Searching for Music with Emotions

By Andrea Hrčková, *research assistant, Slovak University of Technology in Bratislava*
and Milan Macko, *musician, Grizzly*

Music has a strong influence on our brain and wellbeing. According to composer and researcher Barry Goldstein, listening to music evokes emotions and memories, creates new neural connections, and enhances focus [3]. A meta study of Alfredo Raglio, et al., in the *World Journal of Psychiatry* reports that music is efficient in treating depressive syndromes and increasing quality of life of neurological patients with depression, Parkinson's disease, dementia, stroke, or sclerosis [10]. Additionally, a 2015 review by Jenny Hole, et al. in *The Lancet* found that people who listened to music in hospitals experienced less anxiety and pain, compared to patients who did not listen to music at all. [4]

Music has also become a complement to ordinary human lives. The selection of songs is strongly influenced by our current mood, which serves as the first stimulus and results in a certain selection of music. Thus, to be able to find the bands according to the listener´s needs and moods, we need new possibilities for relevant music identification.

Cataloging music according to its metadata and content (author, artist, title, publisher, notes, etc.) is a long-term practice of cultural institutions. The automatic detection of genre according to music tempo, rhythm, melody, harmony, tone, and other aspects is today a given and is part of the algorithms of the commercial information systems for music information retrieval (MIR), such as Spotify and YouTube Music. These tools are also able to recommend similar music to users with similar taste. For searching according to a situation (relaxing, studying, working, even cleaning), the manually created user playlists embedded in these tools might be helpful. However, it is much more complicated to identify and classify music according to someone´s physical or mental state, for it to be useful for retrieval by other users.

COMPLICATED HUMAN EMOTIONS

Why is it so problematic? Besides the multidisciplinary nature of MIR, many contextual influences affect our perception of music. First, it is the individual preferences of music genres and associations with individual memories, not to mention the cultural background of the listener. Second, human emotion is a variable that is subjective and hard to classify. There is little consensus regarding its definition. Note particularly that emotions are not the same as feelings.

According to a 2001 study by Robert Plutchik in *American Scientist*, emotion is a complex chain of freely connected events that begins with a stimulus and includes feelings, psychological changes, impulses to action, and specific, goal-directed behavior. Feelings never happen in isolation, but are responses to significant situations in human´s life. [9] Plutchik discerned approximately 34,000 different emotions during a human life. He classifies them as eight basic emotions that humans as well as mammals have in common—anger, anticipation, joy, trust, fear, surprise, sadness, and disgust. His popular visualization as an emotion wheel serves to identify, understand, and verbalize the complicated state of human emotions, but it is hardly applicable to MIR.

There are some attempts to create a classification of mood for the needs of MIR. At the MIREX conference in 2007 (The Annual Music Information Retrieval Evaluation eXchange), 600 songs were divided into five mood clusters. For this classification, their metadata and human assessments were harnessed and analyzed. The five new groups contained partial moods grouped by to their similarities. [5] Nevertheless, the lack of agreement among scientists and semantic overlaps between the moods in the groups were two of the reasons why this classification is not widely embraced by other researchers.

Cluster1	Cluster2	Cluster3	Cluster4	Cluster5
Rowdy	Amiable/	Literate	Witty	Volatile
Rousing	Good natured	Wistful	Humorous	Fiery
Confident	Sweet	Bittersweet	Whimsical	Visceral
Boisterous	Fun	Autumnal	Wry	Aggressive
Passionate	Rollicking	Brooding	Campy	Tense/anxious
	Cheerful	Poignant	Quirky	Intense
			Silly	

Fig. 1 Five clusters of moods defined by MIREX. Source: Hu, X. and Downie, J. S., 2007

From the various classifications of emotions in music, Robert E. Thayer´s model [13] is more often employed in the context of MIR. It includes various levels and combinations of four emotions ranging in terms of energy and happiness (stress). An example of such publicly available tool benefiting from this categorization is Moodfuse (moodfuse.com), a free online tool that lets its users select from a range of categories to find music according to their preference.

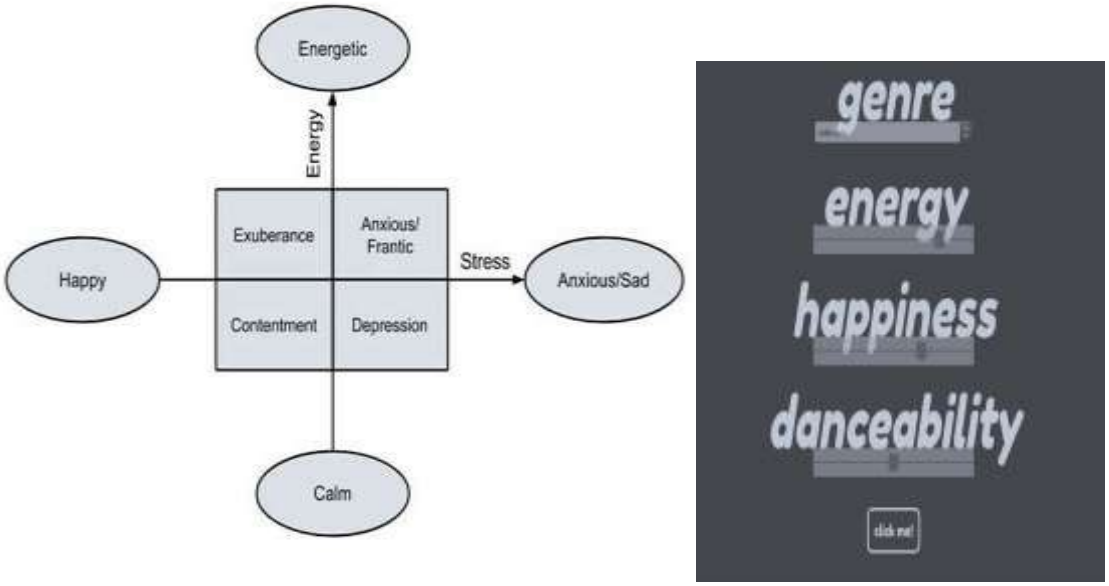

Fig. 2 A Multidimensional Arousal Model and its application in Moodfuse. Source of the model: Thayer, 1980

Aathreya S. Bhat, et al., at the BNM Institute of Technology in Bangalore, created a correlation table of intensity, color, height, and rhythm with different moods in music. They exploited all

eight Thayer mood classifications with a relative degree of different musical components that range from very low to very high. Higher energy moods, such as happy, lush and energetic, generally have a higher intensity, color, tone, and rhythm than lower moods such as peace, contentment, and depression. Automating the categorization of emotions in music is also possible to some extent, for example, by using a variety of digital signal processing methods to identify music components. These researchers also claim that sources of sound that have simple harmonic profiles tend to calm human emotions [1].

Another approach, called the circumplex model of affect, proposed by James A. Russell in 1980 study in *Journal of Personality and Social Psychology*, claims that all emotional states arise from two fundamental neurophysiological systems. One system is related to valence (a pleasure–displeasure continuum) and the other to arousal, or alertness. Each emotion can be understood as a combination of these two dimensions, or as varying degrees of both valence and arousal [12]. This model is applied particularly for the needs of psychopatology, but is widely employed by computer scientists for the sentiment analysis in MIR as well.

Fig. 3 A circumplex model of affect. Source: Russell J.A., 1980

EMOTIONS IN MUSIC VERSUS EMOTIONS FROM MUSIC

Even when the right classification of emotions is found and applied in MIR research, we need to differentiate between inducted emotions in music and perceived emotions from music. These might not correlate. A song that was not meant to be shocking might shock some listeners, and music that expresses happiness does not always awaken the same feeling in different listeners. Listeners identify more with the perceived emotions from music, and the emotional reactions to music are often a result of idiosyncratic associations that have nothing to do with what the music itself was supposed to express. Nevertheless, for the sake of MIR, Jenefer Robinson and Robert S. Hatten suggest a focus on aesthetical parts of music. After all, listeners are often able to recognize or hear that the passage of the song expresses sadness, despite the fact that they do not feel the same emotion [11].

Everyone treats their emotions differently. However, some patterns can be identified. According to the research of Tuomas Eerola and Henna-Rikke Peltola, the majority of listeners who feel sad, prefer listening to sad music, not to happy music. This 2016 study in *PLoS One* shows that listening to a familiar sad piece of music, if it was linked with memorable experiences, produced intense and pleasurable experiences, accompanied by physiological reactions and positive mood changes in about a third of the study participants [2]. On the other hand, listening to sad music makes listeners focus on the feelings of sadness. A study at the University of Groningen conducted by Jacob Jolij and Maaike Meurs showed that listening to music can literally affect your perception of the world. When listening to cheerful music, respondents were more aware of the happy faces and, conversely, sad faces were better recognized, while listening to sad music [6].

DETECTING EMOTIONS IN MUSIC

Japanese researchers Akahiro Ogino and Yuko Yamashita present another approach to detect emotions in music than digital signal processing. They propose mining emotions in music from the text of lyrics by utilizing natural language processing methods. Words that express emotions in texts are summarized into representative words using a synonym dictionary. Based on this, a model that estimates nine emotions of the listener, based on representative words using the machine learning method, was created [8]. Their retrieval system was able to search music lyrics based on the emotions (or impressions) chosen by the listener.

One of the things that traditionally helps with the retrieval of music, is metadata. For this purpose, folksonomies containing human emotions may be employed. Apparently, it is not necessary or appropriate to include all the subjective emotions of any user. Our hypothesis was that the intended emotions of artists in music tracks would match to some extent with the emotions of their fans and therefore these metadata would be suitable to enhance the metadata of the tracks. With this intention, 24 artists with 30 different tracks were asked to provide us the inducted emotions in their own music. Afterwards, we collected 423 answers of users about their perceived feelings from the same tracks. We also asked about the context or reason of the feelings. The data were than cleaned from the individual feelings associated with the life situations of the users.

Our results show that just 21, 4 % of users completely disagreed with the artists and the same amount of them completely agreed. Interestingly, around 78, 4 % of answers agreed either partly or totally [7]. This research needs to be repeated with larger number of users and artists, but we believe, the results indicate that there is not so much difference between intended and perceived feelings in and from the music, if the subjective associations are omitted. Additionally, the emotions experienced by musicians are also an attribute that is of particular interest to their fans.

TOWARDS THE EMOTIONAL MIR

There is a wide range of emotions that could be included in MIR, ranging from five categories to 289 (sometimes very rare) emotions, utilized on the portal Allmusic. As human emotions are complex and subjective, it is not sufficient to recommend music in MIR systems simply according to perceived human emotions. The combination of emotions and individual and cultural preferences in MIR will be more helpful for the users. Nevertheless, the research of emotions in and from music is a step forwards for a better relevance in MIR.

Currently, researchers focus on the possibilities of emotion extraction from music signals and text of lyrics (mainly chorus). The basic emotions in music that are often grasped by MIR, are the following: happy, exuberant, energetic, furious, sad, depressive, quiet and pleasing. Metadata (folksonomies) created by the artists might be useful to provide a wider spectrum of emotions in music. These possibilities are far from being exhaustive, but may be used to better exploit the emotional potential of MIR. The future belongs also to the use of deep and machine learning methods for music emotion recognition.

Acknowledgement: Data were obtained as part of the research project APVV-15-0508 HIBER

Literature

[1] Bhat, Aathreya. S., et al. "An Efficient Classification Algorithm for Music Mood Detection in Western and Hindi Music Using Audio Feature Extraction." *Fifth International Conference on Signal and Image Processing* (2014): pp. 359–364. (ieee.org/document/6754902)

[2] Eerola Tuomas and Henna-Rikke Peltola. "Memorable Experiences with Sad Music—Reasons, Reactions and Mechanisms of Three Types of Experiences." *PLoS ONE* 11, No. 6 (2016). (ncbi.nlm.nih.gov/pmc/articles/PMC4907454)

[3] Goldstein, Barry. "The Fascinating Ways That Music Affects Your Mood and Mind". *Conscious Lifestyle* (2016). (onsciouslifestylemag.com/music-and-the-brain-affects-mood)

[4] Hole, Jenny, et al. "Music as an aid for postoperative recovery in adults: a systematic review and meta-analysis". *The Lancet 386, I. 10004 (2015).* (thelancet.com/journals/lancet/article/PIIS0140-6736(15)60169-6/fulltext)

[5] Hu, Xiao. and J. Stephen Downie. "Exploring mood metadata: relationships with genre, artist and usage metadata". *Proceedings of the 8th International Conference on Music Information Retrieval, ISMIR'07*, 2007. (ismir2007.ismir.net/proceedings/ISMIR2007_p067_hu.pdf)

[6] Jolij, Jacob and Maaike Meurs, M. "Music Alters Visual Perception." *PLoS ONE*, 6, No. 4 (2011)

[7] Macko, Milan. "Emócie a nálada v informačnom prieskume hudby". Diploma thesis, Comenius University, 2019.

[8] Ogino, Akahiro and Yuko Yamashita. "Emotion-Based Music Information Retrieval Using Lyrics". *Computer Information Systems and Industrial Management (2015):* pp. 613–622.

[9] Plutchik, Robert. "The Nature of Emotions: Human emotions have deep evolutionary roots, a fact that may explain their complexity and provide tools for clinical practice". *American Scientist*

89, No. 4 (*2001)*: pp 344-50.
(pdfs.semanticscholar.org/4008/2a9d05ca89d3dcd28fe5528fc79bdddb8f94.pdf)

[10] Raglio, Alfredo, et al. “Effects of music and music therapy on mood in neurological patients” *World Journal of Psychiatry* 5, No. 1 (2015): pp. 68–78.
(ncbi.nlm.nih.gov/pmc/articles/PMC4369551)

[11] Robinson, Jenefer and Robert S. Hatten. “Emotions in Music”. *Music Theory Spectrum* 34, no. 2 (2012): pp. 71-106,149. (academic.oup.com/mts/article/34/2/71/1182683)

[12] Russell, James A. “A Circumplex Model of Affect”. *Journal of Personality and Social Psychology*. I.39 (1980): pp 1161-1178. (psycnet.apa.org/record/1981-25062-001)

[13] Thayer, Robert E.: *The biopsychology of mood and arousal*. Oxford University Press (1989).