MIAMM: Lessons Learned in Haptic & Tactile Interaction

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Abstract. In this paper, we report on the MIAMM project, one of the key goals of which is to explore the use of the haptic and tactile modalities as a means of interacting with multi-dimensional databases through a hand-held device. The device uses a range of haptic and tactile techniques in order to accommodate the range of data and types of request likely to feature in the use of the MIAMM device. We describe these techniques together with our experiences in implementing them with users in exploratory evaluations. We conclude with sets of recommendations as to factors that need to be taken into account when designing and configuring haptic and tactile interaction techniques.

1. Introduction

Haptic and tactile modalities have been under-used up to the present day as a means for human computer interaction, despite the fact that there are many good arguments for their use. The haptic modality is for example the only modality that can be employed in devices as a simultaneous input and output channel, to allow a more exact modulation of input to be achieved [3]. Both Haptic and Tactile feedback is also able to provide users with salient information when auditory or visual information channels are overloaded or have low signal to noise ratios [2].

In this paper, we describe a selection of visualisations and haptic / tactile control methods which were developed in the course of the MIAMM project to accommodate the querying of a multi-dimensional database. As part of the development process a haptic evaluation workshop was carried out at an early stage in the project in order to provide a clearer idea of how to effectively incorporate our planned haptic / tactile interaction techniques into the project. We also describe a selection of the results from this early evaluation which allowed us to gain a helpful insight into haptic and tactile interaction within the context of the project.

The incorporation of haptic feedback into user interfaces is still a relatively new field although some research has been already been carried out in similar areas. Műnch et al. [1] for example describe the generation of haptic profiles by mapping the

visual relief of a standard GUI. Yu et al., [7] describe a form of haptic data representation in terms of the haptic enhancement of graphs for the visually impaired. Both these examples demonstrate the use of haptics in User Interface control and data visualisation, but take an approach more closely related to Virtual Reality where the visual representation is translated into a direct spatial analogue which is felt via the haptic channel. The limitation of the haptic keys in the mobile device form factor means that such a direct approach is not feasible in MIAMM. Brewster at al. [5], report on a multi-modal method of overcoming the limitations of a mobile device, but this does not extend to haptically enhanced input and output mechanisms. Such mechanisms are key to the research issues in MIAMM and pose interesting research questions given the inherent limitations of movement which are present.

1.1 The MIAMM Project

MIAMM is an EU funded project that focuses on Multi-dimensional information access using multiple modalities. State-of-the-art approaches usually require the user to follow a hierarchical menu structure to find a desired piece of content. While being easy to follow if the user knows exactly what he/she is looking for, the search becomes very cumbersome if the user only has a vague idea about the song and little idea about how it is categorised. Most menu-driven search systems are also restricted to the use of a keyboard and mouse for inputting the search string. As a consequence the search result is often unsatisfactory due to misspellings or other simple errors. MIAMM therefore seeks new ways of exploring such multi-media databases thus offering users more intuitive ways of searching for content, even if title, artist, etc. are not known.

The MIAMM Device: The focus of the project is a hypothetical, handheld device that incorporates three haptically enhanced buttons for the fingers, and one extra key for the thumb. The device also incorporates a microphone to receive the speech input and a screen on which visualisations of the data are shown. Together these input/output channels support multi-modal queries to the database. The user may therefore ask for example- “Show me all the rock titles” and narrow the query down for example by saying- “just those from 1982”. Once a suitable title has been found the user could then play the song by verbally saying, “Play this!” to the device. Alternatively the user could carry out the entire transaction by choosing from among different data visualisations of the data, and manipulating these using haptic and tactile enabled keys**.**

Haptic Workshop: Our aim was to evaluate the candidate interaction techniques on a re-iterative basis, such that decisions could be made throughout the course of the project as to which potential interaction methods should be rejected, and which should be taken further. At the preliminary stage of the project described here, it was decided to hold an ‘Expert Workshop’ where project members could try the devices out themselves and provide feedback. The techniques were tested on an experimental test-bed consisting of 3 linked PHANToM devices. These were configured to provide the effect of pressing three keys with a limited range of movement as envisaged in a