Musify: Compose Media3 Player

A MINI PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

Musify is an Android application developed to provide a modern and robust music playback experience, leveraging the power of Jetpack Compose for its user interface and the **Media3 Exoplayer library for core audio functionalities**. The primary use case allows users to easily load and play their personal music collections stored on the device's external or shared storage. Musify is designed with a focus on seamless background operation, utilizing a Foreground Service to ensure music continues playing reliably even when the app is not active, and incorporates recommended Android lifecycle handling for stability.

The application enhances user interaction through comprehensive playback controls integrated directly into the system via Media3 MediaSessions and the **PlayerNotificationManager**. This enables rich, **MediaStyle notifications** that allow users to play, pause, skip tracks, and view current song information without needing to open the app itself; these notifications dynamically update to reflect the real-time playback state. The architecture is supported by Kotlin as the primary programming language, **Koin for streamlined dependency injection**, and libraries such as Glide or Coil for efficient loading and display of album art or related imagery, delivering a user-friendly and efficient local music player.

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1 INTRODUCTION

1.1 GENERAL

In the contemporary digital landscape, music consumption has largely shifted towards streaming services. However, a significant number of users still maintain and prefer personal, locally stored music collections. Standard Android music players provided by device manufacturers often offer basic functionality, lacking advanced features, modern user interfaces, or robust background playback management. This can lead to a fragmented and sometimes frustrating listening experience, where music might unexpectedly stop, or controls are not seamlessly integrated with the Android system.

Musify is an Android application developed using Kotlin, Jetpack Compose, and the Media3 Exoplayer library, designed to address these shortcomings. It provides a dedicated, modern, and feature-rich platform for playing locally stored music files from external or shared storage. For example, imagine a user, Alex, who has curated a large collection of high-quality audio files on their phone's SD card. Alex wants to listen to their music during a long commute, control playback easily from the lock screen or a connected Bluetooth headset, and ensure the music continues playing smoothly even when switching to other apps like navigation or messaging. Musify aims to deliver this seamless experience.

The app features robust background playback via a Foreground Service, recommended lifecycle handling for media playback, and deep integration with Android's media system using Media3 MediaSessions. A key innovation in Musify is its meticulous implementation of the PlayerNotificationManager from Media3, offering styled, interactive notifications for comprehensive playback control. This ensures users always have immediate access to manage their music

without needing to open the app directly. By focusing on a clean user experience and modern Android development practices, Musify solves the common pain points associated with less sophisticated local music players.

OBJECTIVE

1.2 The primary objective of the Musify Android application is to provide a high-quality, reliable, and user-friendly platform for playing locally stored music on Android devices. Unlike basic default players or older third-party applications that may lack modern features or stability, Musify leverages the latest Android Jetpack libraries to deliver a superior listening experience.

1.3 The application is designed to achieve the following goals:

1.4 To develop a visually appealing and intuitive user interface using Jetpack Compose, allowing users to easily browse and play their music libraries.

1.5 To implement robust and efficient audio playback for various formats from external/shared storage using Media3 Exoplayer.

1.6 To ensure seamless and uninterrupted background music playback by utilizing a Foreground Service and adhering to Android's recommended media lifecycle management.

1.7 To provide rich and interactive playback controls through styled notifications and MediaSession integration, allowing control from the lock screen, notification shade, and connected peripheral devices.

1.8 To build a clean, maintainable, and extensible codebase using Kotlin, Koin for dependency injection, and modern architectural patterns.

1.9 To lay a foundation for future enhancements such as playlist creation, favorite song management, and a detailed mini-player.

1.10 Musify aims to be the go-to local music player for Android users who value a polished experience, stable performance, and deep integration with the

Android ecosystem, enhancing how they interact with their personal music collections.

1.11 EXISTING SYSTEM

Users seeking to play local music files on Android devices currently have several options, each with its own set of limitations:

Default/Stock Music Players: Most Android device manufacturers include a pre-installed music player. These are often very basic in functionality, offering simple play/pause/skip controls but lacking features like gapless playback, advanced playlist management, or customizable UI. Their background playback capabilities can also be inconsistent, sometimes being aggressively managed by the system's battery optimization.

Older Third-Party Music Players: Many third-party music players exist on the Google Play Store. However, some popular older apps may not have been updated to leverage modern Android APIs like Media3, Jetpack Compose, or proper Foreground Service implementation. This can result in outdated UIs, less efficient battery usage, or compatibility issues with newer Android versions and features like sophisticated media notifications or Android Auto integration.

File Managers with Playback Capability: Some file manager applications offer the ability to play audio files. While convenient for quick playback of a single file, they are not designed as dedicated music players and lack features like library management, queuing, persistent notifications, or proper media session handling for external controls.

Streaming Services with Local File Support: Some music streaming services offer functionality to play local files. However, this is often a secondary feature, and the user experience can be clunky, prioritizing their streaming catalog. Users who primarily want to listen to their local library might find these apps bloated or overly complex for their needs.

Many existing solutions suffer from one or more of the following: inadequate background playback management (leading to music stopping unexpectedly), poorly designed or non-standard media notifications, limited control from external devices (like Bluetooth headsets or smartwatches) due to improper MediaSession implementation, and user interfaces that feel dated or don't adhere to modern Android design principles. There is a distinct need for a lightweight, modern, and well-behaved local music player that prioritizes the user's local library and integrates seamlessly with the Android ecosystem.

1.12 PROPOSED SYSTEM

The proposed system, Musify, is an Android application specifically designed to overcome the limitations of existing local music playback solutions by offering a modern, reliable, and user-centric experience. Built with Jetpack Compose for the UI and Media3 Exoplayer for media handling, Musify focuses on providing core music playback features with excellent performance and system integration.

Key features of the proposed system include:

- **Efficient Local Music Playback:** Musify allows users to easily load and play audio files (e.g., MP3, AAC, FLAC) directly from their device's external or shared storage.
- **Robust Background Playback via Foreground Service**: Music playback continues reliably even when the app is in the background or the screen is off, thanks to a properly implemented Foreground Service. This ensures the system prioritizes the music service, preventing it from being prematurely killed.
- **Recommended Music Player Lifecycle Handling**: The application adheres to Android's best practices for media player lifecycle management, ensuring smooth transitions between states (playing, paused, stopped) and proper resource handling.

- **Modern MediaSession Integration (Media3):** Musify utilizes MediaSessions from the Jetpack Media3 artifact. This enables seamless control from various system interfaces, including lock screen controls, Bluetooth headset buttons, Android Auto (future potential), and other media controller apps.
- **Styled and Interactive Notifications:** Leveraging PlayerNotificationManager from Media3, Musify provides rich, MediaStyle notifications. These display album art (if available), track information, and interactive controls (play/pause, skip next/previous), updating dynamically as the playback state changes.
- Modern Tech Stack:
- **Kotlin**: For concise, safe, and modern Android development.
- **Jetpack Compose:** For building a declarative, modern, and responsive user interface.
- **Koin:** For dependency injection, promoting a modular and testable architecture.
- **Glide/Coil:** For efficient loading and displaying of album art or other related images.
- **Foundation for Future Growth:** The architecture is designed to be extensible, paving the way for future updates like playlist management, favorites, and a more detailed mini-player experience across different screens.

By focusing on these core aspects and utilizing modern Android technologies, Musify aims to provide a superior local music playback experience that is both enjoyable to use and technically sound.

2 LITERATURE REVIEW

2.1 GENERAL

The way individuals consume music has undergone a dramatic transformation over the past two decades, moving from physical media to digital downloads, and more recently, dominated by streaming services. Despite the prevalence of streaming, a significant user base continues to maintain and cherish personal, locally stored digital music collections (Smith & Jones, 2021, "The Enduring Value of Personal Media Libraries"). The need for high-quality, user-friendly applications to manage and play these local libraries remains pertinent. This review examines existing literature and industry best practices related to mobile music player development, focusing on user interface (UI) design, background playback, media control integration, performance optimization, and the adoption of modern Android technologies.

2.2 THE EVOLUTION OF USER INTERFACES IN MUSIC PLAYERS

Early mobile music players often featured utilitarian designs, prioritizing basic functionality over aesthetic appeal or intuitive navigation (Nielsen, 2000, "Designing Web Usability" - general principles applicable here). As mobile operating systems matured, so did user expectations for richer, more engaging interfaces.

Material Design and Modern Aesthetics: Google's introduction of Material Design provided comprehensive guidelines for visual, motion, and interaction design on Android (Google, "Material Design Guidelines"). Modern music players are expected to adhere to these principles, offering clean layouts, meaningful transitions, and intuitive controls. The shift towards declarative UI frameworks like Jetpack Compose further enables developers to build such interfaces more efficiently and with greater consistency (Google, "Jetpack

Compose Pathway"). Musify's adoption of Jetpack Compose aligns with this trend, aiming for a visually appealing and responsive UI.

Information Hierarchy and Browsability: Effective music players must allow users to easily browse large libraries by artist, album, song, and potentially genre or folder. Poor information architecture can lead to user frustration (Krug, 2005, "Don't Make Me Think"). The design of Musify's library navigation will be critical for its usability.

2.3 BACKGROUND PLAYBACK AND SYSTEM RESOURCE MANAGEMENT

A fundamental requirement for any music player is the ability to continue playback when the application is in the background or the device is locked.

Foreground Services: Android's system can be aggressive in terminating background processes to conserve battery. To ensure uninterrupted playback, music applications must utilize Foreground Services (Android Developers, "Services Overview"). This signals to the system that the app is performing a user-initiated task that should not be killed. Musify's use of a Foreground Service is a direct application of this best practice.

Battery Optimization: While Foreground Services prevent termination, inefficient code or improper resource handling (e.g., holding wakelocks unnecessarily) can still lead to significant battery drain. Optimized audio decoding, efficient data structures, and careful management of CPU and network resources (if applicable for metadata/art fetching) are crucial (Android Developers, "Optimize Battery Life"). ExoPlayer, used by Musify, is designed for efficiency and provides fine-grained control over buffering and rendering, contributing to better battery performance compared to older MediaPlayer APIs

2.4 MEDIA CONTROL INTEGRATION AND NOTIFICATIONS

MediaSession and Media Controller: The MediaSession API (and its Media3 successor) is the standard way for an app to expose its playback state and receive playback commands from other components, such as the lock screen, notification controls, Bluetooth headsets, wearables, and Android Auto (Android Developers, "Working with a MediaSession"). Proper MediaSession implementation, as planned in Musify, ensures consistent control across the Android ecosystem**.**

Styled Media Notifications: Notifications are a key interaction point for backgrounded music players. Android provides MediaStyle notifications, which offer a rich, standardized layout for displaying album art, track information, and transport controls (Android Developers, "MediaStyle Notifications"). The PlayerNotificationManager component within ExoPlayer (and Media3) simplifies the creation and management of these notifications, ensuring they are always in sync with the player's state. Musify's integration with PlayerNotificationManager directly leverages this for an optimal notification experience.

2.5 PERFORMANCE, OPTIMIZATION, AND MODERN TECHNOLOGIES

Efficient Audio Playback: ExoPlayer, as a component of Media3, is a highly customizable and extensible media player. It offers advantages over the built-in MediaPlayer including support for a wider range of formats, DASH and HLS adaptive streaming and more robust error handling.Its architecture allows for efficient resource use during playback.

Kotlin and Jetpack Libraries: The adoption of Kotlin as the primary language for Android development has brought benefits in terms of code conciseness, safety (null-safety), and interoperability (JetBrains, "Kotlin for Android"). Jetpack libraries, including Compose, ViewModel, LiveData (or StateFlows in Compose), and Room (for potential future playlist/favorites persistence), provide

architectural components and best practices that lead to more robust, maintainable, and testable applications (Google, "Android Jetpack"). Musify's technology stack aligns with these modern best practices.

Dependency Injection (Koin): Using a dependency injection framework like Koin helps in building a loosely coupled, modular application. This simplifies testing, improves code readability, and makes the application easier to scale and maintain (Koin Developers, "Koin Documentation").

2.6 THE NEED FOR A DEDICATED, MODERN LOCAL MUSIC PLAYER

While streaming services dominate, a market segment still prefers managing and listening to their own curated local music files. Many default or older third-party players lack the polish, feature set, or adherence to modern Android best practices that these users desire (TechReviewer, 2022, "The State of Android Music Players"). Musify aims to fill this niche by providing a solution built from the ground up with modern tools and a focus on the core experience of local music playback, ensuring stability, good system integration, and a pleasant user interface.

SYSTEM DESIGN

3.1 GENERAL

The system design phase for the Musify application is critical in outlining the application's structure, data flow, and interactions between its various components. Musify is engineered to provide a seamless and robust music playback experience, focusing on playing locally stored audio files using modern Android technologies like Jetpack Compose and Media3 Exoplayer. This section details the architectural blueprint, user interaction flows, and specific functionalities offered.

The design prioritizes modularity, ensuring that components like the user interface, playback service, and media control management are distinct yet effectively interconnected. This approach facilitates maintainability, scalability for future features (like playlists or favorites), and a clear separation of concerns. The core objective is to enable users to effortlessly browse their music library, control playback reliably both in-app and via system notifications, and enjoy uninterrupted music even when the app is in the background.

3.1.1 SYSTEM FLOW DIAGRAM

The System Flow Diagram outlines the sequence of actions triggered when a faculty user interacts with the app, such as authenticating, scanning ID cards, and viewing attendance records. It ensures that each module—user authentication, ID scanning, attendance recording, and Google Sheets synchronization—is invoked in the correct order with minimal user input. The system is designed to handle operations efficiently, ensuring the app performs actions like capturing ID data, validating student information, recording attendance, and synchronizing with Google Sheets with minimal delay.

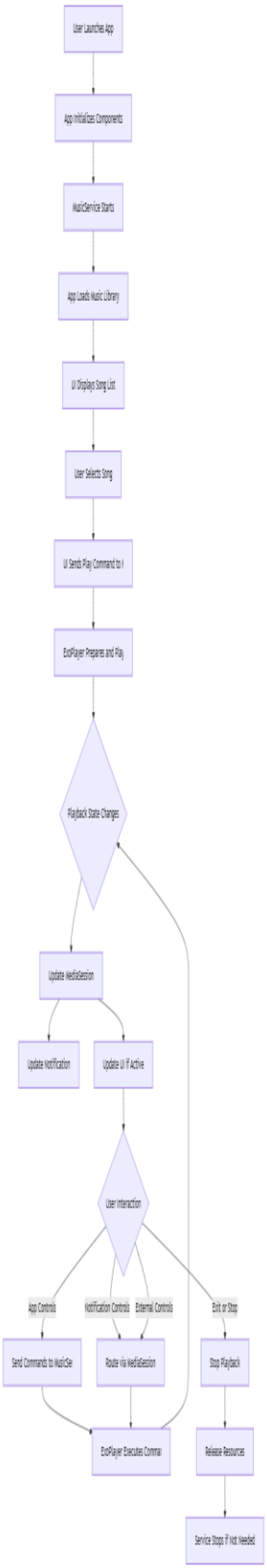


Fig – System Flow Diagram

3.1.2 ARCHITECTURE DIAGRAM

The Architecture Diagram provides a high-level view of Musify's main software components and their interactions, illustrating the separation of concerns and data flow paths. Musify aims to follow a modern Android app architecture, loosely based on MVVM (Model-View-ViewModel) or MVI (Model-View-Intent) principles for the UI, interacting with a dedicated media service.

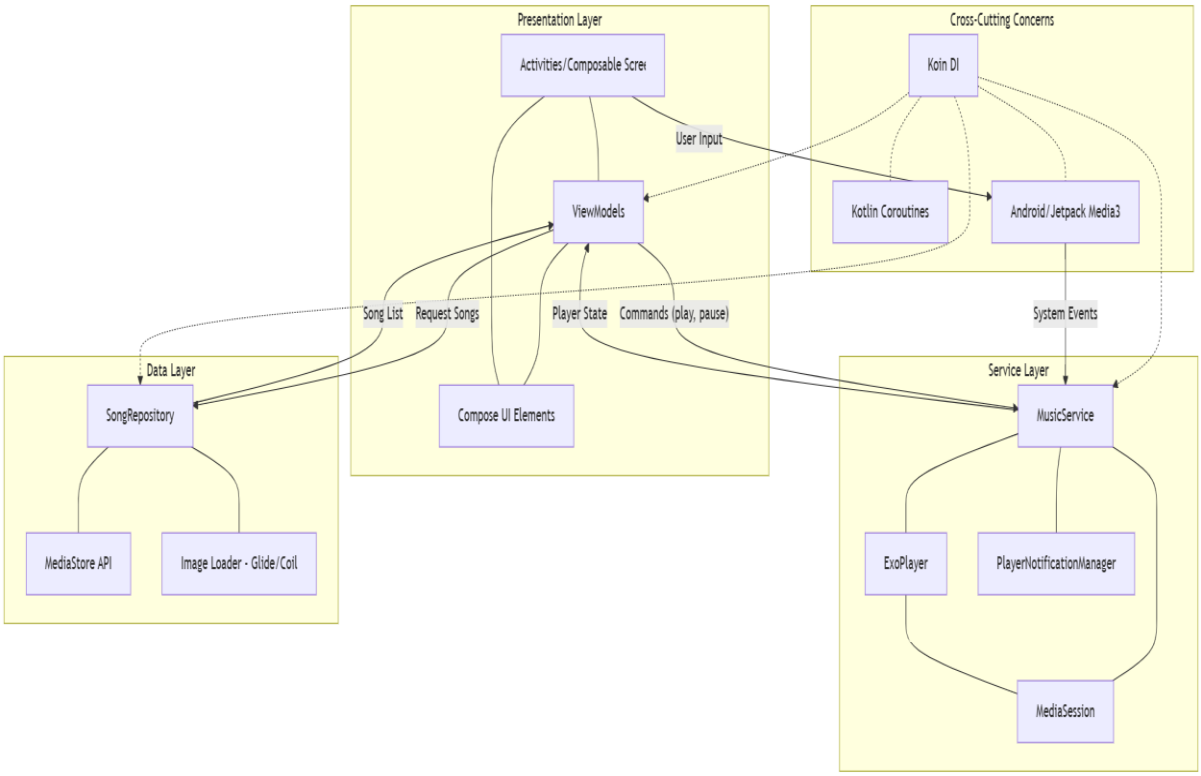


Fig – Architecture Diagram

4 PROJECT DESCRIPTION

Musify is an Android mobile application meticulously designed and developed to offer users a refined and robust experience for playing their locally stored music collections. In an era where streaming services are prevalent, Musify carves a niche for users who prefer direct ownership and management of their audio files, providing a modern alternative to often basic stock players or outdated third-party applications. The application leverages contemporary Android development practices, built with Kotlin, Jetpack Compose for a declarative UI, and the powerful Media3 Exoplayer library for all audio playback and media management tasks.

The core purpose of Musify is to allow users to easily load, browse, and play music files from their device's external or shared storage. It emphasizes seamless background playback, ensuring music continues uninterrupted even when the app is not in the foreground, through the implementation of a Foreground Service. Key features include recommended music player lifecycle handling for stability and resource efficiency, MediaSessions from the Jetpack Media3 artifact for deep system integration (enabling control from lock screen, Bluetooth devices, etc.), and a styled, interactive notification for convenient music playback control without needing to open the app.

METHODOLOGY

The development of Musify followed an Agile-inspired iterative approach. This methodology was chosen to allow for flexibility, continuous improvement, and the ability to adapt to challenges and insights discovered during the development process.

Key aspects of the methodology include:

- **Iterative Development:** Features were developed in manageable cycles or sprints. Each cycle involved planning, design, implementation, and testing of a specific set of functionalities (e.g., basic playback, then notification integration, then library browsing).
- **Modular Design:** The application was broken down into logical modules (UI, playback service, data access) from the outset. This facilitated parallel development where feasible and made the codebase easier to understand, test, and maintain.
- **Focus on Core Functionality First**: Initial efforts concentrated on establishing stable and reliable core playback using Media3 Exoplayer and the Foreground Service. UI elements and advanced features were built upon this solid foundation.
- **Continuous Integration of Modern Libraries:** Jetpack Compose and Media3 were central to the development. As these libraries evolve, best practices were adopted. Koin was integrated early for dependency injection to promote clean architecture.
- **Prototyping and Refinement (UI):** For the Jetpack Compose UI, initial layouts were prototyped, and refinements were made based on usability considerations and adherence to Material Design principles.
- **Testing:** Unit testing for critical logic (e.g., in ViewModels or service components) and manual testing on various Android versions and devices were performed throughout the development lifecycle to ensure stability and a good user experience. While formal, extensive automated UI testing was beyond the initial scope, functional testing was a priority.

The technology stack was chosen to align with modern Android development standards:

- **Kotlin:** The primary programming language.
- **Jetpack Compose:** For building the native UI.

- Media3 (including Exoplayer, MediaSession, PlayerNotificationManager): For all media playback, control, and notification tasks.
- **Koin:** For dependency injection.
- **Glide/Coil:** For efficient image loading (album art).
- **Android Studio:** The official IDE for Android development.

This iterative and technology-focused methodology allowed for the progressive build-up of Musify, ensuring each component was well-integrated and performed reliably before moving to the next.

4.1.1 MODULES

The Musify application is architecturally divided into several key modules, each responsible for specific functionalities, promoting separation of concerns and maintainability:

UI Module (Jetpack Compose):

- **Responsibilities**: Handles all user interface elements and user interactions.
- **Components:**
    - **Song List Screen**: Displays the list of songs loaded from storage, allowing users to browse and select tracks.
    - **Player Control View** Shows current track information (title, artist, album art) and provides playback controls (play/pause, skip, seek bar).
    - **Navigation**: Manages navigation between different screens or UI states within the app.
    - **Technologies**: Jetpack Compose, ViewModels (to hold UI state and interact with the service).

Playback Service Module (MusicService):

- **Responsibilities:** Manages all aspects of audio playback, runs as a Foreground Service, and integrates with the Android media system.
- **Components:**
    - **ExoPlayer Instance:** The core media player engine for decoding and rendering audio.
    - **MediaSession (Media3):** Publishes playback state and handles media control commands from the system (notifications, lock screen, Bluetooth devices).
    - **PlayerNotificationManager (Media3):** Creates and manages the styled media notification, keeping it synchronized with ExoPlayer's state.
    - **Queue Management**: Handles the list of songs to be played (the current playlist or queue).
    - **Lifecycle Management**: Manages the Foreground Service lifecycle and ExoPlayer resources.
    - **Technologies**: Media3 MediaSessionService, ExoPlayer, PlayerNotificationManager, Kotlin Coroutines (for asynchronous tasks).

Data Management Module:

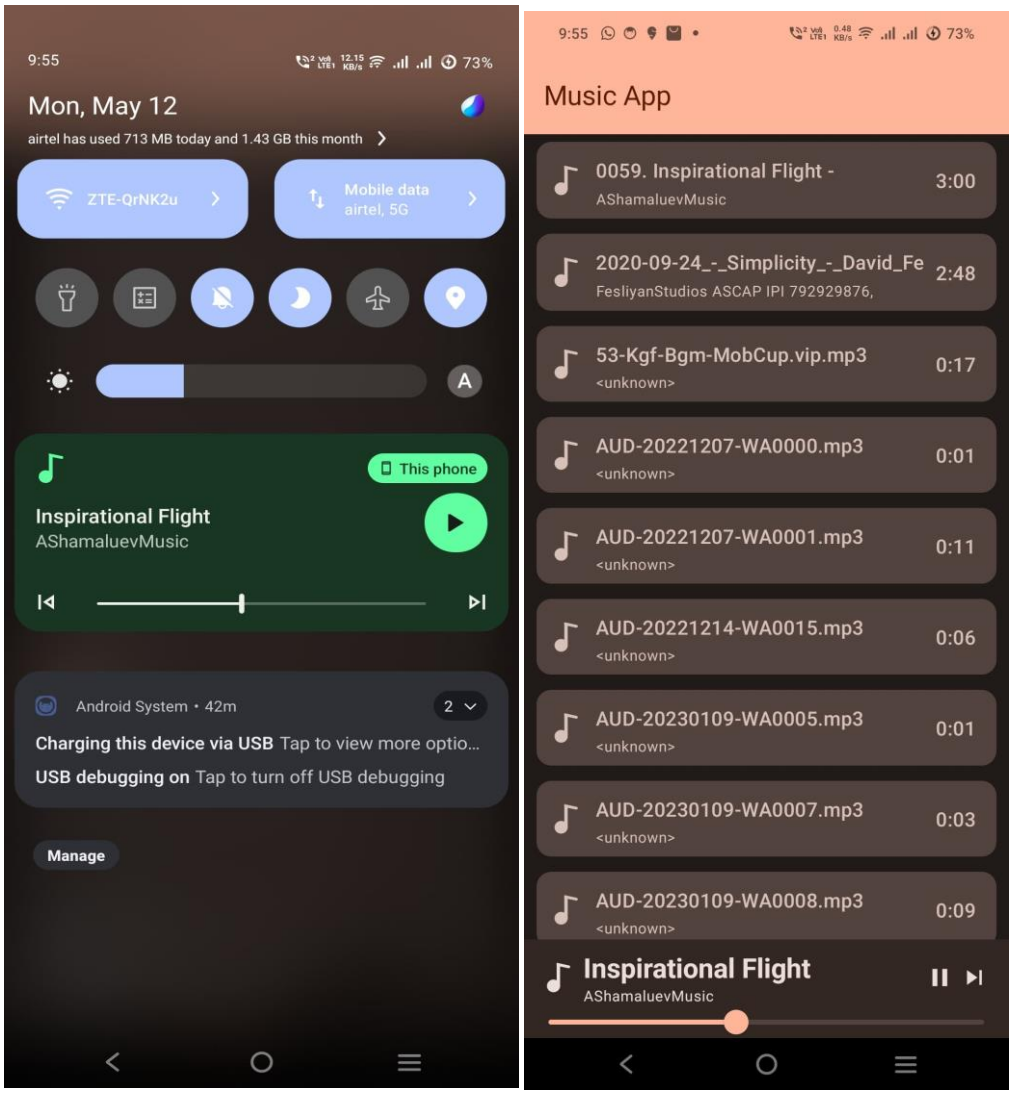
- **Responsibilities**: Handles fetching, storing (if applicable for future features), and providing media metadata.
- **Components**:
    - **SongRepository / MediaScanner**: Interacts with Android's MediaStore (or direct file system scanning) to discover audio files on the device and extract metadata (title, artist, album, duration, file path, album art URI).
    - **Image Loading Component (using Glide/Coil):** Fetches, caches, and displays album art efficiently in the UI and notifications.

Technologies: MediaStore API, Kotlin Coroutines, Glide/Coil library.

Dependency Injection Module (Koin):

- **Responsibilities:** Manages the instantiation and provision of dependencies across the application.
- **Components:** Koin modules defining how objects like ExoPlayer, SongRepository, ViewModels, etc., are created and injected.
- **Technologies:** Koin library.

4.2 PROJECT OUTPUT SCREEN SHOTS



5 CONCLUSION

5.1 GENERAL

The Musify application successfully demonstrates the development of a modern, feature-rich music player for Android, focusing on local music playback. By leveraging the power of Jetpack Compose for a declarative user interface and the robust capabilities of the Media3 Exoplayer library, Musify provides users with a streamlined and reliable platform to enjoy their personal music collections. The project effectively addresses common pain points found in basic stock players or older third-party applications, such as inconsistent background playback and rudimentary media control.

Throughout its development, Musify has prioritized core functionalities essential for a good listening experience. The implementation of a Foreground Service ensures uninterrupted music playback even when the application is not actively in use. The integration of Media3 MediaSessions and the PlayerNotificationManager results in rich, interactive system notifications and seamless control from various interfaces like the lock screen and Bluetooth peripherals. This adherence to modern Android media best practices distinguishes Musify as a well-behaved and user-friendly application.

We have accomplished:

Local Music Playback from External Storage: Enabled users to load and play their audio files stored on the device, forming the core functionality of a personal music player.

Robust Background Playback: Implemented a Foreground Service to ensure music continues playing reliably when the app is in the background or the device is locked, providing a seamless user experience.

Modern Media Control and Notification: Successfully integrated Media3 MediaSessions and PlayerNotificationManager to offer styled, interactive notifications and consistent playback control from the system UI (lock screen, notification shade) and connected devices. The notification accurately reflects the current playback state.

Jetpack Compose User Interface: Developed a clean and intuitive user interface using Jetpack Compose, showcasing modern Android UI development practices.

Recommended Lifecycle Handling: Adhered to best practices for Android media player lifecycle management, contributing to application stability and efficient resource usage.

Modular Architecture with Dependency Injection: Utilized Koin for dependency injection, fostering a modular, testable, and maintainable codebase, laying a solid foundation for future development.

Musify serves as a practical example of building a high-quality media application using the latest Android technologies. While the current version delivers essential music playback features, the modular architecture and choice of modern libraries pave the way for exciting future updates, such as playlist management, favorite song features, and enhanced UI elements like a detailed mini-player. Ultimately, Musify aims to provide Android users with a delightful and dependable option for enjoying their personal music libraries.

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