Context-aware In-flight Entertainment System

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Abstract. Air travel, especially long distance, expose passengers a number of factors that may cause them both physiological and psychological discomfort and even stress. In-flight entertainment system is commonly installed on the long-haul aircraft to improve the passenger's satisfaction level. However, the current installed and commercially available in-flight entertainment systems do not fully explore how the entertainment services can be used to improve the passenger's comfort level physically and psychologically. Also these systems are user adaptive systems where the user is supposed to initiate the system adaptation to get personalized entertainment services. In this paper we present a new context-aware system for personalized stress free in-flight entertainment service provision. It can intelligently provide the passenger preferred stress reduction entertainment services based on his/her personal demographic information, activity, physical and psychological states if the passenger was in stress.

1 Introduction

Travel by air, especially long distance, is not a natural activity for humans. Many people experience some degree of physiological and psychological discomfort and even stress when flying. Excessive stresses may cause the passenger to become aggressive, over-reactive and even endanger the passenger's health (Kalogeropoulos 1998; WHO 2005). Many airlines have realized the potential of using on-board entertainments in improving the passenger's comfort level. However, the current installed and commercially available in-flight entertainment systems do not fully explore how the entertainment services could be used to improve the passenger's comfort level physically and psychologically. Also, they are implemented based on pre-set concept of what customer likes and requires as a homogeneous passenger group that has similar tastes and desires (Liu 2006). However, since the passengers come from highly heterogeneous pools (such as age, gender, ethnicity, etc.), have different individual entertainment preferences and experience different fly situations, one will find that contextually selected entertainment services could bring better physical and psychological comfort to the passenger. Moreover, from control system point of view, the current in-flight entertainment systems are designed and implemented as user adaptive systems (Liu 2006). If the user wants to get personalized entertainment services, he/she needs to use the interactive controller to browser and select the desired entertainment services from the provided options. Regularly if the available choices are

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many and the interaction design is poor, the passenger tends to get disoriented and not manage to find the most appealing entertainment services.

In this paper we present a new context aware system for personalized stress free in-flight entertainment service provision. Compared to the current installed and commercially available in-flight entertainment systems, it has the following features: (1) it can intelligently provide the passenger preferred stress reduction entertainment services based on his/her personal demographic information, activity, physical and psychological states if the passenger was in stress. (2) The passenger is in full control of the in-flight entertainment system, if he/she declines the intelligently provided entertainment services, he/she can browse the personalized entertainment category and contents and reselect his/her preferred entertainment services.

This paper is organized as follows: In Sect. 2 we present our context-aware stress free in-flight entertainment service provision model. After that, section 3 gives a case study. Finally, in Sect. 4 the main conclusion is drawn and the future work is discussed.

2 Context-aware stress free in-flight entertainment service provision

This section describes our new concept model of context-aware stress free in-flight entertainment service provision. We first introduce the entertainment services such as music and games that could be used to reduce the user stress physically and psychologically, and then the way to describe them for selection. After that the user context model is presented. Finally we concentrate on the architecture of the context-aware in-flight entertainment system which mediates between the entertainment services and the user's context to provide personalized stress reduction entertainment services to the passenger.

2.1 Entertainment services

Generally, the entertainment might be divided into two categories (Livaditi 2002): (1) **Passive**- the user-system interaction levels are very low and the passenger simply enjoys a chosen form of entertainment that is presented to her/him in an organized and packaged form. Examples of passive entertainment services are music, movies, etc. (2) **Active** - the user spends time to actively interact with the entertainment system where the following entertainment service content is determined by the interaction between the user and the system. Examples of this type of entertainment are: game, exercise, and gamble**.** In this paper's context, we focus on music and game auto provision to reduce the passenger stress physically and psychologically. There is a long literature involving the use of entertainment services such as music, games, etc. for improving the user's physical and psychological comfort. (Tansik & Routhieaux 1999; Palmer 2005) have shown that "relaxing" music can be used to decrease stress and increase relaxation. It is well known that exercises can reduce the user's stress physically and

psychologically. Usually, the airlines provide some physical exercise tips to the passenger either in paper flyers in front of the passenger's seat or in electronic texts in entertainment systems. However, in most cases the passengers tend to ignore these exercise tips. In our context-aware in-flight entertainment system, these exercise tips are integrated with the game playing. If the passenger wants to play the games, he must move like these pre defined exercises with the game console. Thus, the passenger could improve their physical comfort level with game playing.

Music listeners and game players use many attribute-value items for their entertainment choices such as genre-jazz, language-English, musician-Rain, etc. It is therefore reasonable to represent music and games as a collection of attribute-value pairs.

2.2 User context

Context may be defined as "any information that can be used to characterize the situation of an entity; an entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves" (Dey & Abowd 1999). In this abstract definition "any" information that is relevant to characterize the situation of an entity is used to specify context. This abstract definition is correct, meaning that for different domains and different purposes "context" has specific definition elements.

Our user context is the collection of personalized datum that is pertinent to the adaptive behaviors of the context-aware in-flight entertainment system. The User context data can be either dynamic or static. Static information is mainly the passenger's demographic information such as nationality, sex, age, etc. This information, which embodies different geographic areas, social or ethnic groups, implies different entertainment inclinations. For example, the Entertainment Software Rating Board (ESRB, n.d.), which is set up by the entertainment software industry's trade association, maintains a rating system for video and computer games: the rating symbol, such as E or M, suggesting the game's age appropriateness. Dynamic information includes the passenger's activity, physical and psychological states. Each of them has a set of predefined values which are modeled on signals collected from the corresponding sensors. For the activity dimension, its values include sleeping, working, entertaining, chattering with others which are modeled on the camera signal. For the physical dimension, its values include sub dimensions "time without activity" and "pressure on the body". For the psychological dimension, its values include anxiety, depressed, etc. which are modeled on the fusion of the passenger's bio signals such as heart rate, breathe rate, etc.

2.3 Architecture of the context-aware in-flight entertainment system

Figure 1 shows the main components that make up the context-aware in-flight entertainment system architecture. In the figure, the entertainment service manager is responsible for the in-flight entertainment service (such as music and game) registration, categorization, un-registration, etc service management functions. The user context

manager collects and models signals from the sensors and updates the context information database. The inference engine is the core component of the whole architecture. It is used to mediate between the entertainment services and the user's context according to a set of algorithms to: (1) provide the passenger preferred stress reduction entertainment service intelligently if he/she was in stress and not sleeping, chattering with others, enjoying entertainment services; (2) present personalized entertainment service category and contents according to the passenger's demographic information if the passenger wants to select entertainment services themselves. The coordination mechanism between the above introduced components is based on Event-Control-Action. For example, once the passenger was in stress psychologically and he/she was not sleeping, chattering with others, working or entertaining, the inference engine will get the "calming" music list, select personalized music according to the passenger's demographic information and auto play the music to the passenger to reduce his/ her stress.

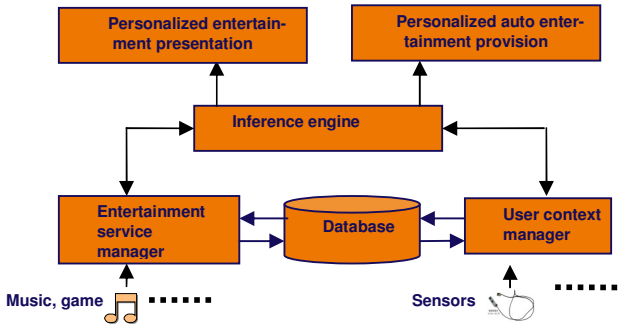

Figure 1. Architecture for the context-aware in-flight entertainment system

3 Case Study

In this section, we use one use case to validate our idea. During the flying, Mr. John is very nervous because this is his first air trip. At the same time, because he just sits near the airplane's engine, the big noise combined with the nervous feeling make John quite anxious. He has no inclination to do some active things such as working, chatting, watching movies etc. By the sensors embedded in the seat and the camera in front of John, the in-flight entertainment system knows the situation and suggests John to put on the anti-noise earphone. Once John did that, the in-flight entertainment system will auto play his preferred "calming" music according to his age, nationality, etc. information to calm him down. After some time, the in-flight entertainment system finds that John has been sitting on his seat without activity more than one hour. It is known that immobility is one of the factors that may lead to the development of a blood clot in a deep vein, so called "deep vein thrombosis" which is obviously not good for John's health. Then, the system recommends a personalized game according

to John's age, gender, etc. information for him to play. Once John played the recommended game, he must move his arms and legs with the game console which can improve his physical comfort significantly.

4 Concluding remarks and future work

This paper has examined a new concept of in-flight entertainment system and how it may be applied to improve the passenger comfort level. We first discussed the concept model of stress free in-flight entertainment service provision which includes how the music and games could be used to reduce the passenger's stress level, and the way to describe them for selection, user's context model and the architecture of our system to mediate between the user's context model and entertainment services to reduce the passenger's stress level. After that a case study of improving the passenger's physical and psychological comfort was presented to validate our ideas. As a conclusion we can say that our context-aware in-flight entertainment system can intelligently improve the passenger's satisfaction level physically and psychologically. In the future, we planned to add components to enable the system automatically learning and adapting to the passenger's preferences base on his/her feedback.

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