FM Transceiver Project:

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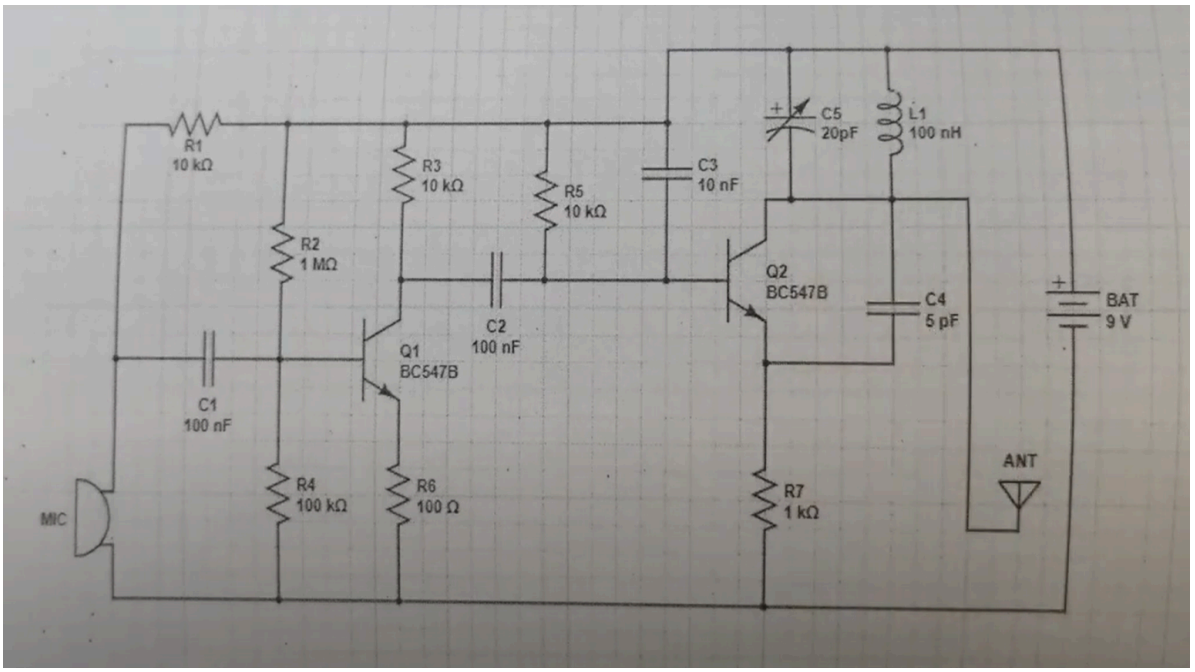
In this project, I build a Frequency Modulated (FM) transmitter & receiver that can establish communication through audio signal (RF signal) in a shorter range.

Transmitter:

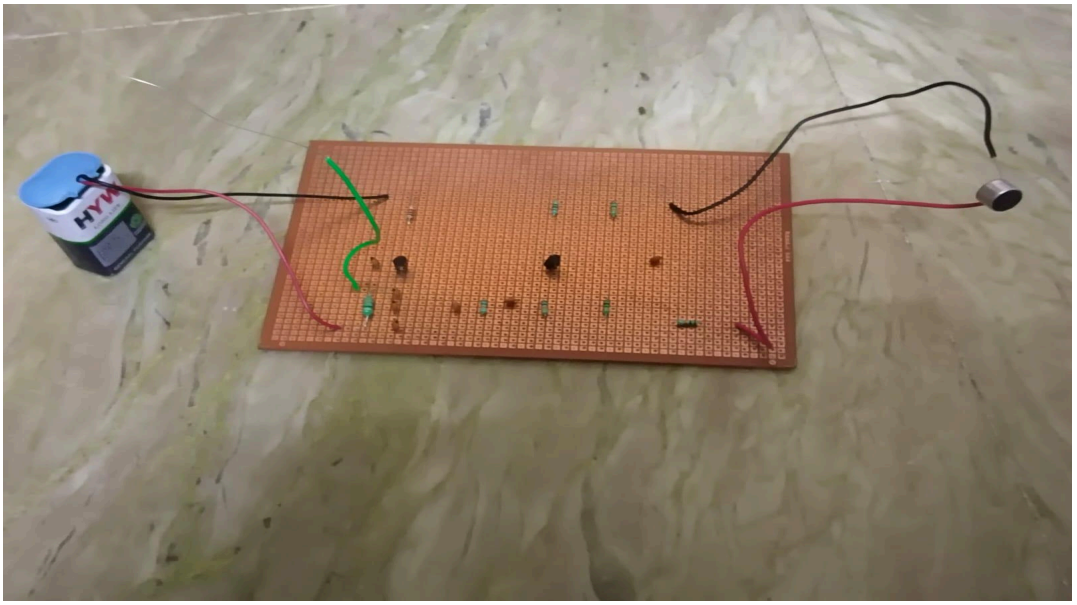


Circuit Diagram of the Transmitter

Circuit Description & Working:

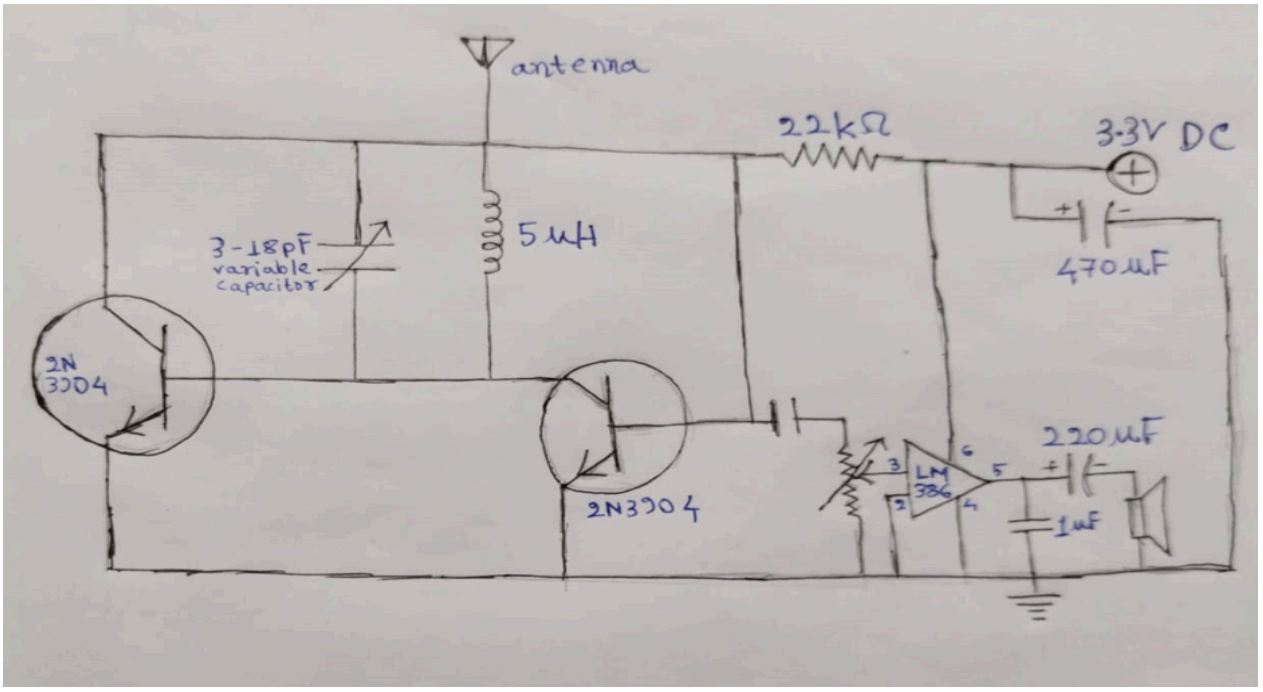
- Microphone Stage: The microphone (MIC) captures sound signals and converts them into electrical signals. The microphone's output is coupled via capacitor C1 to the base of transistor Q1.

- First Transistor Stage (Q1): This portion containing the transistor Q1 acts as a CE amplifier and gives the output to the second transistor state through capacitor C2.
- Second Transistor Stage (Q2): This part acts as an oscillator for frequency modulator. Q2, along with C4 and L1, forms an oscillator, generating a high-frequency carrier signal. The audio signal from Q1 modulates the frequency of this carrier signal. The variable capacitor C5 allows fine-tuning of the carrier frequency.
- Tank Cricuit: This is the LC circuit consisting of capacitor (C1) & inductor (L5). This part determines the frequency of carrier signal.
- Antenna: ANT finally radiates the FM signal into the air.
- Power Supply: A 9V DC battery is used to supply power throughout the circuit.



FM Transmitter Circuit soldered on a Perfboard

Receiver:

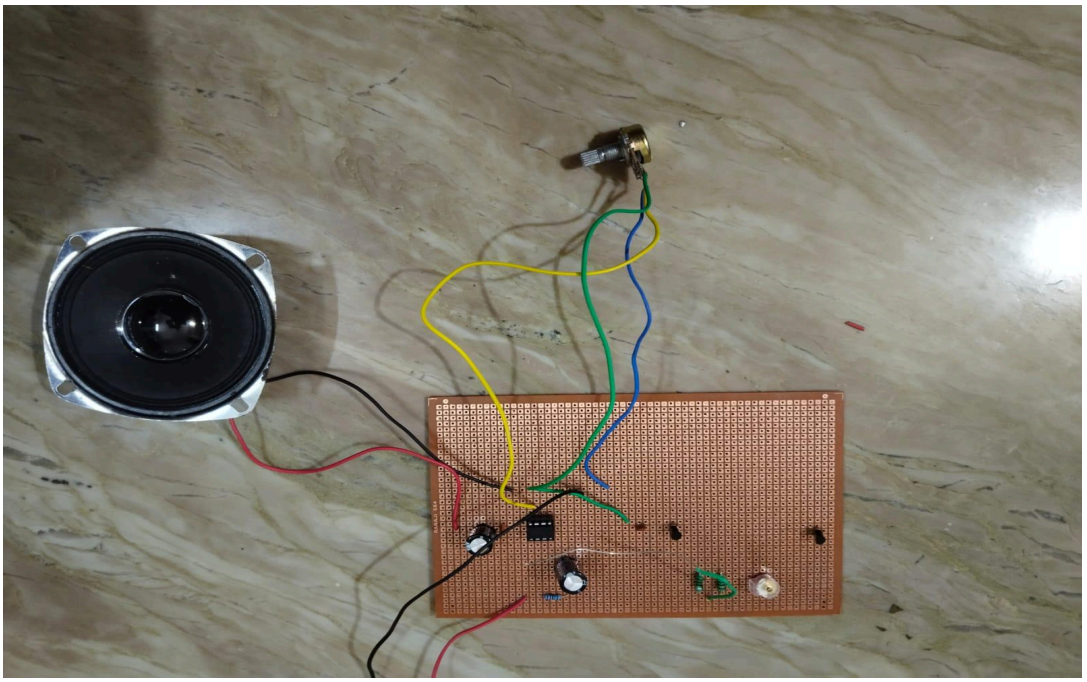


Circuit Diagram of the Receiver

Circuit Description & Working:

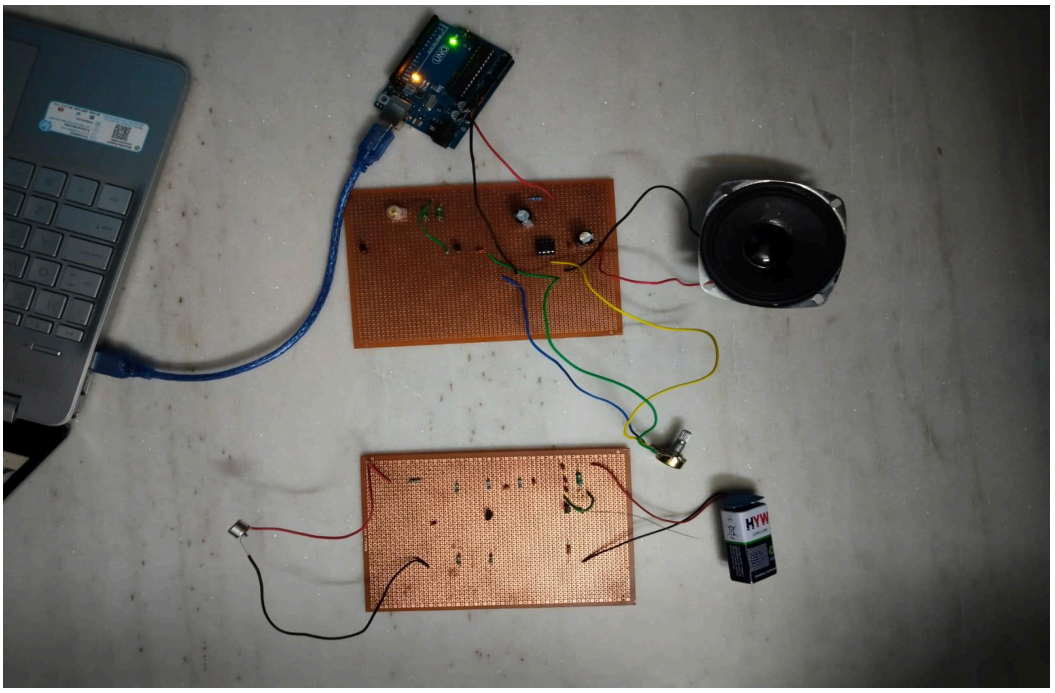
- Antenna & RF Signal Capture: Antenna captures the the incoming signal & sends it to the LC tuned circuit.
- Tuned Circuit: Here, we vary the value of capacitor to select only the desired frequency from incoming signal. The LC circuit resonates at the frequency of the incoming FM signal.
- First Transistor Stage: This part (leftmost BJT in the circuit diagram) acts as a CE amplifier circuit which amplifies the selected weak signal & sends it to the second transistor stage.

- Second Transistor Stage: This part mixes the RF signal with the local oscillator signal & also amplifies it further.
- Demodulation Stage: The capacitors & inductors in the circuit demodulates the FM signal to retrieve the audio signal.
- Audio Amplification: Then LM386 configured with the necessary passive components (capacitors and resistors) amplifies the audio signal. Here, 220 uF capacitor used for coupling and to block DC components whereas 1 uF capacitor provides feedback and stability to the amplifier circuit.
- Output Stage: The amplified audio signal from the LM386 is fed to the speaker, which produces sound corresponding to the original FM transmission.
- Power Supply: A 3.3V DC power source (here, from Arduino) powers the entire circuit.



FM Receiver Circuit soldered on a Perfboard

Final Design:



Complete Transceiver Setup

Finally, the complete circuit is made and tested. The receiver receiving the signal though containing large noises.
Here, implementing digital modulation methods can significantly improve signal quality and efficiency. Additionally, integrating microcontrollers and digital signal processors can also add advanced features like automatic frequency tuning, noise reduction, signal filtering etc.