Automated generation of song lyrics using CFGs

Conference Paper · August 2014

DOI: 10.1109/IC3.2014.6897243

3 authors, including:

Sameerchand Pudaruth
University of Mauritius
82 PUBLICATIONS **955** CITATIONS

SEE PROFILE

Automated Generation of Song Lyrics using CFGs

Sameerchand Pudaruth, Sandiana Amourdon and Joey Anseline
Department of Computer Science and Engineering
University of Mauritius
Réduit, Mauritius

Abstract— **This paper gives an overview of how challenging song writing is and gives an insight on how we developed a semi-automatic lyric generator for English songs. Writing lyrics has always been a challenging task as it involves not only creativity but also inspiration. Prior to implementation of the lyrics generator, much analysis were carried out so as to get in-depth information about the requirements of good lyrics. Research has been done in various fields such as artificial intelligence and natural language processing to be able to master the various techniques for text processing and to be able to use them in our own way. And finally, we carried out our evaluation by making a survey about the generated and existing lyrics and it proved to be very satisfactory. Many people rated the generated lyrics as being an existing lyric.**

Keywords—lyrics generation; English songs; music; artificial intelligence; natural language processing;

I. INTRODUCTION

One of the oldest, if not the oldest art that ever existed – Music - has been there since the very dawn of the human kind. Starting with the caveman's music which consisted mainly of grunts and sound of banged objects to the Renaissance, Baroque, classical and finally to the pop culture in the 21st century [1]. Music has existed in almost every known culture around the world [1]. It has grown with us over time by becoming a universal language that everyone understand irrespective of our race, religion, nationality, age, gender, language or skin colour. For this very reason, music has been and is still being used for numerous purposes. The basic aim of music is to provide relaxation. Listening to music can be quite uplifting. It is incredible how it can just hijack your mind and you soon find yourself so engrossed in it that your sorrows and stress just vanish in thin air. Another important purpose of music is communication. As Ludwig Van Beethoven simply puts it "music can change the world" [2]. The Russian composer, Sergei Rachmaninoff, also once rightly said, "Music is enough for a lifetime, but a lifetime is not enough for music" [16].

With a means as powerful as music, many musicians have aspired to change the world for the better by raising awareness about a number of issues. From the famous Elvis Presley to the King of Pop, Michael Jackson, all artists have thrives to produce good music with great lyrics. Today, with people becoming more technologically aware and with the internet bridging the gap between people from different parts of the world, our world is becoming more of a global village.

Cultures and music are no longer restricted to a particular group of the population. Music has become such an integral part of our lives and daily routines that it is difficult to say whether music affects society or is it vice versa [2]. Modernization and westernization of the world resulted in more and more people, especially teenagers being drawn towards the Western American songs. Today with the flourishing entertainment industry, music creation and song writing has become a career path for many. Presently, the music industry is becoming so demanding that singers will have to record many more songs and together with singing comes song writing.

Writing good lyrics has always been a challenge even to the best of songwriters. This is why we have introduced a semi-automatic lyrics generator (songwriting software) that has the potential to become a very effective tool for song writers and musicians.

The rest of the paper that follows consists of five sections. Section II consists of a critical assessment of previous works in the natural language processing field. In section III, we made an overview of the different analysis which were done prior to implementation. In section IV, we discussed about how the application was implemented. Section V describes how the lyrics generator was evaluated.. Finally, section VI concludes the paper.

II. LITERATURE REVIEW

A. Generating lyrics using rhythm

Tra-la-la-lyrics is a system which is meant for the generation of lyrics according to a particular gpre-enerated melody. Oliveira, Cardoso and Pereira studied the relationship between words, musical beat of melodies and rhymes [3]. They implemented different algorithms which performed the division of syllabs and is able to identify the 'syllabic stress' on a particular word. They also set up a database which was meant to store words and grammatical type. Unfortunately, their result was of not so good quality.

B. Generationof rap lyrics

A Rap Lyrics Generator was developed by Nguyen and Sa [4]. The program consisted of a database of about 40,000 existing rap lyrics. A new lyrics is then generated from the words and verses found in the existing lyrics. A linear-interpolated trigram model approach was used to make the lyrics. However, the result was rated as lacking flow. Therefore, they shift to a quadgram model. They also

978-1-4799-5173-4/14/$31.00 ©2014 IEEE

implemented a database containing rhyming words from two different sentences. In this way, they generated sentences that rhyme with each other. Lastly, all the sentences were pieced together according to the song structure and layout. The generator worked fine but the content of the lyrics were not meaningful and did not relate to a specific theme.

C. Automated generation of poems

WASP (Wishful Automatic Spanish Poet) was the first poem generating program which combined natural language generation techniques with artificial intelligence [5]. It is a system that obtains inputs from users and these were used as seeds. The system is based on a forward reasoning ruled-based system. The results obtained were evaluated as being poor and not very efficient.

D. Semantic similarity in song lyrics

Logan, Kositsky and Moreno experimented on the use of lyrics to automatically identify and classify music and to determine artist similarity [6]. Song lyrics were collected from various sources on the web. Various techniques such as the PLSA (Probabilistic Latent Semantic Analysis) and the k-means clustering methods were used to analyse the content and semantics of the lyrics. Evaluation was carried out by matching the system together with another audio system to check their similarity. Both techniques used had their pros and cons. Hence, a combination of the two techniques could prove to be much better but this was left as future works.

E. Titular and LyriCloud

Tilular and LyriCloud are two software tools that were developed with the aim of creating intelligent and interactive lyrics writing tools for songwriters and musicians [7]. Titular is a system meant for the semi-automatic generation of song titles while LyriCloud suggests a cloud of related words based on input seeds. A database of existing song titles is kept for extracting required information. A template-based technique was used. Vulgar and offensive expressions were filtered out and words, which occur more frequently in the database, are the ones which are more likely to make it to the final generated song title. They obtained satisfactory results but sometimes the titles had no semantic meaning and did not made much sense to a reader.

F. Natural language processing and lyrics generation

Mahedero, Martinez and Cano used basic natural language processing tools to analyse song lyrics [8]. Experiments were carried out on the lyrics to identify the languages, to classify them according to different themes, to extract the structure and to look for similarity between them. A sample of 500 lyrics was selected from several websites. The languages used were Italian, Spanish, German, French and English. The results obtained were 92% accurate. A Naive Bayes classifier was used. The Inverse Document Frequency (IDF) and Cosine distance was used to measure similarity. The identification of languages proved to be an easier task compared to the others.

G. Classification of lyrics based on rhyme and style

Rudolf Mayer *et al*. [9] experimented on rhyme and style features to classify and process lyrics. They used a group of words together with parts-of-speech tagging and other statistical features for processing lyrics. A rhyme is actually two words that when spelt sounds similar. This feature is generally used for words at the end verses. A proper evaluation of the proposed method was not done.

H. Automatic generation of sega lyrics

Bhaukaurally, Didorally and Pudaruth worked on providing a tool for lyricists to generate sega lyrics in the Mauritian Creole Language [10]. Sixty-three persons were asked to classify 10 songs into either a human-written song or a machine-generated song. Out of these 10 songs, five were auto-generated ones. Apparently, the generated lyrics were of quite high quality as about 50% of the respondents really confused as to whether the lyrics were existing ones or generated by a computer program. The major weakness of this work is the lack of information in the implementation part as to how the sentences were actually created or generated.

III. Analysis done prior to Implementation

Lyrics generation is not an easy task at all as it involves not only a sound knowledge of natural language processing techniques but also an in-depth knowledge of songwriting techniques. Hence prior to implementation, we carried out various analyses on a corpus of 300 English song lyrics. Each theme (love, pain and cause) contained 100 songs. Initially, we studied the structure of these song lyrics such as their layout and the different components that make up a lyrics such as chorus, verses, hooks and bridges.

It was found that the real key to songwriting is not only gathering written ideas or capturing inspiration but most importantly it has to do with the assembly. It is vital to know what-goes-where in a song. Secondly, we implemented small programs to perform some statistical analysis on these lyrics. The results of the analysis are shown below in Table I.

A. Text analysis

TABLE I. Statistical analysis of 300 lyrics

Features	**Love**	**Pain**	**Cause**
Maximum number of words in one song	660	789	687
Minimum number of words in one song	66	57	59
Average number of words in each set of 100 songs	212	258	270
Average number of sentences	32	37	41
Maximum sentence length	10	11	11
Minimum sentence length	1	1	1
Average sentence length	5	6	6

As shown in Table I, this analysis was carried out to investigate how many words and sentences a lyrics can have. The minimum and maximum sentence lengths were calculated to estimate the range of sentence lengths for each theme.

B. Grammar analysis

TABLE II. GRAMMATICAL ANALYSIS FOR 300 LYRICS

Features	Tag	Love	Pain	Cause
Coordination conjunctions	CC	314	401	420
Cardinal number s	CD	114	106	127
Determiners	DT	1243	1858	2205
Existentials	EX	47	20	52
Foreign words	FW	12	8	10
Prepositions	IN	1559	1813	1959
Adjectives	JJ	949	1095	1233
Nouns	NN	4616	5346	6381
Adverbs	RB	1355	1402	1299
To	TO	614	597	653
Interjections	UH	63	21	51
Verbs	VB	4927	5209	4978
Pronouns	WP	98	108	99

As shown in Table II, a quantitative analysis was carried out to determine the frequency of each type of word used. Each type of word was classified with respect to its parts-of-speech (PoS) tag.

IV. IMPLEMENTATION

This system has been implemented using Java and MySQL on the eclipse platform. The data stored in the database are: 100 songs on each of the three themes, the PoS tag of each word, word bi-grams, word tri-grams, PoS bi-grams, PoS tr-grams and the n-sentence grammar. An n-sentence grammar is a concatenation of sequential PoS tags obtained from each verse in the corpus. The Stanford tagger was used for this purpose [15]. For example, the sentence 'Kevin loves Sarah' would be stored as NN_VB_NN in the database.

Our lyrics generator is an application designed with comfort and easy maneuvering in mind. The interface is attractive looking and provides a user with a user friendly environment to work with. The tool requires the following input: (a) the user must starting by selecting a theme from either love, pain or cause, (b) next, the user must input optional details such as the song's title, the author and the potential singers, (c) a catchy verse which will be used several times in the lyrics need to be entered as well, (d) some optional seed words may may also be input in order to give more focus to the song and (e) finally, the user needs to create the structure of the lyrics with respect to chorus and verse. An example of a structure is verse-chorus-verse.

Unlike other semi-automatic song lyrics generators, our system does not make use of predefined template of words that just add the user inputs into pre-defined places. Instead, the sentences in the lyrics are constructed based on the n-sentence grammar. A random combination of word bi-grams and tri-grams are used to form a verse of a certain length. The verse length was randomly generated using information provided in Table II. Bi-grams and tri-grams of PoS tags were not used in the final algorithm as they produced poorer results. Thus, in our lyrics, we would have more verses of length 5, 6 and 7 but fewer verses of length 1-4 and 8-13.

TABLE III. ANALYSIS OF SENTENCE LENGTHS

Sentence length	Number of sentences	Probability
1	64	0.0219
2	89	0.0305
3	191	0.0654
4	262	0.0897
5	495	0.1695
6	484	0.1657
7	407	0.1393
8	338	0.1157
9	249	0.0852
10	142	0.0486
11	87	0.0298
12	58	0.0199
13	55	0.0188
Total	**2921**	**1.0000**

Once the lyrics is displayed, the user can save, regenerate a lyrics based on same previous inputs or generate a lyrics from new inputs. The number of verses is also constrained.

V. EVALUATION

Fifty people carried out the evaluation. They were mostly students from the University of Mauritius who were selected with reasonable care was taken to make sure that we are selecting students from all communities. Most of them were aged between 18 and 25 years old. They were asked to fill an evaluation form in which they had to guess if a lyrics is either an existing or a generated one from a list of 10 English lyrics. The titles of the songs were removed because this is how most people remember songs.

A. Evaluation of existing and generated lyrics

TABLE IV. DETAILED ANALYSIS OF EXISTING AND GENERATED LYRICS

Title	Existing or generated	Guessed as existing	Guessed as generated
About today [11]	Existing	58 %	42 %
Behind me lies [12] another fallen soldier	Existing	64 %	36 %
Heart to sharing	Generated	30 %	70 %
Friends of spirits	Generated	28 %	72 %
Forbidden love	Generated	52 %	48 %
Falling slowly [13]	Existing	80 %	20 %
Walk to candlelight	Generated	38 %	62 %
Feelings of grief [14]	Existing	76 %	24 %
Save me	Generated	32 %	68 %
Frustrating [12]	Existing	54 %	46 %
Average:	Existing	66%	34%
	Generated	36%	64%

Given the small number of respondents and the complexity of the Mauritian society, it is very difficult to draw sweeping conclusions about these results. Only two-thirds of respondents were able to pick out the written songs although most of these songs are quite popular. This would tend to suggest that there was some guessing done in this exercise. 36% of respondents got refused when selecting the generated songs. This relatively high value means that some of our generated lyrics were of human-written quality. The generated song, which caused the greatest confusion, was "*Forbidden love*". A majority of 52% of respondents thought that this lyrics was from a human songwriter.

B. Limitations of the lyrics generator

The main limitation of the current system is that the generated lyrics are often not very meaningful semantically although grammatically they were correct. This problem is partly mainly due to the natural ambiguities that are present in natural languages and which cannot be totally eliminated. For example, a word which is classified as a adjective in a particular sentence can be classified as an adverb in another sentence. The English language is so vast that it is quite impossible to define all the grammatical rules that a sentence is bound to follow. This problem can partly be addressed through word sense disambiguation.

VI. CONCLUSION

Indeed music is among the few arts that were passed from one generation to another one, through the centuries the world has existed. It is no doubt that the place of music in the world today is as important as ever. With the booming of the entertainment industry such as Bollywood, Hollywood and Tollywood, opportunities of careers in the field of music and songwriting has become a reality for many. Almost every industry of the world today is using some kind software to perform certain tasks. Therefore, the aim of this research work was to introduce a creative tool that may help songwriters in their task. Our system is a stepping stone to generate lyrics according to certain grammatical rules based on parts-of-speech and statistical constraints derived from a song corpus. In our future works, we intend to experiment with rhythmic verses, quad grams and a much larger corpus.

REFERENCES

[1] *History of music* [online]. Available from: http://en.wikipedia.org/wiki/History_of_music [Accessed: 18th April 2014].

[2] *How music affects society* [online]. Available from: http://www.syncrat.com/5jy [Accessed: 14th April 2014].

[3] Oliveira H. R. G., Cardoso F. A. and Pereira F. C. (2007). Tra-la-la-lyrics: an approach to generate text based on rhythm. In: *Proceedings of the 4th International Joint Workshop on Computational Creativity, pp. 47-54, September 2007 London,*

[4] Nguyen H. and Sa B., (2009). Rap Lyrics Generator. Unpublished.

[5] Manurung H., Ritchie G. and Thompson H. (2000). Towards a Computational Model of Poetry Generation. In: *Proceedings of AISB Symposium on Creative and Cultural Aspects and Applications of AI and Cognitive Science*, *pp. 79-86, April 2000, Birmingham.*

[6] Logan B., Kositsky A. and Moreno P. (2004). Semantic Analysis of Song Lyrics. In: *Proceedings of the IEEE International Conference on Multimedia and Expo, pp. 817-830, 30 June 2004, Taipei City, China.*

[7] Settles B. (2010). Computational Creativity Tools for Songwriters. In: *Proceedings of the NAACL HLT 2010 Second Workshop on Computational Approaches to Linguistic Creativity, pp. 49-57, June 2010, Los Angeles, California*.

[8] Mahedero J. P. G., Martınez A. and Cano P. (2005). Natural Language Processing of Lyrics. In: *Proceedings of the 13th ACM International Conference on Multimedia, pp. 475-478,6-11 November, 2005*, Singapore. 475-478.

[9] Mayer R., Neumayer R. and Rauber A. (2008). Rhyme and Style Features for Musical Genre Classification by Song Lyrics. In: *ISMIR 2008, 9th International Conference on Music Information Retrieval, 14-18 September, 2008, Drexel University, Philadelphia, PA, USA*.

[10] Bhaukaurally B. F., Didorally M. H. A. and Pudaruth S. (2013). A Semi-Automated Lyrics Generation Tool for Mauritian Sega. *IAES International Journal of Artificial Intelligence (IJ-AI), Vol. 1. No. 4, 2012*.

[11] Azlyrics, 2014. About Today [online]. Available from: http://www.azlyrics.com/lyrics/national/abouttoday.html [Accessed: 27th March 2014].

[12] Songlyrics.com, 2014. As I Lay Dying [online]. Available from: http://www.songlyrics.com/as-i-lay-dying/behind-me-lies-another-fallen-soldier-lyrics/ [Accessed: 27th March 2014].

[13] Metrolyrics, 2014. Falling slowly [online]. Available from: http://www.metrolyrics.com/falling-slowly-lyrics-glen-hansard.html [Accessed: 27th March 2014].

[14] Azlyrics, 2014. Feelings of grief [online]. Available from: http://www.azlyrics.com/lyrics/paulkelly/feelingsofgrief.html [Accessed: 27th March 2014].

[15] SNLP, 2014. Stanford Tagger [online]. Available from: http://nlp.stanford.edu/software/tagger.shtml [Accessed: 27th March 2014].

[16] 52composer.com, 2014. Profiles of Great Classical Composers [online]. Available from: http://52composers.com/Rachmaninoff [Accessed: 10th July 2014].

Appendix A

Lyrics of '*Forbidden Love*'

Youth is lost
We whisper and must step
That took not thee but
Baby, we have taste
Reason become mama beside
Escalade to climb to unnoticed times
Guys that all deny just hide and kiss
Missing across silence later brushes
ohohohohoh later makes elegance to another
Express nowhere apart may cause sorrow
Credit though emeralds
Wanted every say
In mellow business
Till called alright beside
Pure girls clothes shining
Fill us with swear somehow
Simple thrill comes
Unless ablaze touch
It is upon drown but dress over melt
Get men this under however whenever
Brain what fooled mama
She ends to bling