EVOBACKMUSIC
How to use it and how it plays

1 User Guide

EvoBackMusic is a multi-agent system designed for composing background music, integrable in any type of (real and virtual) environment and that also takes into account objective aspects of such environment.

Specifically, it is a system for real-time composition of background music that responds to changes of the environment by generating music that reflects the actual state of the surrounding ambient.

From the technical pint of view, the system *(1)* check for any *environment state* (i.e., change of the environment) and *(2)* map each environment change into a *musical state* according to users' musical preferences.

There is no pre-composed music. The music is composed on-the-fly according to some input parameters which describe the surrounding environment. We will refer to these parameters as the *environment state*. The environment state depends on subjective and objective features:

- Dynamicity of the user

- Dynamicity of external objects

- Density of the environment

- Context

- Predominant color

- Emotion.

The *dynamicity of the user* indicates how rapidly the user is moving in the environment. Similarly, the *dynamicity of the external objects* is relative to the moving of the other objects available in the environment. The *density of environment* indicates how the environment is dense, i.e. how many entities, including the user, are present in the environment. The *context* describes the "context"; we consider the following possible contexts: fun, sport, game, film and relax. The *predominant color* described the predominant color of the environment as a Red-Green-Blue (i.e., RGB) specification.

In order to represent the *emotion* of the user, we use a *dimensional approach*. The dimensional approach to emotion conceptualization focuses on identifying
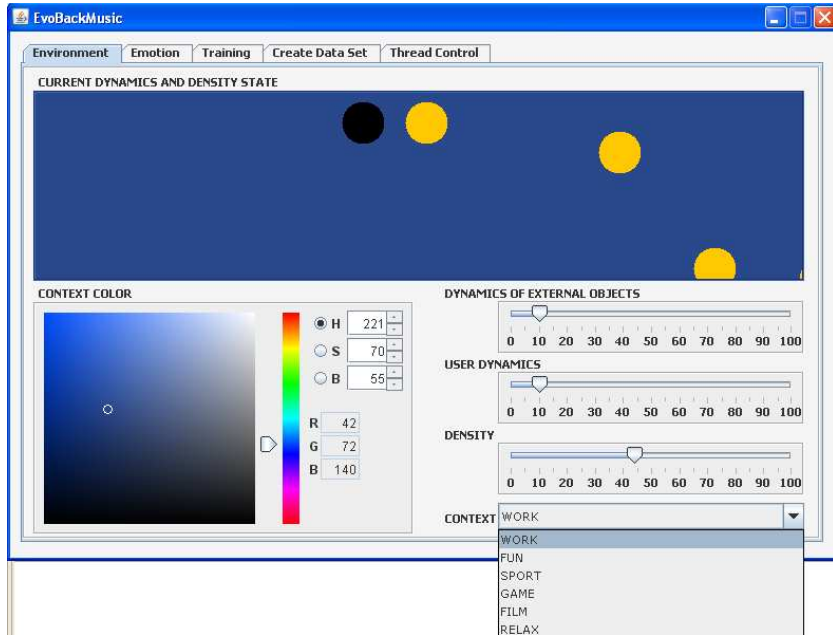
Figure 1: Environment panel.

emotions based on their positions on a small number of emotion "dimensions" with named axes, which are intended to correspond to internal human representations of emotion. In particular, we use the approach proposed by Russell [1]. This model consists of a two-dimensional, circular structure involving the dimensions of *valence* and *arousal*. Within this structure, emotions that are inversely correlated are placed across the circle from one another.

The musical features are grouped into 4 classes: instrument, rhythm, harmony and melody class.

1.1 EvoBackMusic GUI

In this section, we describe the graphical interface of EvoBackMusic. EvoBackMusic contains five panels:

- **Environment panel:** In this panel it is possible to select the objectives features of the current environment state (see Fig. 1).

- **Emotion panel:** In this panel it is possible to select the emotion of the user (see Fig. 2).

- **Training panel:** In this panel it is possible load a data set, load a previous saved or create a new neural network and train it by selecting the training parameters: hidden neurons, epochs, momentum, learning rate and error (see Fig. 3).
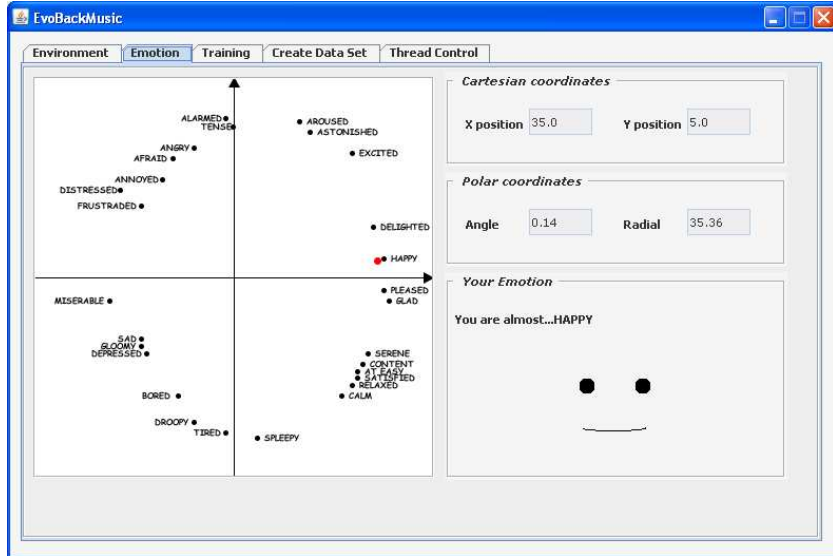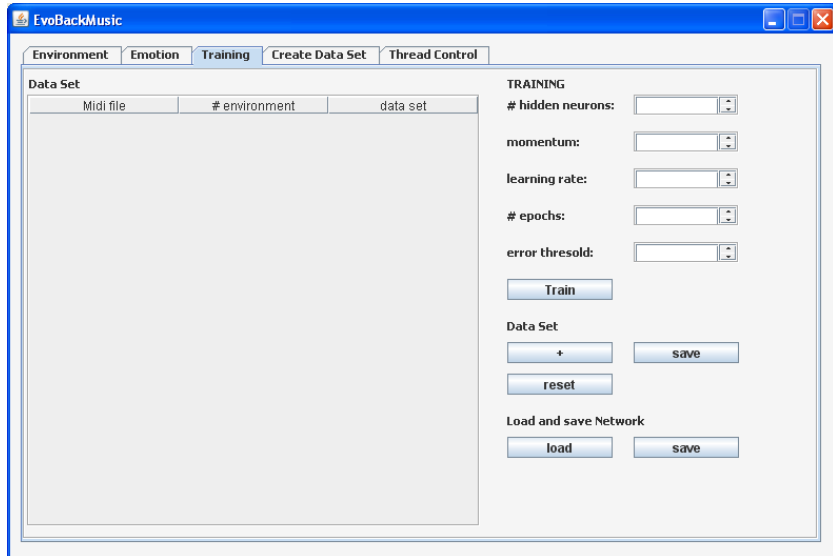
Figure 2: Emotion panel.
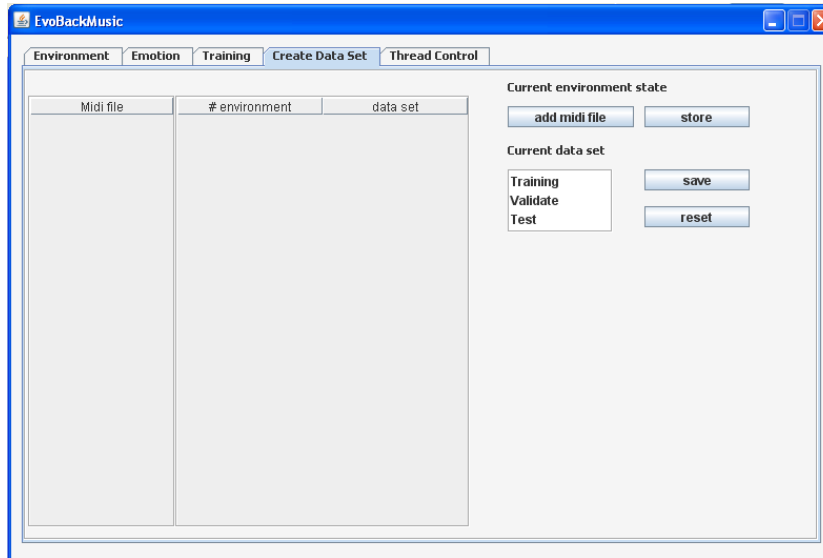

Figure 3: Training panel.

Figure 4: CreateDataSet panel.

- **CreateDataSet panel:** In this panel it is possible to select create and save a data set (training, validation or test), by selecting for each current environment state a midi file (see Fig. 4).

- **ThreadControl panel:** In this panel it is possible to monitor the multi-threading execution of EvoBackMusic (see Fig. 5).

1.2 EvoBackMusic tasks

In this Section we describe the steps necessary to work with EvoBackMusic.

Create data set Task. A data set is a collection of pairs *(environment state, musical state)*. It is composed by three subsets: training set, validation set and test set. In order to create each pair it is necessary to:

1. Select features in the Environment panel (Fig. 1)

2. Select emotion in the Emotion panel (Fig. 2)

3. Select a MIDI file by the *add MIDI file* button in the Create Data Set panel (Fig. 4)

4. Select the current data set (Training, Validate or Test) in the Create Data Set panel (Fig. 4)

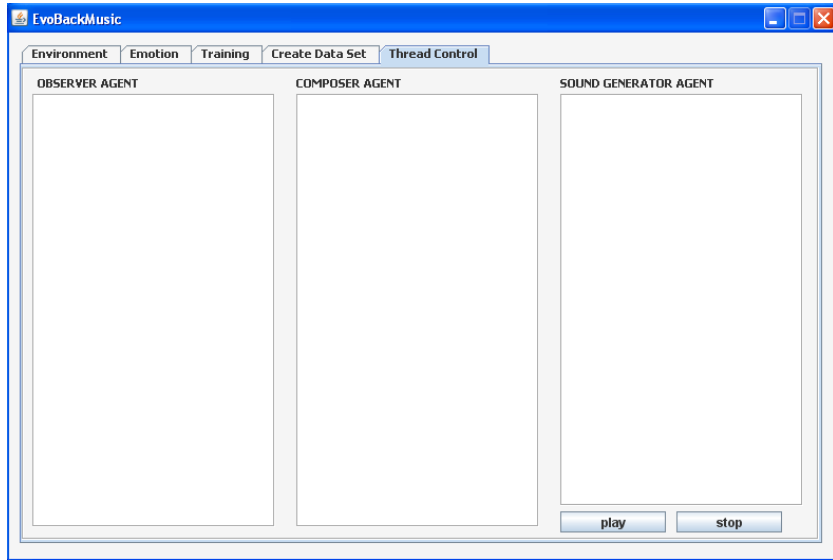5. Push the *store* button in the Create Data Set panel (Fig. 4)

Figure 5: ThreadControl panel.

Finally, when the user terminates the data set, then it is necessary to push the *save* in the Create Data Set panel (Fig. 4).

Train a Neural Network.   In order to train a neural network it is necessary to:

1. Set *hidden neurons, momentum, learning rate, epochs, error* parameters in the Training panel (Fig. 3)

2. Load a previous saved data set by the *+* button in the Training panel (Fig. 3)

3. Push the *Train* button in the Training panel (Fig. 3)

4. Push the *save* button in the Training panel to save the trained neural network (Fig. 3).

2 Survey questions

Questions of questionnaires have been translated from the Italian language.

2.1 Preliminary Survey Questionnaire

- Q1: How much time do you listen to music (hours per day)?

  - Less than one hour
  - Between one and two hours
  - between two and four hours
  - More than four hours

- Q2: During which type of activity do you prefer to listen to music?

  - Work
  - Sport
  - Game
  - Movie
  - Relax
  - Fun

- Q3: I consider important the music in my every-day life

  - Strongly disagree
  - Disagree
  - Neither agree nor disagree
  - Agree
  - Strongly agree

- Q4: I am familiar with the Music Background term

  - *Same answer options as Q3*

- Q5: I am familiar with the Automatic Music Composition term

  - *Same answer options as Q3*

- Q6: I am familiar with the MIDI term

  - *Same answer options as Q3*

- Q7: It is my responsibility to choose the appropriate music to listen to during my activities

  - *Same answer options as Q3*

- Q8: I am aware of the software players that exist (also online) to listen to music

  - *Same answer options as Q3*

- Q9: How often do you update your playlist on the PC?

  - Never
  - Once a month or less often
  - 2 to 3 times to month
  - At least one a week
  - 2 to 3 times to week
  - Every day

- Q10: How much frequently you select and classify the appropriate music for your activities?

  - Never
  - Rarely
  - Sometimes
  - Often
  - Most of the time

- Q11: In which context do you think it could be useful to use EvoBack-Music?

  - Work
  - Fun
  - Sport
  - Game
  - Film
  - Relax
  - Other

If your answer is "Other", can you provide the new additional context?

2.2 Task activities Questionnaire

Task One. Create a dataset of 10 elements (See paragraph 1.2): for 10 times set the features of a current environment state with low dynamics of the user, low dynamics of the objects, low density of the environment, relax context, light tonalities of color as predominant color and thoughtful-sad emotion.For each of environment select a correspondent midi file with a very softly music. So, choose a correspondent MIDI file in the directory *test/midifiles*.

When the dataset is created, train a neural network with 10000 epochs, 0.1 error, 0.5 learning rate and 0.5 momentum (See paragraph 1.2). When the training is terminated select the neural network created and test the system for each environment state previously defined.

- Q12: How easy was it to perform the task?

    - Very difficult
    - Difficult
    - Neither easy nor difficult
    - Easy
    - Very easy

- Q13: EvoBackMusic was able to generate the appropriate music.

    - Strongly disagree
    - Disagree
    - Neither agree nor disagree
    - Agree
    - Strongly agree

- Q14: What kind of emotion have you perceived?

    - *Mark in Fig. 6 the emotion perceived.*

- Q15: The emotion that I've perceived corresponds with what I expected.

    - Strongly disagree
    - Disagree
    - Neither agree nor disagree
    - Agree
    - Strongly agree

Figure 6: Task 1 Emotion. Mark here with a cross the emotion you perceived.

Task Two. Create a dataset of 10 elements (See paragraph 1.2): for 10 times set the features of a current environment state with medium dynamics of the user, medium dynamics of the objects, medium density of the environment, work context, medium light tonalities of color as predominant color and serious-quiet emotion. For each of environment select a correspondent midi file with a very softly music. So, choose a correspondent midi file in the directory *test/midifiles*.

When the dataset is created, train a neural network with 10000 epochs, 0.1 error, 0.5 learning rate and 0.5 momentum (See paragraph 1.2). When the training is terminated select the neural network created and test the system for each environment state previously defined.

- Q16: How easy was it to perform the task?

    - Very difficult
    - Difficult
    - Neither easy nor difficult
    - Easy
    - Very easy

- Q17: EvoBackMusic was able to generate the appropriate music.

    - Strongly disagree
    - Disagree
    - Neither agree nor disagree
    - Agree
    - Strongly agree

- Q18: What kind of emotion have you perceived?

    - *Mark in Fig. 7 the emotion perceived.*

- Q19: The emotion that I've perceived corresponds with what I expected.

    - Strongly disagree
    - Disagree
    - Neither agree nor disagree
    - Agree
    - Strongly agree

Figure 7: Task 2 Emotion. Mark here with a cross the emotion you perceived

Task Three. Create a dataset of 10 elements (See paragraph 1.2): for 10 times set the features of a current environment state with high dynamics of the user, high dynamics of the objects, high density of the environment, game-film context, strong tonalities of color as predominant color and serious-angry emotion. For each of environment select a correspondent MIDI file with a very softly music. So, choose a correspondent MIDI file in the directory *test/midifiles*.

When the dataset is created, train a neural network with 10000 epochs, 0.1 error, 0.5 learning rate and 0.5 momentum (See paragraph 1.2). When the training is terminated select the neural network created and test the system for each environment state previously defined.

- Q20: How easy was it to perform the task?

    - Very difficult
    - Difficult
    - Neither easy nor difficult
    - Easy
    - Very easy

- Q21: EvoBackMusic was able to generate the appropriate music.

    - Strongly disagree
    - Disagree
    - Neither agree nor disagree
    - Agree
    - Strongly agree

- Q22: What kind of emotion have you perceived?

    - *Mark in Fig. 8 the emotion perceived.*

- Q23: The emotion that I've perceived corresponds with what I expected.

    - Strongly disagree
    - Disagree
    - Neither agree nor disagree
    - Agree
    - Strongly agree

Figure 8: Task 3 Emotion. Mark here with a cross the emotion you perceived

Task Four. Create a dataset of 30 elements (See paragraph 1.2):

- for 10 times set the features of a current environment state with low dynamics of the user, low dynamics of the objects, low density of the environment, relax context, light tonalities of color as predominant color and thoughtful-sad emotion. For each of environment select a correspondent MIDI file with a very softly music. So, choose a correspondent MIDI file in the directory *test/midifiles.*

- for 10 times set the features of a current environment state with medium dynamics of the user, medium dynamics of the objects, medium density of the environment, work context, medium light tonalities of color as predominant color and serious-quiet emotion. So, choose a correspondent MIDI file in the directory *test/midifiles.*

- for 10 times set the features of a current environment state with high dynamics of the user, high dynamics of the objects, high density of the environment, game-film context, strong tonalities of color as predominant color and serious-angry emotion. So, choose a correspondent MIDI file in the directory *test/midifiles.*

When the dataset is created, train a neural network with 10000 epochs, 0.1 error, 0.5 learning rate and 0.5 momentum (See paragraph 1.2). When the training is terminated select the neural network created and test the system for each environment state previously defined.

- Q24: How easy was it to perform the task?

  - Very difficult
  - Difficult
  - Neither easy nor difficult
  - Easy
  - Very easy

- Q25: EvoBackMusic was able to generate the appropriate music.

  - Strongly disagree
  - Disagree
  - Neither agree nor disagree
  - Agree
  - Strongly agree

- Q26: What kind of emotion have you perceived?

  - *Mark in Fig. 9 the emotion perceived.*

Figure 9: Task 4 Emotion. Mark here with a cross the emotion you perceived

- Q27: The emotion that I've perceived corresponds with what I expected.

  - Strongly disagree
  - Disagree
  - Neither agree nor disagree
  - Agree
  - Strongly agree

2.3 Summary Survey Questionnaire

- Q28: I consider important the music in my every-day life

  - Strongly disagree
  - Disagree
  - Neither agree nor disagree
  - Agree
  - Strongly agree

- Q29: I am familiar with the Music Background term

  - *Same answer options as Q3*

- Q30: In which context do you think it could be useful to use EvobackMusic?

  - Work
  - Fun
  - Sport
  - Game
  - Film
  - Relax
  - Other

  Now, look at the answer you provided at the same question posed in the Preliminary Survey (i.e., Q11 question). If changes occurred, are you able to explain the motivations that lead to those changes?

  - *Open question*

- Q31: Overall, I am satisfied with how this system produced music that matches my preferences

  - Strongly disagree
  - Disagree
  - Neither agree nor disagree
  - Agree
  - Strongly agree

References

[1] J. A. Russell. A circumplex model of affect. J. Personality & Social Psychology, 39(6), pp.11611178, 1980.