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Music Analysis Using Machine Learning

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***Abstract*— Interaction with computers in musical performances is very much limited by a lack of music understanding by computers. If computers do not understand musical structures such as rhythmic units, chords, keys, and phrases, then interaction with computers will necessarily be difficult and cumbersome. Research into Music Understanding by computer aims to raise the level of human computer interaction in musical tasks including live music performance.**

Automatic music analysis is the automated extraction of relevant perceptual information (notes, instruments, etc.) from music files (like mp3s). First attempted in the 1970s at Stanford University [Moorer], it remains an unsolved problem. The problem is highly multifaceted and interdisciplinary, requiring the extraction of musical notes, instruments, percussion, emotion, etc., and drawing from fields as varied as computer science, mathematics, biology, physics, psychology, and electrical engineering. The problem's difficulty lies in a necessity to reverse-engineer the human brain.

***Keywords*— Melody Analysis, Chord Analysis, Structure Analysis, Machine Learning, Audio Systems.**

I. INTRODUCTION

Chord Recognition is the automated process of assigning musical chord to segments of a music piece. It is an important task in the analysis of western music and music transcription in general, and it can contribute to applications such as key detection, structural segmentation, music similarity measures, and other semantic analysis tasks. The first step of the chord recognition (CR) is the extraction of a meaningful descriptor that enhances the contribution of every note at each instant. One of the main strategies of doing Chord Recognition is based on the comparison of vectors of the extracted descriptor with a set of chords templates by means of a distance measure. This method, due to the interaction of many instruments with different tumbrel characteristics, is very influenced by the noise of the descriptor itself and, for this reason, can be ineffective. In this project, we worked on a method for Chord Recognition based on machine learning techniques. These techniques are designed to automatically learn the complicated relations that link an input observation to the corresponding class making use of probabilistic theory.

Music Understanding refers to the recognition or identification of structure and pattern in musical information. Music understanding projects initiated by the author are discussed. In the first, Computer Accompaniment, the goal is to follow a performer in a score.

II. LITERATURE SURVEY

1. Dannenberg, “Recent Work in Music Understanding,” in Proceedings of the 11th Annual Symposium on Small Computers in the Arts, Philadelphia, PA November 15-17, 1991. Philadelphia: SCAN, November 1991, pp. 9-14.

Interaction with computers in musical performances is very much limited by a lack of music understanding by computers. If computers do not understand musical structures such as rhythmic units, chords, keys, and phrases, then interaction with computers will necessarily be difficult and cumbersome. Research into Music Understanding by computer aims to raise the level of human computer interaction in musical tasks including live music performance.

2. Dannenberg, “Music Understanding and the Future of Computer Music,” Contemporary Music Review, (to appear).

Dannenberg, “Music Understanding by Computer,” in IAKTA/LIST International Workshop on Knowledge Technology in the Arts Proceedings, International Association of Knowledge Technology in the Arts, Inc. in cooperation with Laboratories of Image Information Science and Technology, Osaka Japan, pp. 41-56 (September 16, 1993).

Music Understanding refers to the recognition or identification of structure and pattern in musical information. Music understanding projects initiated by the author are discussed. In the first, Computer Accompaniment, the goal is to follow a performer in a score. Knowledge of the position in the score as a function of time can be used to synchronize an accompaniment to the live performer and automatically adjust to tempo variations. In the second project, it is shown that statistical methods can be used to recognize the location of an improviser in a cyclic chord progression such as the 12-bar blues.

The third project, Beat Tracking, attempts to identify musical beats using note-onset times from a live performance.

III. PROPOSED APPROACH AND METHODOLOGY

• Chord Recognition is the automated process of assigning musical chord to segments of a music piece.

• Due to the complexity to extract meaningful musical attributes, it is common to extract standard features available in common audio frameworks.

• In this project, we worked on a method for Chord Recognition based on machine learning techniques.

• These techniques are designed to automatically learn the complicated relations that link an input observation to the corresponding class making use of probabilistic theory.

• With inputs from the system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality, which is referred to as Unit Testing.

CNN Algorithm:

CNN is one of the main categories to do image recognition, image classification. Object detection, face recognition, emotion recognition etc., are some of the areas where CNN are widely used. CNN image classification takes an input image, process it and classify it under certain categories (happy, sad, angry, fear, neutral, disgust). CNN is a neural network that has one or more convolution layers .

• Step 1: Dataset containing images along with reference emotions is fed into the system. The name of dataset is Face Emotion Recognition (FER) which is an open – source data set that was made publicly available on a Kaggle.

• Step 2: Now import the required libraries and build the model.

• Step 3: The convolution neural network is used which extracts image features f pixel by pixel.

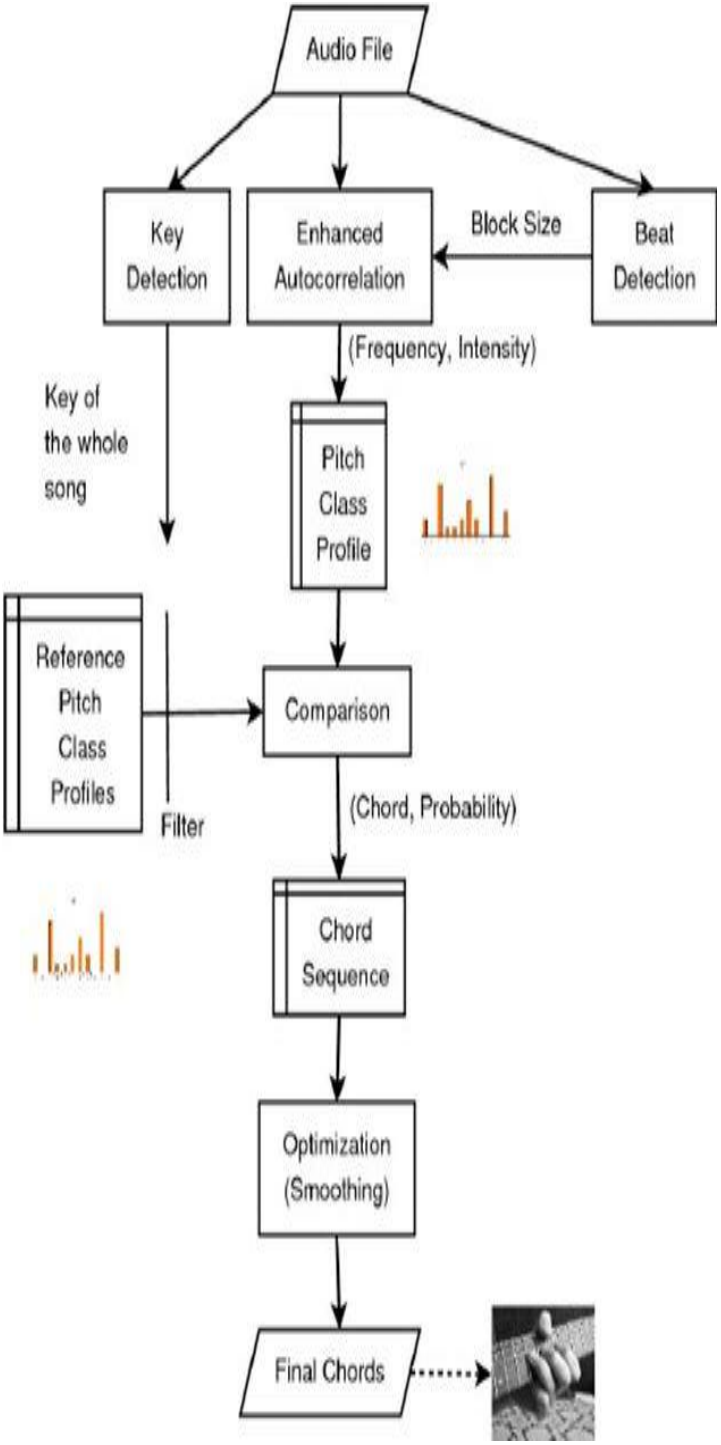
• Step 4: Matrix factorization is performed on the extracted pixels. The matrix is of m x n.

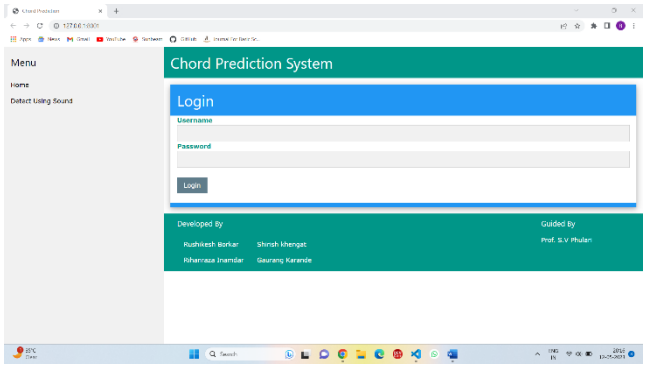
• Step 5: Max pooling is performed on this matrix where maximum value is selected and again fixed into matrix.

• Step 6: Normalization is performed where the every negative value is converted to zero.

• Step 7: To convert values to zero rectified linear units are used where each value is filtered and negative value is set to zero.

• Step 8: The hidden layers take the input values from the visible layers and assign the weights after calculating maximum probability.

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Guided By
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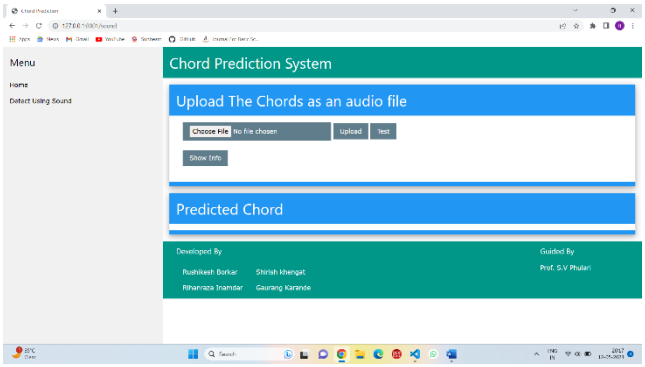
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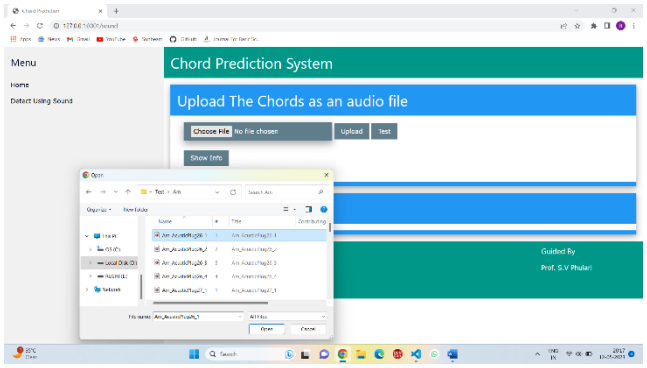
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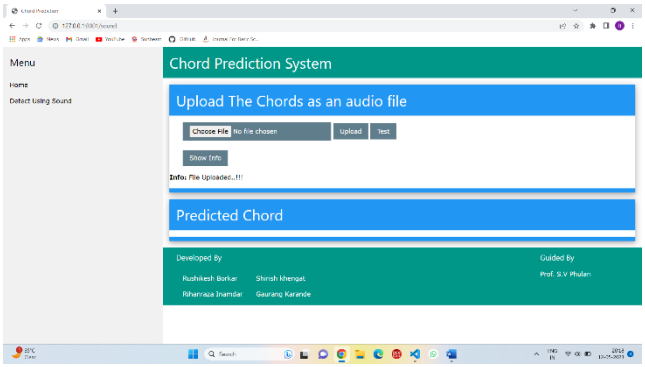
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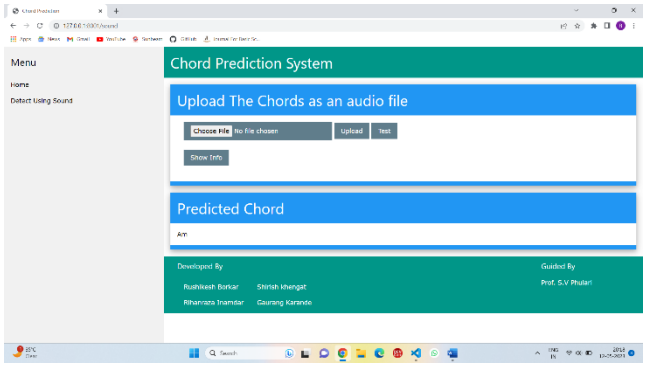
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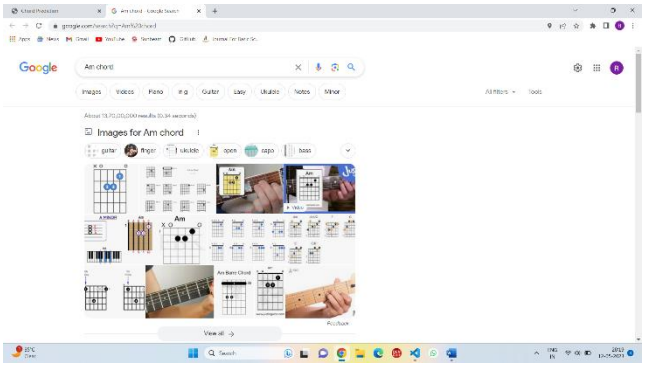
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IV. CONCLUSIONS

As an essential component in complex musical analysis systems, automatic chord recognition has gained more and more attention in the last few decades. In this paper, I propose a new automatic chord recognition method, formalize every stage in its pipeline, discuss some important implementation details, and show its effectiveness through experiments. The proposed method is based on a traditional scheme in, but enhances it with techniques including the Soft Thresholding denoising, the Improved Pitch Class Profile, and the circular shift and weighted sum based Template Matching.

Automatic music analysis is still a vast problem, but I have made breakthroughs in laying a rigorous and theoretically sound foundation off of which to build further analysis sub-systems. Future work should thus be focused on designing and evaluating these sub-systems. The next steps I plan to take in this project, for example, are in separating sinusoidal models of chords into individual notes, using a dual-module process based on learning to distinguish notes from chords with my learning mechanism, then implementing a search heuristic to find optimal separations.

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