CAN HUMAN-POWERED PRODUCTS REDUCE ENERGY CONSUMPTION?

Daniel Shin[1], Paul Johnson[2], Dr. Luke Harmer[3]
Nottingham Trent University
daniel.shin@ntu.ac.uk[1], paul.johnson@ntu.ac.uk[2], luke.harmer@ntu.ac.uk[3]

ABSTRACT

This paper discusses the role of design in the field of human-powered products (HPP) development. Human-powered products, as perceived in recent research literature as alternatives to battery power for electronic products, are considered by some as one of the solutions to reduce the environmental impact caused by the over consumption of energy. The research attempts to create a persuasive argument that there are other notions to consider in wider design and user-centred contexts beyond the existing over reliance on technology and their more scientifically valued benefits. The research investigates how a practice based approach of designing new interactivity in HPP through empirical study can raise the awareness of sustainable energy consumption in everyday life - as a means of de-routinizing the current habitual energy consumption through new interactions.

Keywords: Human-powered products, sustainable energy consumption, interaction design.

INTRODUCTION

In the past two decades, there has been an exponential and significant increase in the number portable electronic devices and new applications of communication and information. Human-powered products (HPP), as perceived in recent research literature as alternatives to battery power for electronic products (Jansen 2011), are considered as one of the solutions to reduce the environmental impact including problems such as over consumption of energy. In other words, users of HPP no longer rely solely on the use of power from the grid to power products. Interactive human-powered products (HPP) such as hand crank radios compare favourably in energy generation terms to solar and natural energy generators due to factors such as cost, manufacturing methods, materials, complexity, and limited interactivity.

The scope of this research is to investigate how a practice based approach of designing new interactivity in HPP - as a means of de-routinising the current habitual energy consumption through new interactions, can derive and promote sustainable energy consumption in everyday life. The research attempts to create a persuasive argument that there are other notions to consider in wider design contexts for greater benefits beyond a current norm – the over reliance on technology from traditional power sources.

The research will follow an experimental and practice-based research methodology. One key objective is to produce artefacts arising from HPP concepts. These concepts could be considered as base materials which inform knowledge to produce new innovations, new practices, scenarios, behaviours and Innovative products that promote and increase sustainable energy use.

LITERATURE REVIEW

ENERGY CONSUMPTION THROUGH CONSUMER ELECTRONICS

The invention of the 'power' unit has dramatically changed human behaviours since the industrial revolution. In recent decades, the proliferation of portable 'powered' devices has resulted in a mass transformation in the way we interact, and use, such

products. Today, people live in lifestyles where we consume 'cultural energy services', in other words, culturally meaningful services that happen to depend on a supply of gas, oil, or electricity (Wilhite & Lutzenhiser, 1998). As many mass products have evolved because of their electrical functionality, users were rewarded with the convenience that reduces the labour required when using the products. Such proliferations of these products are causing people to involuntarily consume energy through use of these daily products. Such sequences and practices of new product development are embedded in every society. However, in the pursuit for convenience through the use of daily products, humans may have lost certain hitherto skills, and the enjoyable experiences of interacting with products.

HUMAN-POWERED PRODUCTS

The leading scholar in this field is Arjen Jansen, who has conducted a number of human-powered system related researches and projects, His research focuses on the use of non-traditional forms of energy systems in consumer products, with an emphasis on human-powered (Jansen & Stevels, 1999). His PhD thesis, 'Human Power empirically explored' (Jansen, 2011), questions how human power can be a viable alternative to batteries in portable products. He has investigated how the human body acts as an energy producer in different ways concentrating on muscle activities, providing new knowledge to support in the design of human-powered products.

While Jansen's research focused on direct force exertion of human muscles, Joseph Paradiso from MIT Media Lab worked on human-powered electric devices in far more diverse way. The lab focused on harvesting energy from parasitic human powers. The idea is to generate power in an ancillary way while people are doing things like walking or typing, or to pick up energy from the body as it breathes, pumps blood and generates heat (Paradiso & Starner, 2005). The power might be scavenged indirectly from the user's everyday actions or might be intentionally generated by the user.

DESIGN PRACTICE AND ENERGY

There have been many design researchers conducting their work using 'research through design' practice (Frayling, 1993) methodology. The notion of associating interaction design into HPP research is furthered by research work carried by Ramia Maze at the interactive institute Sweden. She carried out design research called STATIC, which investigates interaction design as a means of increasing awareness of energy use and for stimulating changes in behaviour. The project considered energy as expressive material for design, where its visibility and use are brought to the forefront in products. This enables people to have an increased awareness of, and control over, the energy in the objects they use on a daily basis. Her approach focuses on energy as a core aesthetic and functional issue in early stages of product design (Backlund et al., 2007)

BENEFIT OF HUMAN-POWERED PRODUCTS

ENVIRONMENTAL IMPACT

The evaluation of life cycle assessment or measures of environmental impact of any product are fundamental in product development. However, research on energy consumption of products receives little attention, despite evidence that they are dominating factor in product life cycle (Pascual, Boks & Stevels, 2003).

Jansen's PhD thesis included an environmental impact analysis by comparing a human-powered radio with three battery powered products. The analysis concludes that human-powered radio show a greater environmental impact from a production perspective, due to factors such as heavier weight and the number of components for embedded dynamos. However, after averages taken between 1.4 and 2.9 years of life time, the environmental impact of battery powered radio will be equal to a human-powered radio and will be incrementally less efficient due to the further consumption of batteries (Jansen, 2011). This research also highlights the main benefit of HPP that they are the devices that generate the power for their use rather 'consuming' during their use phase.

Currently, research is being conducted to create a cost analysis of energy consumption on plug-in powered electric toothbrushes. Tests are still on-going at pilot test stage; the initial results measure

the cost of using an electric toothbrush using power from the grid will cost approximately £0.20 per year. This amount will not necessarily impact on the number of products sold on a price per unit basis, but it is hoped that an increase in the number of 'off the grid' products may bring greater benefits.

INTERACTION OF POWER GENERATION

Another key benefit of the HPP is their interactivity and use. It communicates directly to users an environmental benefit of harvesting your own energy as alternative power source - a clean energy. One such interactivity in the power generation in HPP may be interpreted as educational intervention, i.e. being told what to do, rather than parasitic, but will always inform and communicate to people what our body can do.

INTERACTION MAP

From monitoring concepts of HPP from various different sources, this research developed an 'Interaction map' (Figure 1). The purpose of this map is to characterise and analyse different types of HPP. The map is designed using two dimensional axes. The horizontal axis represents the user interaction of conscious (direct) and sub-conscious (passive) power generating interaction of HPP. The 'conscious interaction' is also described as 'force exertion' by Jansen in his research (Jansen & Slob, 2003). The sub-conscious interaction of energy generation also termed as 'parasitic harvesting' in other related literatures (Kymissis et al., 1998). The vertical axis represents mechanical/electrical power output of HPP. All monitored HPP are being mapped onto this, for example, a hand crank radio is characterised as 'electric + conscious', due to the conscious energy generating interaction and electrical power output.

It also shows the difference in meaning about the HPP where Jansen's definition is a 'non-conventional power source' focusing on products featuring a conversion of muscular work into electricity (Jansen, 2011). In this research, the HPP is defined as any products powered by human physical interaction which are both mechanically and electrically powered. In addition to these two axes, a 'fun' application and range has been inserted central to both axes. The vital challenge for conscious interactive HPP will be how to reduce the power generating labour requirements avoiding real or perceived fatigue. Although the fatigue, or not, is difficult to measure, the motivation of the user may

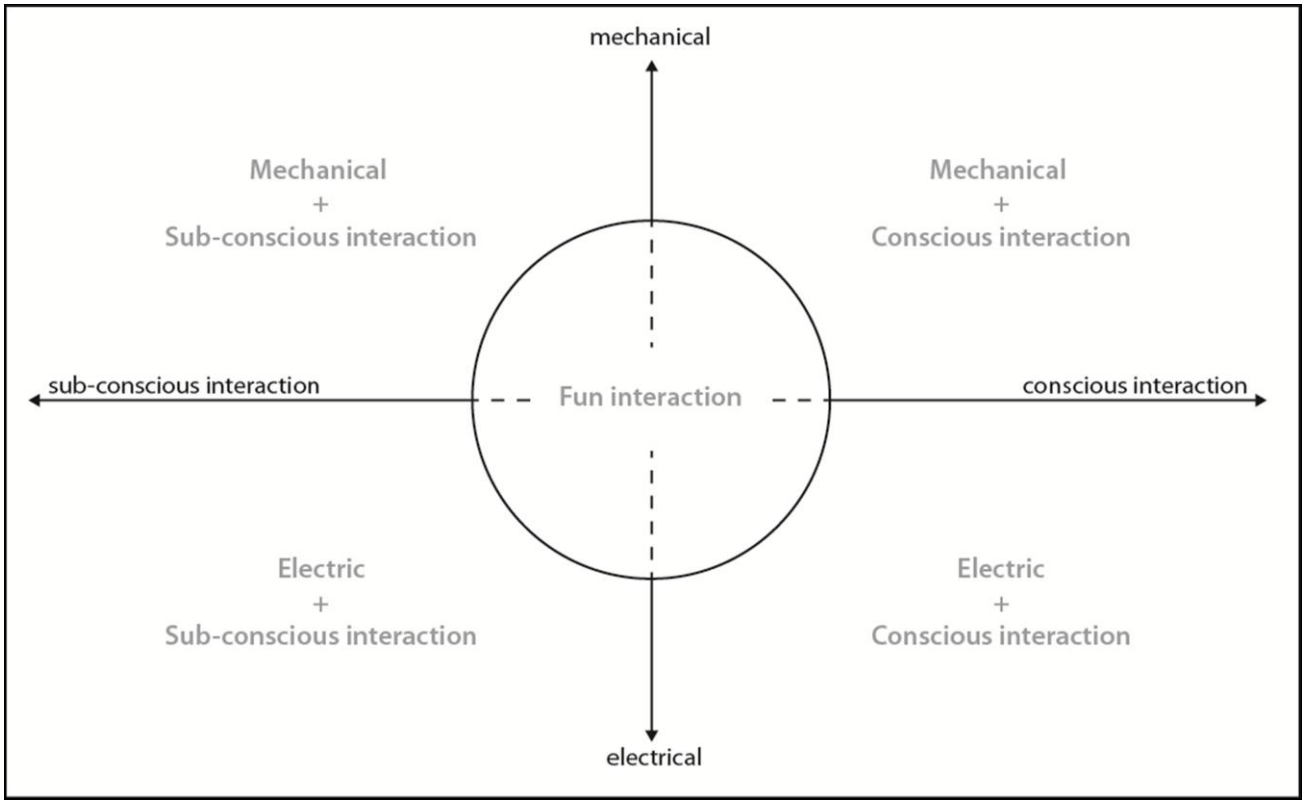

Figure 1. Interaction Map

be determined by the user's perceived benefits such as price saving, fun, environmental friendly, no battery, and feel-good factors while using etc.

MATERIALS

As mentioned in the introduction, this research aims to produce a number of artefacts that enable users to feel, understand, and play with HPP that become design interventions. It is hardly necessary to point out the dramatic changes in society that have resulted from the intervention of today's everyday things. Shove (2007) argues that designers have an indirect but potentially decisive hand in the constitution of what people do. The question remains how HPP design can inform and influence new practices, or retrieve old practices, using human effort for power generation, which hence drive sustainable energy consumption.

OFF THE GRID PROJECT

The research has conducted a case study with first year product design undergraduate students at Nottingham Trent University. The project addressed the problem of over energy consumption from the use of everyday electronics. Students were briefed to select an electronic product and (re)design it into an interactive 'off the grid product', meaning its functional power is not being supplied by neither the power grid nor any kind of technology driven power units such as photovoltaic power cells. The results of the project produced number of speculative concepts that are design driven, proposed as alternative solutions. The result also produced a comparative analysis between mapping of student project concepts and mapping results from real time HPP monitoring onto an 'interaction map'. More detailed methods need to be planned and deployed in order for this research to utilise these results to develop further theoretical material.

DISCUSSION

Studies conducted at this stage show that use of HPPs does not provide a great cost benefit to users based on existing product scenarios. Therefore, further research is not focused in gathering quantifiable or scientific benefit of HPPs. It focuses on investigating other empirically proved benefits, yet defined, that can be applied from a design perspective that helps raise awareness of sustainable energy consumption. Beyond being reliance of technology development, this research aims to explore potential solutions dealing with the broad and diverse role of design, and more intrinsic approach.

Currently, the research is conducting a home user test, investigating whether and how practice based participatory design method could lead to product-led intervention of HPP for attaining new practice level innovation in the direction of slower or sustainable energy consumption. It is argued that individuals have lifestyle choices and therefore, if they are committed in some scenarios to use the human-powered products, they will resultantly and automatically change their behaviours. It is the role of design to increase the use phase of such human-powered products.

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