EC382: Mini Project in Analog System Design

High Fidelity Infrared Audio Transmitter and Receiver System

VI Semester B.Tech 2023

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Introduction :

An IR based audio transmitter and receiver system is a device that allows audio signals to be transmitted wirelessly over short distances using infrared (IR) light. The transmitter converts audio signals into IR light signals that are then transmitted to the receiver. The receiver converts the IR light signals back into audio signals, which can be played through a speaker or headphones.

IR based audio transmitter and receiver systems are commonly used in situations where wired connections are impractical, such as in home theatre systems, gaming consoles, and portable audio devices. They offer a convenient and reliable way to transmit high-quality audio signals without the need for cables or wires.

Overall, an IR based audio transmitter and receiver system is a useful tool for anyone who wants to enjoy high-quality audio without being tethered to a wired connection.

Problem Statement :

The problem addressed in this project is the need for a reliable and efficient IR based audio transmission and reception system. While IR based systems have been used for many years, the current technology available for audio transmission and reception still faces several challenges. These challenges include limited range, interference from other light sources, and poor sound quality.

The current IR based audio transmission and reception systems on the market often suffer from these issues, resulting in poor audio quality and unreliable transmission. This can be particularly frustrating for users who are looking for a seamless and high-quality audio experience.

Therefore, this project aims to develop an IR based audio transmission and reception system that overcomes these challenges and provides a reliable, high-quality audio experience. The system will need to be designed to have a longer range, be resistant to interference, and provide excellent sound quality. By addressing these issues, this project will contribute to the development of an advanced IR based audio transmission and reception system that can be used in a wide range of applications.

Motivation :

The motivation for doing this project on IR based audio transmitter and receiver is to provide a reliable and efficient wireless audio transmission and reception system that offers high-quality sound without the limitations of wired connections. IR technology has been used for many years in various applications, including audio transmission and reception. However, the current technology available for audio transmission and reception still faces several challenges, such as limited range, interference from other light sources, and poor sound quality.

Developing a robust and efficient IR based audio transmission and reception system would offer several benefits. Firstly, it would provide a wireless audio transmission solution that is immune to interference from other wireless signals, such as Wi-Fi and Bluetooth, which can be problematic in crowded environments. Secondly, it would eliminate the need for complex wiring setups, which can be expensive, time-consuming, and difficult to manage. Thirdly, it would offer a high-quality audio experience, free from the distortion and noise that can be introduced by wired connections.

Methodology:

The methodology for developing an advanced IR based audio transmission and reception system would involve the following steps:

1) Requirements Analysis: This step involved identifying the functional and non-functional requirements of the system. The requirements include the desired range, sound quality, supply voltages,bandwidth of transmission,sensitivity of receiver.

2) Circuit Design: Based on the requirements analysis, the hardware circuit design was developed.

3) Component Selection: The selection of the hardware components was done based on the circuit design and requirements analysis. This includes selecting the IR light source, the receiver ,comparators, operational amplifiers, voltage regulators, speaker, transistors,microphone,diodes, batteries,regulator IC, timer IC and passive components.

4) Prototyping: A prototype circuits were developed to test the design and component selection. This involved building the hardware for the circuit on the breadboard.

5) Testing and Evaluation: The prototype circuits were tested to evaluate its performance, including its range, sound quality. The results of the tests was used to refine the system design and identify any areas for improvement.

6) Circuit Integration and Optimization: Based on the testing and evaluation, the circuit was optimised to improve its performance and ensure compatibility with existing

circuit design and finally design freezing was done to manufacture the final prototype for the demo.

Implementation : (Pre-midsem)

Transmitter :

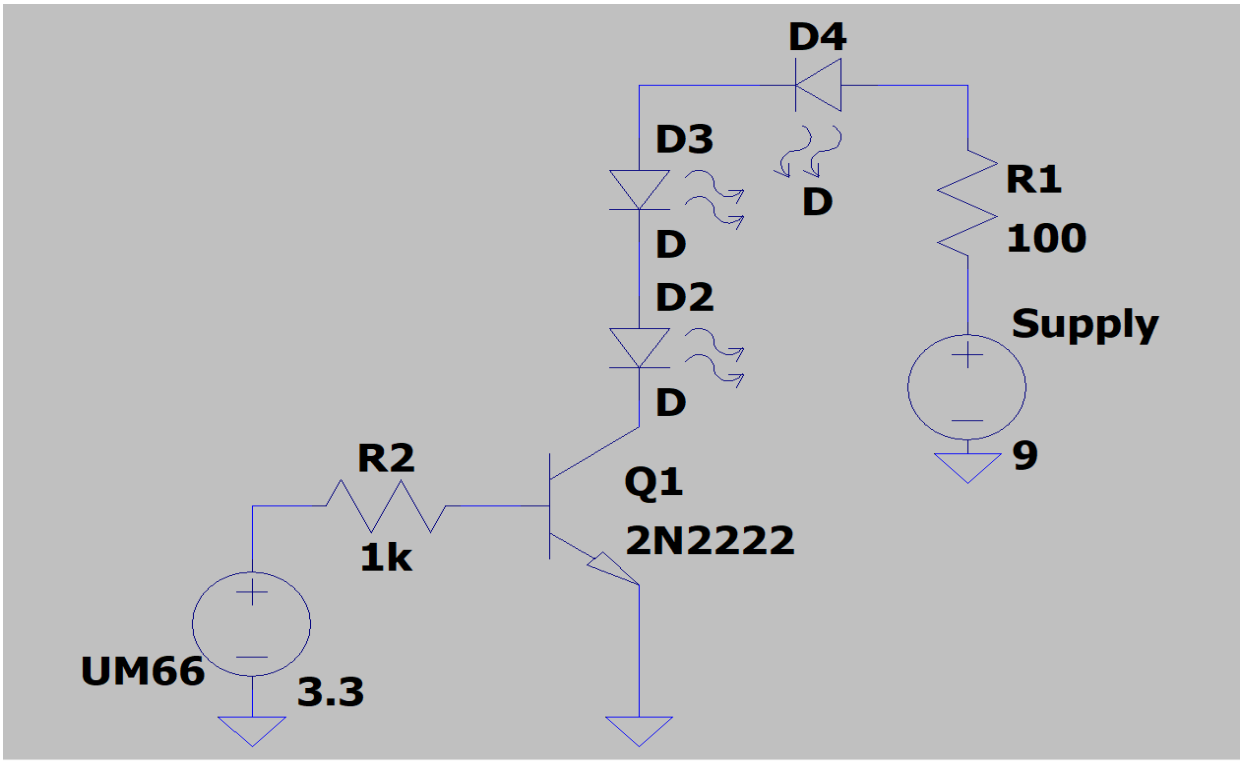

Fig 1 a : Circuit diagram of the transmitter with UM66 tone generation

Audio Input: The audio input is taken from a tone generator UM66.This IC generates audio PWM signals of 3.3vpp which is then used as control signal to switch 3 IR LEDs arranged in series connected fashion using low sided driving from NPN transistor 2N2222.

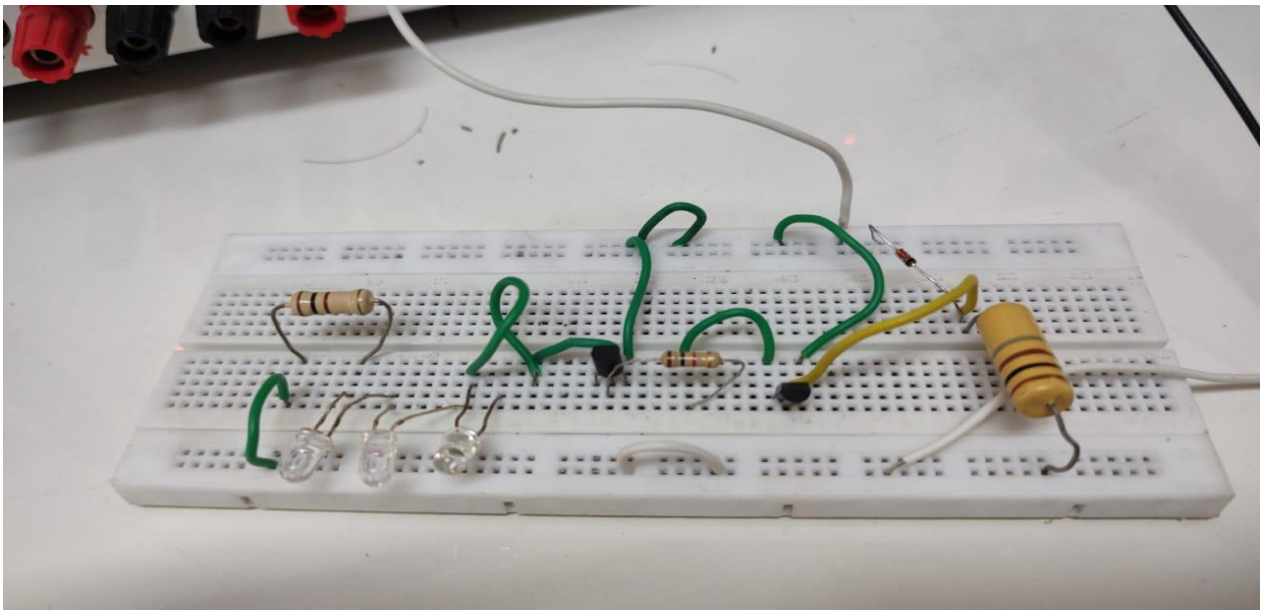

Fig 1 b : Breadboard prototype of the transmitter with UM66 tone generation

Receiver :

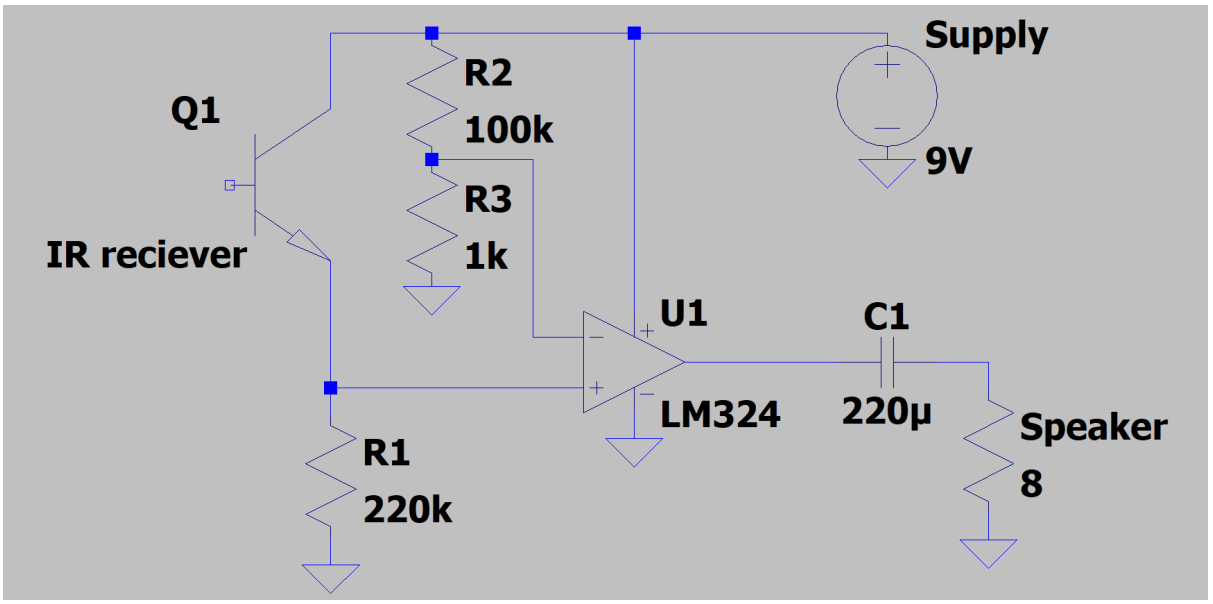

Fig 2 a : Circuit diagram of the UM66 tone receiver

The receiver circuit consists of a phototransistor which is connected to a comparator circuit to retrieve PWM signal from the transmitter.This PWM signal is applied to the speaker through a 220uF capacitor to get the audio/tone transmitted.

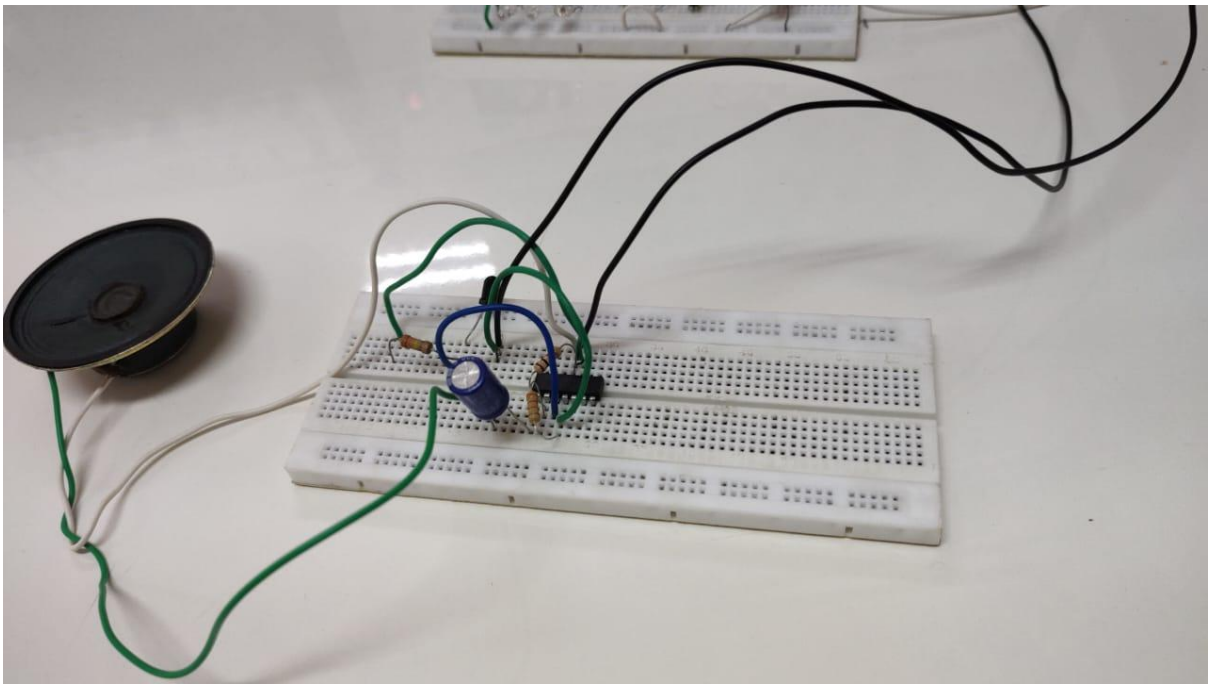

Fig 2 b : Breadboard prototype of theUM66 tone receiver

Post-midsem :

TRANSMITTER :

Audio Modulation for microphone :
We are using pulse width modulation to convert analog audio signal to digital to transmit IR signals which has high signal to noise ratio and controlled volume.We are generating 20Khz ramp signal using BJT constant current source capacitor charging and NE555 timer IC as discharging rate of 20 Khz.Then the LM393 is used as comparator between microphone and ramp signal to generate PWM audio signal which is fed to transmitter circuit.

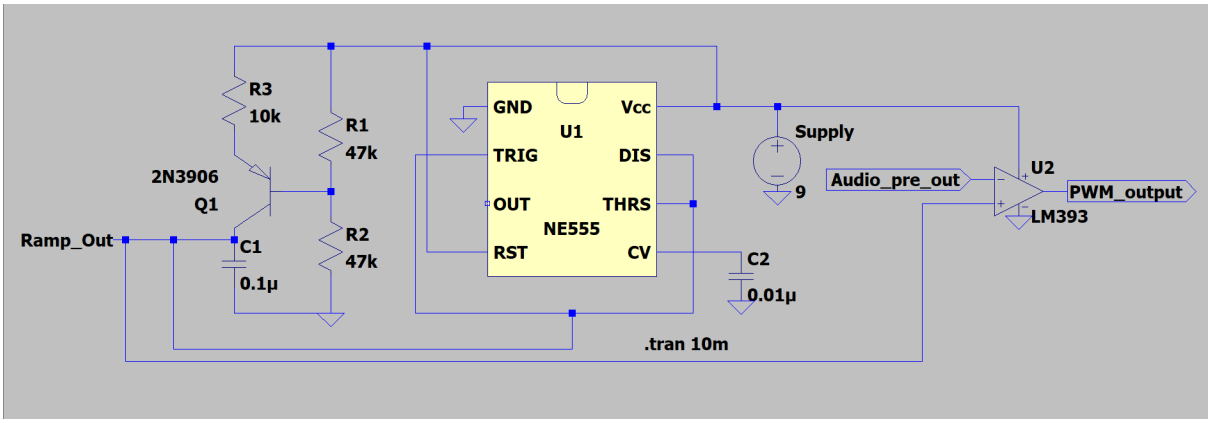

Fig 3 a : Circuit diagram of the PWM conversion of analog signal

Above is the application of the NE555 timer as a monostable multivibrator where instead of charging the capacitor exponentially, we charge in a controlled manner using a constant current source.Constant current source is implemented using BJT biassed using resistive feedback circuit.During charging if current is constant ,voltage across capacitor increases linearly and for the trigger same voltage across capacitor is given as input which will discharges capacitor through discharge pin of NE555 timer IC.

(idea: PWM generation using timers in arduino).

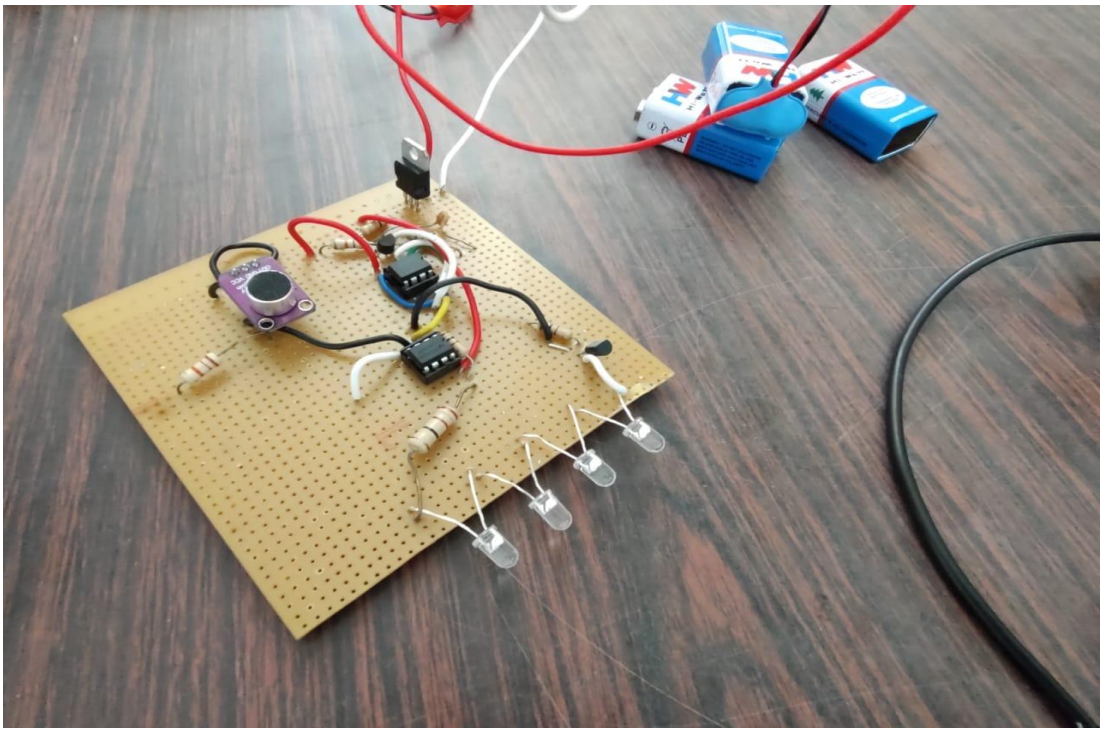

Fig 3 b: Prototype of the real audio IR transmitter

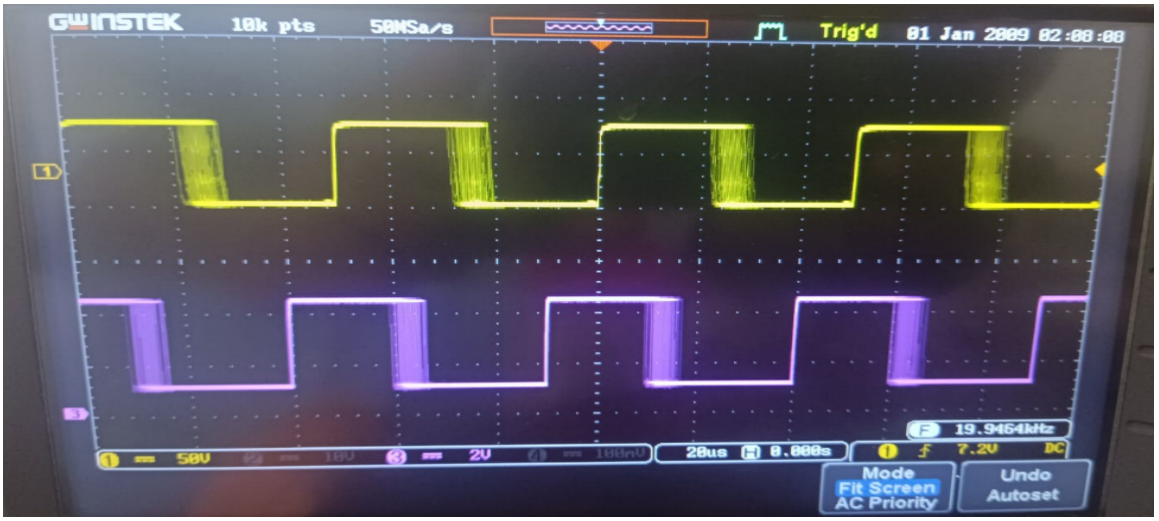

Fig 3 c: Waveforms (yellow : received signal and purple : transmitted signal)

RECEIVER :

The The receiver circuit consists of a phototransistor which is connected to a comparator through capacitor to remove dc.Output of comparator is connected to audio power amplifier LM386 through potentiometer which is acting as volume control.The output of the LM386 is used to drive the 8 ohm speaker through capacitor of 220uF.

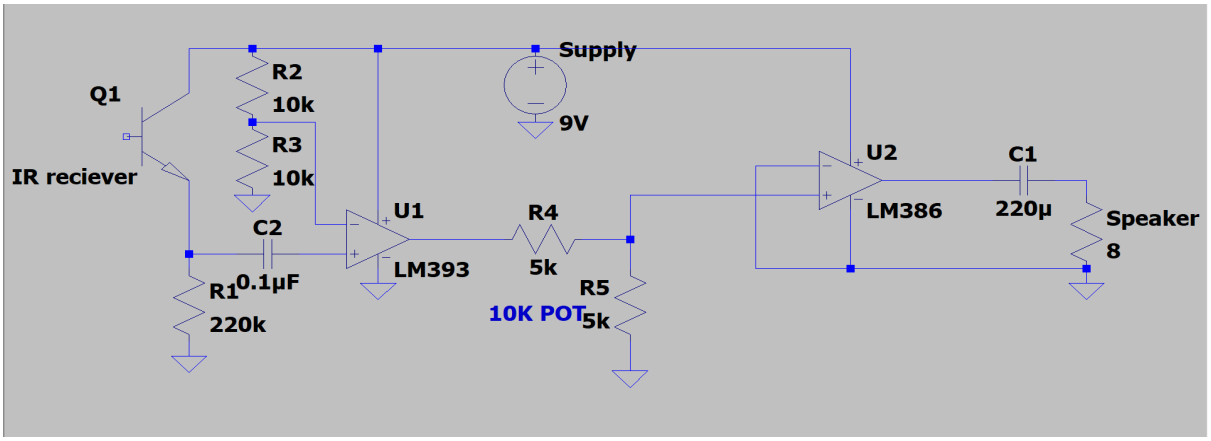

Fig 4 a : Circuit diagram of real audio IR receiver

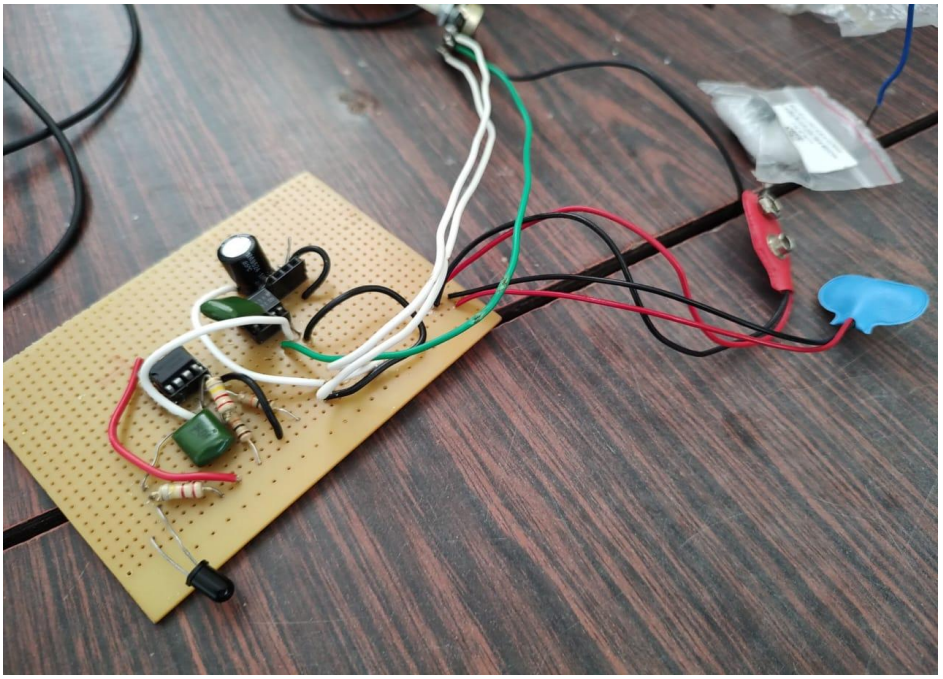

Fig 4 b : Prototype of real audio IR receiver

CONCLUSION:

In this project, we have designed an IR-based audio transmitter and receiver system using PWM conversion of analog to digital signal. The aim of the project was to design a system that could transmit high-quality audio signals over short distances using IR light and PWM conversion.We tested the system extensively to evaluate its performance in terms of audio quality, transmission range, and resistance to interference. Our results demonstrate that the IR-based audio transmitter and receiver system using PWM conversion can reliably transmit high-quality audio signals over short distances of up to 2 to 3 metres.

One potential limitation of our system is that it requires a direct line of sight between the transmitter and receiver, which could limit its use in certain situations. However, our results demonstrate that the system is highly effective for short-range transmission of high-quality audio signals in a variety of environments.

In conclusion, our IR-based audio transmitter and receiver system using PWM conversion represents a novel approach to high-fidelity audio transmission over short distances. Our results demonstrate that the system is highly effective, reliable, and resistant to interference, making it suitable for use in a variety of applications.

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