Interactive Design Activism

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Introduction

"That human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature"
1st Principle of the Rio Earth Summit [a]

"When it comes to computers and the environment, the main oncerns come from the consequences of creating and disposing of the machine."
Computers and the environment (Gajjar, 2010) [b]

This chapter describes a collaborative transdisciplinary research project (by human beings) in response to *awareness* of a health problem, in this case the potential for skin damage and cancer, created by inappropriate use of our natural habitats. From the various elements within the research toolbox created for this project, the importance of computing emerged and resulted in this question:

How can computers support "human" survival?

Design and computer science became the common media to describe the various elements developed for the project toolbox. Through the chapter two different meaning of awareness emerge– *"binary-awareness"* and *"fuzzy-awareness".* Initially, there were differences between the approaches of the participants in the Barrier Solutions© research project; using the language of design and computing helped bring about a common understanding concerning potential solutions.

One of the reasons we focused on the natural phenomenon of solar radiation is its complexity in relation to human survival; on the one hand, supporting life, yet carcinogenic in cases of prolonged exposure or individual vulnerability. There are already a multitude of computer applications, particularly within the medical and health domains, which are utilised to support human life. Below are given some examples of well-known successful applications:

- ✓ regulating cardio rhythms to prevent interruption of blood circulation
- ✓ regulating breathing to prevent apnoea where the patient is asleep therefore unaware
- ✓ maintaining cabin pressure, oxygen levels and air circulation within airplanes/submarines

At this stage, it is important to note that all of these computer applications require decision-making on the part of the computer which could potentially save or endanger life. The interventions also have the characteristics of being unique for each human being (for example, one person's ideal breathing pressure is individually calculated) and this could change over time. Such decision-making also adheres to fuzzy rules- in other words, binary (yes/no) solutions are not appropriate- there is no clear point at which the breathing pressure is ideal for every human, and it may even change for the

human over the course of a night. Additionally, these applications often involve complex feedback mechanisms, for example, within an airplane, if the general solution of providing a given level of cabin pressure fails, a fall-back mechanism of providing individual masks for oxygen will be activated. The applications do differ, however, for example, the first (cardiac rhythm control) is built inside the body and is always present, whereas the second (sleep apnoea treatments such as CPAP machines) is external and used only when the human decides to change their behaviour- to go to sleep and to use the machine. This is an important difference when considering solutions to sun safety and cancer prevention: the latter approach allows the individual human considerable freedom to decide to engage with the device or find another solution, whereas the first relies solely on the medical judgement of another.

It seems plausible, therefore, that computers' *awareness* will firstly be targeted at protecting the physical entity of the human being. At the present time this seems more easily achievable in comparison with protecting humans' complex psychological world; although the two are not mutually exclusive (James, ?). One key problem is that human beings, even when they are aware they have to protect their own bodies do not necessarily do so. This may be due to lack of knowledge, lack of financial resources, lack of psychological motivation and so on. We would like to go further and state that computer technology is capable of helping with this lack of awareness, especially in the case of lack of knowledge and information. We demonstrate this in later sections of this chapter by examining how feedback can be provided using different BarrierSolutions.

As the Rio Earth Summit in 1992 identified, the safe usage of natural resources is a complex and ongoing problem. However, information science has shown enormous potential in finding practical solutions to support life in limited human habitats over time, one notable example being the International Space Station. With further technological advances, the potential for the further management of larger hitherto restricted habitats will grow, for example, computer management might support larger geographical areas such as a particular coastline or mountain range.

Goulev and Farrer disagree with the quote above by Gajjar that the main environmental consequence of computers is product creation and disposal. Aware computers have the potential to beneficially impact the environment and humanity by mitigating damage and managing human-environmental interaction. As such, through the principles of interactive design activism described in this chapter, computers may facilitate sustainable development rather than work against it. This raises a further question to the one asked at the start of this section: could computers manage a human habitat which keeps the body healthy?

Computers and the Human Environment

Since Turing suggested his famous test, it has been broadly accepted that the universal benchmark of computer intelligence is and should remain the comparison with natural intelligence. There are fictional works where the human is perceived as the enemy by highly intelligent computer systems, as discussed in the first chapter. However we would argue that from the aware computer's point of view, the main question should be how to preserve the existence of the human race, as Isaac Asimov suggested in I, Robot (Asimov, 1950). Otherwise, without a human, the comparative Turing test is not possible, and the computer cannot call itself 'intelligent'. Although in films such as Terminator, the 'intelligent' computer, thirsty for power, perceives humanity as a threat to be destroyed, we believe that the more aware the computer becomes, the more it will protect the human and its habitat. To a large extent, the best way to preserve human life is to help humans in the safe usage of the natural resources of their existing habitat rather than creating artificial ones. As the International Space Stations demonstrates, computers already can support human life through such artificial environments; however, we believe there is much greater potential for supporting human life

through computers managing the interaction between humans and their naturally existing environments.

In this chapter, we imagine a computer network which is aware of, and supports the interaction between the environment and the human body. By constantly informing the body "owner" about its state in relation to the environment across parameters such as temperature, solar radiation, humidity or medical indicators, the potential for responsiveness in terms of behavioural change is offered. One of the key goals of design activism is a behavioural change, in response to sustainable principles (Goulev & Farrer, Chicago). The aim is to utilise the power of aware computers and their interactive possibilities in this context. Soon novel applications will appear on the market offering different ways to raise awareness of a whole range of issues; such as the interaction between humans and solar radiation discussed in this chapter.

To Fuzzy or Yes (No)!

An awareness concept battle has been going throughout the whole of recorded human history between binary and fuzzy modes of thinking. This has been the case from before records began, for example, in the contrast between pictorial language (hieroglyphics) in the fuzzy corner and Latin alphabets (binary representations which either are or are not the given sound). For this reason, we do not expect the appearance of any new computer driven technologies to be powerful enough to resolve it. Computers have already performed well on both sides, helping their programmers and owners to score points and conquer new subjects and domains from within both approaches.

On the one side is 'definitive knowledge' forming a world of precise formulas, law and order and undisputable rules. The academics call this "binary logic". Colloquial terms include "black and white", "to be or not to be" dramas, "Just say Yes or No", "I know exactly what to do and have the evidence to prove it". It mimics the court suggested by Aristotle; you are either "guilty" or "innocent" there is nothing in-between. The decision is reached by a group of people randomly selected by the community without any requirement for particular expertise. They demand undisputable evidence to be presented in front of them to reach their verdict.

The other side is vague; the good and bad sides of every problem are evaluated and frequently represented with degrees or percentages. The academics call this "fuzzy logic" (Zadeh, 1965). Colloquial terms include "gray", "wishy/washy" indecisive drama, "Better Yes, than No", "I believe this is the right thing to be done". Here reigns the moral, a set of bendable ever-evolving emotions, a land of religion and sets of beliefs. Expert opinion, even when not supported by obvious evidence, is habitually accepted by society.

Based on this dichotomy, we suggest conceptualizing computer awareness in two ways:

- ✓ "binary aware" computers – following strict rules
- ✓ "fuzzy aware" computers – following moral based rules of influence.

It is clear that both concepts of awareness have their merits and weakness, however it is mathematically clear that fuzzy includes binary at its edges (e.g. if you reach 100% agreement, the answer is 'yes') (Kosko, 1994). We argue that a binary aware computer is more threatening to

humanity, as at one time point, it could decide whether the human race is friend or foe. This is portrayed in the Terminator movies in which the majority of aware technological robots are against humans with only a minority being for them (and these being absolute states). Similarly, in I, Robot, the main computer controlling all robots decides that for the protection of humans, they must be imprisoned as they could not be trusted to behave safely; again, a binary decision-making model (to trust- yes or no). “Computer say so” (from the TV program Little Britain) is already used as a cultural signifier for binary-computing, albeit one in which computers are used to hide the wrong decision making by large organizations without a human face.

We also argue therefore, that “fuzzy aware” computers may be more forgiving towards humans and will try to conceptualise our weaknesses and beliefs. Instead of constantly judging us in the Aristotelian way, they will try to help us, even when we break the rules encoded in them (as humans are prone to doing). The question of their superiority is not expected to arise in the same way as with binary-aware computers; they will be aware that their decisions are not always correct, which creates equality with humans who also make errors in their judgments.

In the project BarrierSolutions discussed in this chapter, fuzzy thinking was posited as an intrinsic concept inherent in the sun safety issue. Judging the correct exposure to the sun is not an exact science; there are arguments for and against the utility and damage that it causes. Furthermore, human variations such as skin colour, type, location, create infinite answers to the question ‘how much exposure to solar radiation is safe?’ Design activism, which promotes design in which individuals are given choices through information, is intrinsically linked to a fuzzy thinking approach. Knowledge is presented including the contradictions of the current science and individually tailored to the variations of the human, giving a plethora of options for protection through awareness.

Design activism

Broadly speaking, this shift towards thinking in terms of computer- supported sustainability sits within the movement of ‘design activism’. This posits the idea that society can be improved by changing the design of the goods which we utilize [7]. At the heart of the design activism program is the idea that emergent social, environmental and personal problems can be tackled using design practices which are both sustainable and collective; such examples being designing intelligent and desirable products to address public health issues and wellbeing to enable inclusivity and behavioural change. Within the context of the public health issue of sun safety, Farrer and colleagues have investigated designing fashion clothing and textiles that are sun protective[8]. As Farrer has argued, ‘this is a paradigm shift from the usual medical research model’ because it acknowledges the drive of consumer culture but imbues it with social values to address current societal issues.

Barrier Solutions: Creation of designed prototypes for skin cancer prevention

To illustrate the potential for aware computing in the context of design activism, the example of how interactive design activism might reconfigure the issue of the safety of users in relation to sunlight, or more specifically, solar radiation is considered in this chapter. The main source of energy in the

human's natural habit is the closest star – the Sun. Strangely enough the human body does not have a dedicated sensor for the level of solar radiation. This is the reason why every year millions of people are surprised by, and complain of, sun-burn. This is in contrast to computers, which have sensors which alert them to overheating, and can even shut down completely to prevent damage to their material 'bodies'.

Sun safety remains a key public health problem about which somewhat conflicting messages exist. On the one hand, health promotion encourages exercise and activity, for example, such as outdoor sports. On the other hand, this creates risks for the human body, primarily through skin cancer (and aesthetic risks also exist such as wrinkles). [1]. Furthermore, the cultural desire to appear bronzed and tanned, at least in many Western societies, with its associations with international travel and holidays abroad, has not abated to any great extent and many people still expose themselves considerably to UV rays to achieve this look. Although there is a general consensus that exposure to UV light (not just present in sunshine conditions but also in cloud) is risky in terms of skin cancer, there is increasing debate about whether drastic limitation of exposure might also limit Vitamin D synthesis which itself has been linked with a number of health conditions [2]. As such, sun exposure is both risky and potentially beneficial, although there is little debate that very prolonged exposure is likely to be damaging, although there is some evidence that in certain populations, moderate exposure might be protective [10]. . There are several aspects that are relevant to deciding on 'correct' exposure; timing, limiting of exposure to sunlight (length of time and intensity of radiation) as well as the addition of protective factors such as clothing, sunscreen or using shade [3].

Skin cancer prevention (as opposed to treatment) attracts significant funding from the medical sector, and continues to excite growing commercial interest from the cosmetic and sun screen industries, yet melanoma rates continue to increase. So we proposed the thesis that the design of desirable and wearable Barrier Solutions coupled with early warning technology could be used to develop a new field or paradigm shift for investigation using the emerging field of SMART materials and design for behavioral change. Our project built upon the team's theoretical and practical expertise to develop ergonomically and aesthetically designed functional and communicative prototypes and a range of technical fabric and body covering design samples demonstrating the possibilities of integrating smart and interactive textiles, computer intelligence and digital communications as 'early warning systems' for sun over-exposure suitable for a young adult trend savvy consumer.

The research project Barrier Solutions© is a transdisciplinary example of Interactive Design Activism. It was funded by Santander Business Research & Collaboration Fund between 2010-2012. The transdisciplinary research team comprised of: Dr Joan Farrer (Director of Design Research Initiatives (DR-I), University of Brighton)- design & materials (PI) with team members Dr Tom Ainsworth (University of Brighton) – design for behavioural change, Dr Cressida Bowyer (University of Brighton) – biologist & cancer researcher, Dr Petar Goulev (London College of Fashion, Targovia Ltd) – fuzzy logic & intelligent networks, Dr Sarah Robertson (Herriot Watt University) – printed textiles & colour chemistry, Julianna Sissons (DazedDigital) – Pattern cutter & fashion, Marney Walker (of Brighton) – occupational therapist and inclusive design. In addition teams of undergraduate BA fashion and textile students contributed to the research outcomes.

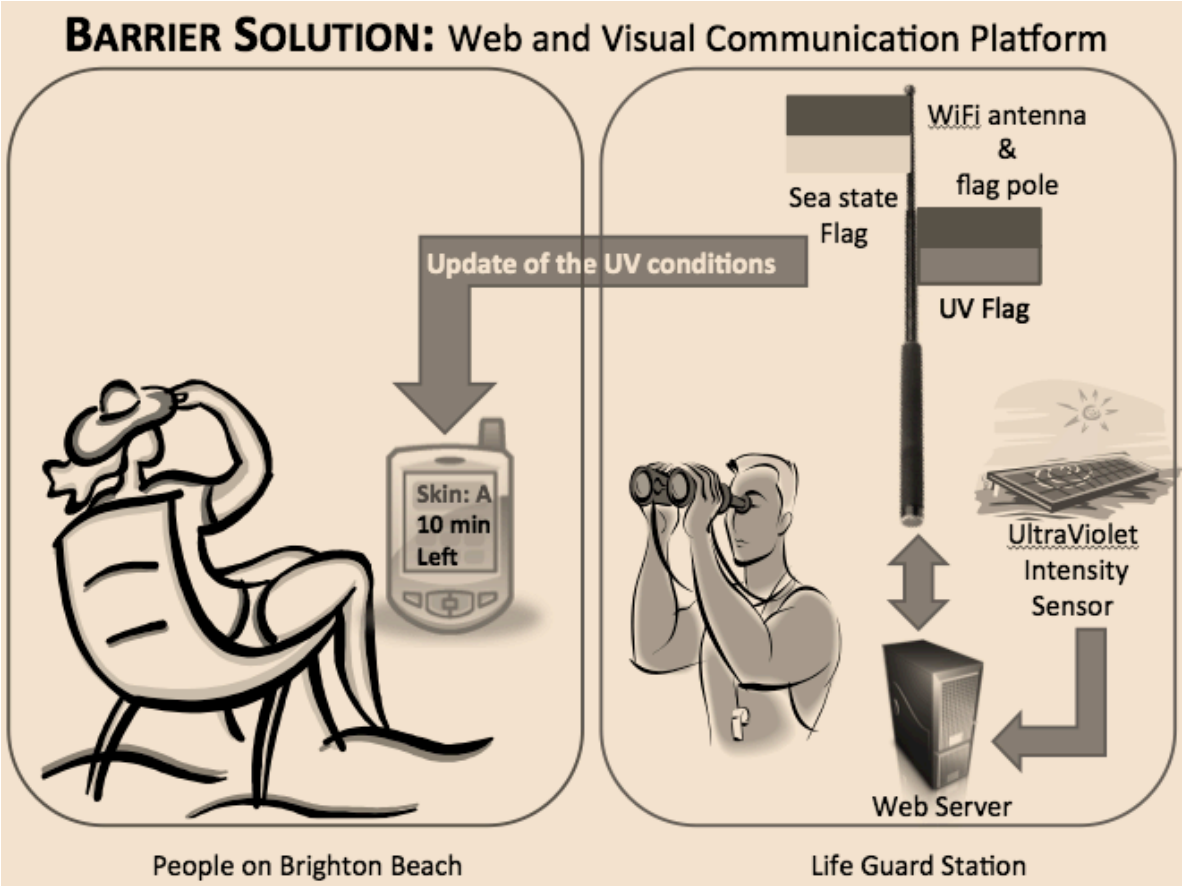

Figure 1: Dr Petar Goulev: early warning aware beach system for UV exposure

In this chapter, we focus on one tool in detail: the 'Beach-Based UV Awareness and Communication Platform' (Figure 1). The aim of the this particular aspect of the project is to utilise developments within computer science, such as intelligent computing, fuzzy logic and designing non-intrusive sensors to achieve the goal of offering personalized and interactive feedback on sun exposure information to enhance sun safety [9].

There is a need for personalized feedback on sun-related risk because not all people have the same level of risk and risk varies according to context [4] . For example, recent research has shown that men are more likely to get skin cancer than women. Personalised feedback could also incorporate other dimensions on which exposure and risk might vary, such as different skin types, genetic heritage (e.g. having the genetic variant for red-hair makes people more susceptible to skin cancer and less likely to benefit from moderate exposure [10]) and geographical location (e.g. as the ozone layer differs in protectiveness in different locations, as well as sun strength). It may also be the case that at a psychological level, people respond better to a more relevant and tailored message that seems designed specifically for them and their circumstances rather than a generic one.

Up until now, there has been little research into how interactive intelligent computing systems might deliver personalized public health advice in the context of sun safety. Here, computer software is used to make the user aware of their personal exposure to UV light. This research extends the work done by Goulev and colleagues at Imperial College which focused on developing non-intrusive

sensors, in that context, to monitory the sensory data of individuals to provide an estimation of their emotional state. [5]. Within the literature and design, there is a need for sensor technology to be as unobtrusive as possible [6]. There is somewhat of a paradox within this design: consumers are likely to deliberately choose to purchase and/or respond to such an app or program because they perceive themselves to be sun-aware or at risk, but they do not necessarily want to be monitored in an intrusive way. As such, any such feedback sensors need to be relatively unobtrusive whilst still offering the user the relevant information that they seek.

To date, a prototype of a mobile system has been developed and tested by the authors. The main feature is an interface in which people input data on their skin type and their current level of ultraviolet radiation, based on their current location. It is important to note that people classify their own skin type, based on broad relevant categories (e.g. red hair/pale skin) whereas the device is able to use geolocalization sensors to identify the particular place the person is in. Based on this information, an appropriate personalized time of solar exposure is determined, and then suggested to the user. As an additional way of representing the same information, visual aids are used to provide data about the level of sun light intensity. Using computer technology offers greatly increased levels of personalisation and geolocalisation.

One advantage of this system is that it can be developed across different platforms to increase availability and coverage: currently the system is being developed using Java, MacOS and Android amongst others. One additional dimension of using these platforms is that it allows a much greater access to groups for public health purposes, for example, younger people who may feel immune to the health risks posed by the sun or who do not feel conventional campaigns address the issues they face. By using the existing technologies they use as platforms (such as iPads and mobile devices), this increases the opportunity for take-up amongst these groups (Figure X).

X. Outdoor lifestyles: typical demographic at high risk of UV exposure and skin cancer

In terms of comparisons with other sun safety products, this suite of products in development has numerous advantages. One is that such applications fit very much within the sustainability agenda,

as they utilise existing technological devices (mobiles, internet), rather than requiring the creation of new ones as with sun screen or clothing. However, there is also the possibility of combining them with existing sun safety solutions, for example, the platform is being further developed through the inclusion of electro-conductive textiles which change in response to UV radiation.

One disadvantage, however, of attempting to modify behaviour through the provision of personalized information, is that the platform cannot control the response of the user who may ignore this in favour of staying longer in the sun or not taking additional preventive measures. This is perhaps not entirely likely give that the user will have had to activate the app/program and input the data, suggesting a high level of awareness of sun safety and motivation to stay safe, however, beyond timed reminders and further sensor input, ensuring that the user really does modify their behaviour is beyond even the most aware computer platform. This is as it should be, given that aware human-computer interactions should be entirely free and not coercive; the computer offers the opportunity for enhanced human protection but does not enforce it. As such, this interactive system is designed to facilitate informed choice about sun safety by offering feedback which is both personalized and responsive to the user, but ultimately respects their autonomy in relation to health choices.

In summary, it is envisaged that interactive computer technology delivered by “aware” computers, designed with sustainability in mind, will have a transformative impact in relation to sun safety behaviour of humans.

There were numerous other tools produced as part of the research tool-kit to increase awareness. These included an Interactive Research Poster (JF, TA, MW) in which local sun safe information is communicated through large digital screens (Figure 2). Another proposed solution (CB) was to create a real-time trigger within the human body (e.g. through chip implanting) when the skin was exposed to UV or groups of vulnerable people were in the locality, giving them information (e.g. delivered through a tablet) about skin cancer (Figure 3). Research workshops looked at the feasibility of thermo-chemical materials to respond to early warning signs, for example SR proposed a thermochromic printed textile t-shirt which changes colour when triggered by external stimuli such as light or heat for an early warning outcome (Figure 4). This is an example of how the ‘aware’ computer could communicate information and the designer would incorporate desirable interactive patterns onto the clothing. Finally, a design for armour inspired garments was created in which the risk of exposure is calculated for different body zones and garments designed to be modified specifically for each personal agent (JS); the aim is to protect the human body but also produce aesthetically desirable clothing (Figure 5).

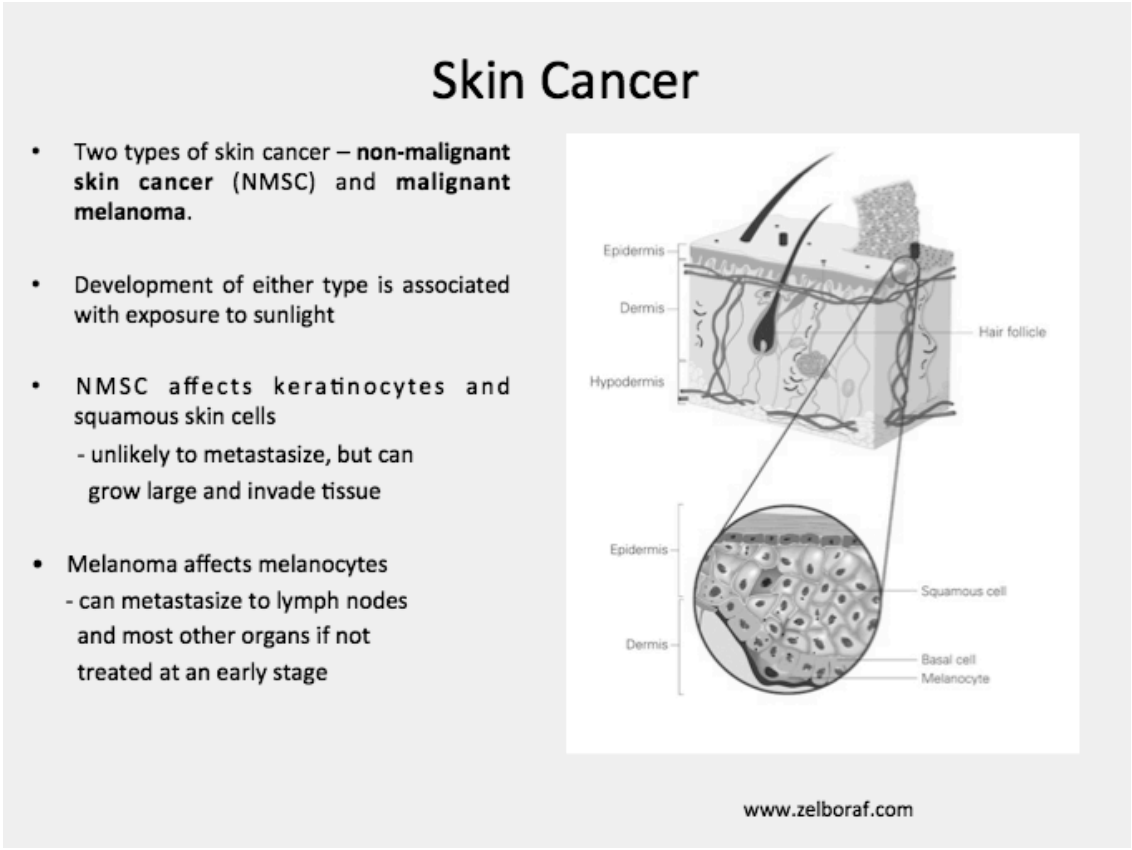

Figure 3: Information for tablet triggered by body implant

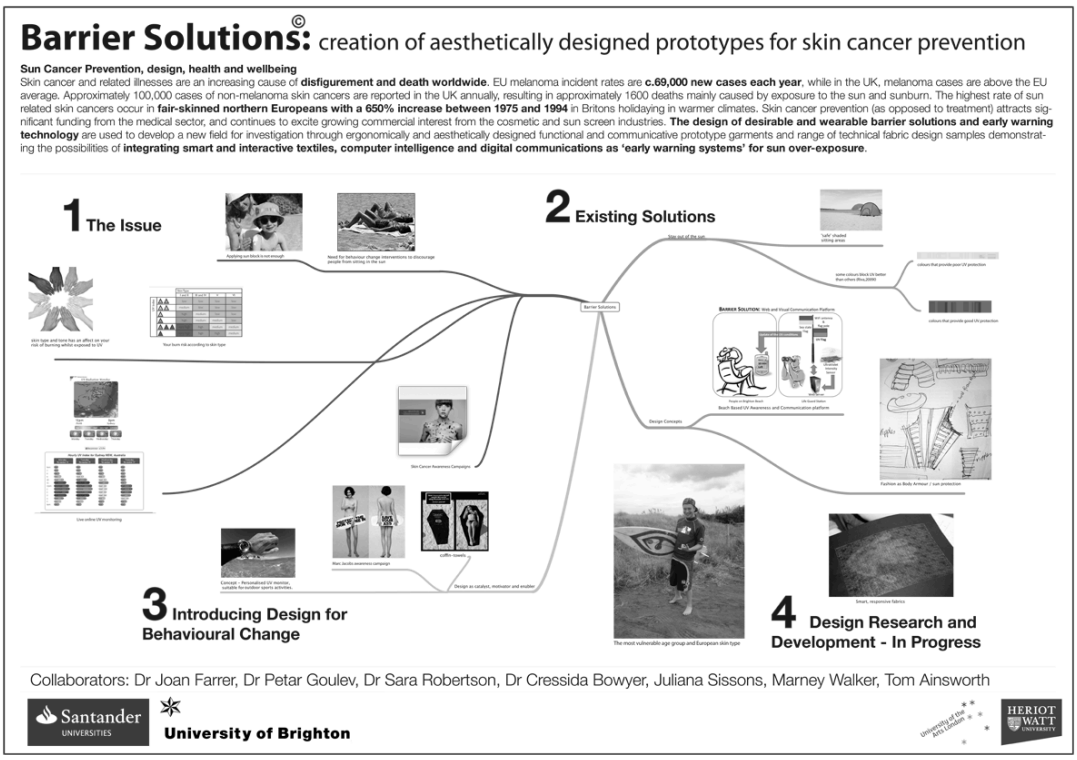

Figure 2: Large interactive touch-screen on sun safety on the beach at Brighton

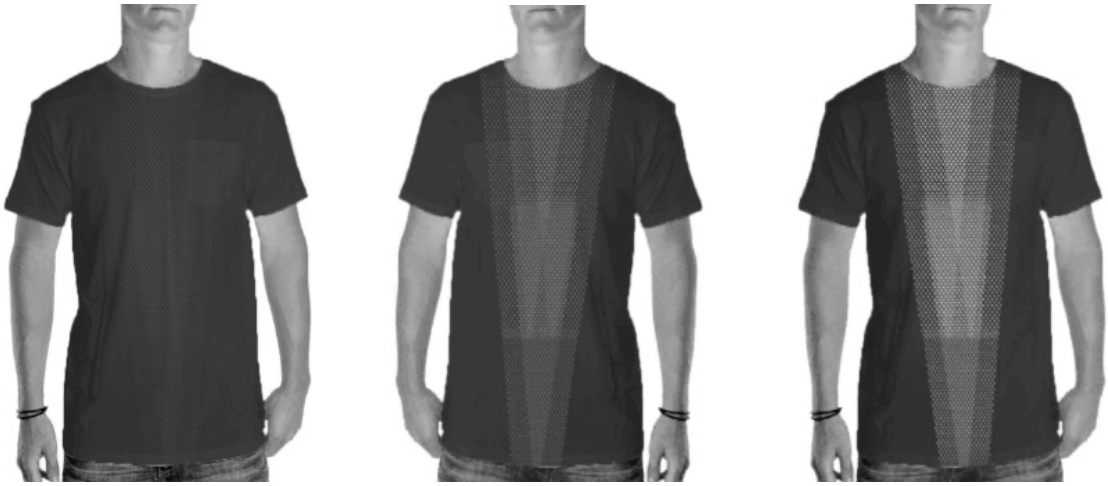

Figure 4: Prototype of responsive garment using thermo-chemical manufacture to trigger awareness of sun risk

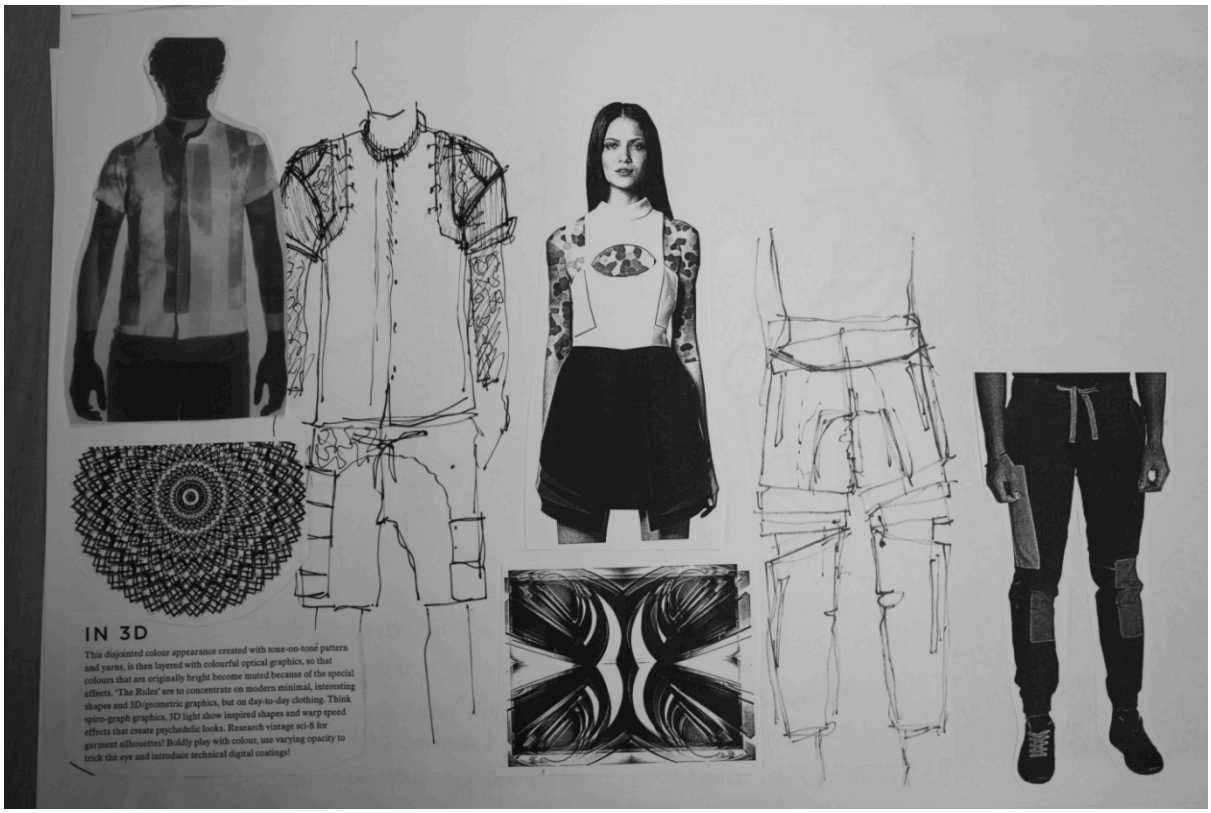

Figure 5

Transdisciplinarity, Knowledge Transfer and Multi-domain

In conclusion, we reflect on the three interpretations of awareness outlined by Pitt in his first chapter as they are drawn on by this project. In particular, our rendering of awareness most closely aligns with the second reading. "The computer after me" is seen from the point of view of the user-

'the benefits of computer representation and reasoning about human concerns and actions, and the potential drawbacks'.

In section 1.2 computer awareness in science-fiction, the author quotes Isaac as in his three laws of Robotics from 1950:

'I robot may not injure a human being, or through inaction, allow a human being to come to harm'. This thought most closely aligns with interactive design activism and the Barrier Solutions research concept case study following, in that today we have the technology to protect human beings from danger, either physical or environmental. The author talks about a robot, as an example, which would need to be able to perceive fully the environment and could be able to reason whether the environment would injure a human and/or whether it can do anything to prevent this. As such, the action of preventing harm to humans becomes an imperative state for the computer.

In the case of Barrier Solutions towards melanoma prevention, this statement makes perfect sense. The 'computer after me' vision in relation to the burgeoning issue of skin cancer coupled with intelligent network systems could protect the human from ultraviolet damage. This future computer could pass the 'Turing test' with ease. Pitt talks about computing devices not being restricted just to sensing and interpreting data according to human actuators such as touch and voice. He mentions the key characteristics of an embedded system which, besides being designed for a specific task, also has the added advantage that it can function as a component of a larger whole. This is a valuable contribution in a dangerous physical real-world environment often with real-time processing constraints, and in which the computer is aware of the issues only in a limited sense due to an inability to process the collected real time data in the way humans. By a form of expanded instrumental sensing, it could perceive a dangerous environment and the computer network could respond to that perception and warn humans of the danger, as shown in the model of Barrier Solutions. As discussed above, this does not control whether the human responds but simply allows it to make an informed decision.

Pitt mentions one of the earliest embedded systems which was developed as part of the US Apollo space program in the 1960s in which the requirement for awareness was critical. Pitt states in the study of sociotechnical systems which recognises and studies the interaction of people and technology, these systems of awareness give more to humans than an understanding of just their physical environment coupled with the conventional environment of rules and regulations commonly understood by people. This also describes the aims and objectives of the model of Barrier Solutions: the creation of designed prototypes for skin cancer prevention.

The editor also talks about artificial systems architectures where agent architecture is one of the most commonly used architectures in intelligent research (Row Sheff, 1995 check). The intentional stance is "the strategy of interpreting the behaviour of an entity (person, animal, artefact, whatever) by treating it as if it were a rational agent who governed its choice of action by a consideration of its beliefs and desires. (Denit, 2009, page 339).

A variety of research including Bratman 1987: and leatheresque 1990 became the basis of practical systems with the work of Row and Sheff in 1995 and has been used in many agent-based systems and programming platforms. The BD I variant includes a model of the agents intentional state its own beliefs desires intentions, its model of the social state, which includes the normative state

expressing its powers, permissions and obligations and its persona which is the config Rebel decision-making component which constrained behaviour. The author says the role of the action language software implementation component was to reason about the sequence of events, performed by the agent itself and by other agents, to compute the resultant social state. The particular BD I variant illustrated here described by the author is a model of the agents intentional state, i.e. its own beliefs, desires and intentions. Its model of the social state, which included the normative state expressing its powers, permissions and obligations and its persona which is the config Rebel decision-making component which constrained behaviour. The role of the action language software implementation component was to reason about sequence of events, performed by the agent itself and by other agents, to compute the resultant social state which describes the model of Barrier Solution.

Pitt in his summary and conclusions (chapter 1) talks about artificial intelligence being used in everyday products such as toasters and goes on to talk about the proliferation of sensors and processes leading to a plethora of new generation embedded systems with significant interconnected intelligence in computational components interacting in tandem or partnership with humans often referred to as sociotechnical or cyber physical systems. He discusses many application domains where embedded systems involve people, software agents and hardware working together in a collective. He also talks about the future benefits of such applications where using these systems possibilities are limitless. He asks the question and makes the comment that the focus of this book

'The computer after me' is to evaluate the societal impact of awareness and self aware in autonomic systems and networks.

Barrier Solutions case study methodology was based upon the relatively new concept and practice of transdisciplinarity. Trans-disciplinarity was first presented by jean Paiget in 1970 (*) where he suggested that interdisciplinary relations, interaction and reciprocity had limitations because of the specialised 'silo' research these interdisciplinary groups produced. Paiget talked about the concept of transdisciplinarity pointing to a 'new knowledge space' which will locate these disciplines inside a total system without boundaries. When the term was first presented, the public was not ready for the true meaning of the latin prefix *trans* and Paiget talked about 'across' and 'between' disciplines to the audience at the time. He omitted a third aspect of *trans* which is 'beyond' and it is the concept of beyond disciplinarity which is at the core of the Barrier solutions methodology in relation to 'the computer after me'. This project showed that computer systems can be not only utilized by different disciplines ranging from fashion, design, medical systems and so on, but that their creations are truly 'transciplinary'. As such this project paves a path for design activism made interactive through computing science and the principles of fuzzy logic.

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