Tracking The Imperceptible: Designs to Visualise Time Dilation

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ABSTRACT

In our project we developed *TimeTravel*, a design for visualising personal time dilation. Time dilation is the effect on time that movement in space produces. Predicted by Einstein's Special theory of relativity (1905) and verified by practical experiment such as the famous Haffele-Keating experiment of 1972 [3], time dilation affects all things in motion and is even included in the calculations for GPS receivers.

Our project developed an application for wearable devices that visualises the imperceptible effects of time dilation on a user's everyday activities in an easy to understand, meaningful way. We used the development to consider what happens when we attempt to visualise the imperceptible.

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

Author Keywords

Visualisation; Time; Time Dilation; Interaction Design; Wearable Devices;

INTRODUCTION

The project is a continuation of previous research [1] [2] into creative visualisation of the perception and representation of time. The design is at an interim stage and will iterate further in the run-up to public release. We wish to share our work so far to engage in a dialogue about our next stage in the design processes. Our design seeks to communicate an esoteric concept from theoretical physics through practical visualisation. The research tackles the issues of developing an artefact for clearly visualising this imperceptible data to users.

Time dilation is described in Einstein's Theory of Relativity and is the actual difference of elapsed time between events measured by two observers moving relative to each other or under the influence of different gravitational fields. The fundamental aspect of the recording and visualisation of time dilation is the effect in relation to other things. The quest to visualise the actuality of the effects of time dilation on every individual led us to a design for a very personal, worn device. The watch being ideal in this scenario.

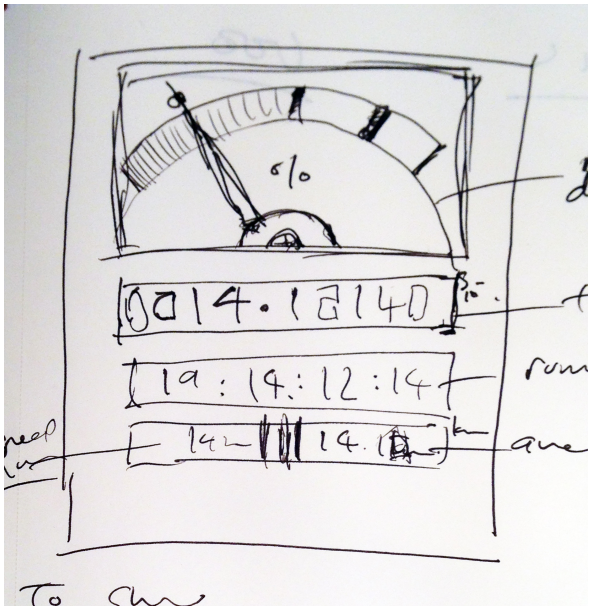

Figure 1. Sketch origins of the design for a personal time dilation indicator

DEVELOPMENT OF THE DESIGN

Our objective was to track the velocity and timing of an individual via geo-location techniques in a physical way. Then use the data collected from the device to calculate time and velocity and visualise subsequent dilation effects relative to a (theoretical) fixed basepoint. The effect of time dilation is non-linear in nature, [5] the range of dilation related to motion, from static to walking speed to modern air transportation generates a wide range of data. At low speeds the effect is extremely small.

The design and presentation of on-screen graphics was reconsidered in constant review with a series of early prototypes. Subsequent designs adopted metaphors from real-time physical displays in the style of a classic VU meter combined with an approximation of an automotive speedometer. Early testers were able to connect the imperceptible changes in their sub-

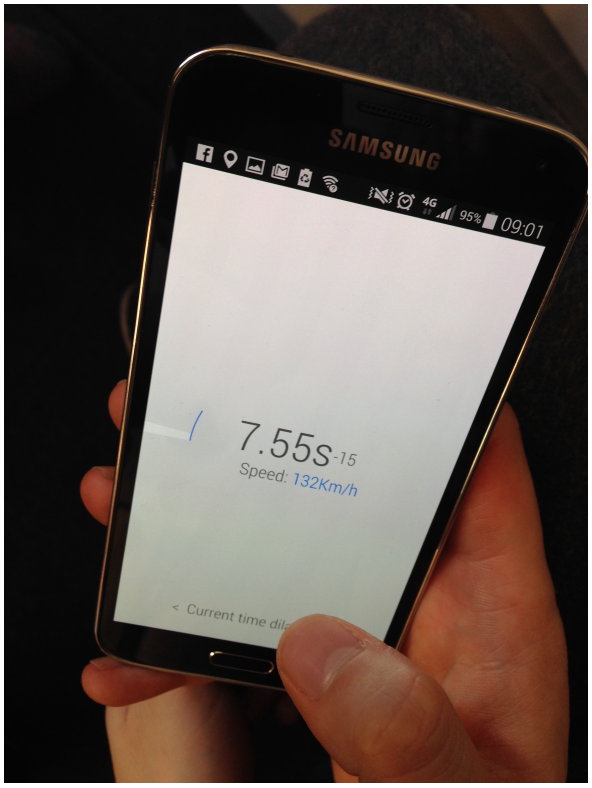

Figure 2. Early prototype developed for Android OS

jective experience of time directly to their speed of motion, walking or travelling by train etc.

Further refinements adopted new AndroidWear [1] UI guidelines more closely, making a more seamless integration into the overall wearables context. Anticipating the personal and physical nature of what we wanted to convey we also incorporated visual references from the styling of quantified self and health and fitness tracking software. Early feedback from alpha test users indicated a *'sense of wonder'* with a small number conveying a *'sense of disorientation'* when considering the challenge that the concept of personal time dilation brings. This response was considered a particular success.

FURTHER DISCUSSION

Our next stage is to conduct an adoptive user study (n =< 10) with a small number of users with Android smart-watches devices. In the adoptive strategy we ask users to engage with the application for an extended period of time. We are primarily interested in studying what if any changes occur when we present seemingly impossible concepts such as the speed of light and the warping of time in visual form to users.

We are working in the arena of making the invisible immediate. The arena where we are augmenting our senses through technology - such as experiments in making wi-fi signals perceivable [6] or detecting magnetism [4] - changes the context of how we live and how we may comprehend our world.

[1] http://www.android.com/wear/

Figure 3. AndroidWear visualisation of the finalised trial version showing instataneous time dilation readout

We see our design research as investigating the bridge between the lived and theoretical worlds and present it as a practical investigation into what happens when we visualise the imperceptible.

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