1. INTRODUCTION

1.1 Overview of the Problem Area

One of the most important achievements in the past few years has been the appearance and wide deployment of wireless infrastructure and portable devices. The inherent mobility caused by the increasing incorporation of wireless interfaces in these portable devices opens a new world of possibilities for the user that the wired infrastructure and fixed devices were **not** able to offer. As studies of this innovative field advance, many different aspects in need of improvement and numerous obstacles to overcome emerge. For instance, the assurance of constant connectivity, as the device moves around, is a very important aspect to look into. Alternatively, this thesis shows that the user might not need constant connectivity as the user's playlist may have sufficient content to be played. Therefore, a period without connectivity until the end of the playlist is reached is possible.

Other important concepts, apart from mobility, to look into when designing new devices are context awareness and the related use of the user's state as an input to the device. As described in [1], people use an increasing number of appliances and portable devices, such as laptops, cellular phones, Personal Digital Assistants (PDAs), as well as fixed devices, such as desktop computers and fixed phones, for a variety of different tasks. However, none of these devices is aware of the environment that surrounds the user and none of them takes the user's state (busy, available, at work, at home,...) as an input. This results in a scenario in which much time is consumed attending to different kinds of notifications from different types of devices (emails on desktop or laptop computers, calls on telephones, messages on pagers[1],...).

Some problems caused by having multiple devices are lack of differentiation in notification cues, minimal awareness of the user and the environment, devices not learning from prior interaction with the user, lack of co-ordinated notifications, and interruptions in the workplace[1]. Having in mind all these problems which one can encounter when using such devices, it is not difficult to imagine why some people reject them and why a new approach is necessary in order to improve the user's experience.

"Nomadic Radio" is defined as: "... a wearable computing platform that provides a unified audio-only interface to remote services and messages such as email, voice mail, hourly news broadcast, and personal calendar events..."[1]. The *"Nomadic Radio"* can be a partial solution to the

information overload situation of multiple devices, by giving timely and filtered information relevant to the current user's state[2]. The development of *"Nomadic Radio"* builds upon speech recognition, text-to-speech synthesis, speaker recognition, and spatial audio. Continuous sensing of the user and their environment, prioritisation of incoming information, and a suitable wireless network infrastructure is also necessary.

By implementing seven increasing levels of notification: silence, ambient cues, auditory notification, message summary, preview, full body, and foreground rendering, *"Nomadic Radio"* provides a scalable presentation, delivering sufficient information while minimising interruption to the user. By using contextual cues, such as message priority, usage level, and likelihood of conversation, the parameters such as notification level and presentation latency are calculated, resulting in notifications for incoming messages that are dynamically scaled[1].

"SmartBadge version 4" is considered a suitable platform for a possible approach to realise all the improvements possible for the *"Nomadic Radio"*. PCMCIA, USB, infrared, and compact flash ports are available on the SmartBadge, giving it the capability of communicating in different ways in various environments. It is small and can be powered by batteries, so mobility is also supported by the SmartBadge. It has an Intel Strong ARM processor, allowing applications to run on the badge, and it has a variety of sensors[3].

The possibility of having and using multiple wireless interfaces, which *"SmartBadge version 4"* offers, raises the potential value of context-awareness. This concept refers to a knowledge of the 'context' in which the user is; hence his/her activities can influence the functionality of the device(s). The term 'context' is quite broad and can encompass the user's current physical location (location-awareness) and/or the user's state (working, resting, sleeping...).

A good context-aware multimedia system combined with the multiple wireless interfaces of *"SmartBadge version 4"* , gives us the *possibility* of assuring constant connectivity (if required), while, at the same time, choosing the type of wireless interface that suits best the user's current needs and available infrastructure.

Keeping in mind the huge investment in wireless infrastructure currently being made along with the need to improve the design of wearable devices[2] and the possibility of using the *"SmartBadge version 4"* as a real platform to test applications , a deeper study of this subject came as a natural next step.

1.2 Problem Specification

This master thesis aims to address the problems presented above concerning multiple devices and the desired changes introduced by *"Nomadic Radio"*. By understanding how to use and exploit the audio interface of a mobile device and building on text-to-speech synthesis, speaker and speech recognition, and a context-awareness infrastructure, we hope to explore the potentials of this emerging field.

To realise the test environment, a client/server application was designed using the UDP protocol. This application consists of a server-manager and several clients. The manager builds and modifies a list of audio-content, which determines what to output to the user as audio and when it should be output. The manager maintains and manipulates this playlist (see section 2.1.3). This list will be dynamically modified to include new information which is of interest to the user (songs, audio notifications, ...) by inserting this new content into the appropriate place in the list according to certain priorities.

Initially we studied how playlists are usually built, for example for commercial radio broadcast. When studying how to structure the data that a playlist usually contains, the XML protocol was considered to enable the external representation of the playlist in a flexible, easy to use manner and which is readily mapped to the internet protocol. XML builds upon the strengths of SGML and HTML, details of XML will be given in section 2.1.5.

One of obvious clients is a player for the playlist built by the manager. The player-client generates audio output from audio content by selecting the appropriate (media) player. Details of some of the available audio players are given in section 2.1.2. Another client provides a user interface and enables the user to specify the audio files they want the manager to include in the list. To generate audio notifications for inclusion in the list, a client using the text-to-speech synthesis tool *Festival-Lite*[16], previously built by Sean Wong[19], was modified to interact with the manager in the appropriate way.

The resulting system was tested in a laptop computer running linux and using a wireless card in a private wireless network. This computer was connected via WLAN with a *"SmartBadge version 4"*. This later computer can be seen as a wearable computer and was also running linux and using a wireless card inside the same private wireless network. Based on tests with this system and the initial clients (see chapter 3), some conclusions are drawn (see chapter 5) and possible improvements will be pointed out for future work (see chapter 6).