

A Mobile System for Music Anamnesis and Receptive Music Therapy in the Personal Home

Kerstin Denecke

Bern University of Applied Science, Bern, Switzerland

Abstract

Receptive music therapy is active hearing of music that is specifically selected to cause a certain effect on a person, such as pain reduction, mental opening, confrontation etc. This active, guided hearing could be helpful as a supporting ritual for patients at home and could extend traditional therapy. However, patients are often unable to select the music pieces that might be helpful for them in a current situation. We are suggesting a self-learning decision support system that allows a patient to answer questions on music anamnesis, is ready for inclusion into an electronic health record, and which enables a therapist to compile a therapeutic music program for the patient at home. Beyond this, the system also suggests appropriate music and duration of listening based on the patient's reported current mental state. In this paper, a concept for such a mobile system for receptive music therapy will be proposed.

Keywords:

Music Therapy; Decision Support Techniques; Mobile Applications

Introduction

Music therapy is defined as "the use of sounds and music within an evolving relationship between patient and therapist to support and encourage physical, mental, social, emotional and spiritual well-being." [1]. It is a young treatment method indicated in patients with autism [2], dementia [3], depression [4], pain [5], and other conditions. In 2005, it was included in the DRG catalogue for multimodal clinical pain therapy. The objective is primarily to help clients improve their health in several areas, such as cognitive functioning, motor skills, emotional development, social skills, and quality of life. To achieve this, patients are encouraged to experience music by free improvisation, singing, listening, and moving to music. Active and receptive music therapy can be distinguished. We are focussing on receptive music therapy in this paper.

Receptive music therapy comprises "active hearing of selected music pieces under certain conditions" [6]. The difference from everyday listening of music is that certain effects are to be achieved, e.g. a confrontation, spiritual opening etc., which requires a careful selection of the music pieces. In addition, there is a concrete guide which encourages listening.

Even though the therapist-patient relationship is important in this context, there are use cases where it would be helpful for patients and for the treatment – similar to doing physical exercises at home – if aspects of receptive music therapy could be continued in a guided manner in the personal home of a patient. For example, from the treatment of patients with

chronic pain, it is known that patients can be equipped with a therapeutic program for home use, but this requires exact specification of usage to create an individual ritual against pain [7].

The problem is that clients have difficulties in deciding which music would be good for them in a particular situation. They could even select music that could harm them or achieve undesirable results. Existing music compact discs (CDs) for individual music therapy, e.g. by W. Zeitler [6] are described very well with a lot of practical experiences. Nevertheless, Zeitler reports that the help-seeking clients often do not understand these descriptions and would choose some music which does not help them.

A decision support system implemented on a mobile device such as a smartphone or tablet as designed in this paper could help in selecting the appropriate music and make suggestions according to a therapy plan. More specifically, the objective of this paper is to design a system that supports a patient in using the therapeutic capacities of music therapy at home. Taking existing practice into account, the system will in particular support the therapist in collecting music anamnesis and in creating therapeutic music therapy programs. Starting from a requirement analysis, we are developing a concept for a mobile system supporting music therapy.

Using digital media in music therapy has gained interest in the last couple of years. Computers, smartphones, and tablets are mainly used for recording, composing, adapting music pieces and accessing music libraries [8-9]. Several case studies have illustrated multiple uses of technology with young adults [10-11]. In particular, recording technologies are exploited for enabling immediate capturing of spontaneous music making during therapy session or with others. There are apps available that allow users to arrange music into loops (e.g. Relax melodies, <http://www.ipnosoft.com/app/relax-melodies/>) in order to create a personal meditation or relaxation program. However, to the best of our knowledge there is no system available that supports the music anamnesis and therapeutic home usage we are considering.

Material and Methods

We performed a requirement analysis by means of a structured questionnaire. The current and target situations had to be described together with functional and non-functional requirements. The questionnaire was completed by one music therapist. Additionally, we collected requirements from existing literature on music therapy. Afterwards, we designed the architecture for the system and developed first mock-ups. In this section, we are describing the current procedure in music therapy and possible usage scenarios for the system as

received through the requirement analysis. Further, we are summarizing the requirements.

Music Anamnesis and Music Therapy

Traditionally, within receptive music therapy, the therapist selects music and plays the recorded music to the patient. Afterwards, a discussion on the feelings caused or other effects takes place. A main characteristic is that selection of the music focuses on symptoms of the patient and his/her personality. Three main issues determine selection of music within the therapy session: the music anamneses which are habits and preferences of music listening of the patient, the current situation (emotional or health state) and the therapeutic goal. We describe these three aspects in more detail below.

In the first session, the music therapist makes a *music anamnesis*. For this purpose, questions are directed to collect information on the patient's experiences with music in childhood and current life, preferences in music listening, etc. (see Table 1). Additionally, emotions caused by music listening will be identified and the patient will be asked to judge personal experiences with music. Further, it is important to determine habits in music listening and preferences towards certain instruments, genres or music pieces. The objective is not to identify the preferred music – this can cause the person to experience past emotions that can become problematic in the current situation. The objective of the music anamnesis is to get an idea of the categories of music that could help a person in situations targeted by the therapy.

Table 1 – Music anamnesis: Examples for relevant aspects

Early experiences with music
- Lullabies, Christmas songs
- Learned an instrument? Which?
Experiences as youth
- Listening with friends
- Party
Habits of music consumption before getting sick
- Situations when music was recognized with positive impacts
Current habits of music consumption
- Kind of music
- Frequency of listening
- When / Situations
When do you listen to music?
- While working
- Dancing
- Learning
- Car driving
Recognized effects or emotions while listening to music
- Getting calm
- Making someone cry
- Tears

For the *current situation of a patient*, his or her mental state is assessed by asking for current feelings and symptoms. Consider for example a patient suffering from chronic pain. The current situation comprises that pain at the given time and the general mental constitution (e.g. feeling entirely surrendered to the pain, depressed, afraid). The *therapeutic goal* has two dimensions: the long-term goal of the entire therapy and the goal for a specific session. It is specified in the discussion between patient and therapist.

The information on all three aspects forms the basis for selecting appropriate music pieces and creating a specific therapy program for a patient.

Use Cases

1. Music Anamnesis and Preparation of a Therapy Program

Consider a patient with chronic pain. For him it is important to regularly use a music therapy program for pain relief. The patient answers questions in the music anamnesis through the music therapy application as preparation for the therapeutic session. The session is held as usual, but the therapist can begin with some knowledge of the patient's background since the anamnesis has been completed by the patient in advance. During the session, the therapist gets an impression of the mental state of the patient and they jointly define the therapeutic goal. The information in the anamnesis can be extended by the therapist in the session. This information is entered by the therapist into the system as part of general documentation which is stored in the electronic health record of the patient. After specifying the therapeutic goal, the system suggests music pieces supporting the therapeutic goal and considering the preferences of the patient as derived by the music anamnesis. The therapist can select music pieces that are compiled by the system later on to training programs for the patient at home. The system helps to select appropriate pieces and to create therapy programs.

2. Running the Therapy Program at Home

The same patient suffering from chronic pain starts the mobile application at home. The app asks the patient for his current mood and health status. Depending on the responses, the application compiles an appropriate program of suitable length based on pieces preselected by the therapist. The program is suggested to the patient. After listening to the music and some relaxation time, the system asks for feedback in terms of the mood of the patient or changes in symptoms after listening to the program. This information is forwarded to an electronic health record as a structured report that contains the date, length of listening, initial health state, and state after listening. In this way, an anti-pain ritual is created in the patient. The feedback information helps the system adapt its program creation strategy. The therapist also receives feedback on whether a music piece was helpful or not, which can be considered in the follow-up.

Requirements

From these use cases, we can derive the system objectives: to increase quality of life and provide music therapy for patients that can be continued at home. In terms of quality, the system will support patients in listening to an appropriate music program that is directed to the therapeutic goal. The economic value is that therapeutic sessions are accompanied by a continuous practice which can support the effects of therapy. The music anamnesis can be collected already in a digitized manner, available for the first therapy session.

We collected several functional and non-functional requirements. Functional requirements include:

- Supporting a music anamnesis
- Capturing current emotional or mental state or constitution of a person before and after listening
- Proposing a helpful music therapy program, taking into account recorded music history and current constitution of the person as well as the therapeutic goal and recommendation of the therapist
- Allowing listening to receptive music therapy program
- Collecting feedback and reconsidering emotional and mental state according to the therapy program (independent learning of the preferences of a person)

Non-functional requirements include: 1) standardized information modelling of the music anamnesis, 2) standardized reporting of home therapy sessions, 3) connection to an electronic health record to store the anamnesis and reports of therapeutic sessions at home, 4) consistent graphical user interface (GUI), also suited for patients less experienced with digital devices, and 5) response time less than 1 second.

Additionally, there are quality standards relevant for music applied in medical contexts [10] which need to be considered in the implementation of the system. This means, not each music piece is appropriate for usage in music therapy. Some relevant aspects are: a music piece needs to be defined (composing criteria, interpretation, instruments), selected according to the indication, should have a known profile of effect and the dosage needs to be specified (volume and duration of listening) [10].

Results

The system is designed as a service-oriented system architecture. Figure 1 shows the four major components of the architecture. It comprises a client-facing application acting as a user interface and a server application orchestrating single services. Processing services include the computational components, and resources encapsulate data that need to persist for the system to work properly. Details such as acquiring data from a client application or from multiple data sources of several types are not shown explicitly in the figure and will not be explained in detail. The components of the architecture are described below in more depth. First, a general overview is provided followed by a detailed description of single components.

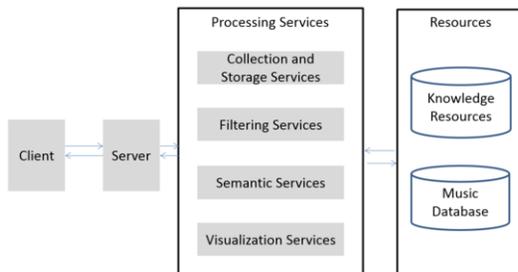


Figure 1 – System architecture comprising client, server, processing services, and resources

Architecture

The **Client** is a system user interface, partially designed as a conversational user interface to maintain a conversation-like style particularly in the anamnesis part. It allows starting the system, i.e. for patients this includes the anamnesis, and the therapy program. For physicians, the user interface presents the anamnesis, enables inputting the therapeutic goal or adapting the anamnesis, and supports compiling appropriate therapy programs.

The **Server** is responsible for interaction between client and processing services, invocation of services, and communication with external applications. In its role as service orchestrator, it invokes services in the right order and transmits the results of one service as input to the next service if required. It prepares responses of the processing services, collects results of the services and transmits the results to the client.

The **Processing Services** realise the actual processing. They might be independent from each other or the output from one processing service is required as input for another. We identified four different groups of processing services that are required to realise the music therapy app. These include: Data Collection and Storage Services, Filtering Services, Semantic Services, and Visualisation Services. Details are given in the following paragraphs.

Data Collection and Storage Services are responsible for collecting and storing data from and to different resources. One service retrieves the questions for doing the music anamnesis from a knowledge resource (see below) and forwards them to the GUI. Another service is needed for storing the completed music anamnesis into an electronic health record or for retrieving a stored anamnesis for a given patient. The data entries need to be stored in a structured manner for interpretation by the system later on in the music recommendation phase. Furthermore, it stores a report on the therapy program the patient received through the app including his feedback on health status in the electronic health record (EHR). It also stores information on the patient's mental state, frequency of listening, and music anamnesis – i.e. all information that is of relevance to the music therapist and which helps in monitoring progress. An additional service provided is retrieving music from music libraries or even data from a user's desktop as required.

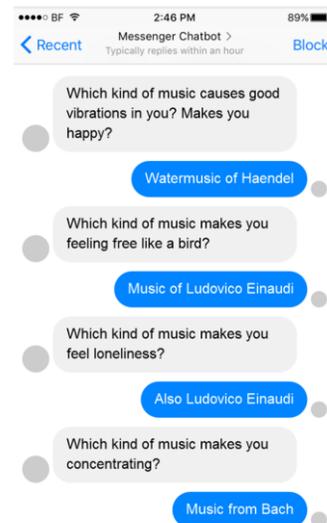


Figure 2 – Mock-up of the music anamnesis conversation

Filtering Services mainly aim at supporting the therapist in selecting appropriate music pieces from the database. Filtering criteria may include user-specified preferences as described in the music anamnesis, the specified therapeutic goal, etc. One potential filtering service is a recommendation service that makes suggestions for appropriate music pieces for a given patient or composes a therapeutic program suited for a specific patient given his/her mental and physical state. The therapeutic program that is created could for example be structured considering the phases in a therapy session where according to Zeitler [6] music of different characteristics are appropriate:

1. Salutation (music is rather slightly touching),
2. Warming-up (releasing music, more touching),

3. Confrontation (confronting music),
4. Closing and calm down.

For home usage, confronting music should not be included to avoid negative impacts.

Semantic Services provide music and text analysis functionalities on different levels of granularity. Their main task is to analyse music pieces, to select appropriate pieces when semantic information is unavailable. Additionally, semantic services are required for structuring and interpreting conversation with the patient through the conversational user interface. However, there are also services that are necessary to interpret the responses given by the patient in the conversational user interface.

The **Visualisation Services** realise the visualisation and result presentation of the application. Visual alerts, a conversational user interface, and scales for answering questions are some options that might be relevant. Additionally, the information from the music anamnesis is visualised to improve readability and perception of the information by the therapist.

Some of the processing services presented before require additional knowledge which is represented in the proposed

architecture as the **Resources** component. Two different kinds of resources can be distinguished. Knowledge resources contain background knowledge on a patient including the music anamnesis, therapeutic goal, and preferences in listening. This can be considered a patient information model. One knowledge resource is the questionnaire for music anamnesis. In order to recommend appropriate music to a given music anamnesis and therapeutic goal, corresponding knowledge needs to be available, i.e. knowledge on effects of music on patients in specific situations.

Music needs to be available to the system. It can be either integrated as resources or retrieved from external applications. For each music piece, knowledge on the effects it might cause and the type of music need to be available. Another option would be to develop algorithms that do such classification automatically.

Figure 3 shows the information flow for the use cases separated into three parts: music anamnesis, creating music therapy program, and music therapy. The structured report that is stored at the end contains information on the music pieces the patient was listening to, initial emotional and health state and feedback afterwards.

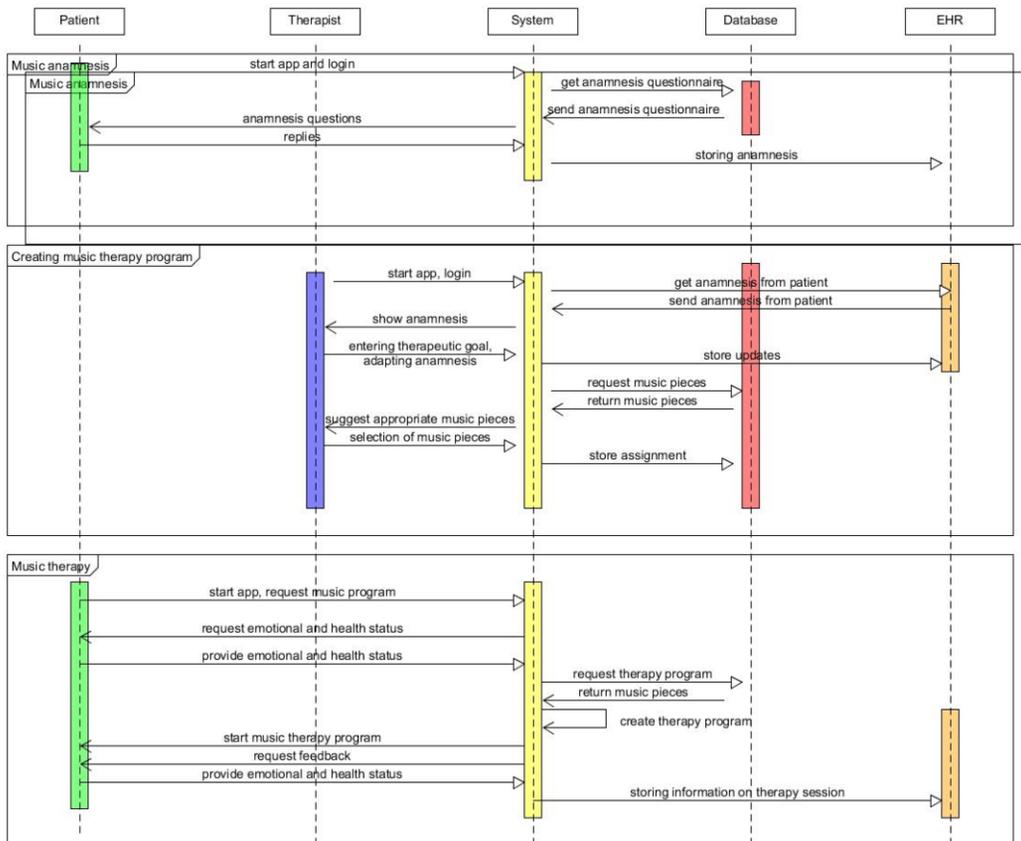


Figure 3 – Information flow diagram for music anamnesis, creation of music therapy program and consumption of music therapy

The music anamnesis will be realised using a conversational user interface, i.e. it resembles a short message function. This has the benefit of creating the impression of being interviewed by the therapist. Example queries in the music anamnesis screen is shown in Figure 2. Additionally, Figure 4 shows the user interface for starting the assessment of the current health state and mood.

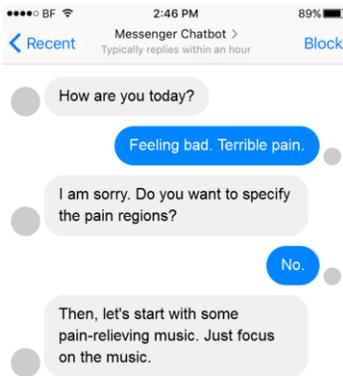


Figure 4 – Mock-up for starting the therapeutic music program

Discussion

In this paper, we introduced possibilities of information technology to support receptive music therapy. We introduced a concept and architecture for an IT-based music anamnesis and music therapy support. The next step is to evaluate the anamnesis tool with music therapists. It is clear that the app will not replace the therapist, but it could offer an opportunity for running therapy programs at home, like repeating exercises that have been introduced in a physiotherapy session. There are some open questions for future work. For the actual app, it needs to be clarified where the music is taken from. When using the music library of a patient, it would require an automatic classification of the music pieces in order to support the therapist and system in creating an appropriate program. Taking music from the internet also requires careful selection due to varying quality, interpretation, instrumentation etc. In order to automatically classify music, an open research question is how to formally describe the profile of music in terms of which effects or emotions are caused and whether it is possible to determine such categorization automatically. From a music analysis perspective, it is of interest to describe the relation between composition style and effect.

Secure data transmission needs to be ensured when transferring data to an electronic health record. Further, it needs to be checked whether this system should become a medical device.

The suggested approach tries to respect the current therapeutic procedure. The effect of music on the emotional and health state of a patient is difficult to predict and assess. The objective is to develop means to exploit the power of digital media to guide individuals to helpful, supporting music.

Conclusion

In this paper, we presented a concept and architecture of a mobile system that supports receptive music therapy. One aspect is the music anamnesis which can be filled in by a patient in a digital manner and can be extended during a therapy session. In the future, we will test the music anamnesis app and collect feedback from therapists for improvements. Beyond, the app is intended to enable home use of a music therapy program. It is still unknown to what extent home practicing supports receptive music therapy or improves quality of life for patients, such as those with chronic pain. The app will also allow the running of studies to assess this or similar questions.

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Address for correspondence

Prof. Dr. Kerstin Denecke, Bern University of Applied Sciences, Quellgasse 21, 2502 Biel / Switzerland; (kerstin.denecke@bfh.ch)