A

Mini Project Report

on

Notefy – Companion For Your Instruments

Submitted in partial fulfillment of the requirements for the

degree

Third Year Engineering – Computer Science Engineering (Data Science)

by

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CERTIFICATE

This to certify that the Mini Project report on **Notefy – Companion For Your Instruments** has been submitted by Arjun Talekar (23107005), Shrikant Thakur (23107045), Ranjana Yadav (23107059) and Parth Pawar (23107048) who are bonafide students of A. P. Shah Institute of Technology, Thane as a partial fulfillment of the requirement for the degree in **Computer Science Engineering (Data Science)**, during the academic year **2025-2026** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

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ABSTRACT

The project Notefy – Companion for Your Instruments is designed to simplify music learning and creation using signal processing. The main objective is to convert raw audio files (MP3) into instrument-specific sheet music that musicians, learners, and creators can directly use.

The system first separates vocals from instrumental tracks to improve transcription accuracy. It then detects which instruments are playing using the Random Forest machine learning model, which identifies unique sound patterns of different instruments. Next, the YIN algorithm is applied to perform accurate pitch detection, ensuring that the melody and notes are captured correctly without confusion from overtones Independent Component Analysis (ICA) is an algorithm used to separate mixed signals into their original sources. In Notefy, it helps isolate vocals from instruments so the instrumental part can be converted into sheet music.

Users are given flexibility to adjust the pitch or tune of the final output according to their needs. A History feature is also included, allowing users to revisit and manage their previous work easily. The output is generated in two formats: readable sheet music (PDF), making it useful for practice, composition, and performance.

Unlike existing systems, Notefy goes beyond basic sound classification by providing a complete end-to-end solution—from vocal removal to instrument recognition and final sheet music generation. This makes the system accurate, user-friendly, and highly practical for real-world music applications.

Chapter 1

Introduction

Music is one of the most universal forms of human expression, and over the years, technology has played a major role in shaping how it is created, shared, and learned. In traditional practice, musicians relied on handwritten notation and manual transcription, which required deep expertise and significant time investment. With the rise of digital music formats such as MP3, music has become more accessible, but it also introduced a new challenge—transforming raw audio into structured sheet music that musicians and learners can directly use.

Manual transcription is not only time-consuming but also prone to errors, especially for beginners. Existing computer-based systems provide only partial solutions, such as instrument classification or basic pitch extraction, but they fail to deliver complete instrument-wise sheet music. Moreover, these systems often lack flexibility, as they do not allow users to adjust pitch or tune, nor do they provide a way to revisit and reuse past work. This gap highlights the need for an intelligent and user-friendly system that can automatically convert digital audio into meaningful notation while giving users more control and flexibility.

The project Notefy – Companion for Your Instruments has been developed to address these challenges. It combines signal processing techniques with machine learning algorithms to provide an end-to-end solution for music transcription. The system first separates vocals from instrumental tracks, then detects which instruments are playing, identifies the pitch of each note, and finally converts the information into instrument-specific sheet music. In addition, the system provides features like pitch/tune adjustment and a history section that stores past transcriptions for easy access. These features make the system practical for musicians, students, and creators who want to learn, practice, or compose music efficiently.

Unlike existing tools that stop at classifying sounds or showing frequency patterns, Notefy generates final outputs in PDF sheet music, which can be used both in traditional learning environments and modern digital platforms. This makes it more versatile and relevant for real-world music applications. By using a machine learning model (Random Forest) for instrument detection and a signal processing method (YIN algorithm) for pitch detection, the system ensures accuracy and reliability.

In summary, this project aims to reduce the effort required for music transcription, improve accuracy in separating vocals and instruments, and provide musicians with a complete and user-friendly tool. It bridges the gap between raw music recordings and structured notation, making the process of learning and creating music more accessible and interactive.in

1.1 Purpose:

The purpose of this project, "Notefy – Companion For Your Instruments", is to fundamentally change how people learn and interact with music. Our primary goal is to bridge the gap between digital audio and traditional musical notation.

This project goes beyond simple transcription. By using sophisticated signal processing and machine learning, Notefy aims to provide a comprehensive, end-to-end solution for musicians and learners. The system is designed to:

- **Automate a manual process:** Eliminate the time-consuming and often inaccurate task of manually transcribing audio into sheet music.
- **Enhance accessibility:** Make complex musical information accessible to a wider audience, including beginners who may not have transcription skills.
- **Provide a versatile tool:** Offer a robust platform that not only generates sheet music but also offers practical features like instrument separation, vocal removal, and pitch adjustment.

  Ultimately, Notefy is a practical, intelligent tool that makes the process of understanding, learning, and creating music more efficient and intuitive for everyone.

1.2 Problem Statement:

Musicians today face a significant challenge: turning a song they hear into sheet music they can play.

While many digital tools exist, they often fall short.

- Existing tools are incomplete. They can identify a sound but don't create a full sheet of music.
- Vocal and instrument sounds are mixed up. This leads to messy transcriptions because the system can't tell the difference between singing and the instruments.
- The technology struggles with real songs. Most systems are trained on simple data, so they don't work well with complex, real-world music.

- They don't create usable output. The tools stop after analyzing the sound, without turning the data into a readable format like sheet music file.
- Users can't customize the result. You can't adjust the key or choose which instruments you want to see in the final output.

This project aims to solve these problems by creating a complete and user-friendly system that

handles everything from separating sounds to generating a perfect, customizable sheet of music.

1.3 Objectives:

The primary objectives of the Notefy – Companion For Your Instruments project are to develop a comprehensive and user-friendly system for automated music transcription. This is achieved through the following goals:

- **To separate vocals (lyrics) from instrumental tracks in audio files using signal processing or AI-based techniques:** We did this by using technology to split the lyrics from the music. This is an important first step that helps our system focus only on the instruments, leading to more accurate results.
- **To convert raw MP3 files into instrument-specific sheet music**: This is the main goal of our project. We built a system that listens to a song and automatically writes down the notes as sheet music, saving musicians a lot of time and effort.
- **To let users convert or change the tune or pitch of the final output:** We added a feature that gives users control. It lets them easily change the key of the sheet music, so it can be played on a different instrument or match a singer's vocal range.
- **To Keep track of History for further references:** We created a way to save all of the transcribed music. This means users can always go back and find their old work whenever they need it, without having to start over.

1.4 Scope:

The scope of this project is to develop a system that can automatically convert raw MP3 audio files into instrument-specific sheet music (PDF format) using signal processing and machine learning techniques.

The system provides a complete workflow that includes vocal separation, instrument detection, pitch identification, and transcription into clear and readable notes.

In addition to transcription, the project includes user-friendly features such as pitch/tune adjustment and a history section that stores past work for future reference. This makes the system practical for musicians, learners, and creators who want accurate sheet music directly from digital audio.

At present, the system is designed to handle small and medium-length MP3 files and focuses mainly on common instruments. In the future, the framework can be expanded to support more complex compositions, larger datasets, and additional functionalities, making it an even more powerful tool for music practice and education.

Chapter 2

Literature Review

Many researchers have worked on music processing and audio classification. Their work has helped in building the base for this project. Some of the important studies are explained below.

- Selected Features for Classifying Environmental Audio Data with Random Forest (Yan Zhang, Dan-jv Lv, 2015) This study focused on finding the important audio features for classification. The authors used Mel-Frequency Cepstral Coefficients (MFCC) and Code Excited Linear Prediction (CELP) as features and applied the Random Forest algorithm for classification. Their work showed that Random Forest can classify audio accurately. In our project, this idea is used for instrument classification from MP3 files.

- Music Information Retrieval: Recent Developments and Applications (Markus Schedl, Emilia Gómez, Julián Urbano, 2014) This research explained the gap between low-level audio features and symbolic music like notes. The study reviewed different Music Information Retrieval (MIR) methods such as feature extraction, tagging, and recommendation. It highlighted the need to connect raw audio with readable sheet music. In our project, this approach is useful to convert audio into sheet music using signal processing.

- Independent Component Analysis: Recent Advances (Aapo Hyvärinen, 2013) This study showed that Independent Component Analysis (ICA) is a strong tool for separating mixed signals. It can separate vocals and instruments by treating them as independent components. The method has been used in many areas like audio, speech, and neuroscience. In our project, ICA is used to remove vocals from MP3 audio so that only i+nstrument sounds remain, making sheet music generation more accurate.

Chapter 3

Proposed System

The proposed system, Notefy – Companion for Your Instruments, is developed to provide an end-to-end solution for automatic music transcription. Unlike existing systems that only classify sounds or extract features, Notefy focuses on generating instrument-specific sheet music in PDF format. It combines signal processing and machine learning techniques to improve transcription accuracy and provide flexibility to users.

3.1 Features and Functionality

The system is developed with the following key features:

- **Vocal Separation :-** The system uses Independent Component Analysis (ICA) to remove vocals from MP3 files, leaving only the instrumental track. This step improves transcription quality by reducing interference from lyrics.

- **Instrument Detection :-** Random Forest, a machine learning model, is used to classify instruments in the audio. Features such as Mel-Frequency Cepstral Coefficients (MFCCs) are extracted to identify the unique patterns of each instrument.

- **Pitch Detection and Note Extraction :-** The YIN algorithm is applied to detect the fundamental frequency of sounds, which is then converted into musical notes. This ensures that the transcription captures accurate pitch information.

- **Sheet Music Generation :-** The detected notes are arranged into structured notation and exported as a PDF sheet music file. This provides musicians with a readable and shareable output.

- **Pitch and Tune Adjustment :-** Users can modify the pitch or tune of the final transcription according to their preferences. This adds flexibility for learners and performers.

- **History Tracking :-** The system stores a history of previously processed files, allowing users to review and reuse past transcriptions easily.

Chapter 4

Requirements Analysis

Requirements analysis is a crucial step in ensuring that *Notefy – Companion for Your Instruments* is built on a solid foundation. This stage involves identifying hardware, software, datasets, and performance requirements essential for accurate music transcription.

Dataset: The system requires structured datasets containing diverse instrumental audio samples for training and evaluation. Popular datasets such as IRMAS, Medley-solos-DB, and NSynth are used to cover multiple instruments and recording conditions. Preprocessing steps like MP3-to-WAV conversion, normalization, and instrument labeling are applied to improve accuracy.

User Interface: The system must feature a user-friendly web interface built using HTML, CSS, and JavaScript. It should allow users to upload MP3 audio, select instruments, and view/download the generated sheet music in PDF formats.

Accuracy: The system should achieve above 90% accuracy in instrument recognition and pitch detection. The transcription must minimize errors in both melody and rhythm to produce reliable sheet music.

Scalability: The architecture must support growing datasets and additional instruments without degrading performance. It should handle longer recordings efficiently while maintaining real-time responsiveness.

Real-time Response: The system should ensure that uploaded audio is processed and converted into sheet music within a few seconds, providing an efficient workflow for users.

Security Measures: User data, uploaded audio, and generated outputs should be handled securely. Access controls and proper error handling are necessary to ensure data privacy and prevent unauthorized use.

Chapter 5

Project Design

Project design is the blueprint that defines how Notefy – Companion for Your Instruments will be implemented. It ensures that all identified requirements are systematically translated into workflows, diagrams, and system interactions. The design phase focuses on how users interact with the system, how data flows through various modules, and how the backend architecture processes audio files to generate sheet music.

5.1 Use Case Diagram

It is a visual representation that models the interactions between users (or other systems) and a system, describing its functionality and behavior from the user's perspective.

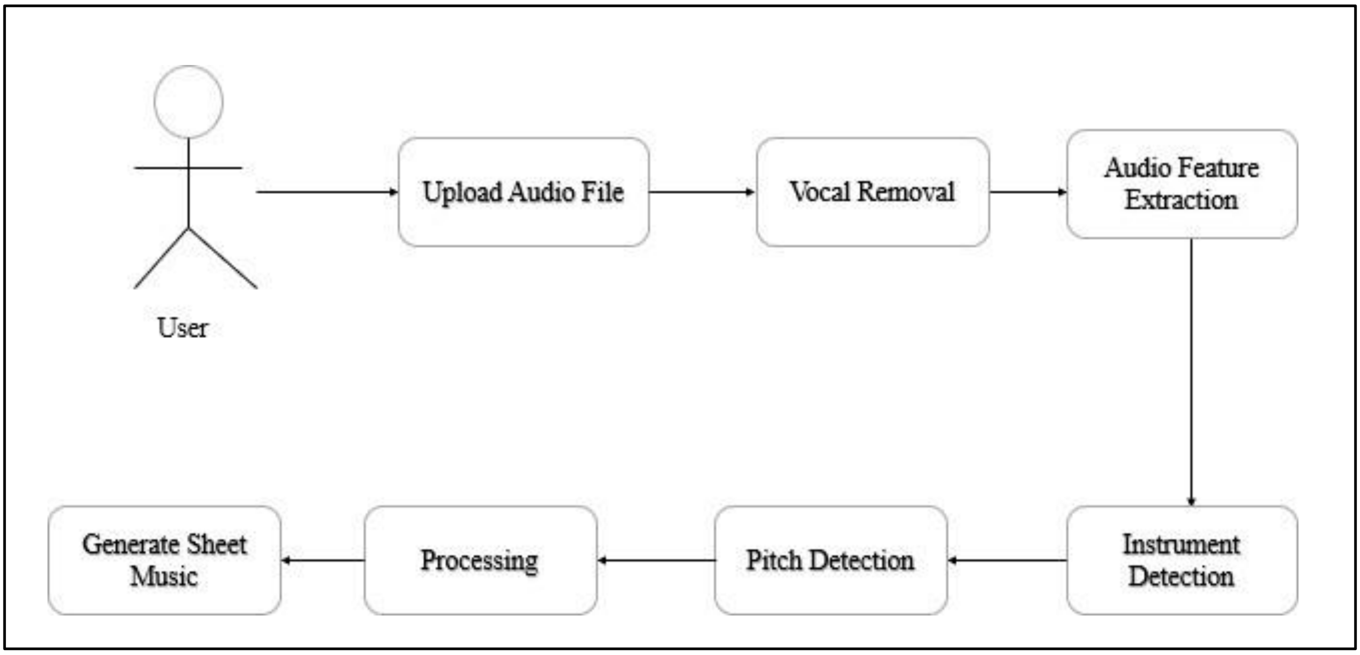

Figure 5.1: Use Case Diagram

In figure 5.1, The figure illustrates how a user interacts with the system to convert an MP3 audio file into sheet music. It shows the step-by-step flow from uploading the audio file to generating the final output.

- **User:** A musician, student, or composer who uploads audio files and downloads the sheet music
- **User Uploads MP3 File:** The process begins when the user provides an input audio file.

- **Vocal Removal (ICA):** Independent Component Analysis (ICA) is applied to separate vocals from the audio, creating a clean instrumental track for analysis.
- **Audio Feature Extraction:** The instrumental track is divided into smaller chunks, and important features such as Mel-Frequency Cepstral Coefficients (MFCCs), Zero Crossing Rate (ZCR), and Spectral Centroid (SC) are extracted to represent sound properties.
- **Instrument Detection (Random Forest):** The extracted features are passed into a pre-trained Random Forest model, which identifies the instruments present in the audio (e.g., piano, violin, drums).
- **Pitch Detection (YIN Algorithm):** The system analyzes the audio to detect fundamental frequencies, producing a continuous sequence of pitches that represent the melody line.
- **Sheet Music Generation:** The detected notes are mapped with pitch and duration values. The Music21 library assembles them into staff notation.
- **Final Output Files:** The sheet music is saved as .musicxml, which is then converted into PDF for printing.

5.2 DFD (Data Flow Diagram)

A Data Flow Diagram (DFD) is a graphical representation of the flow of data within a system, illustrating how information moves between processes, external entities, and data stores. It is widely used in system analysis and design to model the logical flow of information through a system.

The project architecture depicted in the Data Flow Diagram (DFD) outlines a smooth workflow for the Notefy System, which converts audio files into instrument-specific sheet music. The process begins with the user uploading an MP3 file, which serves as the input to the system. The system then performs the following key functions:

- **Vocal Removal (ICA):** Separates the vocal track from the instrumental track to improve feature extraction accuracy.
- **Audio Feature Extraction:** Extracts musical features such as pitch, rhythm, and timbre from the instrumental audio.

- **Instrument Detection (Random Forest):** Identifies and classifies the instruments present in the audio using machine learning.

- **Sheet Music Generation:** Converts the detected notes into MusicXML format and finally produces sheet music in PDF format.

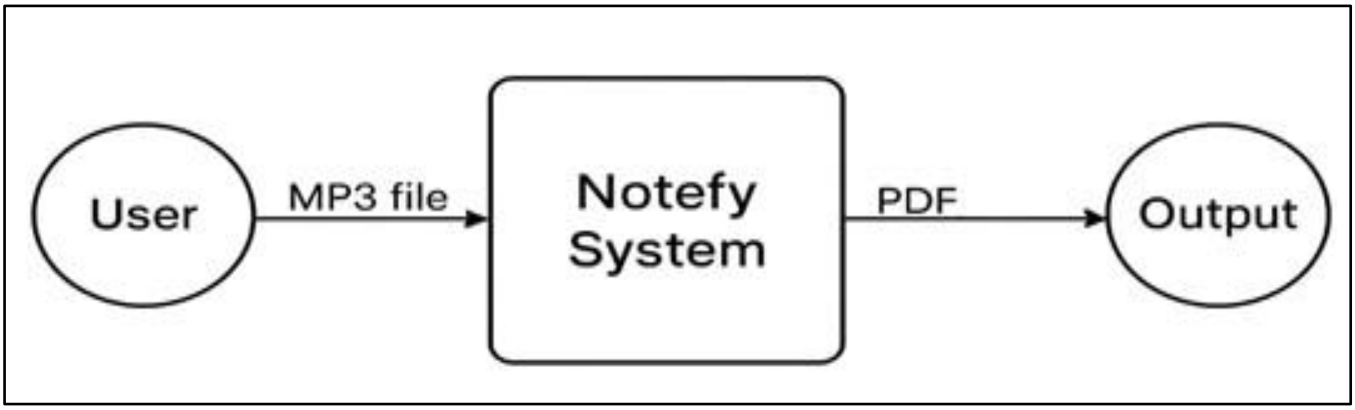

Figure 5.2.1: Data Flow Diagram Level 0

In a DFD Level 0 for the Notefy system, the User provides an MP3 file as input. The Notefy System processes the file and outputs the corresponding Sheet Music (PDF). The data flow involves the MP3 file as input and the PDF as output. Shown in figure 5.2.1.

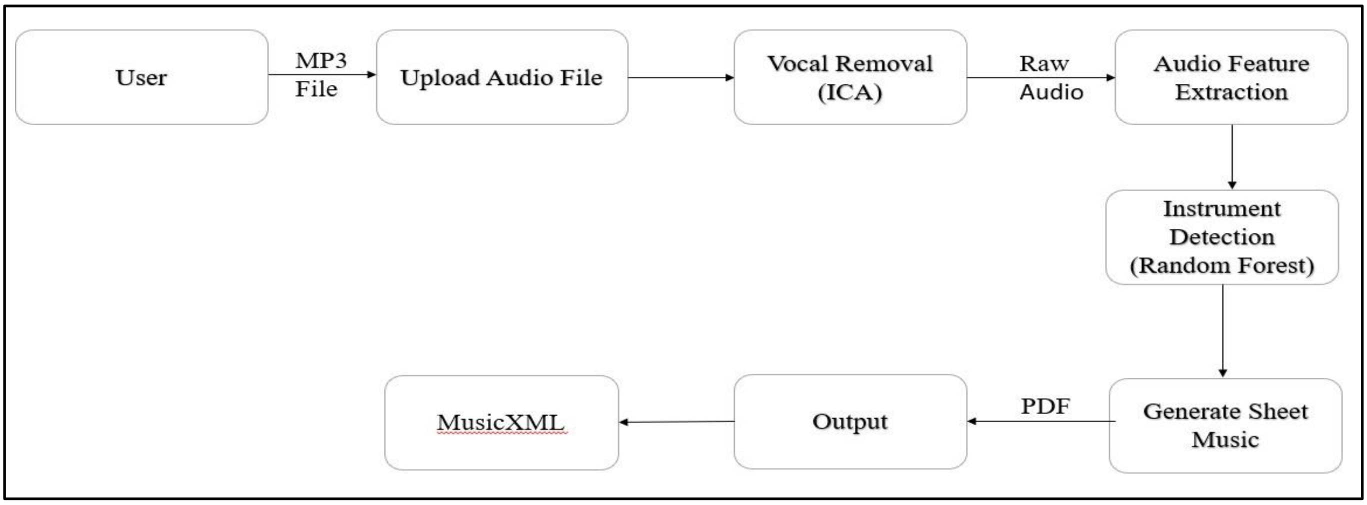

Figure 5.2.2: Data Flow Diagram Level 1

As shown in the figure, the process begins when the user uploads an MP3 file. The system first removes vocals using ICA, ensuring only the instrumental track is analyzed. The cleaned instrumental data is sent for audio feature extraction. The extracted features are processed through the Random Forest classifier to detect instrument-specific notes. These notes are then converted into MusicXML and subsequently transformed into a PDF sheet music file. Finally, the output is delivered back to the user.

The Data Flow Diagram provides a structured overview of how raw audio input is processed, analyzed, and transformed into meaningful sheet music output, ensuring a smooth and efficient user experience.

5.3 System Architecture

The system architecture of the Notefy System represents how audio input is processed step by step to generate the final sheet music output. It shows the internal modules and how data flows between them. The process ensures that raw audio is transformed into a readable and standardized musical notation format.

The main modules are:

- **Audio File Input:** The user uploads an MP3 or audio file, which serves as the raw input to the system.
- **Source Separation (Random Forest Algorithm):** The system performs source separation to remove vocals and isolate instrumental components, improving the accuracy of feature extraction.
- **Audio-to-pdf Conversion (YIN Algorithm):** The instrumental audio is processed using the YIN algorithm to detect pitch, rhythm, and note timing, which are converted into pdf format.
- **MusicXML Generation:** The Mp3 data is then converted into MusicXML, which is an industry-standard format for representing musical notation. MusicXML acts as an intermediate step in the background, ensuring compatibility with professional music tools.
- **PDF Sheet Music Output:** Finally, the MusicXML is rendered into a PDF file, which is provided as the final output to the user. The user interacts only with the PDF file, while MusicXML remains part of the background processing.

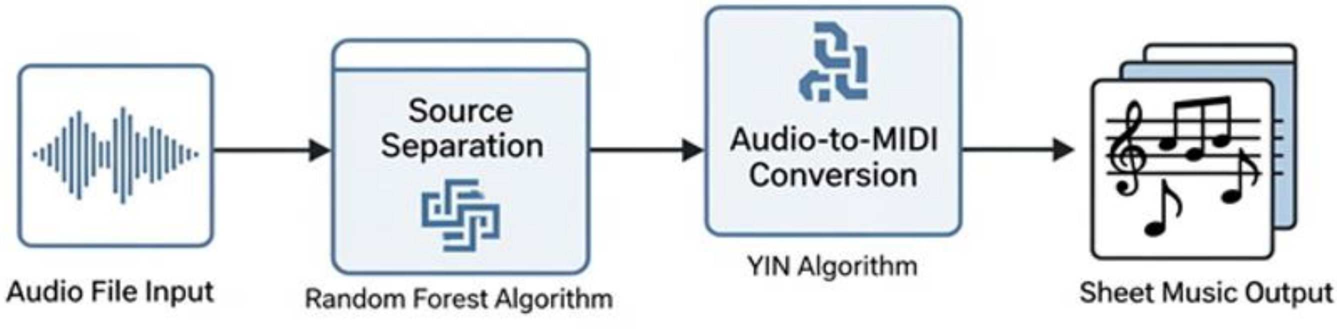

Figure 5.3: System Architecture

From the above Figure 5.3, the proposed system ensures efficient audio processing and accurate sheet music generation. By combining source separation, audio feature extraction, and MusicXML formatting, the system achieves reliable results with high accuracy. Its modular design makes it easy to expand and integrate additional features, such as support for more instruments or advanced editing tools.

With its ability to automatically convert raw MP3 audio into structured PDF sheet music, the system enhances accessibility for musicians, learners, and composers. This structured approach ensures flexibility, scalability, and adaptability, making Notefy a powerful tool for bridging the gap between digital audio and traditional music notation.

5.4 Implementation

The implementation of the Notefy system focuses on translating the project's design into a fully functional, user-friendly platform. It combines a responsive front-end interface, a robust back-end server, and a secure database to handle all aspects of audio processing and music transcription. By seamlessly integrating these components, the system ensures efficient real-time processing, accurate sheet music generation, and an interactive experience for users. The design emphasizes scalability, performance, and security, allowing the platform to adapt to future enhancements while maintaining high usability standards.

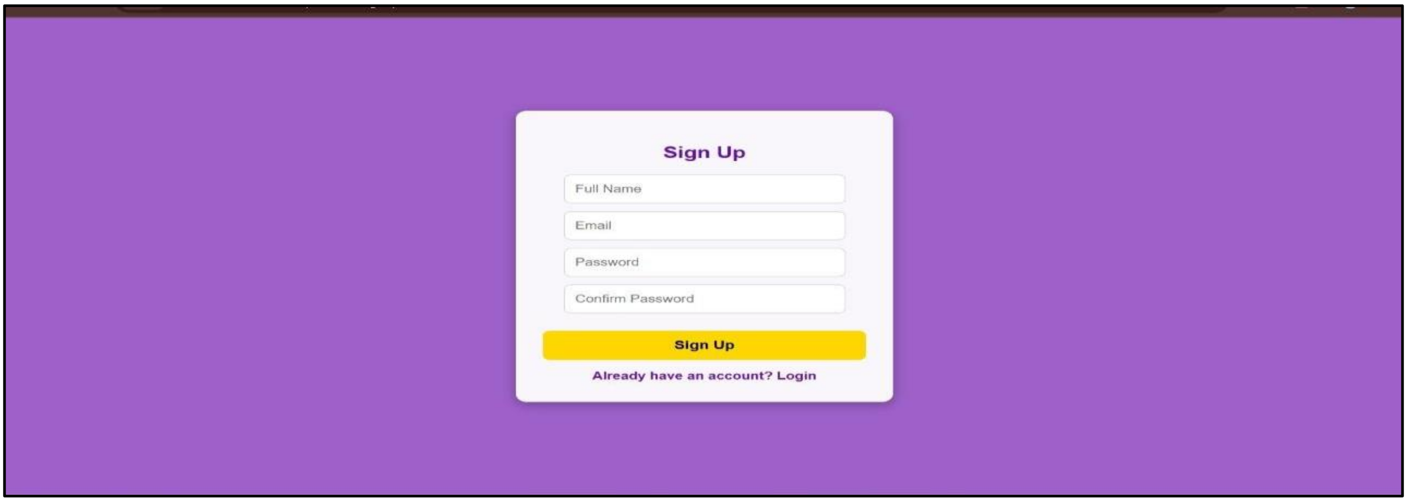

Figure 5.4.1: Sign Up Page

The Sign Up page introduces the system to new users by providing a registration interface where essential details such as full name, email, password, and confirmation of password are required. This step is necessary for account creation and secure access to the application, as depicted in Figure 5.4.1.

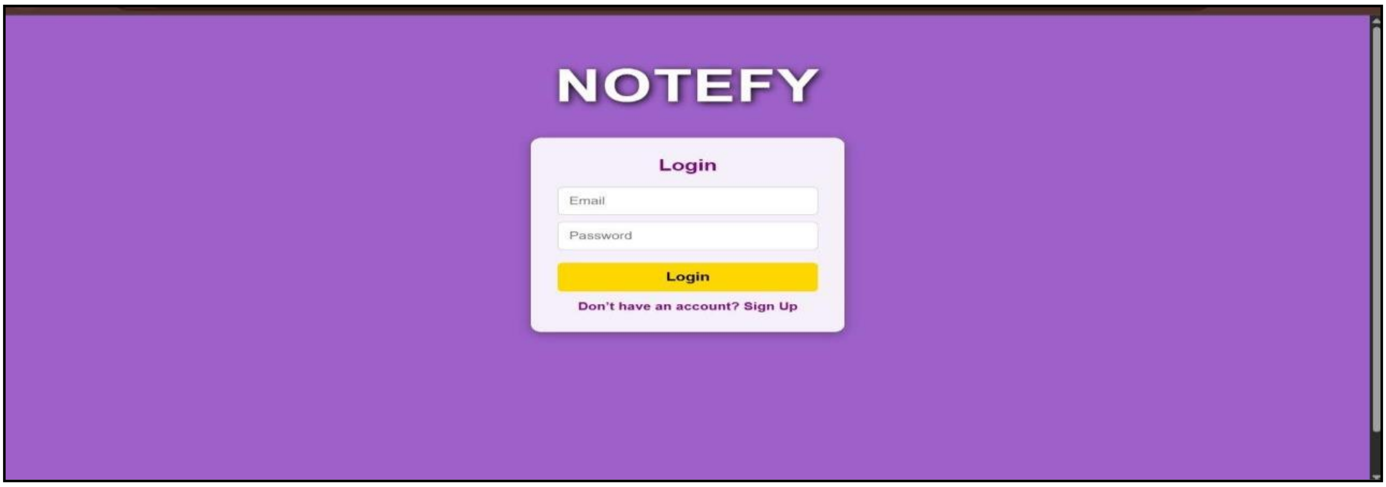

Figure 5.4.2: Login Page

The Login page provides existing users with a secure interface to access the application. Users are prompted to enter their registered email and password to authenticate and proceed, ensuring that only authorized individuals gain entry, as illustrated in Figure 5.4.2.

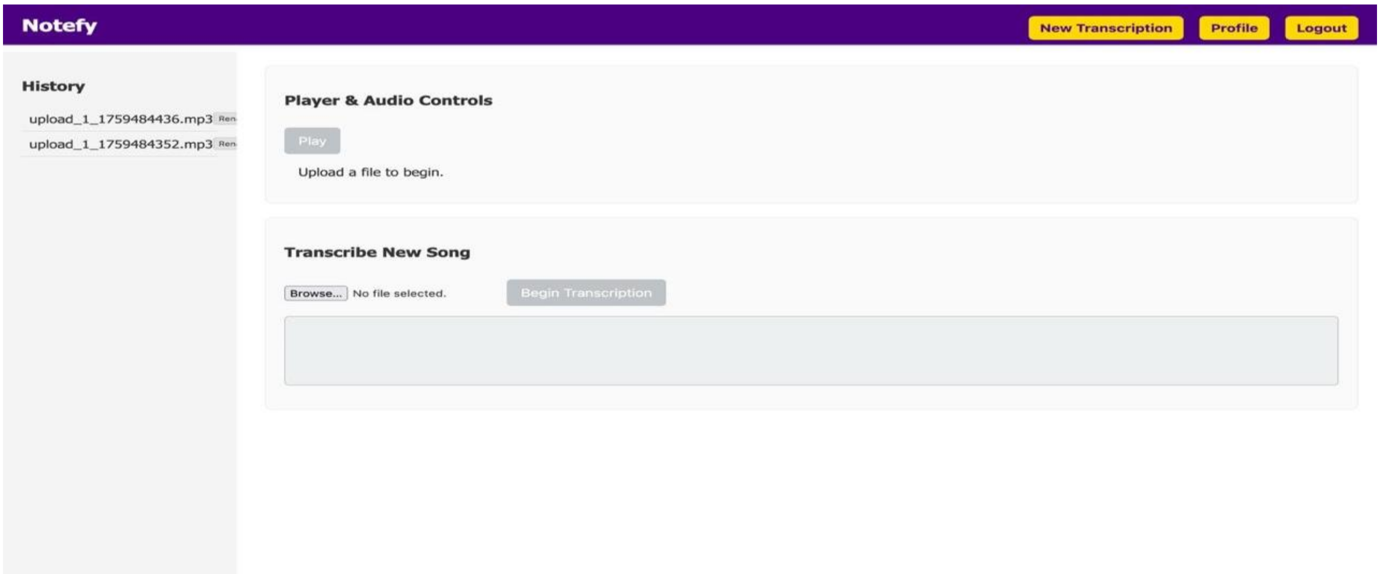

Figure 5.4.3: Dashboard Page

The Dashboard page serves as the main control center for users after logging in. It provides an overview of key features and functionalities, allowing users to navigate through various sections such as real-time gesture recognition, user settings, and data insights. This central hub streamlines user interaction with the application and offers easy access to all essential tools, as depicted in Figure 5.4.3.

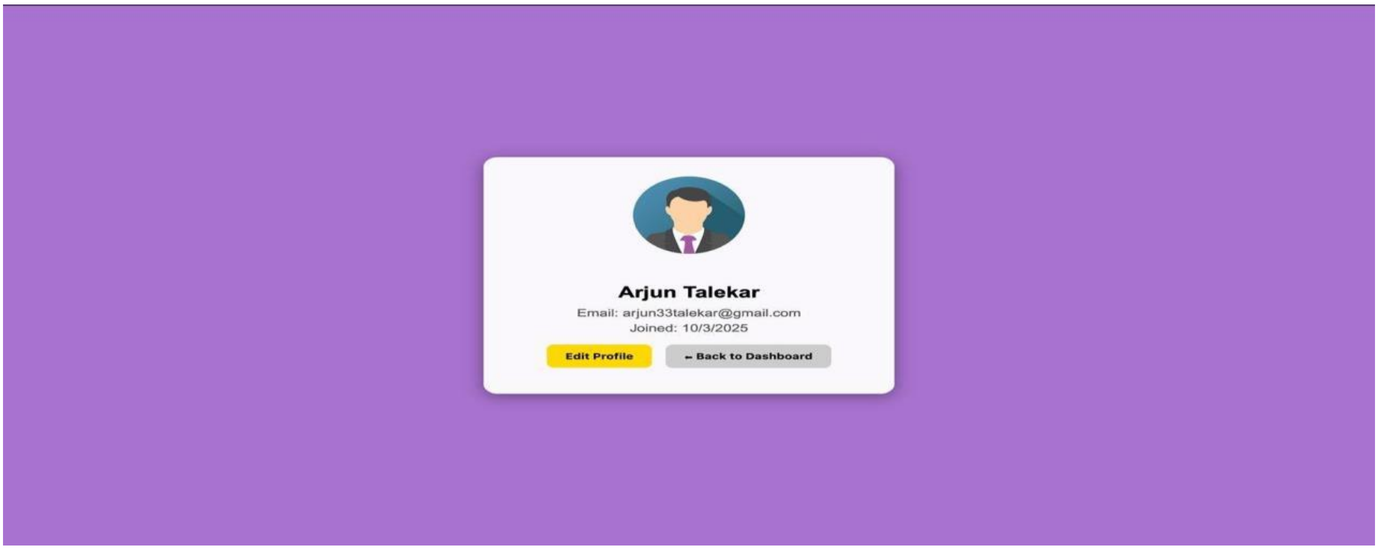

Figure 5.4.4: Profile Page

The Profile page shows the user's personal information like name, email, and profile picture. Users can update their details easily on this page. It helps users keep their information up to date and personalized, as seen in Figure 5.4.4

Chapter 6

Technical Specification

The technical specifications of the Notefy project define the hardware, software, data sources, and methodologies used to convert MP3 audio files into instrument-specific sheet music. These specifications ensure the project is developed with optimal compatibility, efficiency, and scalability.

Software Requirement

- **Operating System:** Windows 10 and Above / Linux / macOS
- **IDE:** Visual Studio Code
- **Programming Language:** Python 3.11.0
- **Frontend Technologies:**
  i. HTML, CSS
  ii. JavaScript
- **Python Libraries:** Librosa, NumPy, SciPy, Keras, TensorFlow, OpenCV
- **Database / Storage:** Pickle Files (.pkl), JSON Files, MusicXML / PDF

Methodology

- **Machine Learning Model:** Random Forest trained on IRMAS, Medley-solos-DB, and NSynth datasets for instrument recognition.
- **Data Preprocessing:**
  - MP3 → WAV conversion
  - Normalization
  - ICA Vocal Removal
  - HPSS (Harmonic-Percussive Source Separation)

- **Algorithms:**
  - Onset Detection – For note timing
  - Pitch Detection (YIN / Piptrack) – For pitch extraction
  - Random Forest – For instrument classification
  - ICA – separating mixed audio signals (vocals + instruments) into independent sources.
  - Range-Based Assignment – Mapping notes to instruments
  - Transpose Handling – Adjusting for key changes
- **Feature Extraction:** MFCCs, Spectral Centroid, ZCR, and Pitch Curves to capture tone and melody.

Datasets

- **IRMAS Dataset:** Instrument Recognition in Musical Audio Signals.
- **Medley-solos-DB:** Solo instrument recordings for training.
- **NSynth Dataset:** Annotated dataset of musical notes.
- **Dataset Links:**
  - https://www.upf.edu/web/mtg/irmas
  - https://colinraffel.com/projects/lmd/
- **Dataset Size:**
  - IRMAS Dataset → 6,705 × 55
  - LMD-Clean Subset → 1,270 × 55
  - Total Dataset → 7,975 × 55

Formulas used:

- **ICA:** $x(t)=A\cdot s(t)$

s(t) = W * x(t)

- **Random Forest:**

$$Gini = 1 - \sum_{i=1}^{C} p_i^2$$

- **YIN**: YIN estimates pitch using difference function:

$$d(\tau) = \sum_{t=1}^{N} (x_t - x_{t+\tau})^2$$

Then compute cumulative mean normalized difference:

$$d'(\tau) = \frac{d(\tau)}{\frac{1}{\tau} \sum_{j=1}^{\tau} d(j)}$$

Chapter 7

Project Scheduling

A schedule outlining planned start and finish dates, durations, and allocated resources for each task ensures the project is completed on time and within scope. Project scheduling helps the team track progress, manage dependencies, and ensure that development activities are aligned with the objectives of the Notefy system.

Gantt Chart:

In our project, the Gantt chart outlines the major activities where each task is represented by a bar, indicating its start and end dates, duration, and dependencies. This allows project stakeholders to monitor progress,

Sr. no.	Group Members	Duration	Task Performed
1.	Arjun Talekar Shrikant Thakur Parth Pawar Ranjana Yadav	2nd Week of July	Group formation and topic finalization. Identifying the scope and objectives of the project "Notefy: Companion for Your Instruments." Discussing the project idea and preparing a basic paper prototype.
2.	Arjun Talekar Shrikant Thakur	2nd Week of July	Identifying functionalities of the Notefy system and listing required modules for implementation.
3.	Arjun Talekar Shrikant Thakur Parth Pawar Ranjana Yadav	3rd–4th Week of July	Discussing the project flow, creating the system architecture diagram, and preparing the mini project (Paper Prototype).
4.	Shrikant Thakur Parth Pawar	1st Week of August	Designing the graphical user interface (GUI) for the Notefy application.

5.	Arjun Talekar Shrikant Thakur Parth Pawar Ranjana Yadav	2nd Week of August	Phase I Presentation
6.	Arjun Talekar	3rd Week of September	Designing, creating and connecting the project database schema.
7.	Ranjana Yadav	1st–2nd Week of October	Integration of all modules, report preparation, and ppt.
8.	Arjun Talekar Shrikant Thakur Parth Pawar Ranjana Yadav	3rd Week of October	Final Presentation and Project Submission.

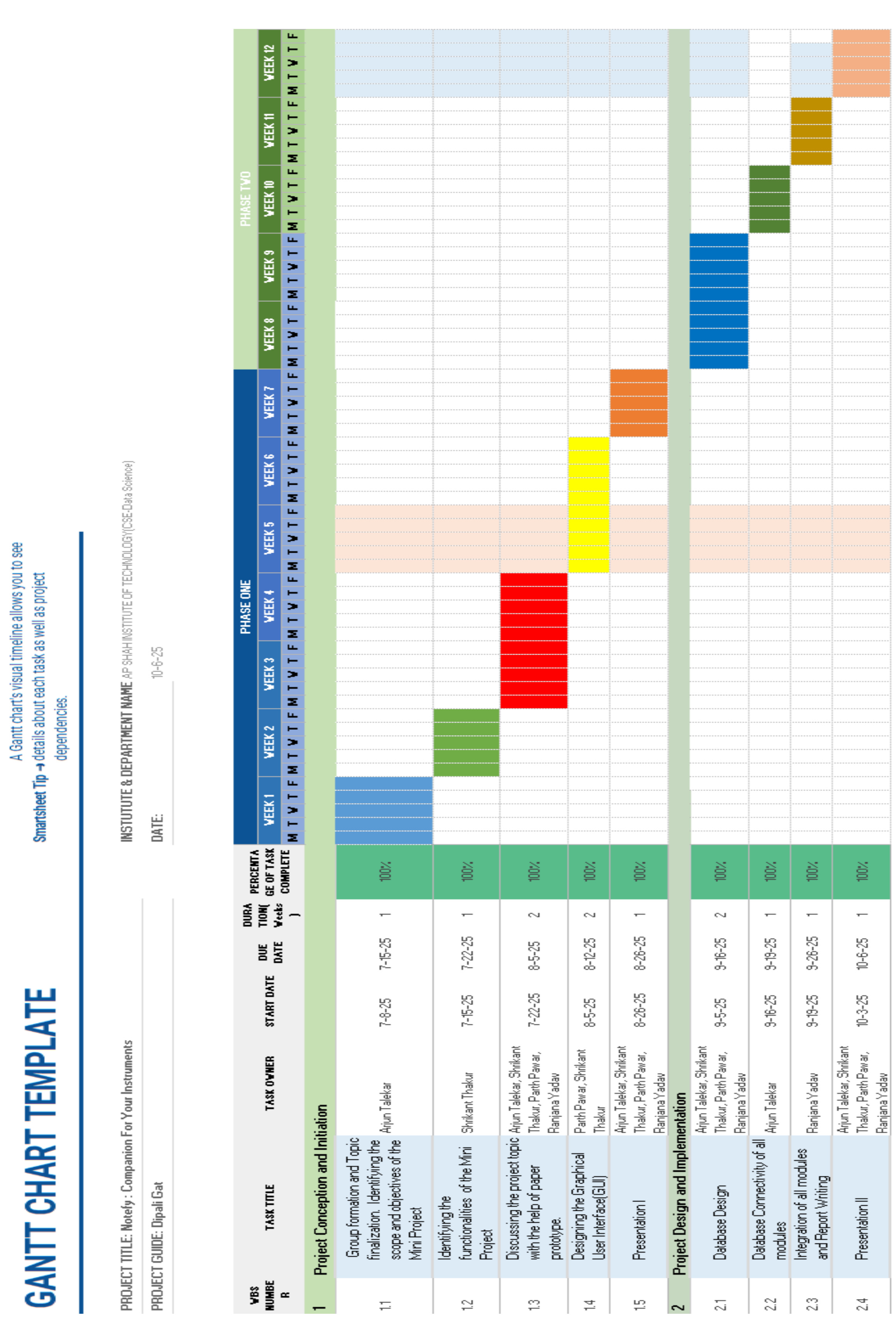

Figure 7.1: Gantt Chart

Following is the detail in Figure 7.2 of the Gantt chart – In the second week of July, Arjun Talekar, Shrikant Thakur, Parth Pawar, and Ranjana Yadav formed a group for their mini project and finalized the topic *Notefy: Companion For Your Instruments*. During this meeting, the team discussed and identified the scope and objectives of the project. By the third week of July, Shrikant Thakur identified the core functionalities required in the mini project.

In the fourth week of July and the first week of August, the team discussed the project topic with the help of a paper prototype to refine ideas and possible features. Later in August, Parth Pawar, Shrikant Thakur designed the Graphical User Interface (GUI), which was followed by the first project presentation on 26th August, successfully concluding the initiation phase.

During September, the project moved into the design and implementation phase. In the first two weeks, Arjun Talekar, Shrikant Thakur, Parth Pawar, and Ranjana Yadav collaboratively worked on the database design.
Afterward, Arjun Talekar ensured database connectivity across all modules. By mid-September, Ranjana Yadav led the integration of different modules and contributed to initial report writing.

Finally, in October, the team worked together to finalize the documentation and prepare for Presentation II, scheduled on 26th October. This marked the completion of module development, integration, and project documentation for the mini project.

Chapter 8

Results

The results of the Notefy system demonstrate the effectiveness of combining signal processing and machine learning algorithms for music transcription. The system was tested with different audio files to evaluate its ability to separate vocals from instruments, convert instrumental tracks into pdf format, and generate accurate sheet music. The outcomes highlight the system's accuracy, efficiency, and user-friendliness.

The Notefy system efficiently converts MP3 audio files into instrument-specific sheet music in PDF format. It first separates vocals from instrumental tracks using Independent Component Analysis (ICA), ensuring that only the instrument sounds are processed. Then, using techniques like Random Forest for note detection and the YIN algorithm for precise pitch estimation, the system accurately identifies musical notes and rhythms. This process allows the generation of readable sheet music while maintaining high accuracy across different songs and instruments.

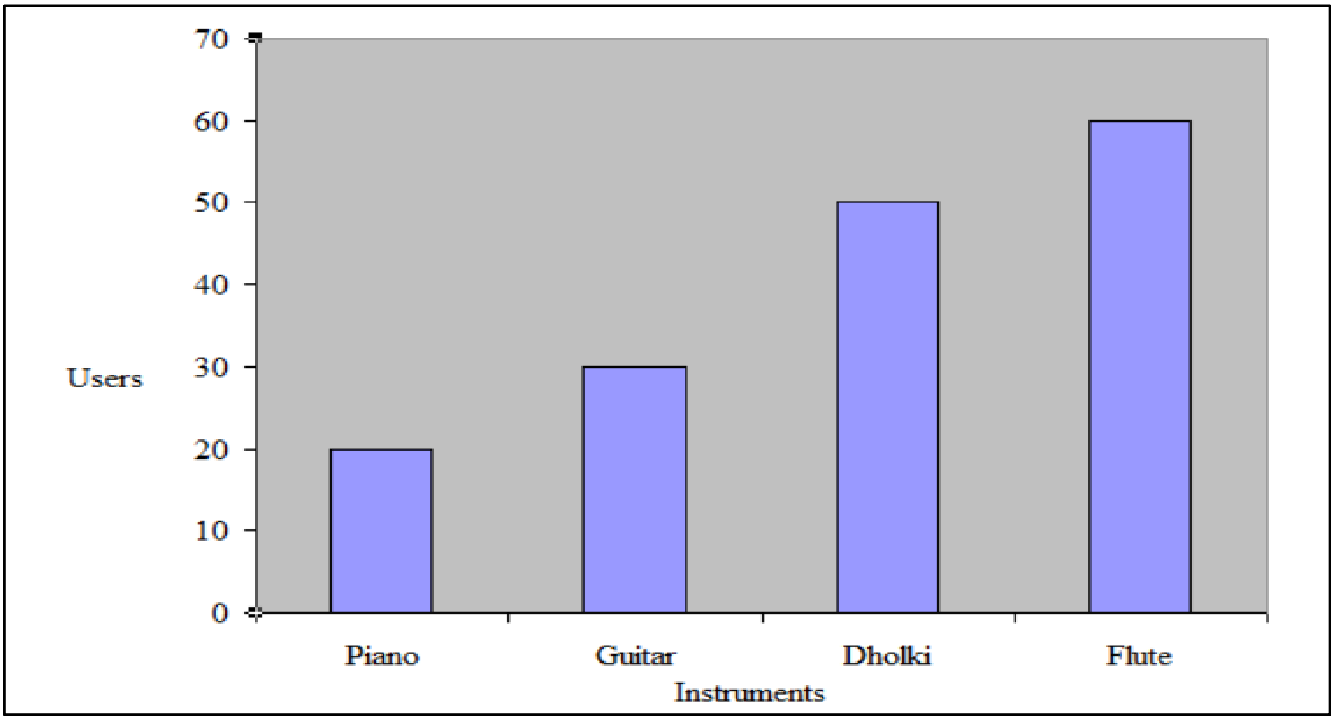

Figure 8.1: Graphical Representation of Notefy System Results

In Figure 8.1: Graphical Representation of Notefy System Results presents the relationship between users and the instruments recognized by the system. The graph helps to visualize how different users interacted with the Notefy system and which instruments were most commonly used during testing. By plotting users on one axis and instruments on the other, the figure shows how widely the system was applied across various musical contexts.

The first observation from the graph is that multiple users tested the system with different instruments. This allowed us to check whether Notefy can maintain its accuracy across varied inputs. Each user selected their own instrument track, and the graph displays these choices clearly. This representation highlights the diversity of the testing process.

Another point shown in the graph is the distribution of instruments among users. Some instruments, such as piano and guitar, were used by more users, while others like drums or violin had fewer participants. This indicates that the system was tested more extensively on popular instruments, but it also worked correctly on less common ones, showing adaptability.

The graph also reflects the system's consistency. Even though different users worked with different instruments, the results were uniform. Users were able to obtain accurate sheet music regardless of the instrument they selected. This demonstrates the robustness of Notefy in handling different types of sounds without losing accuracy.

Finally, the graph emphasizes the practical reach of the system. By showing how users interacted with different instruments, it proves that Notefy is not limited to a single type of music. Instead, it can be applied to a wide range of instruments, making it a versatile tool for learners, musicians, and educators. This versatility is one of the main strengths shown by the graphical representation.

Chapter 9

Conclusion

The development of Notefy has demonstrated how technology can simplify the process of note management, audio transcription, and content organization for users. By focusing on the real-world challenge of extracting meaningful information from audio files, the project successfully implemented methods to separate vocals, isolate instruments, and transcribe audio into structured formats. This outcome not only reflects the technical feasibility of the system but also highlights its potential to reduce manual effort, enhance accessibility, and save valuable time for students, professionals, and creators. Throughout the project, various technical components such as signal processing, transcription models, and systematic workflows were integrated into a single cohesive platform. The combination of vocal separation and conversion of instrumental tracks into music notes further strengthened the system's utility by bridging the gap between audio processing and music representation. In addition, the structured design of Notefy was guided by data flow diagrams, modular architecture, and user-friendly features, ensuring the system remained easy to understand and practical to use. This project has shown that with the right design and implementation, advanced concepts like Independent Component Analysis (ICA) can be applied effectively in academic projects. The evaluation of Notefy also brought out the challenges faced during implementation. Issues such as handling noisy data, ensuring accuracy in transcription, and optimizing system performance provided valuable learning experiences. These challenges encouraged deeper research, testing, and innovation, which strengthened both technical skills and problem-solving abilities. Despite the limitations, the project's outcomes were encouraging and established a foundation that can be further refined in future enhancements. By identifying the system's strengths and limitations, the project ensures that future iterations of Notefy can achieve greater accuracy, scalability, and adaptability.

In conclusion, Notefy has been a successful attempt at combining academic knowledge with practical application in the field of audio processing and data management. The project not only met its primary objectives but also provided a platform for exploring interdisciplinary concepts involving computer science, signal processing, and usability design. The knowledge gained through this work extends beyond the scope of the project and can be applied to future research or professional projects. Overall, Notefy has proven to be an innovative, functional, and impactful solution that demonstrates the importance of applying theoretical learning to solve real-world problems.

Chapter 10

Future Scope

The future scope of Notefy is vast and highly promising, especially in the field of music and education. For musicians, this system can act as a powerful tool to separate vocals, extract instrumentals, and generate sheet music or pdf files, helping them experiment with tunes, remix songs, or improve their practice sessions. In music academies, Notefy can be used as a teaching aid to demonstrate how songs are structured, how instruments can be isolated, and how audio can be converted into readable music notes, making learning more interactive and practical.

For beginner musicians, Notefy provides an easy entry point into the world of music creation and learning. By offering simplified access to instrumental notes and transcriptions, beginners can better understand rhythm, pitch, and tune, while practicing without the confusion of overlapping vocals. Similarly, in schools, this system can support music education by enabling teachers to create simpler versions of songs, help students analyze instrument-specific parts, and encourage creativity in music learning.

On a larger scale, Notefy can be very useful for orchestras, where managing multiple instruments and coordinating sheet music is often challenging. The ability of the system to extract, convert, and present instrument-specific notes can make rehearsals more efficient and performance-ready. Finally, for music bands, this tool can help in practice sessions, composition, and experimentation by allowing individual members to focus on their specific instrument parts, ultimately improving synchronization and creativity within the group.

Thus, the scope of Notefy is not limited to just personal use but extends across individual learners, professional musicians, educational institutions, and large-scale music groups. With further improvements, this system can become a widely adopted platform for simplifying music practice, teaching, and performance preparation.

References

[1] Y. Zhang and D.-jv Lv, "**Selected Features for Classifying Environmental Audio Data with Random Forest**," The Open Automation and Control Systems Journal, vol. 7, pp. 135–142, **2015**.

URL:- https://benthamopen.com/contents/pdf/TOAUTOCJ/TOAUTOCJ-7-135.pdf

[2] M. Schedl, E. Gómez, and J. Urbano, "**Music Information Retrieval: Recent . Developments and Applications," Foundations and Trends in Information Retrieval, vol. 8, no. 2–3, pp. 127–261, 2014.**

URL:- https://www.nowpublishers.com/article/DownloadSummary/INR-042

[3] A. Hyvärinen, "**Independent Component Analysis: Recent Advances**," Philosophical Transactions of the Royal Society A, vol. 371, 1984, p. 20110534, Feb. **2013**.

URL:- https://pmc.ncbi.nlm.nih.gov/articles/PMC3538438/

[4] "**Sheet music generator with AI**," *La Touche Musicale.*

URL :- https://latouchemusicale.com/en/tools/ai-sheet-music-generator/