Share Aware: An interactive Pervasive System

To Promote Awareness of Workstation Ergomonics

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ABSTRACT

Workstation ergonomic problems have become a major health issue in the office. Sitting in the same place for a long time and improper sitting postures while using computers can lead to a wide range of computer-related injuries.

We introduce a system promoting workstation health called 'Share Aware'. 'Share Aware' is designed to make people aware of how to prevent computer-related injuries and help them build up correct long term computer-using habits.

The interactive system consists of a seat cover with embedded sensors which track user posture and sitting time with a screen-based application that represents the data in two modes: intrusive or discreet. Real-time feedback, data log of sitting conditions, and customizability are keywords.

This paper discusses the user-centred design and development of the system and how its features benefit the user. These features include context histories, ambient displays, interesting visualisations and self-evaluations.

1. INTRODUCTION: MISSION

115 million days were lost from work due to back pains by computer related work in Britain 1994-95. (Department of Social Security) "After the workstation is built correctly (this is the easy part) the real issue in the office is correct behavior". (Eyal Levy, Ergonomics Researcher)

The interactive system consists of a seat cover with three embedded sensors tracking user posture and sitting time with a screen-based application that represents the data in two modes: intrusive or discreet. For adolescents, a wrong posture while using computers negatively and irreversibly affect body growth. Companies spend an increasing amount on injury compensation claims and the medical costs of occupational illness caused by computers. For workers, work performance is reduced by the physical injuries, which could also lead to work stress. In some cases, RSI (Repetitive Strain Injury) could disable work abilities permanently.

Instead of monitoring computer-using habits, we aim to trigger users awareness and self-consciousness through the use of real-time feedback and reflection of context history.

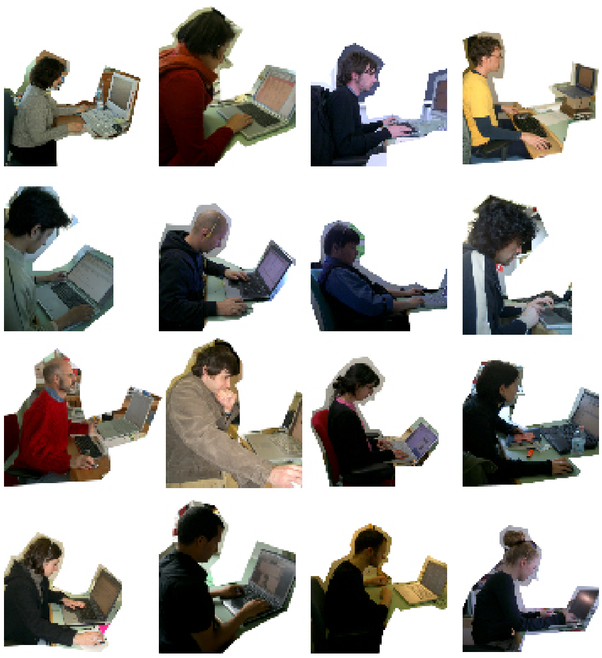

Figure 1: Shows the postures of many people from our user research. None of them demonstrated correct sitting postures.

CARPE '04 New York, New York USA

2. EXISTING SOLUTIONS

Ergonomic Products

Existing ergonomic chair's have two main functions: automatic adjustment to the human body, or alerting users by embedded alarms. The form of the chair limits its use to be in locations, however, a sensor-embedded seat cover works on any chair design and together with the application can satisfy the needs of users in any work environment that requires an extensive use of computers. Besides, the multi-sensor-embedded ergonomic chair to a certain extent takes away the users control which is a negative effect to user. Therefore, we aim to give control to the user and use subtle hints.

An Ergonomic keyboard aims only at improving hand position. But sitting postures and sitting time are also fundamental factors in computer-related injuries. **Software**

Applications

There are screen-based applications that are preset by the user to alert him or her after a certain duration of time. However they do not account for posture or the fact that the user might not be working at all. Also, such interruption might come at inconvenient times like the presentations. Other applications allow users to take breaks from the computer through peer pressure or surveillance. One application, for instance tells you if your friend has gone for a coffee break and urges you to do the same. We think such solutions invade privacy even though they are setup with the permission of other users because there are moments when one would not like to disclose one's working habits.

3. OUR RESEARCH

Our Goal was to design technologies that help solve problems caused by technologies. After extensive research we focused on workstation ergonomics, an increasingly serious problem in industrialised countries. We then looked at people's careers, lifestyles, technological objects, interfaces, timings, exercises, body parts etc. The following sections describe our Research topics.

Figure 2: Shows our User Testing done at an office.

Figure 3: The user testing helped us iterate our design and come up with a more meaningful solution.

Actors Computers and its various parts, the human body, human postures, health exercises, human senses and possible feedbacks and displays, offices, office work, interiors and workstations, universities and schools, social networks in these locations.

Possible Target Groups Schools, universities, factories, private computer learning centers, typical office, call centers, publishing companies

Chosen Target group The office worker.

Types of physical computer-related injuries We looked at the most common physical problems under Workstation Injuries: Eye Strain, Neck Pain, Carpel Tunnel Syndrome, Triggling Fingers, Back Pain

Correct habit of using computer We looked at what constitutes healthy ways of using computers as suggested by medical experts. We found three areas very relevant in our research: sitting posture, sufficient break, computer positioning

Reasons of having the incorrect habits We then did desktop research and interviewed many people to understand why they do not observe a healthier routine while working on computers. We found the listed factors most common responses were: Cant remember, lack of guidance, ignorant.

Opinions from experts We wrote to ergonomic experts and therapists in leading semiconductor companies with large budgets for research in workstation injuries and their prevention. In particular, the experts mentioned that besides having an ergonomically safe environment, it is more important to help workers develop good ergonomically safe working habits.

Existing tools to prevent or cure computer-related injuries We looked at products and services that presently try to the prevent or cure workstation injuries. We made good use of their findings and learned from the mistakes that they made when designing our own system.

User Test We performed user tests with iterated prototypes at a mobile game design consultancy. Ribes Informatica, Via Jervis 6, Ivrea(To) Italy. 23rd March 2004. Two sets of prototypes were set up in the office for two users. After the set-up, the users worked as usual. Their screens actively displayed their sitting conditions and sitting time throughout the day. Their posture history was being recorded in a text file. At the end of the day we carried out interviews to take reactions, feedback and criticism. The users were shown the text files with their posture history which told a lot about how they worked. They found the real-time feedback was able to make them aware of their sitting postures and thus reminded them to correct these immediately.

Stake holders To understand the business plan we identified some stakeholders who might take particular interest in our service. Organisations: offices, government, health insurance companies, labour organisations, ergonomic consultancies. Individuals: Workers, office executives, ergonomic consultants, physicians, friends, family.

4. OUR PROPOSED SOLUTION: HOW IT WORKS

The design consists of a sensor seat cover and a screen-based application. The sitting conditions and sitting time will be subtly suggested to the user by a real-time graphical display on the computer screen. The display has two modes: intrusive and discreet .

The application can be customised according to the preferences of users. For instance, they can personalise the application to have a take-a-break alert for every hour they sit.

Data regarding the users sitting habits detected by the sensor seat cover are collected and visualised.

Figure 4: Shows the various components of our system that helps the user evaluate his workstation habits.

5. ADVANTAGES OF OUR SYSTEM

5.1 Contributions and challenges

Our discussion of pervasive technology and context history focuses on personal preventative healthcare and devices. The discussion is drawn from the evaluation of our product Share-Aware, which is based on a user centered approach. We now discuss the challenges and contribution of using visualization, real-time feedback and context history with reference to the features of our product.

5.2 User experience of temporal displays and visualization

Screen-based display Vs Ambient Display

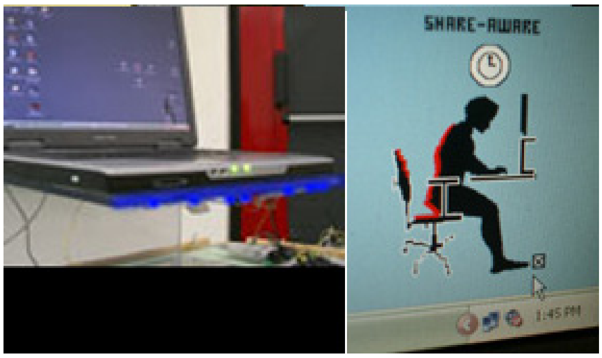

Figure 5: Shows the comparison between the ambient display hidden in the laptop stand and the screen based display in the corner of the screen.

Share-Aware users are given hints about of their posture and duration through with a graphical display on screen. The display takes only a few distinctive features to illustrate the sitting posture but does not completely imitating the way the user sits. This is to avoid suggestion of the surveillance a simple but responsive display is sufficient for the effect we seek.

Only three sensors are embedded in the seat cover because we do not intend to monitor the users sitting pattern completes, which might imply to users that they are being monitored. Instead, we work on raising the users awareness as principle, thus, even three sensors work perfectly in such condition.

Earlier we tested offering the user real-time feedback through an ambient display. However, the effect is unsatisfying. While users work at their computers, their concentration is focused only on the screen. Ambient display is not useful unless it is intrusive enough to catch the users attention off the screen. However, being intrusive could be annoying especially when users are concentrated on their work. Thus, this is avoided in our subtle screen-based solution in which the intrusion level can be personalized by the users.

Discreet mode Vs intrusive mode

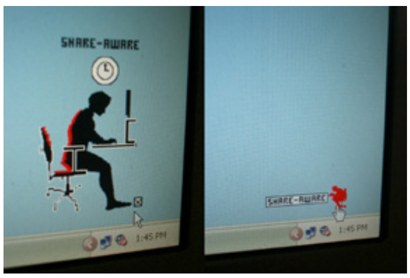

Figure 6: Shows the graphical display in the two modes: Icon mode, a discreet mode and the Display mode, an intrusive mode.

As we noted before the screen-based graphical display can be illustrated in two modes: discreet and intrusive .The discreet mode is suitable when a users prefer a full screen display of the program they are working at: A very small display at the corner of the screen in the task bar avoids undue intrusion. In contrast, the intrusive mode occupies more screen space and tells users which parts of their posture need to pay attention to and clearly indicates their sitting time. The screen-based graphical display can always sit on top of the other computer applications the user is working at to help gain the user's attention.

Working habits vary from user to user. Having two modes of display addresses the needs of different conditions.

Personalization

Most of the features of the screen-based application can be personalized depending on the users preference.

By default, the sitting time alert is prompted after the user has sat for one hour. The user can configure the time alert to be prompted, for instance, after two hours.

The display size and location of the graphical screen-based display can be customized, as can the duration and type of audio feedback hinting.

We offer these options because we do not intend to change the working habits of users. While using the computer, the user always has full control over the system. They can configure the screen display, volume, screen contrast etc. As they prefer therefore, when we apply the use of pervasive technology, it should not in any way obstruct the users preference nor invade the users freedom.

5.3 Context History

Visualization of History over a Timeline

Figure 7: Shows the data file created storing the users posture and time durations of each posture which is then used to make interesting visualizations of the same information.

Context data history is meaningful to users only when it is visualized and presented properly to them. In Share-Aware, the data is visualized against time. To show users how their sitting patterns improve or vary over a long period. Users can easily identify the possible cause of their computer-related injury, if any, by comparing or analyzing their sitting pattern. Context history is also served to raise the users self-consciousness. The data history stores the user sitting posture and sitting time for each posture which then can be visualized in may interesting ways for different kind of users. Our visualizations shows one such example.

Unlike many existing products Share-Aware does not provide an analysis to the context history. We found that an automated analysis of the data is rarely true and in certain situations might itself cause stress and in turn add to the users injury.We focus instead on accurately visualizing what happened and leave the analysis up to the conscious user who knows their working habits more than any machine could.

Extensive use of Data

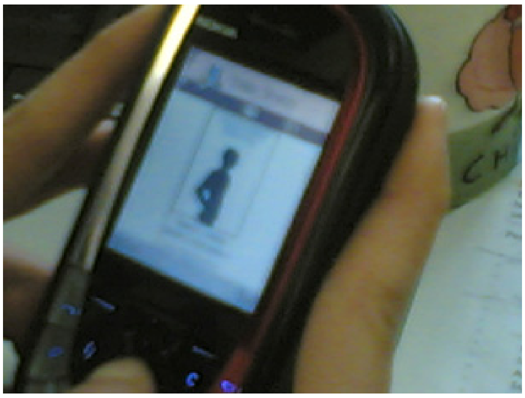

Figure 8: Shows a mobile phone that gives useful feedback to the user by becoming an extension of the system.

Context data history can be used in other mediums. An example in Share-Aware is to offer user a stretch exercise tip through the user's mobile phone in responses to the users sitting problem during the day. It is of the designers interest to interpret the data in different purpose. It is in the designers interest to interpret the data in different ways for various uses.

Sharing Vs Privacy

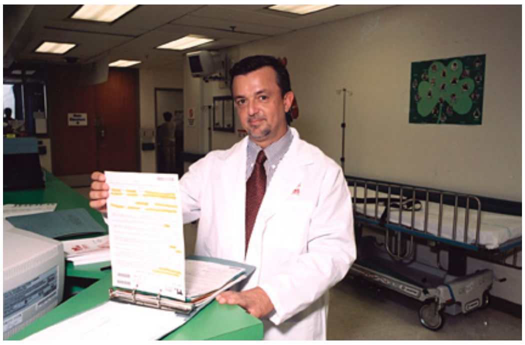

Figure 9: Shows an ergonomic expert who could benefit from such a system.

Though Share-Aware is designed for personal preventative healthcare, we are also concerned about the social impact , earlier we had suggested that our users might share sitting patterns with each other. We assumed this might create good peer influence amongst users to achieve correct computer-using habits. But users saw this request as an invasion of their privacy. It may be, however, appropriate if the data is presented collectively and compared anonymously. In our context, such collective representation does not serve a very meaningful purpose and therefore this is excluded in our design.

But it is clearly useful to share the data with ergonomics experts if users give their permission.

5.4 Realtime Feedback

Visual: The Share-Aware user is given hints about his or her sitting pattern with real-time feedback. We emphasize hint as we are concerned about the need for subtlety an non-intrusiveness.

Audio: We also found a need for subtle and personalisable sound feedback users are so engrossed in their software that they might miss a discreet visual alert.

In many products a default time fixed alert usually appears as ineffective and even disturbing if it prompts users to take a break when they are just starting to work. Share-Aware, on the other hand, reminds users about their sitting time and postures in response to the particular computer-using habits of different users. Hints are displayed in real time and thus helps users correct themselves immediately. Depending on users, intrusion level preference the application hints to the users any required change in their habit when it matters most to them, that is at that moment itself.

6. AUTHOR BIOS

Anurag Sehgal holds a B.A. in Fashion Design from the National Institute of Fashion Technology, India and a Masters in Interaction Design from the Interaction Design Institute Ivrea, Italy. With his background in fashion design and a graduation project on wearable electronics, Anurag worked on ubiquitous and tangible interface design with The Crossing Project, a research initiative of Xerox PARC and Interaction-Ivrea Explorer Ranjit Makkuni. He has also interned at the ePI lab of Professor Steve Mann at the University of Toronto regarding work on ubiquitous and wearable computing.

Patray Lui received her B.A. in Environmental Design, The Hong Kong Polytechnic University, Hong Kong and a Masters in Interaction Design from the Interaction Design Institute Ivrea, Italy. She worked as an interaction design intern in Philips Design, focusing in multimedia interface. Her current interest is in investigating the interaction quality between a screen-based interface and a physical object.

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