Song Recommendation System on Mobility Based on Geotagged Tweets and User Preferences

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***Abstract*—In this paper, we propose a method for recommending songs that match the atmosphere of spots along the route and the user's preferences. The proposed method extracts the ambiance around the spot from Social Networking Service data, the artist's atmosphere from a set of songs, and the user's preferences from the play history. We evaluate the proposed method of artist extraction for a spot.**

I. Introduction

When playing a song while moving, the surrounding conditions and atmosphere, such as scenery and crowd size, play a significant role in song choice. Therefore, in this study, we propose a method for recommending songs that match the atmosphere of spots along the route and the user's preferences.

A recommendation system recommends songs that match the context, such as recommending songs based on the location information [1]. Shang et al. [2] focused on the emotional and affective connotations of a piece of music and study new issues in music retrieval. While most studies determine lyrics and audio separately, Rachman et al. [3]. integrate lyrics and audio to detect the emotion of a song. Murata et al. [4] proposed a music recommendation system based on time-series topic analysis of lyrics. Because the climax of a song frequently depicts story development, the system extracts story development as topic transitions and recommends songs based on their similarity. The similarity calculation is based on the Dynamic Time-Warping (DTW) method.

In this paper, we propose a method for detecting the atmosphere around a moving spot based on a spot vector generated by geotagged tweet data. To reduce the processing cost of calculating the similarity between the spot vector and tens of thousands of lyrics, an artist vector is generated from the lyrics obtained from the Uta-Net [5], and the similarity between the spot vector and the artist vector is calculated. Furthermore, the artist who is closest to the user's preferences and similarity in the spot is extracted by generating a user vector from the user's playback song and calculating the similarity between the user and the spot. Finally, the song with the highest similarity between the extracted artist's lyrics vector and the user vector is recommended as the moving song at the spot.

II. Song Recommendation System on the Move

Figure 1 shows the user interface for music recommendation. When the user enters a destination, the shortest route and the transit spots are displayed. When the user starts moving, songs are recommended and played to the intermediate points of the departure point, each transit spot, and the destination point, based on the information at the current (departure) point. Since the music recommendation is based on the information of tweets near the spot, the recommended music differs depending on the location and time of the year.

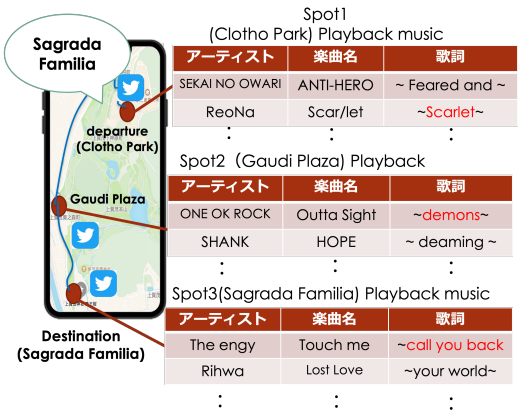

Fig. 1. Schematic diagram of the on-the-move song recommendation system.

TABLE I
User Playback History (Profile)

Artist Name	Title	Lyrics
Masumi	Apple Song	apple red
Mori Calliope	Off With Their Heads	I'm savege
Mori Calliope	Dance Past Midnight	Don't call me lazy

In Figure 1, when the destination is the Sagrada Familia, the starting point, Clotho Park, and Gaudi Plaza are extracted as spots on the shortest route, and multiple artists are extracted for each spot. For spot 1, they are "SEKAI NO OWARI" and "ReoNa", etc. In the case of a user whose music history is shown in Table I, an artist who is close to the multiple artists in the spots and the user's preferences is selected, and "Scar/let" is selected for Spot 1. In addition, a song by that artist is recommended, and the song is played until the intermediate point between the next spot and the next spot.

III. Song Recommendation Method

We propose a method of recommending songs that match the atmosphere of a spot and user preferences, using the

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information on the spot's location, song, and geotagged tweets.

A. Artist Recommendation for Spots

The proposed method generates three vectors: a user vector, a spot vector, and an artist vector calculates the similarity between the artist and user preferences for spots and determines the artist with the closest similarity.

First, to recommend the user's favorite artists, we obtain the user's playlist of songs, extract nouns and adjectives from the lyrics, and generate a feature vector for the user by word2vec. Next, for the spot vector, the latitude and longitude of the spot obtained from Open Street Map (OSM) are used to obtain tweets within a dm radius of the spot, and a feature vector is generated from nouns and adjectives in the content of the tweets using word2vec. The third, artist vector, integrates lyrics information for each artist and generates a feature vector of lyrics from nouns and adjectives using word2vec.

After generating the three vectors, the similarity between the spot features and the user features is calculated from the cos similarity between the user vector and the spot vector. For each spot, the similarity to the artist is calculated from the cos-similarity between the artist vector and the spot. Finally, the artist with the closest similarity to the user is determined.

B. Song Recommendation for Spots

From the previous section, artists suitable for the atmosphere of the spot and user preferences were determined. For music recommendation, the similarity between the feature vectors generated based on the user's playback history and each artist's music is calculated. A vector for each song is generated from the lyrics of each song by the artist, the cosine similarity is calculated, and the song is determined.

IV. Verification of Song Recommendation Method

Verify a song recommendation method based on the artists and spots recommended for a spot and the user's preferences.

A. Datasets and Evaluation Methods

A total of 8,203 spots were obtained using Overpass Turbo for the city of Kyoto. A total of 49 groups of artists and 535 lyrics were retrieved. The number of geotagged tweets was 277,030. In this experiment, we targeted spots with 30 or more tweets per spot, and a total of 4,926 spots (60%) in Kyoto City were selected for recommendation. The spots targeted in the experiment were Kinkakuji Temple and Ginkakuji Temple as temples and shrines, Kyoto Station and Kuramaguchi Station as public institutions, and Doshisha University (Imadegawa Campus) and Kyoto Sangyo University as universities.

To validate the proposed method, we evaluated the recommended artists against the atmosphere of the spots.

B. Artist Validation for Spots

To validate the recommended artists against the atmosphere of the spot, subjects read the chorus of songs by five groups of artists, ranked the artists in order of compatibility with the atmosphere of the spot, and evaluated them from Normalized Discounted Cumulative Gain (nDCG) based on the ranking results.

TABLE II
Results of artists' evaluations of spots

Spot Name	#Tweets	nDCG@5
Kinkakuji Temple	943	0.8672
Ginkakuji Temple	782	0.9545
Kyoto Station	18,889	0.9538
Kuramaguchi Station	990	0.9342
Doshisha University	1,564	0.8439
Kyoto Sangyo University	125	0.8906

The results of nDCG@5 for spots and artists are shown in Table II. The nDCG was between 0.84 and 0.9 for Kinkakuji Temple, Doshisha University, and Kyoto Sangyo University, while it was above 0.9 for Ginkakuji Temple, Kyoto Station, and Kuramaguchi Station. In the categories of temples and shrines, the Kyoto station, and universities, the accuracy was higher for stations containing a variety of commercial facilities than for universities with less age bias. The extraction of artists should also take into account the preferences of users such as the characteristics of spot visitors of the proposed method.

V. Conclusion

This research proposed a method for recommending songs based on the atmosphere around a spot and the user's song preferences while moving between spots. The proposed method recommends songs that are similar to the spot and the user's preferences by extracting the ambiance around the spot from Social Networking Service data, the artist's ambiance from a set of songs, and the user's preferences from the play history. Evaluation experiments showed that artist extraction for a spot was successful. In the future, we plan to improve the accuracy by recommending songs with the length of the song as a weight.

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