Interactive Machine Learning for Incorporating User Emotions in Automatic Music Harmonization

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Abstract—Harmonization enriches piano melodies by adding variations such as mood, sound enhancements and beats that are the key building blocks of piano music. However, not all piano players and song writers are gifted with the musical talent of harmonizing piano melodies effectively since it requires keeping track of an extensive set of western music rules and concepts, years of training and practice and also musicality within them to harmonize a melody accurately.

This paper discusses a solution for the tedious task of harmonization by introducing 'ChordATune', an interactive tool for harmonizing melodies and generating chord progressions according to user emotions. Further, ChordATune provides a mechanism to arrange chords according to different genres, drum beats and tempi based on user preference. A machine learning approach with Hidden Markov Model (HMM), along with dynamic programming is used to generate the chord progression for a given melody and embed the emotional factor of the user. The melody is taken in as an audio file to the system, where a pitch class profile is created at run time representing the pitch content of the file over time. In order to embed the emotional factor, the Hidden Markov Model is dynamically created, and HMM properties are generated at run time according to the selected emotional factor and the input pitch classes (melody). Around 250 lead sheets were used to train the system using data driven and heuristic approaches, and the evaluation results represented 80% user satisfaction of the prototype. This research further opens a path for research concerning chord progression generation for vocals, taking into account the extraction of words, emotional factor and the tune extracted from the actual voice of the user.

I. INTRODUCTION

Harmonizing a melody by use of accurate chords according to the theories and practices of western music is an important aspect of piano playing right from the early stages of learning piano music. Therefore, finding the most suitable harmony is a crucial task [1]. However, most novice pianists find this to be a tedious task since harmonization needs comprehensive knowledge in music and years of experience in piano playing.

This paper focuses on a tool that can ease the task of harmonization for novice pianists by introducing a software tool 'ChordATune' that harmonizes a given melody according to the emotional factor and the genre of choice. Harmonization depends on the composer [2]; therefore, one of the main goals of this research is to involve the user's emotional factor when creating harmony. This allows the user to experiment with different styles and varieties of chord progressions when displaying the harmonized melody. This helps novice pianist to build their creativity in song writing and music creation.

The core development concept of this product is based on a machine learning approach combined with Hidden Markov Model (HMM) concepts. HMM is an Artificial Intelligence System and also a statistical probabilistic model in which the state of the process is described by a single discrete random variable [3]. ChordATune is modeled according to the Hidden Markov Model where the observations are taken as the melody (input audio file) and the adequate chord progressions are represented as the most probable states in the model.

II. RELATED WORK

There are a variety of prior work in the form of tools and algorithms related to automatic accompaniment. Lewis [4], Hild, Feulner and Menzel [5] use a neural network to harmonize chorales that divide harmonization into harmonic skeletons, chord skeletons and ornamentations. Further, Bellgard and Tsang [6] constructed a Boltzmann machine for harmonization that generates harmonies non-deterministically. Also, Hörnel and Degenhardt [7] generated harmonization for four part chorals in baroque style. There are several tools which can be used to harmonize melodies; "MySong", an accompaniment tool that provides piano accompaniment to a given vocal melody [8], "Tonica", a four part choral harmonizing tool that harmonizes a given melody by generating the other 3 parts of the choral bias to the composer Bach [9]. "Arranger Tool" and "Harmony Assistant" [10] both provide instrumental harmony to a given melody.

However, none of these tools and approaches can be utilized by novice pianists to assist their learning process. Further, these tools do not support creativity when generating harmony. Therefore, ChordATune focuses on piano music and facilitates the user to experiment with music; it also enables the option of generating chord progression according to the genre of music.