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MUSIC CLASSIFICATION BASED ON GENRE USING BACKPROPAGATION AND SOCIAL TAGGING IN WEB MUSIC DATABASE

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ABSTRACT

Many researchers have explored the *Music Information Retrieval (MIR)*. Music is one of the interesting scopes to research which is developing rapidly and become the most entertaining part. The taste of music is dependent by the taste of people. There are many genre types of music which is developing rapidly and that it is difficult to classify so that difficult for the listeners to determine what types of genre music they are listening to. The genre of music could be classified using artificial neural network such as *back propagation* and five musical features such as key, mode, loudness, energy and tempo were used as the basis for classifying groups of genre music. 420 music data obtained from the echonest.com and social tagging obtained from www.last.fm and us.7 digital com. The data were divided into 294 training data and 196 testing data. The test was done using the score of learning rate is 0.1, the score of minimum error is 0.01, with 50.000 maximum iteration, and the result of precision was 0.5556.

Keywords: Music Information Retrieval, Music Classification, Genre, Back Propagation, Social Tagging.

1. Introduction

Music is a collection of tones that are bound with features. Kind of features can produce different music from another one. Feature become important because the strains of beautiful music depending on the arrangement of these features. Regardless of how the arrangement of the features, music can be heard and appreciated depends on personal taste of each individual.

Growth of music can be seen as more types (genres) of music. Music genre is a classification of music according to the similarity between features. The development of music are marks the musical genre of music as one of the entertainment that can dig into the creativity and lifestyle. Examples of pop music genre that evolved into a genre of pop punk music, pop rock, and slow pop.

Many genres make music classification is uncertain. For example, The International Society for Music Information Retrieval (ISMIR) in 2004, classify the genre into 6 is classical, electronic, jazz / blues, metal / punk rock / pop, and world (Panagakis, Benetos, & Constantine, 2008). The Music Information Retrieval Evaluation eXchange (MIREX) in 2007 has a different classification of the 10 genres include blues, jazz, country / western, baroque, classical, romantic, electronica, hip-hop, rock, and hardrock / metal.

Based on the studied, music are classified into 5 genres of music genre is country, folk, grunge, hip-hop, and metal (Mayer, Neumayer, & Rauber, 2008). One of the web www.allmusic.com are classify 15 music genre into blues, classical / opera, comedy, country, electronica, folk, gospel, jazz, latin, pop / rock, R & B, rap, reggae, vocals, and the world.

On the web music like www.last.fm and www.7digital.com which has a large-scale music database, does not list any certainty genre of each singer and song, but only displays the genre on the link text entered by visitors to the web (social tagging). The highest social tagging of web visitors will be the main genre of the singer.

The implementation in this research using five features: key, mode, loudness, energy, and the tempo, to classify music into seven groups of the genre that are acoustic / reggae / soul, jazz / blues, classical, country, electronic / R & B / hip hop, emo / metal, and pop / rock.

2. Material and Method

Music features were used as the basis for the classification of music is key, mode, loudness, energy, and tempo. Key identifying the notes / tone, chord, major / minor, which is represent a focal point on the tone of a passage. Mode is used to determine the type of major or minor of a key. Loudness is the overall loudness of the music, while the tempo is the speed on the average duration of a song that is expressed in beats per minute (BPM).

This research use a dataset value of extracted feature which is product from Echonest and names derived from www.last.fm and us.7digital.com. Data taken by Echonest track from 7digital.com API query song using the method with an XML format like the following example:

http://developer.echonest.com/api/v4/song/search?api_key=96GANOIWHEX5ZI6LL&format=xml&results=1&artist=katy%perry&title=fireworks&bucket=id:7digital-US&bucket=audio_summary&bucket=tracks

From this URL will be given the results of feature extraction from Katy Perry's song, entitled Fireworks as in figure 1.1.

```
▼<response>
  ▼<status>
     <version>4.2</version>
     <code>0</code>
     <message>Success</message>
   </status>
  ▼<songs>
    ▼<song>
       <title>Fireworks</title>
       <artist_name>Made famous by Katy Perry</artist_name>
       <id>SOJMSLP13167713BF4</id>
       <artist_id>ARADBRT12D5CD7438F</artist_id>
       <audio_md5>ff0c19ddcfbd14df3f37173a1dac9280</audio_md5>
      ▼<audio_summary>
         <key>7</key>
         <mode>1</mode>
         <time_signature>4</time_signature>
         <duration>229.45914</duration>
         <loudness>-7.101</loudness>
         <energy>0.566096593171</energy>
         <tempo>124.002</tempo>
         <audio_md5>ff0c19ddcfbd14df3f37173a1dac9280</audio_md5>
         <analysis_url/>
         <danceability>0.632286921719</danceability>
       </audio_summary>
     </song>
   </songs>
 </response>
```


Figure 1. Result of Extraction Feature

The results of feature extraction are used as the basis for music classification using back propagation neural network which is a systematic method for training multilayer neural networks. In back propagation, each unit of input layer is have a connection with each unit of hidden layer, and each unit of hidden layer is have a connection with each unit of output layer. The architecture of network is show at figure 2.

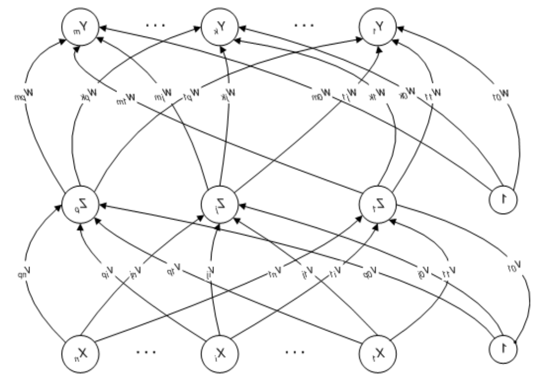

Figure 2. Architecture of Back Propagation Network

Training algorithm of back propagation includes 3 phases (Siang, 2005). The first phase is the forward propagation of the input pattern that's calculated forward from the input layer to the output screen using the specified activation function. The second phase is the backward propagation. Difference between actual output with a target output is the error value were back propagation. The third phase is the modification of weights to reduce errors that occur.

Back propagation algorithm show as below:

0. Initialize weights with small random numbers.
1. If the condition is not achieved, perform steps 2-9.
2. For each pair of training data, perform steps 3-8.
3. Each unit of input (xi, i = 1, 2, ..., n) receives the signal xi and forward this signal to all hidden layer units.
4. Calculate all the unit of output layer in z_j (j = 1, .., p).

$$z\_net_j = v_{j0} + \sum_{i=1}^{n} x_i v_{ji}$$

$$z_j = f\left(z_{net\,j}\right) = \frac{1}{1 + e^{-z_{net\,j}}}$$

5. Calculate all the unit of hidden layer in y_k (j = 1, .., p).

$$y\_net_k = w_{k0} + \sum_{j=1}^{p} z_j w_{kj}$$

$$y_k = f\left(y_{net\,k}\right) = \frac{1}{1 + e^{-y\_net_k}}$$

6. Calculate the factor of δ hidden units of output per unit based on the error in the output y_k (k = 1, 2, ..., m).

$$\delta_k = (t_k - y_k)\, y_k(1 - y_k)$$

Calculate the correction weights (used to update w_{jk}) at a rate of acceleration α.

$$\Delta w_{kj} = \alpha \, \delta_k \, z_j$$

7. Calculate the factor δ hidden units based on the error at each hidden unit z_j (j = 1, 2, ..., p).

$$\delta_j = \delta_{net\,j} \, z_j (1 - z_j)$$

Calculate the change of weight v_{ji} (which will be used to change the weights v_{ji}).

$$\Delta v_{ji} = \alpha \, \delta_j x_i$$

8. Calculate the weight of all the changes.

Change the line weight to the output unit:

$$w_{kj}(new) = w_{kj}(old) + \Delta w_{kj}$$

Change the line weights to hidden units:

$$v_{ji}(new) = v_{ji}(old) + \Delta v_{ji}$$

9. Test conditions to stop algorithm using RMSE or maximum iteration. RMSE values can be calculated by counting the total sum square error values (Kiki & Kusumadewi, 2008).

$$SSE = \sum_{k=1}^{n} (t_k - y_k)^2$$

$$RMSE = \sqrt{\frac{SSE}{n.k}}$$

t_k = target value of k
y_k = output value of k
n = amount of training data
k = amount of output group

When the training phases are completed, then the next step is to conduct tests on the music, or in other words is the classification of music. The testing phase only taken steps 3 to 5 of the back propagation training algorithm.

Result and Discussion

In the present study used 70% of the data track as training and 30% of the data track as a test of the overall data are 420 songs in 10 studies to determine the learning rate and weight initialization used in the testing of the data track. The results are listed in Table 1.

In this research is used learning rate of 0.1 to 0.5 and the maximum number of iteration are 50000 iterations, obtained 10 values of accuracy with RMSE values are different. There are two types of weights initialization used to determine the initial weight which should be used in the testing data.

RMSE and maximum number of iterations is used as a condition to stop condition of the training data. If the value of RMSE is reached or less than the minimum error of 0.01 then the iteration stops. However, if the minimum error value is not reached then the iteration is continued until the specified maximum iteration is 50000.

Table 1. Result of Research

Type of Weights	*Learning Rate*	Iterations	RSME	Accuracy (%)
1	0.1	50000	0.0950908	55.5556
1	0.2	50000	0.0753621	51.5873
1	0.3	50000	0.0675693	44.4444

1	0.4	50000	0.0520101	42.0635
1	0.5	50000	0.0551565	41.2698
2	0.1	50000	0.0950934	55.5556
2	0.2	50000	0.0717961	54.7619
2	0.3	50000	0.0579878	44.4444
2	0.4	50000	0.0520101	42.0635
2	0.5	50000	0.0284462	36.5079

Based on the value in results table obtained the highest accuracy of 10 research was 55.556% with learning rate value is 0.1 and the first type of weight. Table 1 shows that the iteration continues until iteration 50000, this is because the minimum error value of 0.01 is not fulfilled.

Music classification (testing data) using 30% of the 420 data tracks there are 126 tracks. By using the back propagation algorithm testing data obtained 70 songs that have a genre that according to the social tagging of last.fm and the 7digital.com site with an accuracy of 55.556%.

Determination of learning rate, the maximum number of iterations, and the number of nodes in the hidden layer can cause an increase or decrease the value of accuracy. The example of music classification and the result of genre will shown in figure 3 and figure 4.

Evaluation of classification results calculated using the formula of precision (Kadyanan, 2011).

$$Precision = \frac{|obtain\ set\ \cap relevan\ set|}{|obtain\ set|}$$

$$Precision = \frac{|126\ \cap 70|}{|126|} = 0{,}5556$$

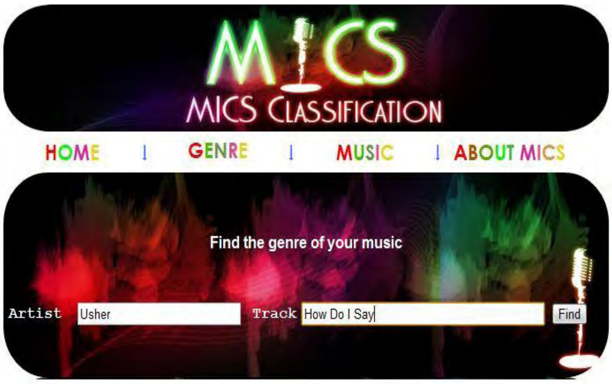

Figure 4. Page Music Classification

Figure 5. Result of Music Classification

Conclusion

1. Back propagation algorithm and social tagging can used to classification music based on genre. Classification music based on five feature music (key, mode, loudness, tempo, energy) and seven groups of genre (acoustic/soul/reggae, electronic/R&B/hip hop, classical, country, emo/metal, pop/rock, and jazz/blues) as dataset in this research.
2. Based on alpha cronbach, precision value of music classification by MICS Classification system is a good value that is 0.5556.
3. Optimal value of learning rate is 0.1 which is used first type of weight initialization is the value that used on testing data on 126 data tracks.

Acknowledgement and References

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