

Information Visualization Final Project Report

1 Overview



POPVIS is a Visualization of the POP909 dataset. The visualization gives a brief summary of the musical structures of Chinese pop songs that was published in different years between 1974 and 2021, including statistics of chord progressions, melody pieces, keys, etc., and can be a reference for music composers and lovers when they are creating new pop music.

The online version of the project can be found at <https://billyyi.top/online/popvis/>, and the source code can be found at <https://github.com/billyblu2000/popvis>.

2 Data

2.1 Description

The dataset contains 909 Chinese pop songs. This dataset is very complex, but it is generally a table dataset, with each rows represent a song. Each song has multiple attributes to describe the music structure, including song name, author, meter (high-level variable), key/tonic, mode, and phrases. The phrases contains many phrase, each phrase has multiple attributes to describe the music structure, including chord progressions (high-level variable), beats (high-level variable), and a phrase-splited MIDI file.

2.2 URLs

- Original: <https://github.com/music-x-lab/POP909-Dataset>
- Processed: https://billyyi.top/api/popvis_back_end/data

2.3 Process Pipeline

Similar to what it stated in the proposal, the process pipeline is as the following:

1. Retrieve the publish date of each song. This process is finished by a Python web-crawler, retrieved from the public QQ Music website.
2. Convert the high-level variable "chord progressions", "beats", "meter", and into a simple and understandable pattern. (Derive new from the old). The converted chord progressions is a list, each element represents a chord. e.g., '[I, vi, IV, V]'.
3. Derive two new variables "pitch range" and "melody piece" from the MIDI files. The "pitch range" is the distance of the highest pitch and the lowest pitch of a phrase and the melody piece is the pieces of melody lines in a phrase.

3 Goals and Tasks

3.1 Task Description: Usage Scenarios

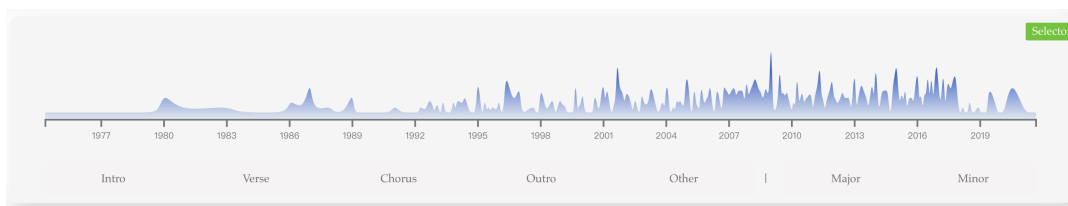
- Task 1: Prove whether the statement: 'Chinese pop songs are getting worse and worse nowadays, because the capital is making song a product and hence songs are homogenizing' is true or not.
- Task 2: To build a tool where music lovers and composers can get inspirations from the musical structures of previous Chinese pop songs.

3.2 Task Description: Visualization Language

To summarize the appearance times of different chord progressions, melody pieces, key-mode, meter, pitch-range, chord-duration, and encode them mainly using saturation and other supporting channels; To build a selector that can filter songs according to the published date, and filter phrases by phrase type and phrase mode.

4 Visualization

4.1 Selector



4.1.1 Year Selector

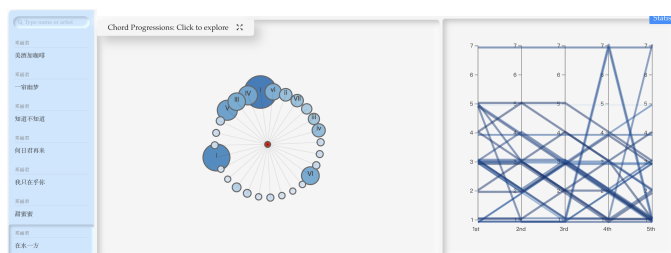
The year selector is a brushable area chart. The x-axis is the year and the month, and the y-axis is the amount of songs that published in this specific month. In this way, the users of the application will be able to select songs according to the publish time, and then to compare the statistics of different time interval.

4.1.2 Phrase Selector

The phrase selector can be divided into two selectors: the phrase type selector and the phrase mode selector. By default, if none is selected, all phrases will be displayed. After the songs was filtered by the year selector and the phrases was filter by the phrase selector, the remaining phrases will be displayed in the statistics.

4.2 Statistics

4.2.1 Song Selector & Highlighter



The song selector has 3 functions: the hover, the search, the click. For the hover, hovering on the song will trigger highlights of the corresponding songs in different views. For the search function, the user will be able to type name / artist to search for songs. For the click, the detailed information of the clicked song will be displayed in the song tooltip.

4.2.2 Chord Progression View

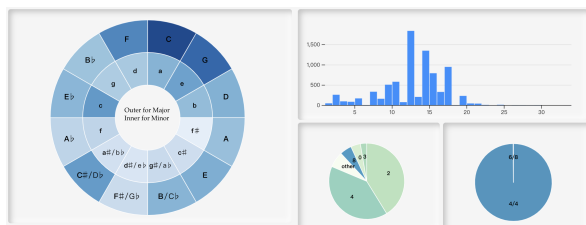
The chord progression view is a force directed tree, the progressions are represented by the hierarchy of tree, the saturation and the 2d size of a node is the popularity of the current progression. It has the following features: 1. when click the child node, all other siblings will be collapsed into the parent, and all the children of the current child will be shown. 2. when hover on the a node, a tooltip will be shown to show the number of the current chord progression.

4.2.3 Melody Pieces View

The melody pieces view is a parallel coordinates chart that shows the popular melody pieces in the selected phrases. Melodies are sliced with each piece contains five notes. The coordinates from the left to the right shows the pitch of the first note to the fifth note. The saturation shows the popularity of a specific melody piece. When hover on the a line, a tooltip will be shown to show the appearance time of the current melody piece.

4.2.4 Key-Mode View

The Key-Mode view is a pie chart that shows the amount of each kind of key and mode in the selected phrases. The inner circle is all the minor tonics, while the outer circle is all the major tonics. The saturation represents the amount of a specific key and mode. When hover a tooltip will be shown to show the appearance time of the current tonic-mode. It is designed as this form because it is similar to the 'Circle of fifths' in music theory.



4.2.5 Pitch Range View

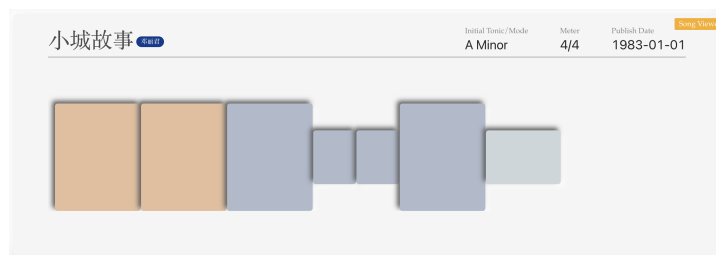
The pitch range view is a histogram that shows the number of each kind of pitch range in the selected phrases. The x-axis is the pitch range and the y-axis is the amount. Hovering

will show the tooltip of the phrase number of the corresponding pitch range.

4.2.6 Chord Duration View / Meter View

The chord duration view is a pie chart that shows the proportion of each kinds of chord duration in the selected phrases. The meter view is a pie chart that shows the proportion of each kinds of meters in the selected phrases. Hovering on both views will show the tooltip of phrase number or the song number of the corresponding value.

4.3 Song Tooltip View



The song card shows the detailed information of a song. To view it, users have to first click a song on the left side of the statistics card. The song information is represented by a flow of phrase cards. The phrase cards are ordered from left to right, its horizontal position represents the actual phrase location in the song. The type of the phrase is represented by color hue, with the mapping relationship: light-orange: intro; orange: verse; blue: chorus; light-blue: outro; gray: other. The width of the phrase card represents the length of the phrase, measured in bars. Two kinds of height exist. Card with larger height means the phrase have vocal, cards with smaller height don't have a vocal track. Users may also view the detailed information of a phrase by clicking the card. Clicking the chord progression in the card will play the chord progression.

4.4 Helper



User guide will be shown after clicking the card ribbon or the view title.

5 Reflection

5.1 Development

The project was developed as the following sequence:

- The data was processed, some new variables was derived, and the data server was built.

- The project was created using create-react-app, and the static structures including HTML and CSS was constructed, together with all the empty components classes and functions.
- The year selector was implemented first, followed by the phrase selector (phrase type and phrase mode). After the song selector was finished, the data (filtered by selectors) was linked to different views (statistics).
- The song tooltip was then implemented, linked with the song selector.
- The key-mode view was the first-finished statistics, then followed by the melody view, the two pie charts, then the pitch range view, and the chord view at last.
- Solve bugs, implement welcome notice and user guide.

5.2 Visualization Goals Changed

The visualization goals has changed a little. In the beginning, my focus was more about the music structure changes with the change of years. However, after I realized some visualizations, I found that many music structures changed little with the year. Although there are still changes, I don't think these changes are significant enough to become the major focus of this visualization. So in the later stage, I focused more on how to make music lovers better explore this dataset. At the same time, the visualization scheme of the Key-Mode view switch from the stacked bar chart to a kind of 'Stacked double layer pie chart'. This switch is because this kind of pie chart is similar to the 'Circle of Fifth' in music theory, and this will be familiar to music composers.

Another change is I failed in visualizing the meter attribute, as the users might notice that almost all the meters are '4/4'. So there's no significance for visualizing it. This is because the author of the POP909 dataset actually failed in analyzing the phrases of the songs that does not have a meter of '4/4'. The data of these songs are incomplete, so my only choice is to delete them. Therefore the remaining songs all has a meter of '4/4'.

5.3 Technical Goals Changed

The technical goals has not changed. In the whole project, the only technical problem was encountered when implementing the chord progression view (the Collapsible Force-Directed Tree). The idea is quite new and there are only few supports on the internet. So I have to implement many functions by myself, like "collapsing the parent node when a child is clicked, but the child that were clicked must not be collapsed". Although it takes a long time to implement this function, I still think it's worth it, and this is the best design that I can come up with.