Utilizing real time AffectiveSensors to incorporate emotions into human computer interactions

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A real-time 'AffectiveWare' platform has been built to measure the physiological states strongly connected with human emotion, called 'AffectiveWare', with the aim of improving human-computer interaction. This paper presents some preliminary results of data collected in The Science Museum, London with 86 participants using this platform. Subjects used an e-commerce programme whilst wearing AffectiveSensors such as the 'AffectiveRings' and 'AffectiveMouse'. It was found that it was not necessary to know the absolute values of the skin conductance measurement, rather the relative change of the readings in response to onscreen events. In terms of the relative merits of the two different sensors, it was found that the AffectiveRings offered more easily interpretable data in comparison with the AffectiveMouse. In addition, fewer subjects wearing the AffectiveRings were lost to interpretation through being out of range. Ultimately, the 'AffectiveWare' platform allows emotions to be deduced in real-time. It could be integrated into existing or newly built systems which would considerably improve human-computer interaction.

Key words – Affective Computing, Wearable Sensors, Expert System Platform Integration, Communication Protocol

I. Introduction

It has been argued that to improve the quality of human-computer interaction it should simulate as closely as possible the social interaction between human beings (2). One of the key facets of this interaction is the recognising of emotion, which humans do easily. However, until recent developments within affective computing, this has not been possible for the PC without interrupting their main functionality (4).The research emphasis of the AffectiveWare platform is to extend and optimise existing theoretical models of human-computer interaction by offering a more accurate representation of human emotional state (6). Typical systems within affective computing research are static, only taking measurements at fixed points in time, thus making the interpretation of emotional states less accurate. The system used here is different, being dynamic and operating in real-time. This allows the interpretation of the physiological information associated with emotion (1,5) based on the subject's ongoing interaction with the computer. Two different AffectiveSensors were developed so that a comparison could be made between them, in particular focusing on the usability of the sensors and their results.

II. Evaluation Setup and Methods

Figure 1 shows the two AffectiveSensors for measuring skin conductance used in the experiment. The schematics inside them are identical.

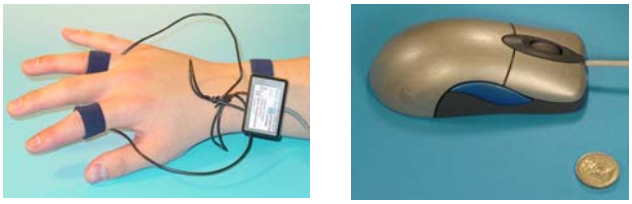

Figure 1. AffectiveSensors for measuring hand skin conductance

On the left is the subject's hand wearing the AffectiveRings. These are elastic tapes containing electro-conductive material and are placed on the index and fourth fingers. The sensor's electronics are attached to the wrist of the wearer, and is similar in weight to an ordinary watch. On the right is the AffectiveMouse. The measurement is taken between the left and right button and the body of the mouse via conductive paint. **The Science Museum is a perfect place to conduct an experiment involving measuring skin conductance as the humidity and temperature are electronically controlled and stable. It took place in the Life Science Department inside the Wellcome Wing (see figure 2).**

Figure 2. AffectiveWare at the Science Museum.

Each of the participants was given an e-commerce task involving selecting some bottles of wine. We suggested the

session length would be approximately 10 min per person, but we did not enforce this.

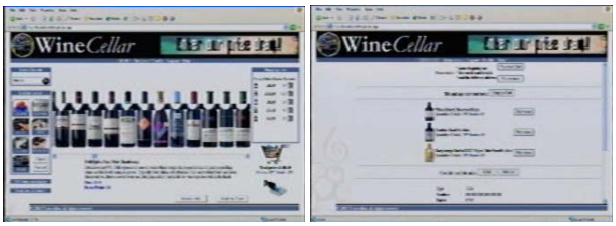

Figure 3. AffectiveWare at the Science Museum.

Two videos were taken of the subjects' face and the relevant sensor (Figure 4). These were correlated with the output of the skin conductance and the PC screen via the Video Quad. Later analysis of the four data sources by the researchers allowed the matching of changes in emotional states with the events onscreen.

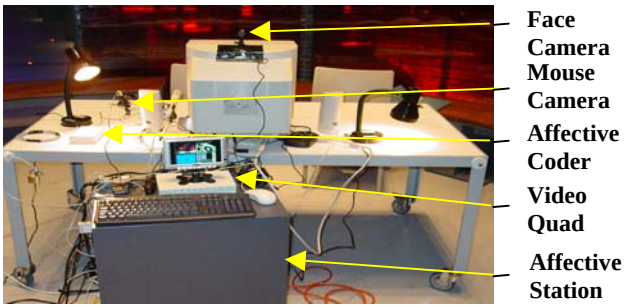

Figure 4. AffectiveWare Platform

III. RESULTS

Figure 5 shows the AffectiveReadings of two different users generated by the AffectiveRings. The arousal and relaxation times that correspond with events on the screen can clearly be seen.

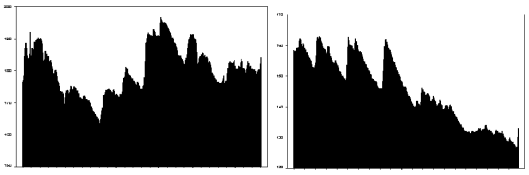

Figure 5. AffectiveReadings taken with AffectiveRings

Figure 6 shows the AffectiveReadings of two different users generated by the AffectiveMouse. The person in the left diagram operates the computer using mouse most of the time, whilst the one of the right prefers to use the keyboard. The data is more sporadic in comparison with the AffectiveRings because the subjects' hands are not always in continuous contact with the conductive surface of the AffectiveMouse.

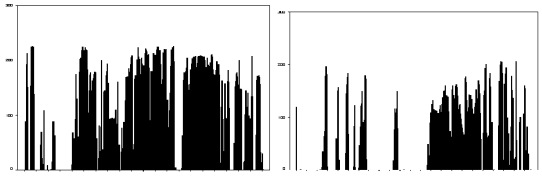

Figure 6. AffectiveReadings taken with AffectiveMouse

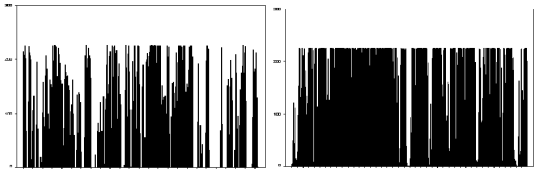

Figure 7. 'Border Line' and 'Out Of Range' AffectiveReadings

Figure 7 shows AffectiveReadings that are not amenable to interpretation. Two categories were defined; 'Border Line' and 'Out of Range'. Border Line (left in figure 7) is when the subject's conductance leave the range of the sensor for short period's of time. In this case it is possible to continue the analysis later on, ignoring the peak values. On the right side of figure 7 is shown a typical 'Out of Range' scenario where the readings are not interpretable.

Due to right of the participants to switch off the video recording, only 74 video records or 86% of all 86 subjects were included in the analysis. 31(41.9%) were female and 43(58.1%) were male. The AffectiveRings were used 33 times (44.6%) and AffectiveMouse 32 times (43.2%). In nine cases (12.2%) the recording had not been made because of the right of the participants to prohibit the data storage.

Category	Subjects	%
Borderline	10	13.5%
Not Applicable	9	12.2%
Out of range	8	10.8%
Within the range	47	63.5%

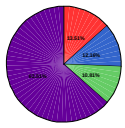

Figure 8. Distribution of AffectiveReadings Categories

The usage of different sensors did not change how long the subjects participated in the experiment. Both appear equally useable. This is shown in Figure 9.

SENSOR	Mean Length	N	Std. Deviation
AffectiveMouse	0:09:33	32	0:05:12
AffectiveRings	0:09:19	33	0:04:14
Total	0:09:26	65	0:04:42

Figure 9. Usage of AffectiveSensors and Session Length

In comparison of the two AffectiveSensors the AffectiveMouse is less accurate and it works only in half of the cases, as indicated by Figure 10.

	AffectiveMouse		AffectiveRings	
Category	Count	%	Count	%
Borderline	10	31.3%	0	0
Out of range	6	18.8%	2	6.1%
Within the range	16	50.0%	31	93.9%

Figure 10. Frequency analysis of category with AffectiveSensor

IV. Discussion and Conclusions

This preliminary analysis shows that interpretable results can be obtained for the majority of people (63.5%), indicating the potential for widespread use of the AffectiveWare platform. However, this was not the case for a significant minority, whose reading were either borderline or out of range. One of the major limitations of any system which relies on the measurement of physiological parameters is that it will not be suitable for use by all people. This is because people differ in ways specific to the use of any given sensor. Some of these differences are genetic, for example, not all individuals sweat, therefore any sensor based on skin conductance will not operate in that instance. Other differences might be produced as a result of the person's behaviour, for example using a certain beauty product on the skin such as moisturiser, or the person's environment, such as pollution. In addition, not all individuals will feel comfortable about having their physiological data recorded and analysed. This was the case for 12% of our sample.

It is also the case that the type of sensor affects the interpretability of the output. In this experiment it was clear that the AffectiveRings consistently produced readable results for most subjects (94%), unlike the AffectiveMouse which produced them for only 50% of cases. When out of range readings occur, this problem cannot be fixed by software procedures, rather the options are to readjust the AffectiveSensors, recalibrating them or accept their limitation as not useable by all people. The AffectiveMouse, however, it has arguably other benefits which may outweigh this disadvantage. In particular it collects the measurements in a non-intrusive way so that the participants are not continuously aware of its presence once use has commenced, unlike with the AffectiveRings. The usage of non intrusive sensors is an area that is likely to expand in the future.

This experiment also showed that it was not necessary to know the absolute values of the skin conductance measurement, rather the relative change of the readings in response to onscreen events.

The development of new sensors will increase the usability and accuracy of the AffectivePlatform for detecting emotional changes whilst using computers. The potential exists for numerous non-intrusive devices to this end, such as an AffectiveChair, AffectiveMobilePhone and even an AffectiveRoom.

V. References

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