A Mobile Visual Diary for Personal Pain Management

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Abstract. Back-pain is one of the most prolific health problems within the population and costs industry lost revenue due to the amount of days people have to take off in order to recover. In this paper, we have targeted this problem and suggested a mobile app for visually diarizing the pain experience of patients. The Android platform is utilized and its technology stack forms the basis for this 3D centric application. Positive evaluations obtained provide evidence of the promising nature of the approach and indicate several future directions of research within mobile pain management.

Keywords: Pain management, pain diary, interface, mobile application, android, 3D

adfa, p. 1, 2011.

1 Introduction

Chronic pain can be a debilitating condition; it affects men and women in equal measure, citizens of both developed and developing countries, impacting considerably on countries' GDP through reduced productivity and lost working days. Moreover, back-pain does not affect solely the adult population: studies across Europe show that back-pain is very common in children, with around 50 percent experiencing back-pain at some time [1]. Any improvement in the way that patients with back-pain can be analyzed (and subsequently treated) is therefore potentially capable of significantly saving both benefit expenditure and lost man-hours [2 - 6].

To this end, in this paper we propose the use of mobile application ('app') for visually diarizing a patient's experience of pain. Our solution is based on the use of a "pain drawing" – these are two dimensional representations of the contour of a human body, widely used in clinical settings, on which the patient indicates the location, spread and type of pain [3, 4, 6, 7]. Based on previous work of ours [8], we extend these traditional paper-based pain drawings not only into the digital realm, but, given the ubiquity of mobile phone technology, into an app through which patients can indicate on a 3D mannequin not only the type and position of the pain experienced, but also its intensity. This enables chronic pain sufferers to keep electronic diaries of their pain; given that the app is available on a mobile platform, the diarizing process can be performed anytime-anywhere. Moreover, in so doing, not only does the patient become an active stakeholder in the management of his/her pain, but, s/he builds a better understanding of the relationship between the pain experienced and the type of activities undertaken as well as the timing and quantity of the medication administered [9]. Indeed, by engaging in this process, chronic sufferers have reported a better pacing of medication intake, with a reduction of up to a third in the quantities of medication involved.

2 Application Architecture and Design

The application is developed for the Android platform [10]. By the nature of the Android platform, this enables the application to run on smartphone devices as well as tablets. The full benefit of the application is first reached when running on a 7" or larger tablet device. In such a device we are able to facilitate full interaction and visualization for the user, emphasizing the interaction with the displayed 3D model as the main feature of the app. The application is built around a 3D toolkit implementation to allow cross device Android implementation, increase developer environment sup-

port and provide a robust, scalable architecture.

2.1 Platform Architecture

Google released Android in November 2007, under the framework of the Open Handset Alliance [11]. The goal was to provide a platform for open innovation for mobile solutions and that the source code should be provided free of charge and made available through open source arenas. Android is an open source mobile operating system based on the Linux kernel and facilitates developers to write managed code in Java using Google developed Java libraries [12]. The Android platform does not only provide the mobile operating system itself including the development environment, but also provides a custom built runtime environment, named the "Android Runtime Environment (ART)" starting from their 2014 release of the operating system codenamed "Lollipop" (This replaced the previous virtual machine runtime based on the Dalvik Virtual Machine). Applications can run independently as well as acting as the middleware between native code / API components and the operating system. For application development, Android facilitates the use of 2D and 3D graphic libraries, a customized, a media framework, onboard SQL engine for persistent storage, near field communication capabilities and advanced network capabilities such as 3G, 4G and WLAN (Fig. 1).

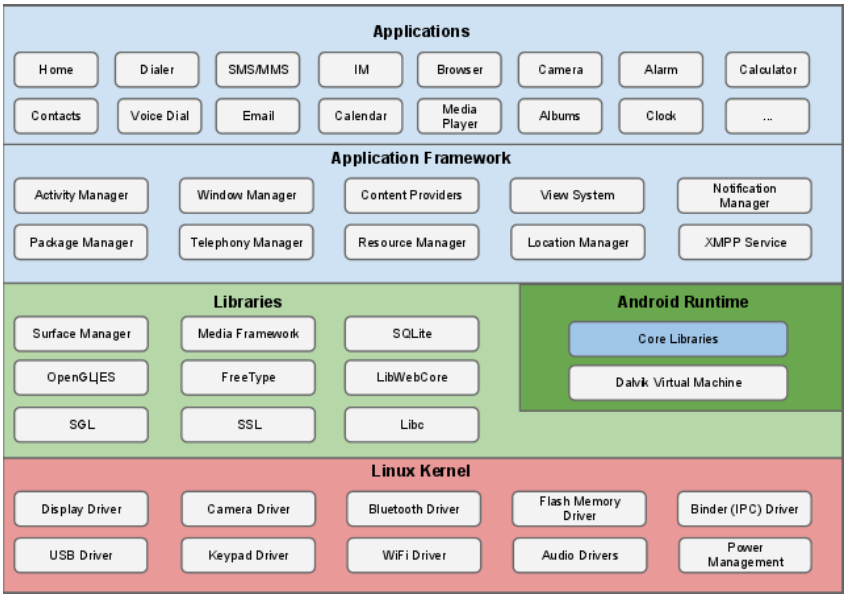

Figure 1 Android system architecture [10]

The API is constantly evolving and the current release (5 Lollipop) [12] is a huge increment compared with number of available features from release 1.0. The current version of the API facilitates not only programming for mobile devices, but also separate segments for TV, cars and wearables. Since Android is an open source mobile operating system, the community is welcomed to collaborate in the evolvement of the programming environment, the operating system and the API.

2.2 Application Design

The Mobile Visual Diary for Personal Pain Management product reduces the cost of caring for patients suffering significant pain whilst improving their overall quality of life. It does this by replacing the current traditional 2 dimensional paper based pain indication methods during consultations with a system that records patient's pain profile over time, away from the clinic. The data collected by the patient can later very efficiently be presented for clinicians during their appointment. This reduces clinician/patient exposure time and increases the accuracy of determining prescription, saving significant costs and increasing the number of patients seen during clinics. By applying a mobile approach we take advantage of the everyday presence of mobile devices and empower the user to take control of his/her own situation. The native environment on the Android platform enables easily for integration of 3D based figures and everyday mobile gestures such as tap, pinch-to-zoom, drag and drop etc. are available in the platform software development kit.

On the screen (Fig. 2), the user is presented with five different pain types; numbness, stabbing, pins & needles, burning, and stiffness, which were arbitrary color-coded. These types were chosen carefully after consultation with clinical staff, and are well documented in the literature [2, 7].

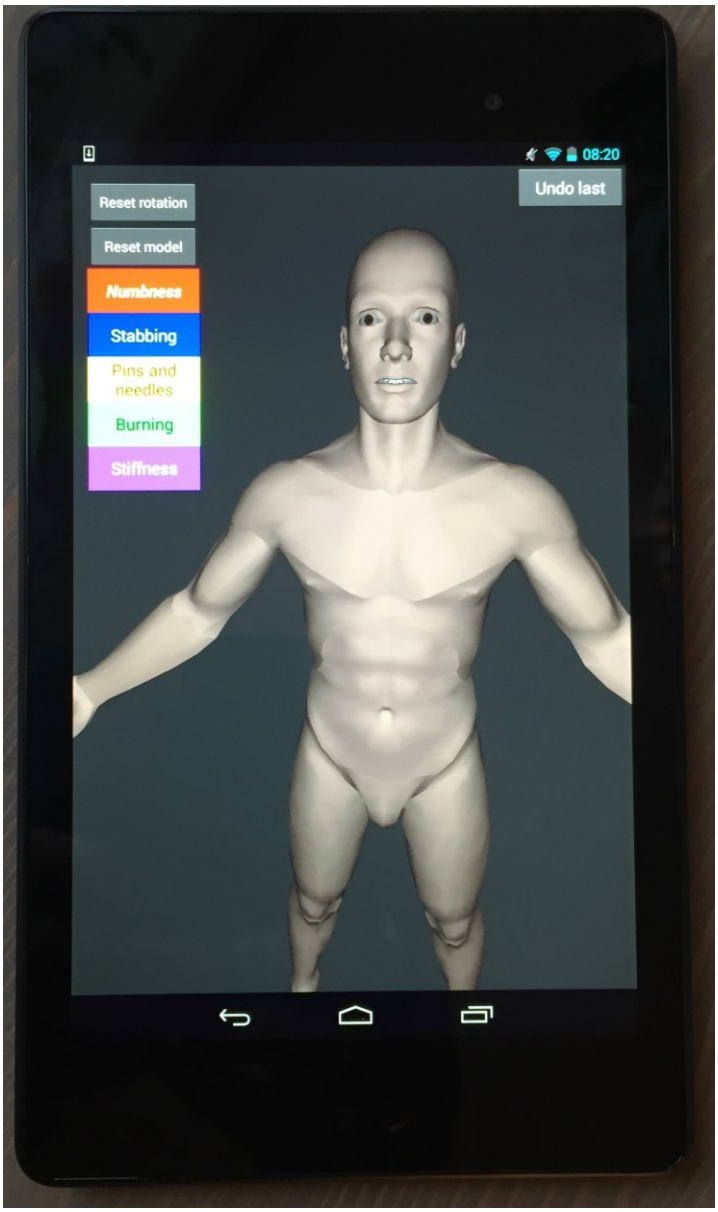

Figure 2 App running on a Nexus 7” tablet device

User interaction is based both on touch and gesture input. For example, the user can tilt the device and engage the device accelerometer to rotate the 3D mannequin model. Additionally for pain selection, the user selects an appropriate pain type by tapping on the predefined list presented on the left of the screen, and then the location of the pain is selected, again by tapping on the desired body part of the model. Each color represents a pain type and the model is colored at the selected location (Fig. 3). With multi-tap (up till four times) the color is applied on the same body part, a darker color will be displayed for each tap, indicating a stronger pain.

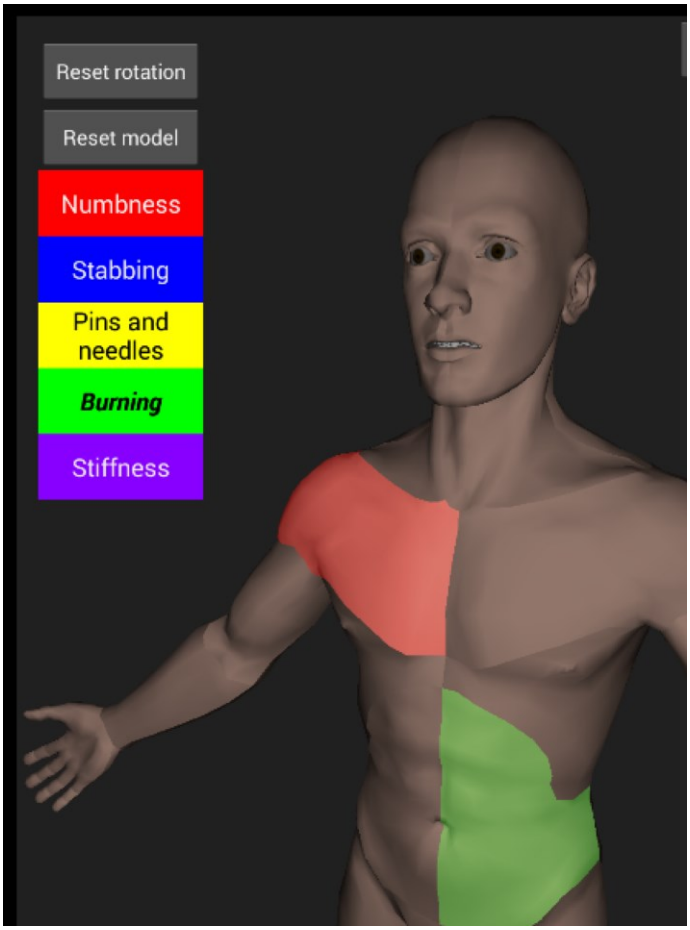

Figure 3 User interface close up with the 3D model including pain indicator

When the user exits the model interaction screen, the application saves model history data about the selected body part (s) and pain type (s), timestamp and a comment. Later the user can revisit the saved models and play back the history of indicated pain levels for any period of his/her choosing.

3 Results & Conclusion

Preliminary evaluation of the application indicates a generally positive user experience when interacting with the app in respect of the apps usability and functionality (the features receives very positive feedback and commentary when presented and tested). The application shows how it can be a feasible alternative for users in conical pain in terms of self-management of the pain and possibly lead to positive benefits such as improved life quality, intake of medicines adjusted to pain development and daily control the personal pain levels.

Back-pain is one of the most prolific health problems within the population and costs industry lost revenue due to the amount of days people have to take off in order to recover. In this paper, we have targeted this problem and suggested a mobile app for visually diarizing the pain experience of patients. The positive evaluations obtained provide evidence of the promising nature of the approach described; this will however have to be confirmed by more extensive studies benefitting from clinical settings.

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