Higher National Diploma in Software Engineering 24.2F

Programming Data Structures and Algorithms

Harmony Map

Project Report

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Student Management System

1.0 Introduction

Harmony Map is an intelligent music practice and improvisation tool that models chord as nodes and harmonic relationships as edges using graph theory.
It helps musicians (especially in jazz, blues, and modal harmony) explore chord progressions and melodic pathways in a visual and interactive way.

2.0 Objectives

- Provide an interactive chord graph visualization.
- Generate intelligent chord progressions based on user input.
- Suggest smooth melodic pathways between notes.
- Offer real-time playback for practice.
- Allow saving progressions.
- Loads saved progressions.

3.0 System Overview

- **Backend (FastAPI)**
    - Exposes APIs for chord graph, progression generation, and melodic pathways.
    - Implements graph algorithms:
        - **DFS / BFS** → progression generation.
        - **Dijkstra** → melodic pathway finder.
- **Frontend (React + Vite)**
    - Displays chord graph using react-force-graph-2d.
    - Provides interactive UI for chord selection and progression generation.
    - Visualizes harmonic routes in real-time.

4.0 Functional Requirements

1. **Inputs:**
   - Start chord, end chord.
   - Number of bars.
   - Complexity level.
2. **Processes:**
   - Build chord graph (nodes + weighted edges).
   - Generate valid chord progressions.
   - Find shortest melodic pathways.
   - Render chord graph visually.
   - Save generated progressions.
   - Load saved files.
3. **Outputs:**
   - Suggested chord progression list.
   - Interactive chord graph visualization.
   - Suggested scales/notes for improvisation.

5.0 Data Structure Used

Graph

- **Nodes** → chords (C, Dm, G, etc.)
- **Edges** → harmonic relationships with weights.
- **Weights** → represent harmonic strength/smoothness.

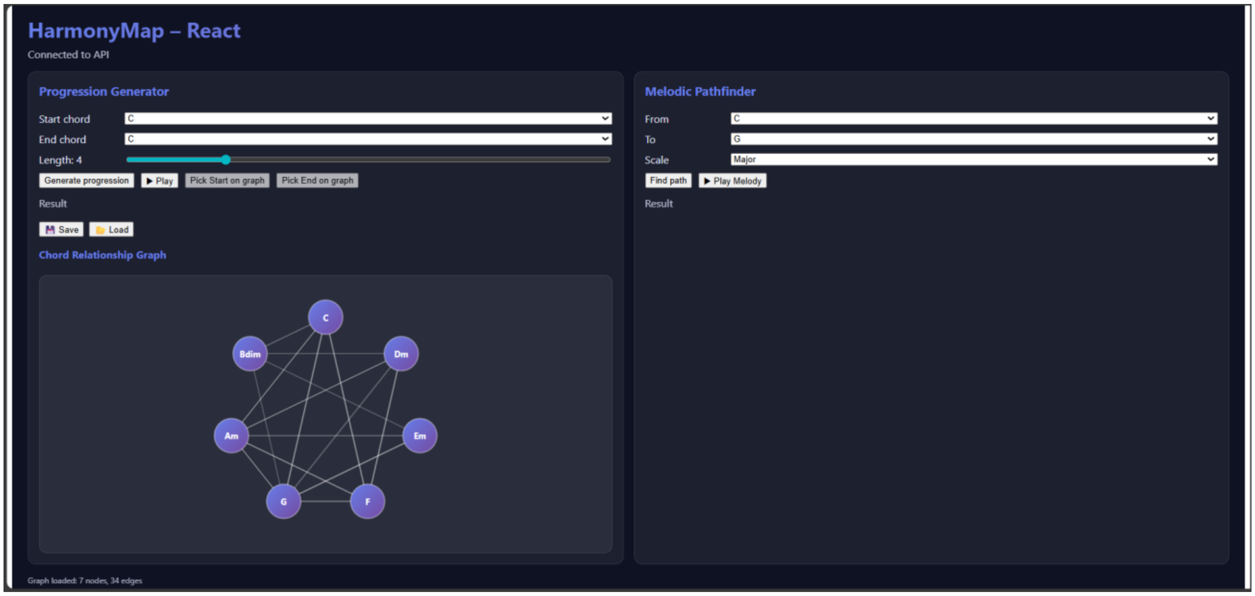
Justification:

Graph theory is ideal since music is nonlinear (a chord can lead to multiple others). Graph algorithms allow exploring multiple harmonic paths.

6.0 Technologies Used

- **Frontend**: React, Vite, react-force-graph-2d, Tone.js
- **Backend**: FastAPI, Python
- **Other**: JSON for chord graph data

7.0 User Interface



HarmonyMap – React

Connected to API

Progression Generator

Start chord: C

End chord: C

Length: 4

Result

Chord Relationship Graph

Melodic Pathfinder

From: C

To: G

Scale: Major

Result

Graph loaded: 7 nodes, 34 edges

8.0 Novelty Compared with Existing Apps

Most existing chord progression tools or circle-of-fifths apps such as Autochords, ChordChord, Hooktheory / Hookpad, iReal Pro (mobile app), etc. have these limitations:

- Only generate basic or random chord progressions.
- Offer static diagrams (circle of fifths, chord charts) without interaction.
- Do not support melodic improvisation guidance.
- Lack graph-based visualization of harmonic movement.

Harmony Map brings novelty by:

- Using graph theory to model harmony (nodes = chords, edges = relationships).
- Applying graph algorithms (DFS, BFS, Dijkstra) to create progressions and melodic pathways intelligently.
- Offering an interactive chord graph where users can visually explore harmonic routes.
- Providing both chord progression generation and melodic improvisation support in one tool.
- Allowing real-time playback + scale suggestions for practice.
- Saving generated chord progressions and load them in the future.

Unlike existing apps, Harmony Map is not just a random generator or static diagram — it is a music theory assistant powered by algorithms, designed to make learning harmony more creative and methodical.

9.0 Conclusion

Harmony Map provides a new way for musicians to learn and practice harmony. By applying graph theory to music theory, it makes chord progressions and improvisation more visual, intelligent, and interactive compared to existing tools.