Designing a Mobile Music Sharing System Based on Emergent Properties

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Abstract

We are exploring the use of emergent properties of complex systems in a mobile music sharing application. In our approach, songs are treated as individual agents that act autonomously according to input (e.g. listening habits) and given rules. We introduce the concept and report on a study that was conducted to inform the design of such an application.

Keywords

Mobile media, mobile music technology, music sharing, emergent systems, media agents

1. Introduction

Music is an area of great interest and concern to many people. The emergence of purely digital distribution channels, on both stationary and mobile devices, makes music particularly interesting in the context of active media technologies. One opportunity for the future of music entertainment might be the increasing market for narrow music applications where people move away from the mainstream charts and are helped to find more niche-oriented music [1].

We are exploring how a mobile music sharing application could benefit from using emergent behaviour. Emergent behaviour arises when individuals start to collaborate without a central control, in order to gain more power to create something they could not have done alone [4]. Complex systems make use of the knowledge that entities, when acting together, can grow smarter over time and manage to respond to changing needs in the environment. Emergent behaviour and modern technology appear in *smart mobs*, which are collections of humans whose collective cognitive capabilities are augmented with information technology [7].

We build our work upon recently presented mobile music sharing applications such as Sound Pryer [9] and tunA [2]. However, by looking at and using emergent properties and the concept of smart mobs, we take a different approach in designing for new music experiences. We have begun investigating how a peer-to-peer music sharing and listening application could "learn" about different users' listening habits and introduce new music based on peoples' shared music interest. We believe there would be a difference in listening to and sharing music in applications based on a "shared radio" model and in a system where some actions would be performed autonomously by agents based on listening behaviour. Our motivation is to see if and how emergent behaviour of agents could affect mobile music listening. In the future, we are also interested in seeing if and how this kind of system could give rise to emergent behaviour among people.

2. Concept

We introduce two terms, *media agents* and *media ecologies*, in order to explain how we explore merging ideas of emergent behaviour with the distribution of music files in a mobile network.

Imagine that you carry a mobile device that has the ability to store and play back music files, e.g. a mobile phone with an MP3 player. As you encounter various people, the devices you are carrying connect to each other, e.g. via Bluetooth. Media agents from other nearby devices check the status of your media collection. Based on what you have been listening to in the past and which files you already own, some other music might spontaneously "jump" from another device to yours (and vice versa), on its own accord. Later, when you listen to your jazz songs, the system also plays a newly obtained Frank Sinatra tune that you had not heard before.

In our model, the music files themselves are considered autonomous entities; we call them *media agents*. A media agent could be likened to an autonomous agent [5], which is a software entity that senses the environment it is in and acts on information according to its own agenda. A media agent has a number of components of which an MP3 file is the basic media content. Furthermore, it has a set of "senses", i.e. ways to examine the world around it (what other mobile devices are nearby, who owns

them, what files are on them etc). Finally, the agent has a set of rules that govern certain "behaviours" based on sensor input. An agent's behaviours can for instance be to copy itself from a device to another, attract the user's attention, etc.

Like any small entity, the media agent must exist in a larger context – we call this the *media ecology*. The media ecology is the collection of files in which the agent resides, and it is typically housed on a mobile device. Depending on the environment, an agent may thrive or starve, be stimulated or bored, which impacts on its behaviour. One can also imagine larger collections of ecologies, much like any natural habitat is a collection of smaller micro-ecologies.

3. Related work

Recently there has been an increased focus on the intersection of music listening and technology. Studies have for instance concerned the management of personal stereos (i.e. Walkmans) [3].

Several applications have also been designed to explore the area. Mobile technology makes it possible to support and benefit from the fact that people are mobile and move around in different physical and social contexts, which opens up for new opportunities of experiencing e.g. music. Sound Pryer [9] is a mobile peer-to-peer application designed for joint music listening on the road between people in nearby vehicles. It can be likened to a shared car stereo where you can choose between listening to your own music and overhearing what people in nearby cars listen to. tunA [2] is a similar project, however not focusing on traffic encounters. It is currently based on PDAs and wireless network that allow users to share music locally in a synchronised way. In tunA, users can "tune in" and listen to each other's music.

Related services that are currently moving from stationary PCs to mobile devices are recommendation systems based on collaborative filtering. The PocketLens project [6] is looking at how to provide users with recommendations wherever they are, using collaborative filtering and peer-to-peer networking. MobiTip [8] is another portable recommendation system, which already runs on mobile phones and where recommendations become available to users as they pass each other or Bluetooth hotspots.

3.1. Legal issues

Related to the increasing development of peer-to-peer sharing applications is the fact that copyright protection on music is currently moving towards more open structures. An example of this is the licence model from Creative Commons (creative-commons.org), which enables a more flexible copyright for e.g. sharing. As for our system, we see that either new payment models (for instance micro payment) or copyright free music is required. This is something we will explore in future implementations.

4. Music interviews

After outlining the basic concept of media agents and media ecologies, we conducted interviews with music-interested people to learn more about what role music could play in mobile settings and social contexts, such as among friends. We planned for an interview that would touch on issues such as shared music experiences, how new music is found (e.g. via recommendations) and when and how music is listened to (e.g. individual or shared?).

We conducted six semi-structured, audio recorded, in-depth interviews in Swedish with seven music-interested people (one woman and six men aged 22-34) during summer 2004. The participants were interviewed individually except for two friends, who were interviewed together. The interviews lasted for 30-60 minutes each.

4.1. Results and implications for design

In general, we got a strong indication that music can be a crucial matter to people and that it is a relevant area of exploration from several points of view. The participants stressed in many ways the importance of music listening in their lives.

They claimed they listen to music "a lot", which to them essentially meant wherever and whenever the context would allow them. In a work context, for example, this could mean that music was listened to as long as it did not interfere with the current work task. At home, music could replace the sound of the TV, even if the TV was on. In a mobile context, music could be used to strengthen or control feelings while moving in a particular physical context.

Based on the interviews and the analysis thereof, we drew four implications that we found important for the design of the system. They are introduced below.

1. Provide support for active personal recommendations

One of the most significant implications from the interviews was the importance of music recommendations from trusted people. The participants mentioned several ways of how they get to know about new music, but recommendations from friends were highly appreciated. They all had a rather clear picture of what music their friends listen to. The majority of the interviewees also said that, based on this knowledge, they regularly recommend music to friends:

"even if someone really likes other music genres [than me] it happens quite often that I tell him or

her that you would like this too [...] mostly I do a good job"

As mentioned earlier, taking advantage of recommendations among people is not new. However, in a mobile, peer-to-peer application, recommendations could be more active and personal, for example by sending a song directly to someone's playlist when that person is in the proximity. Compared to anonymous recommendations as used in e.g. Amazon.com, here you would see and/or know the person you recommend a song to or receive a song from. We believe that the ability to actively recommend and get recommendations (from friends, not only from the system) is crucial in our system. From a technical point of view, active recommendations also provide the system with valuable input.

2. Provide new influences using emergent behaviour and recommendations

The interviewees all shared their interest in music with friends. This primarily meant listening to the same kind of music, going to concerts together and enjoying talking about music when seeing each other. However, although friends often provided each other with new musical influences within a genre, we also learned from the interviews that if a group of friends listen to the same kind of music, it could sometimes be viewed as a drawback. Listening to the same music could make it more difficult to get to know music in other music genres and sometimes even new music within the familiar genres. We got a sense that all interviewees were very eager to get to know more music. As one interviewee explained:

"I want a great variety of music all the time, [...] I get tired of music extremely easily so I want a large diversity [of music]".

Besides active recommendations as mentioned above, we set to explore the potential benefits of emergent properties to help introducing new music and influences in the system. For example, based on some rules, media agents could occasionally autonomously (and provocatively?) place themselves in a user's playlist to add surprise and hopefully also introduce new influences. These agents could come from the user's own media ecology to help him/her re-discover his/her own music, or from other users' media ecologies when they pass each other.

3. Support different song contexts (e.g. albums) in the media ecology

The playlist has recently become increasingly important as a new music entity. However, although the interviewees did listen to playlists of various songs or single hit songs, they mentioned several reasons

why they considered the album to be more or as important. For instance:

"I prefer albums [...] because [...] it is an art to put together songs in a certain order and some artists even have themes that make the songs follow each other".

Another interviewee also stressed that he needs to listen to an entire album a couple of times before knowing which songs he really likes:

"I can't just listen ten seconds and then [know whether to] buy that song [...] when I listen to music I do it seriously even if I don't sit down [and listen], I listen to an album a couple of times."

We believe this is of relevance for the design of the media agent system. Should media agents, although considered as independent entities, belong to one or several other contexts than the actual order they are being played in? How could we support the need for various song "contexts" in the music ecology, whether it is an album or if it is a personally created playlist? The results from the interviews indicate that we need to support different contexts. A solution might be to mark media agents with different classifications (while letting them be individual entities), e.g. that they belong to an album. If a user wants to listen to a complete album the system could then be triggered to put all the relevant songs in the playlist.

4. Provide a reasonable life span of a media agent in the ecology

One of our initial conceptual ideas was that songs that are not played at all will eventually "emigrate" to another more suitable ecology where the chance of getting played seems higher. However, agents should not move before the owner of the ecology has had a fair opportunity to play them. When adding new songs to the existing ecology, how should they be treated before they get a substantial memory (or history) of their own? Songs that are played instantly might immediately adapt and start to settle in the ecology. Songs that are added but not played might on the other hand sit in the "outskirts" of the ecology. When talking about music albums, one interviewee mentioned that it usually takes some time to discover the best songs on an album. These might not be the songs that you first enjoyed the most. For various reasons (e.g. social, emotional), songs might be played in different intervals, which is something that needs to be added in the system.

5. Proposed implementation

The next step is to implement the system on WiFi-enabled PDAs where each would have its own local media ecology of media agents (songs). Overall, the

application should have the same basic functions as a normal digital music player. The media ecology of media agents should be seen as an underlying self-organising system that structures itself based on the user's listening behaviour. It is supposed to help users discover new music: among the users' own music files as well as from other users. It would hopefully inspire and perhaps even surprise or provoke. The system could be thought of as a dynamic playlist that puts songs from the ecology on queue. However, the user could at any time listen to other songs than the ones suggested. In fact, any actions from the user would contribute to the listening behaviour that helps the agents to self-organise.

A media agent would be a representative of (and linked to) an MP3-file. The agent would record what happens to the music file when it is played. For example, is the entire song played or skipped, how often has the song been played, does the user actively recommend the song to another user and in what context (e.g. in the playlist) is the song played. This information would be saved in the agent's memory and thus give the agent a history of its 'life' in the music ecology. A set of rules would define what the media agent could do in the ecology and how it would "socialise" with other agents.

If two or more users meet, their devices would automatically and wirelessly connect to each other. This 'social' network of devices or nodes would be dynamic as users encounter other users. The connection between devices would make it possible to actively recommend a song to someone by sending a copy of it to another device. The recommended song's agent would then be placed as next song in the playlist. Media agents themselves could also take advantage of the proximity of other ecologies. If the media agent, according to its memory, has not been played in a long time or has been skipped the last times it was played, it might look for a more suitable ecology (where the chances to be played more often are higher). If another ecology in the proximity contains agents that have been played in a similar musical context as itself (with the same or related songs, for instance), the agent would autonomously move or copy itself to that device. A connection between devices would create a bidirectional link that can be evaluated by the system. An active recommendation could be one way of evaluating a bidirectional link: if the receiver of the song plays it and makes it an "established" song in the ecology, one could judge it as a strong link. A strong link could, if the users meet again, give rise to more agents moving autonomously between the devices. A media agent could also remember the last visited devices that could open up for new links between more distant nodes. The system would hopefully self-organise in a sense of strong connections between devices, implying that the self-organising behaviour is done at two levels: between agents on a device, and between devices (users) at a global level.

6. Conclusions and future work

Emergent behaviour of agents is something that can be designed for in a system (you can increase the chances that it is going to develop), but it cannot be guaranteed. Due to the spontaneous and random nature of emergence, it is difficult to tell how a larger system would function. In a fully implemented mobile system: will agents self-organise according to input and given rules? Will they autonomously act according to what happens to them? And most interestingly, how would people use such a system?

The next step is to run simulations of the system and implement it on PDAs. It will then be tested and evaluated by potential users. For future implementations, we are also interested in investigating how other contexts (e.g. time and location) than the song context could be used to affect emergent behaviour among media agents.

7. Acknowledgements

8. References

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