FM based Wireless Public Announcement System

A MINI PROJECT

Submitted by

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Mini Project Report Cover Sheet

Title of the Project : FM Based Wireless Public Announcement System

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Particulars	Max. Marks	BadmalathaV. (RA2211004010612)	Ujjayati Saha (RA2211004010632)	K.Aparna (RA2211004010638)
Problem Understanding & Objective	5	3	4	4
Methodology/Algorithm/ Design Approach	15	12	14	14
Implementation / Experimental Work	15	12	13	13
Testing & Analysis	5	3	4	4
Presentation & Viva	5	3	4	3
Report	5	4	4	4
Total	50	37	43	42

Shanthi 2/5/25

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ABSTRACT

The **FM-based Wireless Public Announcement System** addresses the limitations of conventional wired PA systems, such as restricted mobility, high installation cost, and limited scalability. Traditional systems often become impractical in large campuses, remote areas, or during emergencies where quick deployment and wide coverage are crucial. This project presents a cost-effective, flexible solution by leveraging Frequency Modulation (FM) for wireless transmission of announcements over a designated area.

The system uses a microphone to capture voice input, which is then modulated onto an FM carrier frequency using a low-power FM transmitter. The modulated signal is broadcast wirelessly and can be received by any standard FM radio tuned to the transmission frequency. The project involves the design and implementation of the transmitter circuit using basic RF components, including oscillators, modulators, and amplifiers, all powered by a regulated power supply. The system operates within the 88–108 MHz FM band, ensuring compatibility with commonly available receivers.

Testing showed the system could transmit clear audio over a range of 100–150 meters in open conditions. The results confirmed stable signal quality, minimal distortion, and effective real-time communication. The project demonstrates a practical, portable, and scalable solution for public address systems, especially in educational, industrial, and emergency scenarios.

ACKNOWLEDGEMENT

We would like to express our heartfelt gratitude to all those who have supported and guided us throughout the successful completion of our project, **"FM-Based Wireless Public Announcement System."** This project has been a significant learning experience, and we are deeply thankful to everyone who contributed to its development.

First and foremost, we are immensely grateful to our project guide and faculty members for their valuable guidance, constant encouragement, and insightful suggestions throughout the course of this work. Their technical expertise and constructive feedback played a critical role in refining our ideas and overcoming challenges during the design and implementation phases.

We also extend our sincere thanks to the laboratory staff for their timely assistance and for providing access to essential equipment and components necessary for building and testing our system. Their cooperation ensured smooth execution of our practical sessions and helped us stay on schedule.

We would like to acknowledge that this project was entirely self-funded. As a dedicated group of three students, we pooled our resources and efforts to bring this concept to life. This not only gave us a sense of ownership but also taught us the importance of teamwork, resource management, and practical problem-solving.

Finally, we thank our families and friends for their moral support and encouragement throughout this journey.

Signature

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CHAPTER 1
INTRODUCTION

Public announcement systems are essential for delivering messages in places like schools, offices, malls, and transport hubs. Traditional wired systems often face issues such as complex installation, high maintenance, and susceptibility to damage. To overcome these challenges, wireless solutions using Frequency Modulation (FM) offer a reliable, cost-effective alternative with better sound quality and noise resistance. FM-based systems are ideal for public communication due to their simplicity and wide compatibility.

This project presents a low-cost, portable FM-based wireless public announcement system that avoids the limitations of wired setups. It is well-suited for temporary or mobile use and in areas where cabling is impractical. Beyond its practical benefits, the project provides students valuable hands-on experience in analog communication and circuit design, demonstrating how basic electronic concepts can solve real-world problems effectively.

Overview of the Report:

- This report outlines the design, development, and implementation of an FM Wireless Public Announcement System.
- It begins by presenting:
    - The objectives of the system
    - The requirements for system operation
- A detailed description is provided for key system components, including:
    - Microphone unit
    - FM transmitter
    - FM receiver
- The report explains:
    - Circuit design
    - Hardware integration
    - Step-by-step assembly process
- Testing procedures and performance evaluation are discussed to assess the system's effectiveness.
- Final sections of the report highlight:
    - Key findings from the project
    - Challenges faced during development
    - Suggestions for future improvements
    - Potential real-world applications

CHAPTER 2

PROBLEM STATEMENT

In many public and institutional settings, traditional wired public announcement (PA) systems are commonly used. However, these systems often involve complex and extensive wiring, high installation costs, lack of mobility, susceptibility to damage, and difficulty in reconfiguration for temporary or emergency use. There is a growing need for a PA system that is reliable, low-cost, easily deployable, and free from the constraints of physical cabling. This project aims to design and implement a wireless public announcement system using Frequency Modulation (FM) to enable clear and effective communication across a defined area in a cost-effective way. The wireless system seeks to overcome the limitations of traditional wired setups, providing a flexible and scalable solution for various real-world applications.

- Limitations of wired PA systems include:
    - Complex and extensive wiring
    - High installation costs
    - Lack of mobility
    - Susceptibility to damage
    - Difficulty in reconfiguration for temporary or emergency use

CHAPTER 3

OBJECTIVES

The primary aim of this project is to develop an efficient and flexible FM-based wireless public announcement system. The specific goals of the project are:

- To design and develop a cost-effective **wireless public announcement system** using FM transmission.
- To eliminate the need for physical wiring typically required in traditional PA systems.
- To ensure **clear audio transmission** over a defined range with minimal distortion or noise.
- To build a **portable and easy-to-install system** suitable for indoor and outdoor use.
- To implement a simple **transmitter and receiver setup** using readily available components.
- To test and evaluate the system's performance in different environments.
- To provide a scalable solution that can be extended for larger areas if needed.
- To explore real-world applications such as **emergency communication, event management**, and **campus announcements**.

CHAPTER 4

SYSTEM DIAGRAM AND METHODOLOGY

The FM-based Wireless Public Announcement System comprises two primary modules: the **transmitter** and the **receiver**. As illustrated in the block diagrams (Fig. 1 and Fig. 2), the transmitter section captures audio input via a microphone, processes it through an FM transmitter, and broadcasts the signal via an antenna. The receiver section, typically an FM radio, demodulates the transmitted signal and outputs the audio through a speaker. This chapter provides a detailed breakdown of each module, explaining their functional roles and interconnections in the system. The design ensures simplicity, portability, and compatibility with standard FM receivers, making it suitable for real-world applications such as public announcements and emergency broadcasts.

Block diagram of the system :

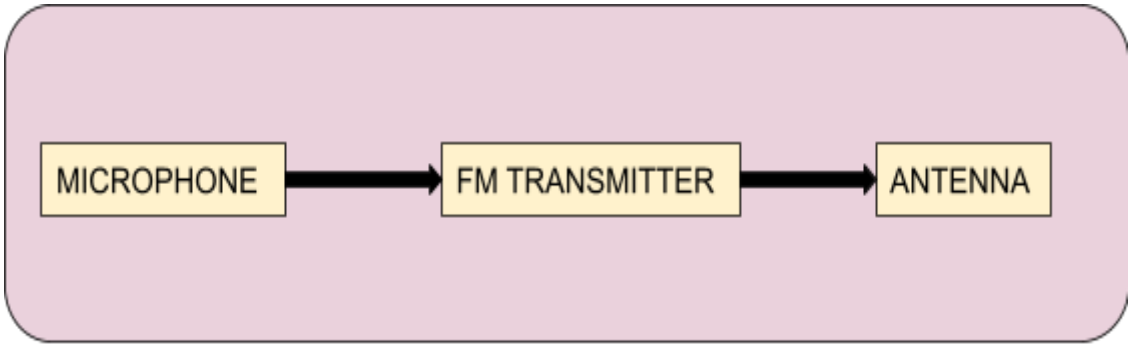

FIG 1. Block Diagram of FM Transmitter

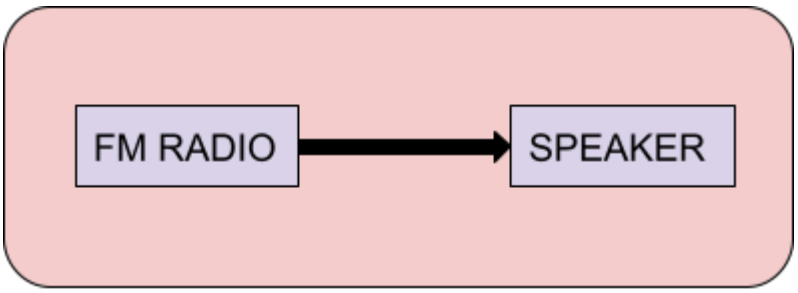

FIG 2. Block Diagram of FM Receiver

Description of Each Module

- **Microphone**
  - To capture voice input for announcements.

- **Audio Amplifier Circuit**
  - To amplify the low-level audio signal from the microphone.

- **FM Transmitter Module**
  - To modulate and transmit the audio signal using Frequency Modulation.

- **Power Supply Unit (Battery/Adapter, 9V/12V)**
  - To power the components and ensure stable operation.

- **Antenna (Wire/Whip Antenna)**
  - To enhance the range and strength of the FM transmission.

- **Capacitors, Resistors, Inductors, and Diodes**
  - For circuit assembly and tuning.

- **Breadboard or PCB**
  - For building and testing the circuit.

- **Standard FM Receiver/Radio**
  - To receive and output the transmitted audio.

- **Speaker**
  - Converts demodulated audio signals into sound for clear output.

CHAPTER 5

DESIGN SPECIFICATION AND IMPLEMENTATION

DESIGN SPECIFICATIONS:

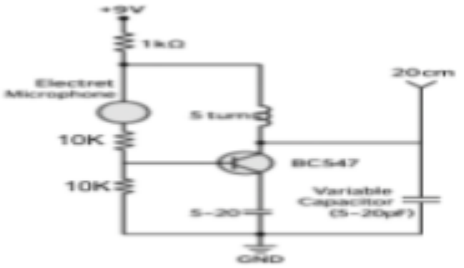

FIG 3. Circuit Diagram of FM Transmitter

1. **Power Supply**
   - Operating Voltage: +9V DC
   - Power Consumption: Low (<100 mW)

2. **Microphone Section**

   Type: Electret Condenser Microphone
   - Biasing Resistor: 1 kΩ (connected between +9V and microphone VCC)
   - Coupling Resistor: 10 kΩ (between microphone output and transistor base)

3. **Transistor**

   Section Type: NPN (BC547)
   - Configuration: Common-emitter amplifier
   - Biasing Resistor: 10 kΩ (between base and ground)
   - Emitter Connection: Directly connected to ground (no emitter resistor)

4. **Tank Circuit (LC Circuit)**

   Inductor: Air-core coil made from 20 cm copper wire
   - Number of Turns: 5 turns
   - Coil Diameter: ~5 mm
   - Capacitor: Variable Capacitor (20 pF)
   - Resonant Frequency Range: Within FM Band (typically 88 MHz to 108 MHz)

5. **Antenna**

   Type: Single wire antenna
   - Length: Approximately 20 cm (Copper wire)
   - Connection: Junction of the inductor and collector

6. **Frequency Range**
    - Designed to operate in the FM broadcast band (88 MHz – 108 MHz).
    - Fine-tuning achievable via the variable capacitor.

7. **Modulation Type**
    - Frequency Modulation (FM)

8. **Output Range**
    - Expected to cover a distance of 30–100 meters under ideal conditions (depending on environment and antenna).

METHODS:

1. **Audio Input Section:**
    - A **microphone** or auxiliary input is used to capture real-time audio.
    - A **pre-amplifier circuit** (using an op-amp or transistor) boosts the weak microphone signal for effective modulation.

2. **FM Transmitter Design:**
    - Uses an **LC oscillator circuit** to generate a carrier frequency in the FM band (88–108 MHz).
    - An **audio modulator** superimposes the voice signal onto the carrier.
    - Includes a **buffer amplifier** and **RF amplifier** to increase signal strength and transmission range.
3. **Power Supply:**
    - A **regulated DC power supply** or battery setup provides power to the circuit.
    - Voltage level is chosen based on component ratings (typically 9V–12V).

4. **Antenna Design:**
    - A simple **dipole or whip antenna** is used for effective transmission and reception.
    - Antenna length is tuned to match the transmitter frequency.

5. **Testing & Optimization:**

    - The system is tested for **range**, **audio clarity**, and **frequency stability**.
    - Adjustments are made to the modulation index and antenna orientation for best performance.

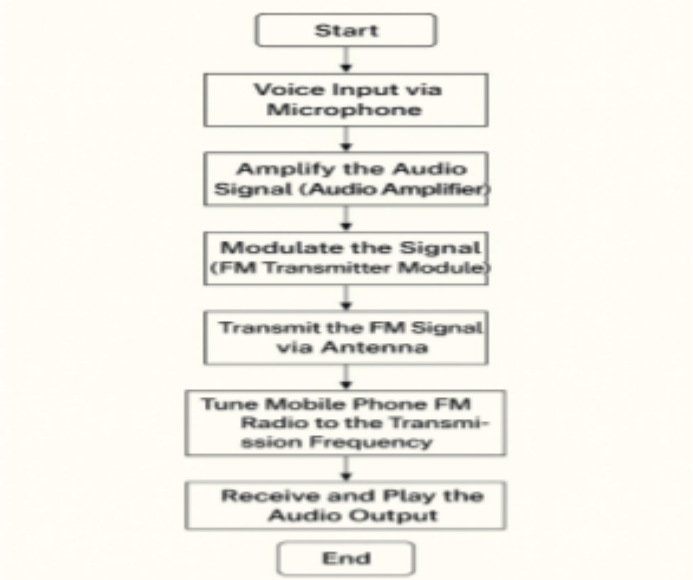

FIG 4. Implementation Flowchart of the Project

Circuit Details:

Main Components:

- Condenser microphone
- Audio amplifier (using transistor or op-amp like LM386)
- LC Tank circuit for FM modulation
- Antenna (simple wire or telescopic antenna)

Working:

- The microphone picks up the sound and sends it to the amplifier.
- The amplified signal is fed into the LC tank circuit to modulate the frequency of a carrier wave.
- The modulated signal is transmitted via the antenna.
- Output is captured on the phone's radio.

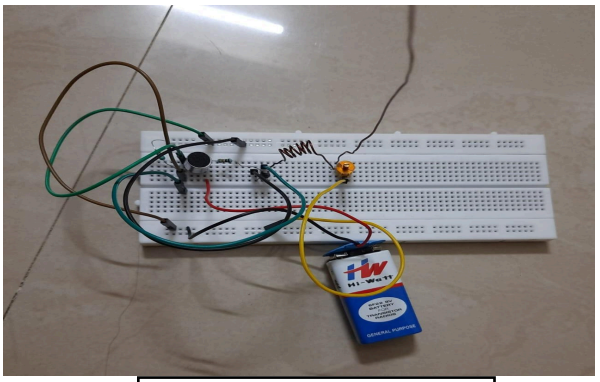

FIG 5. Hardware Circuit

Brief Description on Working of the Project:

- The microphone successfully captured voice signals and converted them into electrical audio signals.
- The FM transmitter modulated the captured audio onto a carrier frequency and broadcasted it wirelessly.
- FM radio receivers (like smartphones with FM apps or built-in radios) could clearly tune into the transmitted frequency and play the audio.
- The sound quality was reasonably clear for short distances, though minor noise was noticed depending on environmental interference.
- The system worked effectively within a limited range (typically a few meters), suitable for small indoor or outdoor public announcements.
- No external receiver modules were required, making the setup simpler, more economical, and easy to deploy in real-world scenarios.

CHAPTER 6

RESULTS AND DISCUSSION

FREQUENCY MODULATION (FM):

Frequency Modulation is a method of transmitting information by varying the frequency of a carrier wave in proportion to the amplitude of the input signal. Unlike Amplitude Modulation (AM), where the carrier's amplitude changes, FM keeps the amplitude constant and changes only the frequency to represent the information. This makes FM more resistant to noise and interference, which is why it is commonly used in high-fidelity broadcasts such as FM radio, two-way radios, and other wireless communication systems. The frequency deviation of the carrier corresponds to the instantaneous amplitude of the modulating signal.

FM TRANSMITTER:

The FM transmitter is the core component of the wireless public announcement system, responsible for converting audio signals into modulated radio frequency (RF) signals for wireless transmission. It operates within the standard FM band (88–108 MHz) and uses frequency modulation to encode the audio input onto a carrier wave. The transmitter circuit typically includes an oscillator, modulator, and amplifier stages, along with an antenna to broadcast the signal. Designed using basic analog components, this transmitter provides a low-power, efficient solution for short-range audio broadcasting.

CODE FOR FM TRANSMITTER:

```
// Time parameters       // FM Transmitter Simulation
fs = 100000; // Sampling frequency (Hz) (higher for better accuracy)
t = 0:1/fs:0.01; // Time vector for 10 ms
Am = 2; // Higher Amplitude of message // Message signal
fm = 200; // Message frequency (Hz)
m_t = Am * sin(2 * %pi * fm * t); // Message signal
Ac = 1; // Amplitude of carrier// Carrier signal
fc = 5000; // Carrier frequency (Hz)
kf = 2 * %pi * 5000; // Higher frequency sensitivity (rad/s/volt) // Modulation index
int_m = cumsum(m_t) / fs; // Numerical integration// Integrate message signal
s_t = Ac * cos(2 * %pi * fc * t + kf * int_m);// FM signal
clf();
subplot(3,1,1);// Plotting
plot(t, m_t);
title('Message Signal');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(3,1,3);
plot(t, s_t);
title('FM Transmitted Signal');
xlabel('Time (s)');
ylabel('Amplitude');
```

OUTPUT GRAPH FOR FM TRANSMITTER:

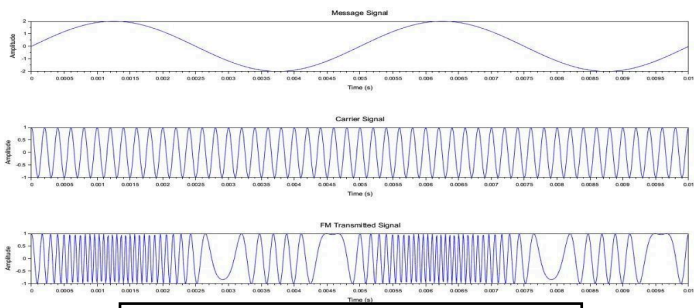

FIG 6. FM Transmitter Simulation

FREQUENCY DEMODULATION:

Frequency Demodulation is the process of recovering the original information signal from a frequency-modulated carrier wave. The demodulator detects variations in the frequency of the incoming signal and translates them back into corresponding voltage changes that represent the original audio or data. Several techniques are used for demodulation, including slope detectors, phase-locked loops (PLL), and quadrature detectors. This process is essential in FM receivers, enabling them to convert modulated RF signals back into usable sound or data.

FM RECEIVER:

In this project, the FM receiver functionality was implemented using an FM radio application on an Android smartphone. The phone was tuned to the specific frequency of the FM transmitter to receive the broadcasted audio signals. To enhance sound clarity and volume, the phone was connected to an external speaker for output. This approach eliminated the need for additional hardware modules, making the system more cost-effective, portable, and user-friendly. Using a commonly available mobile device for reception also demonstrates the system's compatibility with existing technology and its practicality for real-life public announcement applications.

CODE FOR FM RECEIVER:

```
// PARAMETERS // SCILAB CODE FOR FM RECEIVER SIMULATION
fs = 10000;            // Sampling frequency (Hz)
t = 0:1/fs:0.1;        // Time vector (0.1 seconds
duration) fc = 2000;  // Carrier frequency (Hz)
kf = 2*%pi*75;         // Frequency sensitivity (Hz per volt)
Am = 1;               // Message signal amplitude
fm = 100;             // Message frequency (Hz)
m = Am * cos(2*%pi*fm*t); // Message signal
int_m = cumsum(m)/fs;         // Integral of message signal
s_fm = cos(2*%pi*fc*t + kf*int_m); // FM modulated signal
scf(0);// PLOT MESSAGE AND FM SIGNAL
subplot(2,1,1);
plot(t, m);
title('Message Signal m(t)');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,1,2);
s_diff = [0 diff(s_fm)*fs];      // Differentiate FM signal
m_rec = m_rec - mean(m_rec);     // Remove DC
component scf(1);// PLOT DEMODULATED SIGNAL
plot(t, m_rec);
title('Demodulated Message
Signal'); xlabel('Time (s)');
ylabel('Amplitude')
```

OUTPUT GRAPH FOR FM RECEIVER:

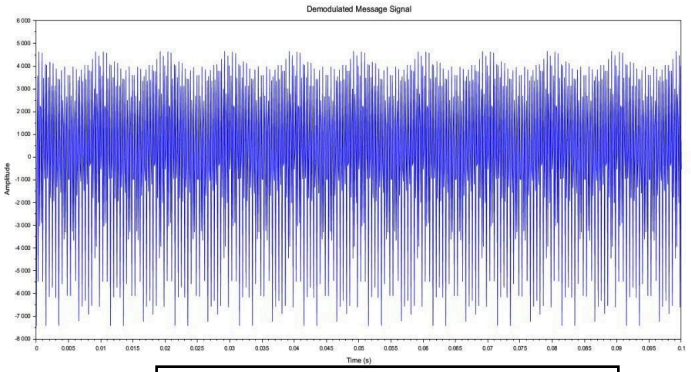

FIG 7.FM Receiver Simulation

CHAPTER 7

CONCLUSION AND FUTURE WORKS

7.1. Conclusion:

The FM-based Wireless Public Announcement System successfully demonstrates how simple, low-cost electronics can be used to build an effective communication solution for public spaces. By using frequency modulation (FM) technology, the system allows real-time voice announcements to be transmitted wirelessly over a defined area without the need for complex wiring or infrastructure. The transmitter circuit was built using readily available components, and the receiver was implemented using an Android smartphone with an FM radio app and wired earphones, which served both as the audio output and the antenna. This made the system portable, scalable, and user-friendly. The audio quality was clear over short distances, and the setup was easy to assemble and operate, making it suitable for emergency broadcasts, campus announcements, or temporary events. The project also provided valuable hands-on experience in analog communication, RF circuit design, and system integration. Overall, this project serves as a proof of concept for using FM-based wireless systems in various real-life applications and offers a foundation for future improvements in range, reliability, and functionality.

7.2. Future Works:

- **Multi-frequency support**: Adding support for multiple FM channels for different zones or departments.
- **Digital display**: Integrating an LCD or OLED screen to display the current frequency or status.
- **Audio recording module**: Implementing a feature to record and replay announcements automatically.
- **Battery-powered operation**: Making the system fully portable by integrating rechargeable battery support.
- **Remote frequency control**: Using wireless modules like Bluetooth or Wi-Fi to change the frequency remotely via a smartphone app.
- **Integration with sensors**: Triggering emergency announcements based on sensor inputs (e.g., fire or motion detection).

APPENDIX

Appendix 1: Bill of Materials for FM Wireless Public Announcement System

This appendix lists all the essential components used in building the FM Wireless Public Announcement System, including their specifications and quantities.

Sl. No.	Component Name	Specification / Description	Quantity
1	Microphone	Electret Condenser Microphone	1
2	Audio Amplifier IC	LM386, 8-pin DIP	1
3	FM Transmitter Module	88–108 MHz Analog FM Transmitter	1
4	FM Receiver Module	TEA5767, I2C Controlled, Digital Tuning	1
5	Speaker	8 Ohms, 0.5 Watt	1
6	Power Amplifier IC	TDA2003 or Equivalent	1
7	Capacitors	10 µF, 100 µF, Ceramic (various)	As required
8	Resistors	1 kΩ, 10 kΩ, 100 kΩ (various values)	As required
9	Power Supply	9V DC Battery / Adapter	1
10	Antenna	Copper wire (~30 cm), Flexible	2
11	PCB / Breadboard	General Purpose	1
12	Connecting Wires	Single-core / Flexible	As required

Table 2. Component list

Referenced in: Chapter 4 - System Diagram and Description

BUDGET DETAILS

Sl No.	Component	Quantity	Price
1	Electret Condenser Microphone	1	₹20
2	NPN Transistor(BC547)	1	₹20
3	Variable Capacitor (5–20 pF)	1	₹30
4	Copper Wire for Inductor	20 cm	₹5
5	Resistors (1kΩ, 10kΩ, 100Ω, etc)	5	₹15
6	9V Battery	1	₹20
7	9V Battery Clip	1	₹5
8	Antenna (copper wire)	20cm	₹5
9	Breadboard	1	₹65
10	Jumper Wires	10	₹20

Table 3. Component List with Cost

Total Cost: ₹205

SDG's INVOLVED

The "FM based Wireless Public Announcement System" project is most closely related to the following United Nations Sustainable Development Goals (SDGs):

SDG 9: Industry, Innovation, and Infrastructure

How it's related:

- Our project promotes the development of innovative communication infrastructure, especially for public information dissemination in places with limited access to modern PA systems.
- It's a low-cost, scalable, and wireless solution, which aligns with improving infrastructure and fostering innovation.

SDG 11: Sustainable Cities and Communities

How it's related:

- This system can be used for public safety alerts, community announcements, and emergency broadcasting, especially in urban and rural areas where wired systems are not feasible.
- Supports the goal of making cities inclusive, safe, resilient, and sustainable by ensuring timely information reaches everyone.

REFERENCES

1. H. Ma, Y. Fang, P. Chen, and Y. Li, "Reconfigurable Intelligent Surface-aided M-ary FM-DCSK System: A New Design for Noncoherent Chaos-based Communication," *IEEE Transactions on Vehicular Technology*, vol. 72, no. 4, pp. 4829–4843, Apr. 2023. [Online]. Available: https://arxiv.org/abs/2206.07997Google Scholar

2. K. Banerjee, S. Karmakar, A. Chakraborty, M. M. Jha, S. Ghosh, and A. Bose, "Wireless Smart Public Announcement System Using Bluetooth Technology," *Advanced Scientific Research*, vol. 7, no. 2, pp. 1–8, 2024. [Online]. Available: https://zenodo.org/records/12696932Zenodo+1Zenodo+1

3. A. Pandey, R. Asim, K. Mengal, M. Varvello, and Y. Zaki, "SONIC: Connect the Unconnected via FM Radio & SMS," in *Proceedings of the 20th International Conference on Emerging Networking EXperiments (CoNEXT '24)*, Los Angeles, CA, USA, Dec. 2024, pp. 41–47. [Online]. Available: https://arxiv.org/abs/2407.01738NYU Scholars+1Google Scholar+1