bluetooth module to get an output using headphones. From the fig. 8 we can see that the switches are connected to microcontroller which is used for controlling the device using CC2500 trans-receiver.

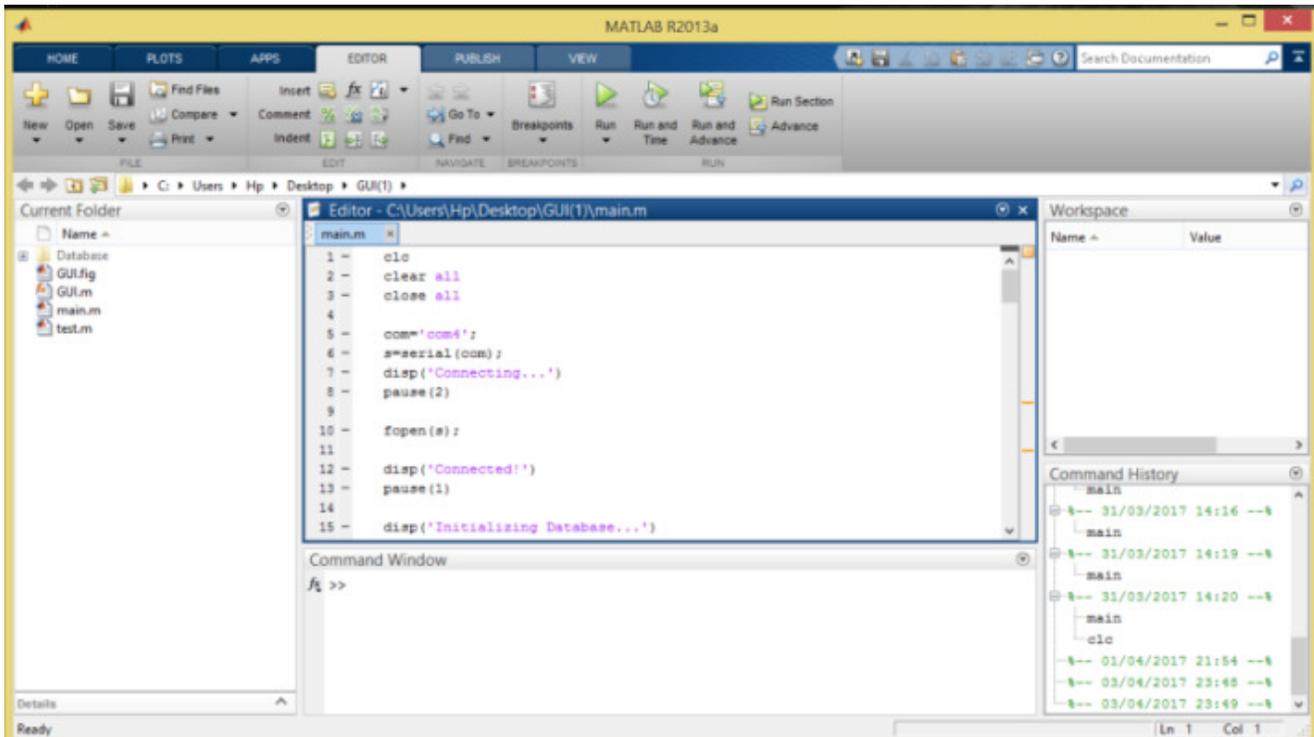


Fig 9: Programming in Matlab

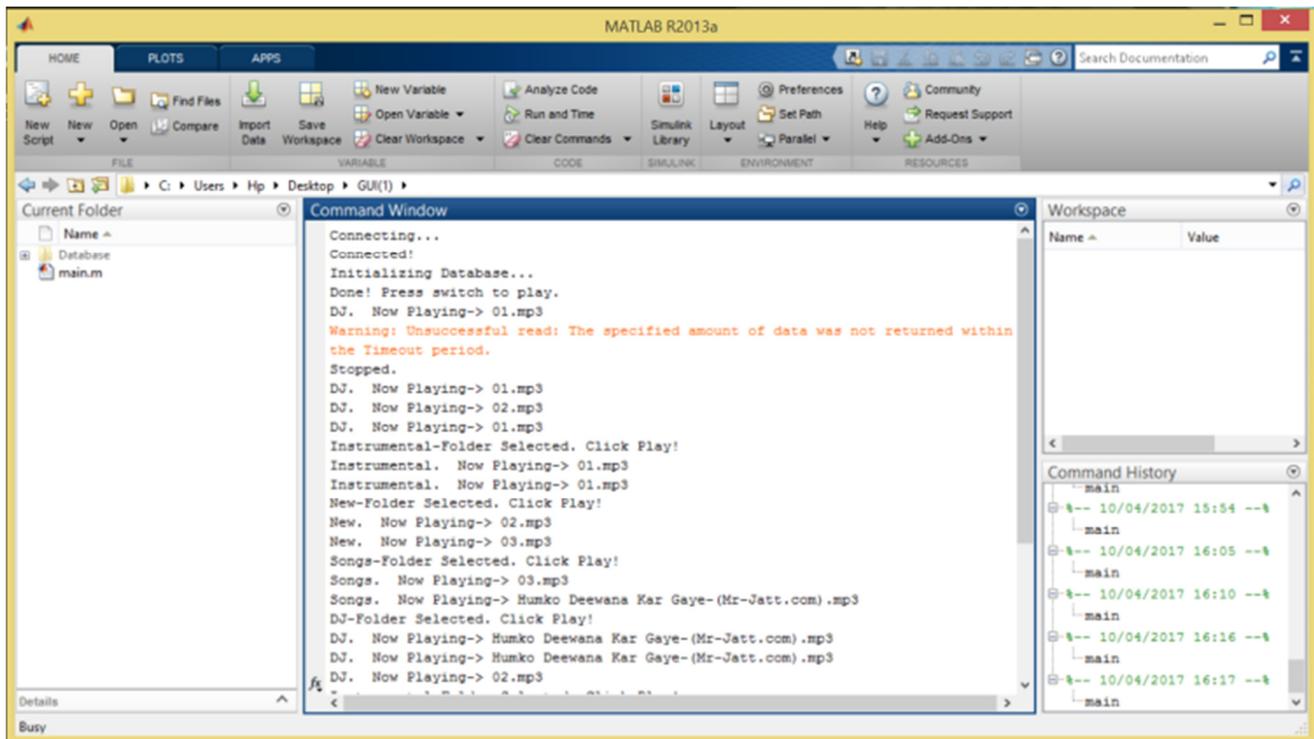


Fig 10: Controlling using Matlab GUI

The fig. 9 shows the programming in matlab for controlling the signal. The programming language used can be in c or c++.

Fig. 10 shows how instructions are send by using CC2500 trans-receiver. In matlab we can see the controlling part. The different folders can be played and the notification will be displayed on the screen.

5. Circuit Diagram

5.1 Transmitter:



Fig. 11: Transmitter section

5.2 Receiver:

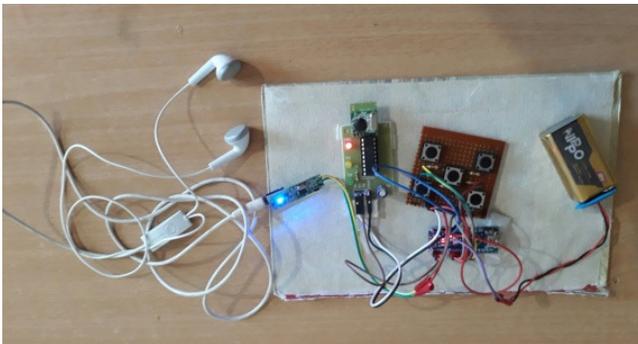


Fig. 12: Receiver section

6. Software Used

6.1 Matlab

MATLAB is a fourth-generation high-level programming language. Matlab has interactive environment for visualization, numerical computation and programming. It allows matrix manipulations, plotting of functions and data, creation of user interfaces, interfacing with programs. A program in matlab is written in other languages which include C, C++, Java, and FORTRAN and creates different applications. It has numerous commands and math functions which help in mathematical calculations and generating plots. MATLAB allows writing two kinds of program files:

Scripts - Script files are program files with “.m extension”. In these files, you write series of commands, which you want to execute. Scripts do not accept inputs and do not return any outputs. They operate on data in the workspace.

Functions - Functions files are also program files with “.m extension”. Functions can accept inputs and return outputs. Internal variables are local to the function. You can use the MATLAB editor or any other text editor to create your “.m” files. So in this section, we will discuss the script files. A script file contains multiple sequential lines of MATLAB commands and function calls. Here you can run a script by typing its name at the command line.



Fig 13: Matlab logo

MATLAB is built around a programming language. Guide extends MATLAB's support for rapid coding for building GUIs. Guide is a set of MATLAB tools. It is designed to make building GUIs easier and faster. Just as writing math in MATLAB is much like building a GUI with Guide designed one on paper. So as a result, you can lay out a complex graphical tool in few minutes. The GUIs are used in matlab because it makes things simple for the end-users

of the program. The principles of good GUI design are for the most part, timeless and universal.

6.1.1 Important Commands in Matlab:

- **cd** – Display/ Change current working directory
- **clc** – Clear command window
- **clear** – Clear content of workspace
- **clf** – Clear content of current figure window
- **close** – Close current figure window
- **^c** – Abort / terminate the execution of current program/command
- **date** – Current date as date string
- **demo** – Runs the demo programs
- **dir** – List files/folders in present directory
- **exit** – End (quit) a MATLAB session
- **help** – Display help text in command window

6.2 Atmega 328

The ATMEGA-328 integrated chip consists of 28 pins. It consists of 6 analog inputs that are shown in the pin diagram. Analog inputs can be represented as PC0 to PC5. These analog input pins possess the continuous time signal which acts as an analog input for the system. Further it also consists of 12 digital inputs. It can be represented as PD1 to PD11 which act as a digital input ports based on pulse width modulation (PWM). These PWM, which transmits the signal in the form of discretized form. Both analog and digital input ports can be used for various applications for the input power supply, VCC and GND pins are used. Pins PB6 and PB7, which acts as a crystal to generate a clock signal. By using these crystals, we can generate the clock signals and by these clock signals, we can use this clock signals for input sources. PC6 pin are the one where it can be used for the reset option. Resetting the program can be done by using this PC6 pin. The pin diagram of atmega-328 microcontroller can be shown in fig.9.

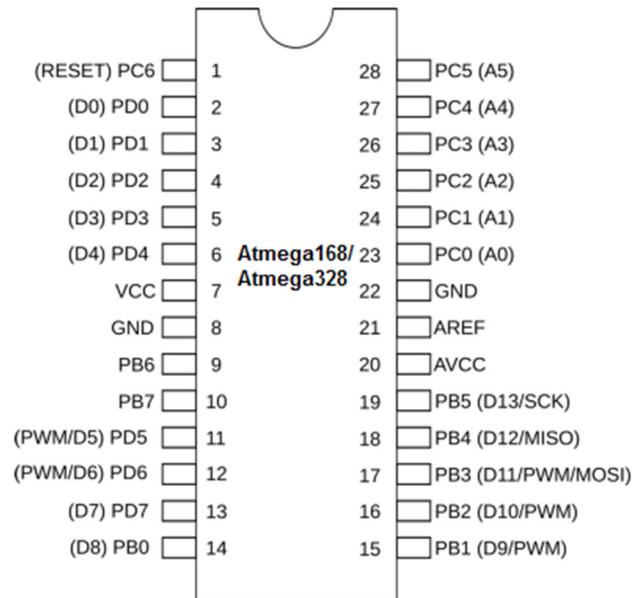


Fig 14: Atmega 328 Pin Configuration

Arduino ATMEGA-328 microcontroller has been programmed for various applications. Power jack cable is used in arduino microcontroller to program so that the execution of the program may takes place. Arduino software must be installed in the computer so that we can edit and upload the program according to the applications to be designed. Mostly these arduino software supports c and c++ programming languages. Different inputs and outputs are present in the arduino board and therefore we can simultaneously use 8 input and output ports for various applications some of the applications used by using arduino boards are rotating general motor, stepper motor, control valve open, etc. Thus, the Arduino ATMEGA 328 microcontroller can be used for various applications such as industrial and laboratory applications. These Arduino ATMEGA 328 microcontrollers are the most suitable microcontroller for the robotic applications. These Arduino ATMEGA 328 microcontrollers can be widely used in automation process industries.

7. Flowchart

7.1 Transmitter Section:

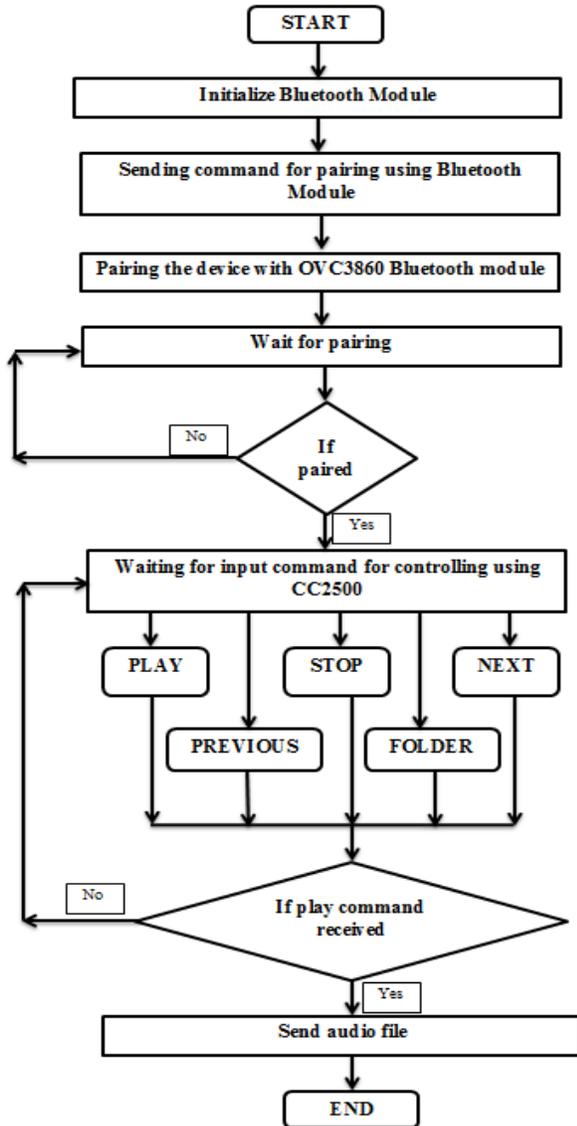


Fig 15: Flow-chart of transmitter

7.2 Receiver Section:

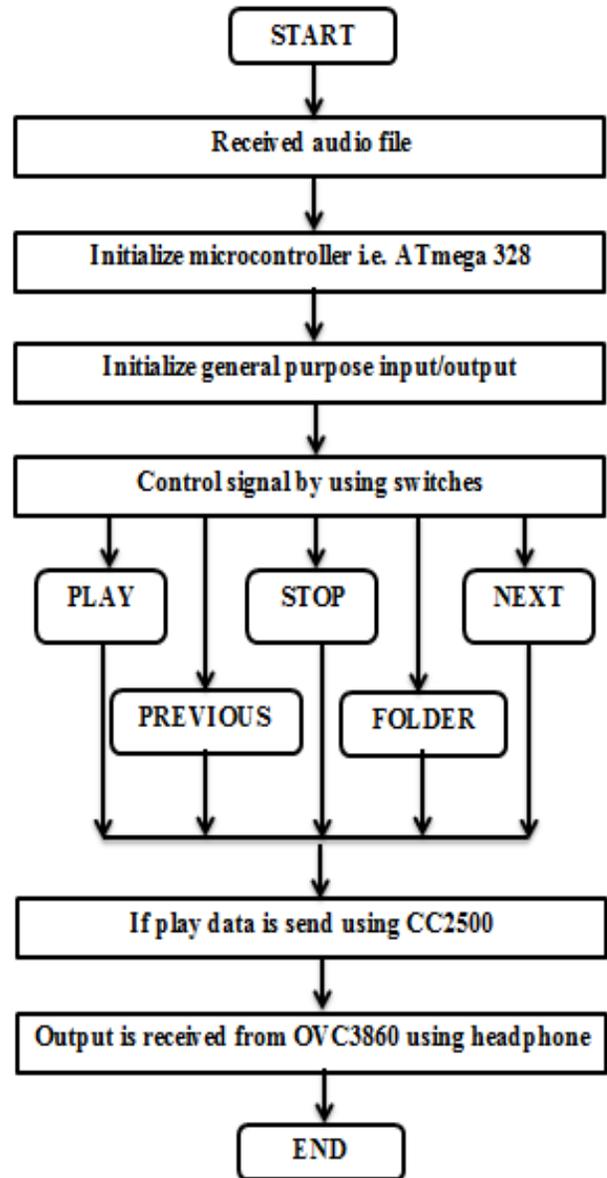


Fig 16: Flow-chart of receiver

8. Results and Conclusion

Thus, we have implemented Bluetooth technology for transmission of audio signal. Bluetooth remains a very promising technology, with sound quality and connectivity of the device. Along with quality, the range of the device is also improved. The controlling part of the device can be done very efficiently by

using switches. Hence, we conclude that the device work efficiently as audio transmitter.

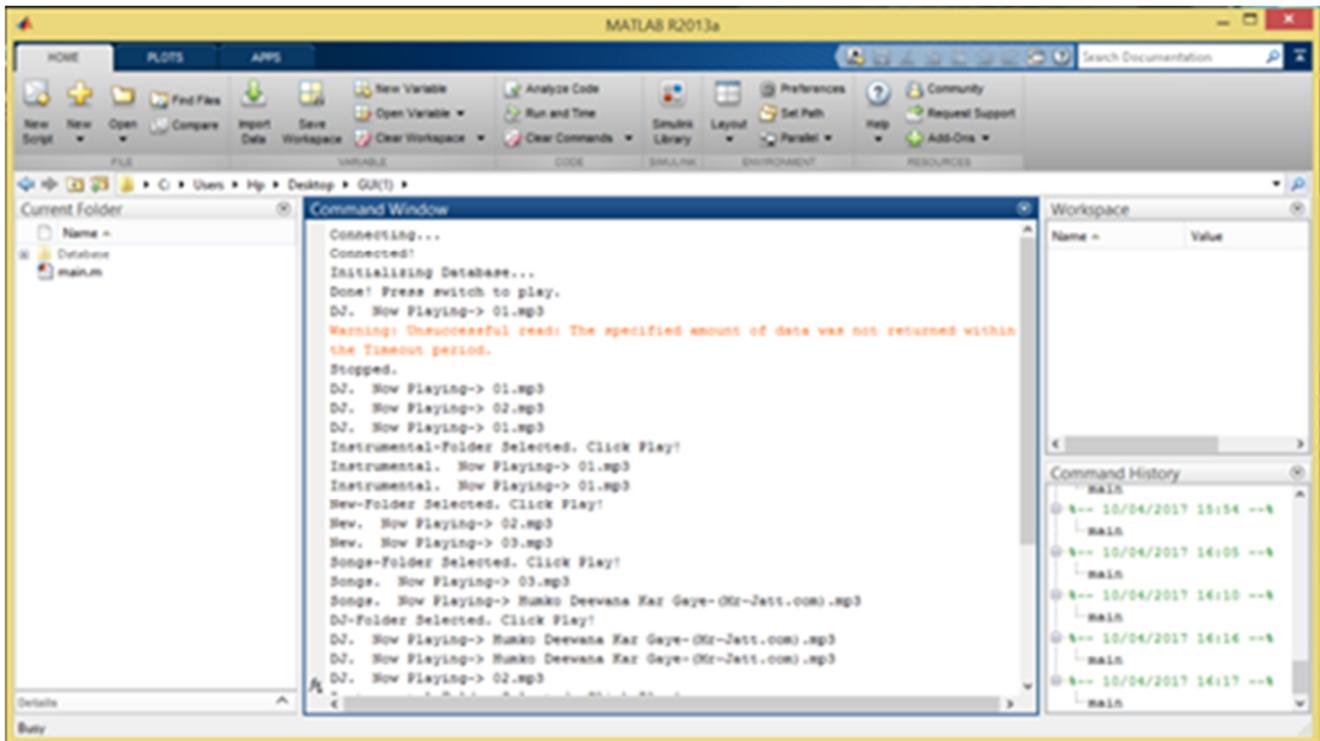


Fig 17: Output through Matlab

References

- [1] Erina Ferro, Francesco Potortì, “Bluetooth and Wi-Fi wireless protocols: a survey and a comparison”, IEEE Wireless Communication’s magazine, June 2004.
- [2] V.Abinayaa, Anagha Jayan, “Case study on comparison of wireless technologies in industrial applications”, International Journal of Scientific and Research Publications, Volume 4, Issue 2, February 2014.
- [3] Mrs Anisha Cotta, Miss. Naik Trupti Devidas, “Wireless communication using HC-05 Bluetooth module interfaced with arduino”, International Journal of Science, Engineering and Technology Research (IJSETR) Volume 5, Issue 4, April 2016.
- [4] Nalini Bagal, Prof. Shivani Pandita, “A Review: Real-Time Wireless Audio-Video Transmission”, International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008) Certified Journal, Volume 5, Issue 4, April 2015.
- [5] Rajeeb Lochan Dash, Mrs. A. Ruhan Bevi,” Real-time Transmission of Voice over 802.11 Wireless Networks Using Raspberry Pi”, Volume 2, Issue 1, International Journal of Engineering Development and Research,p.793-800,2014.
- [6] <http://in.mathworks.com/product/Matlab>
- [7] Matlab: <http://www.tutorialspoint.com>
- [8] Yingjie He, Liwei Ding, Yuxian Gong, Yongjin Wang,” Real-time Audio & Video Transmission System Based on Visible Light Communication”, *Optics and Photonics Journal*, 153-157, 2013.
- [9] Bhushan R Jichkar., "Proposed System for Placing Free Call over Wi-Fi Network Using VoIP and SIP", Int. Journal of Engineering Research and Applications, ISSN:2248-9622, Vol.4, Issue 1(Version 3), pp.132-135, January 2014.
- [10] G.Sai Prasanna, S.Karunakar, “Implementation of VOIP Communication on Embedded Systems”, International Journal of Research in Computer and Communication technology, IJRCCT, ISSN 2278-5841,Vol 2, Issue 1, January 2013.
- [11] Akshay Iyer, Akshay Badgujar, Maheshkumar Eaga, Rohit Iyer,” Voice and Video over Wireless LAN”, International Journal of Scientific and Research Publications, Volume 3, Issue 9, September 2013.
- [12] Daniel Jakubisin,Marshall Davis,Casey Roberts,Dr. Ivan Howitt, "Real-Time Audio Transceiver Utilizing 802.11b Wireless Technology", IEEE,2007.
- [13] Dapeng Wu, Yiwei Thomas Hou, Wenwu Zhu, Ya-Qin Zhang, Jon M. Peha, “Streaming Video over the Internet: Approaches and Directions”, IEEE 2001.

- [14] Kostas Maraslis, Periklis Chatzimisios, Anthony Boucouvalas," IEEE 802.11aa: Improvements on video transmission over Wireless LANs", Ad-hoc and Sensor Networking Symposium, IEEE ICC 2012. A. Panayides, I. Eleftheriou, M. Pantziaris, "Open-Source Telemedicine Platform for Wireless Medical Video Communication", International Journal of Telemedicine and Applications, Article ID 457491, Jan 2013.
- [15] Misun Yu, Woosuk Cha, Jun-Keun Song, Ji-Young Kwak, Seon-Tae Kim," Design and Implementation of an Audio/Video Group Chat Application for Wireless Mesh Networks", ICACT 2013.
- [16] Irfanullah, Amjad Ali, Abdul Qadir Khan, Rehanullah Khan, Akhtar Khalil" WiMAX Based Audio/Video Transmission", IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 1, No 3, January 2013.