Marwadi University Marwadi Chandarana Group NAAC A+	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**	
Subject: Capstone	**System Design and Architecture - Intermediate Review**	
Submission - 3	**Date:**	**Enrollment No: 92200133044**

1. Introduction

- Purpose: Explain *why* this system exists in simple terms.
    - Example: “The project aims to develop a unified voice analysis system for comparing and managing voice data efficiently.”
- Scope: What the system will do.
    - Example: “The system allows users to upload voice data, search and match voices, and compare two audio files for similarity.”
- Stakeholders: Identify users who will benefit.
    - Example: “Target users include security personnel, researchers, and audio analysts.”

2. Problem Statement

- Describe the problem your system solves.
    - Example points:
        1. Manual voice management is time-consuming.
        2. Searching for a voice in large datasets is error-prone.
        3. Comparing voices manually is impractical for large libraries.
        4. Lack of a scalable, reliable solution to store and analyze voice data.

3. Objectives

- Use **bullet points** for clarity:
    1. Develop a modular voice management system.
    2. Enable uploading and storing voice files securely.
    3. Allow searching and matching of voice data efficiently.
    4. Provide accurate comparison between two voice samples

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4. Relevance to ICT Domain

- Explain why this is important for ICT engineering.
    - Points:
        1. Involves **data storage and database management** (SQLite/MySQL).
        2. Uses **signal processing** (MFCC, DTW, cosine similarity).
        3. Implements **software engineering best practices** (modular design, reusable code).
        4. Can integrate with **cloud services** for future scalability.
        5. Supports **AI/ML applications** in audio processing.

5. Feasibility Analysis

- **Technical Feasibility:**
    1. System uses Python, Streamlit, SQLite – all open-source and easy to deploy.
    2. Audio processing with **Librosa and Numpy** – lightweight and well-documented.
- **Operational Feasibility:**
    1. Users can upload and compare files with simple UI.
    2. No advanced technical knowledge required to use system.
- **Economic Feasibility:**
    1. Minimal cost as system relies on free/open-source tools.
    2. Scalable on cloud infrastructure if needed later.

6. Market / User Needs Analysis

- Identify real-world need for the system:
    1. Security agencies need **accurate voice identification**.
    2. Educational institutes and researchers need **voice datasets management**.
    3. Companies need **voice authentication systems** for secure access.

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7. Literature Review

- Review existing solutions and why your system improves on them:
    1. Traditional manual matching is slow and error-prone.
    2. Some AI-based systems require expensive hardware.
    3. Open-source projects may lack a **user-friendly interface**.
    4. Your system provides **modular, scalable, and cost-effective solution**.
- Include **citations** (IEEE, ACM, or official Python/Librosa docs).

8. System Design / Modular Design

- **Overview:** Divide system into modules for clarity.
    - **Modules / Components:**
        1. **Front-End:** Streamlit interface for uploading, searching, and comparing audio.
        2. **Back-End:** Python scripts handling audio processing and logic.
        3. **Database Layer:** SQLite database to store voice metadata.
        4. **Audio Processing Module:** Extract MFCC features, calculate similarity.
        5. **Comparison Engine:** Cosine similarity + DTW for matching.
- **Benefits of Modularity:**
    - Easy to maintain and update.
    - Components can be reused in other projects.
    - New modules (like cloud storage) can be added later.
- **Include Diagram:**
    - Use Draw.io / Lucidchart.
    - Label each module.
    - Show data flow (upload → process → store → compare → output).

9. Technology Stack

- **Languages:** Python (main logic), SQL (database).
- **Frameworks / Libraries:**
    1. Streamlit – UI development.
    2. Librosa – Audio feature extraction.
    3. Numpy / Scipy – Calculations.
    4. SQLite – Lightweight database.
- **Justification:**
    - Open-source, easy to use, lightweight, scalable.
    - Well-documented libraries ensure reliable implementation.
- **Optional Future Additions:**
    - Cloud storage (AWS, GCP) for scalability.
    - AI models for voice recognition.

10. Scalability Plan

- **Horizontal scaling:** Use multiple servers if user/data load increases.
- **Database scaling:**
    - Use SQLite initially, then migrate to MySQL/PostgreSQL for larger datasets.
- **Performance optimization:**
    - Cache frequent queries.
    - Use batch processing for large audio uploads.
- **Reliability:**
    - Backup database regularly.
    - Error handling in audio processing.

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11. Conclusion

- Summarize system's technical design and benefits:
    1. Modular and scalable design ensures maintainability.
    2. Technology stack balances performance and cost.
    3. System meets user needs efficiently and reliably.