

Finding the Lost Treasure: Understanding Reuse of Used Computing Devices

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ABSTRACT

In this paper, we report our findings on the adoption practices of used personal digital assistants (PDAs) to inform reuse of outdated computing products. Our interviews with 12 eBay users who bought used PDAs showed a variety of ways in which users indirectly supported sustainability. This allowed us to re-examine sustainability as something that is dynamically and arbitrarily shaped by the users and not just dependent on the sustainable feature of the product. We end with design implications for supporting users' shaping of sustainability.

Author Keywords

Sustainable interaction design, sustainability, reuse

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Design, Theory

INTRODUCTION

Sustainability has emerged as one of the critical problems in the CHI community [1]. More specifically, Blevis' Sustainable Interaction Design (SID) [2] was one of the major stepping stones in putting forward a design agenda that directly tackled the issue of sustainability. One of his visions for SID included promoting renewal and reuse, which could be enhanced through embedding materials that were easily upgradable and updatable and would not easily become obsolete.

This product-centered notion of how sustainability can be achieved has been expanded, employing situated and contextual factors. Huang [3] stressed the need to incorporate concerns towards the ecology in which the product exists such as the availability of information on battery recycling of a phone.

Furthermore, Wakkary and Tanenbaum [4] discussed users as creative everyday designers who practiced SID at home with paper-based information items such as planners, recipe

books, and calendars. This allowed the HCI field to explore yet another agent that supports sustainability – the user. However, how outdated computing devices are reused and sustained by the users is under-explored. People often unintentionally support sustainability, for example, through purchasing older computers even if they may not have sustainable traits that SID mentioned.

In this study, we wanted to explore how sustainability was being achieved by users in the real world through reuse. What makes people buy outdated computing devices over new ones? How do users transform products designed without an eye toward sustainability into sustainable devices?

In this paper, we present our findings on a small group of users who adopted used and outdated personal digital assistants (PDAs). We discuss why certain outdated PDAs were still being purchased by our participants and re-examine what sustainability in computing means from the users' perspective. We end with design implications.

Sustainability is an overloaded term, and even within the CHI community we have seen a wide range of accounts towards what it means to support sustainability: persuasive technology [5], sustainable design criteria [2], SID practiced in the everyday lives of users [4], and investigations of how people abandon, acquire, or replace cell phones [6], and what people keep [7]. What was common among these works was that the end goal was to make the environment more sustainable. That is, reduce e-waste, reduce energy waste, and increase our abilities towards so-called green practices.

PREVIOUS WORK

Accordingly, in this paper, we use the definition of sustainability as environmental sustainability, and sustainable practices as practices that support environmental sustainability.

Much of the current discussion on SID is about how we could design sustainable products and their environments, and how we could support users to think sustainably. However, little research has engaged in a discussion of how users make products sustainable, without consciously deciding to support sustainability.

Our study examines how a product's sustainability is shaped by users, what users' shaping of sustainability looks

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like, and how we might be able to design for the users' shaping of sustainability.

METHOD

We searched for PDAs introduced in 2004 or earlier that were discontinued. We then examined which of them were actively sold and bought on eBay by searching each product and seeing how many were being sold. We found that the following PDAs were still actively being sold among our list of selected PDAs: Apple Newton (released in 1989), HP iPAQ hx4700 (2003), Atari Portfolio (1989), Palm Zire 71 (2003), Dell Axim x50 (2003), HP Jornada (1989). We contacted 242 buyers that we tracked through the comments they had left for the sellers, among which 12 buyers responded. The respondents were four Newton users, five iPAQ hx4700 users, and three users each for Atari Portfolio, Palm Zire 71, Axim x50. Except for two, all of our participants were male. Only two of our participants were in their 20's, and the rest were in their 40's.

Each phone interview lasted from 30 to 50 minutes. The interview consisted of questions that examined reasons for purchasing a discontinued and used PDA, the roles the PDA played in conjunction with other computing devices, experiences with other used computing devices if there were any, ways to maintain failing devices, and the buyers' thoughts on sustainability of a digital product. Each interview was transcribed and then analyzed with the open coding analysis[8].

FINDINGS

Our participants did not consider sustainability when buying the used PDAs. Rather, the reasons included nostalgia, their hobby as a collector, feature and functionality, and simple practical concerns such as price in adopting a used PDA. In the following, we discuss our participants' adoption practices of used PDAs as sustainable practices, regardless of their intentionality. This is because, as with Blevis' discussions on longevity of use [2], our participants were able to prolong the life of a used PDA, at least to a certain degree, that would otherwise have been thrown away as e-waste.

Nostalgia

As one might suspect, one of the major reasons for buying discontinued computers was nostalgia. P9, a Newton buyer said:

Because way back when, when Apple came out with a Macintosh to the first Mac with a color screen, I always wanted one and I couldn't afford it back then. It was kind of a nostalgia thing. ... I just bought one because it was one of the things I wanted to and I could have it. (P9)

All of the Newton buyers we interviewed – P1, P3, P6, and P9 – remembered the old times when Newton first came out with advanced handwriting technology. Now that the Newton has become much cheaper than the original price, they were able to afford one and fulfill their old dreams.

While our participants who bought Newtons had nostalgia for the device itself, for P4, the Atari Portfolio allowed his past memory to come alive:

The Atari Portfolio is a recovery effort.. I recently discovered an old package of source code that I had written on the portfolio the year it was released. This was an immensely personal thing, because the code is of course crap. (P4)

In the case of P4, the Atari Portfolio in itself was not necessarily what he felt nostalgic for. However, the Portfolio was able to recover the codes he had written many years ago that were kept in a disk sitting in his closet, and it brought back nostalgic memories tied to his experiences back then when he was writing code for mini games while traveling.

Nostalgia is probably one of the major reasons that many nearly decade old computers are being sold. This made us rethink about the notion of sustainability. Is a computing product considered sustainable as long as it does not go into a landfill? Or does it have to be operational in order to be considered sustainable? In fact, as we will see next, we found an interesting connection that some users made between nostalgic artifacts and operational products.

Collections need to be “operational”

Closely related to nostalgia, our participants adopted used PDAs because their hobby was collecting outdated computers. However, there was one condition in order for outdated PDAs to be added to their collections. P4 emphasized the “operational” aspect of his collection of old computers:

For me the key issue with my collection is that the state of operational be attained. If I can turn it on and use it, I keep it. (P4)

The collections had to be in working condition so that P1's older son, who was interested in the evolution of computing, could learn how to use and play with them. Similarly, P9 collected vintage Apple products:

I have a small collection of, for lack of better term, vintage Apple products. ... Most of it just sits and once in a while I'll fire up just to play with. (P9)

Although P9 did not buy the vintage products to use them, when asked whether he then would also buy a broken used computer, he wanted a working one. And when asked what was going to happen if the Newton broke, he said he would throw it away. Thus for P9, clearly the Newton was just a collector's item, but it needed to work in order to sit on his shelf.

Items that some of our participants collected needed to be operational because their value was determined by what the PDA did and not the mere physical presence of it:

I found something more tactile, a better user experience with the Newton. The funny noises it makes, it's very..i don't know what the right word is. Its fun.(P3)

The used computers discussed in this section maintained an intricate status including that of antique collection item, toy, and a usable computer. Otherwise devices may even be thrown away, which contradicted the common idea of keeping something for collection purposes. Then sustainability, in this case, was only achieved if the PDA was operational.

Not all participants, however, purchased used PDAs for nostalgic or collection purposes. In fact, quite a few of our participants had functional and practical reasons for acquiring these outdated PDAs, as Huang and Truong found in their study on PDA acquisition practices [6].

Functionality

P10 bought the Axim x50 to upgrade it to a smartphone so he could email and browse the Internet at a cheaper price than the currently available smartphones. He believed his Axim was more powerful than the current smartphones:

With a quick unofficial ROM update, the Axim x51v or x50v could be updated to a new firmware and work just as well, or even better than a smartphone. ... The new axim is powerful. Even more powerful than most current smartphones. (P10)

Similarly, P5 bought an iPAQ hx4700 to appropriate it as an ebook reader. He had a school exam at the end of the year, and he just needed a cheaper ebook reader that he could use until his exam. And then the interviewer asked whether the PDA had a warranty, and P5 said:

I guess not but I don't care ... as long as it is good until my exams in December this year ... I just want to read the exam materials with it ... and of course I am not going to buy another one [if it breaks after the exam]. (P5)

P5, unlike many of our Newton or Portfolio users, bought the iPAQ solely for the purpose of using it as an ebook reader and nothing more. Similarly, P11 utilized the iPAQ as a GPS mapping unit in an aircraft because it was much cheaper than buying a Garmin.

Likewise, P2 and P3 highlighted the hand writing capability in the Newton as a technology that they believed was still competitive even in this day and age:

In the case of Newton, a lot of people are going back to it because in particular with the hand writing recognition, which hasn't been duplicated up until now. It started with Newton, and other PDAs sort of dabbled in it I don't think to the extent that Newton has. (P3)

P3's opinion was reflected by P2 who utilized Newton in his daily life as a replacement for papers and taking notes at work because his work did not allow bringing in iPod Touch due to its wireless capability. As well, P4 preserved the Atari Portfolio as a game machine and also utilized it as a way to access obsolete data materials and I/O channels such as Zip drives and serial ports.

We observed from this section that the features and functionalities of a PDA that allowed users to reuse them could be seen as sustainable design features of a PDA.

However, whether a feature is useful or not was increasingly a subjective and individual assessment to make:

I found iPAQs to be not user friendly and complicated and Palm Pilots to be difficult and complicated and not fun. I just thought well lets give it a try and along the way I discovered a lost treasure [the Newton].” (P3)

P3 described Newton as a lost treasure that let him take notes with nice handwriting recognition and at the same time have fun with it because of its nostalgic and historical value. And he mentioned iPAQ as not user friendly and complicated when other participants utilized iPAQ as a GPS device and an ebook reader. In a way, iPAQ was sustainable to P11 and P5, but not to P3, again indicating sustainable features are very much dependent on the users and their context.

Practicality

The underlying reason cutting across all participants for buying an old used PDA was the fact that it was low cost and there was little risk in buying it off of eBay to either play with it, make it into part of their collections, or utilize it for one functionality. P9 and P6 mentioned cheap price as a necessary condition in buying what they felt nostalgic about, and both P11 and P5 utilized iPAQ mainly for utilizing certain functionalities because buying a Garmin or a new ebook reader was more expensive.

Not all participants reasoned carefully before buying the PDAs. P8 bought the iPAQ hx4700 only because her boyfriend was using it and it was cheap:

My boyfriend has [iPAQ] and his power button got broken so I got him a newer used one and then I happened to see the one that I got. And the bid was so low so I bid on it and won it (P8)

P7 also had no particular reason for choosing the Palm. He had just gotten used to using her old PDA that broke, and so he bought the same model again. He said that if he had known about iPod Touch when he was buying the second Palm, he probably would have bought the iPod Touch, not the Palm.

Unlike our participants who felt nostalgic about certain PDAs and collected old computers for hobbies, P7 and P8 adopted the used PDAs mainly because they have just gotten familiar with using it. When asked what was great about Palm Zire, or iPAQ to P7 and 8, they both told us that they do not know because they have not compared them to other products.

As discussed in this section, some outdated PDAs were purchased without clear reasons why they were selected. This again suggests the arbitrary notion of what makes computing products reused.

Users' perceptions on sustainability

None of our participants purchased used PDAs because they consciously chose to support sustainability. However,

when asked what their opinions were on sustainability of computing products, the participants addressed the issue of how much control they perceived to have over sustainability in computing products.

P2 said as long as users can upgrade software themselves users would be able to prolong the life of computing products. P10 said that there were many ways in which used computers could be utilized, but casual users would not have enough knowledge to utilize used computers. P3 was willing to fix things himself to prolong the life of his Newton.

However, P7 said he was conscious of sustainability in general, but the fact that computing products were rapidly becoming outdated did not allow him to control how long he could use a computing product. Also, because a used computer would not come with instructions, P4 stressed that it was difficult to maintain a computer by himself.

As participants told us, sustaining computing products was indeed a challenging problem for users to carry out by themselves. However, they did not realize that they were in fact playing an important part in sustaining computing products through readopting used PDAs.

DISCUSSIONS

Because our interviews did not involve a high number of users across a variety of older PDAs, we will not attempt to generalize our findings to the adoption practices of used computing products. Rather, we want to examine why some people bought used PDAs using the data we collected through the interviews and use this as a starting point to investigate how different meanings of sustainability were being achieved by the users.

In order for the outdated PDAs to be reused by our participants, the PDAs needed to have some features and abilities that would allow them to be utilized even after many years, namely sustainable design features. And these sustainable abilities – long battery life, easily upgradable software/hardware, and competitive technical features (e.g., Newton's hand writing recognition technology) as mentioned by SID– indeed played an important role in the devices being re-appropriated and readopted by the users.

Although certain sustainable features of PDAs contributed to their ability to be reused, it was the users who had the agency to make a product sustainable and this agency reflected their various value systems, incentives, technical abilities, and needs. Accordingly, sustainability of a product, in our participants' cases, was not just a fixed, measurable trait that we could engineer – but rather a dynamic and situated notion that transformed depending on who owned the product and for what purpose.

The challenge, however, is that what we observed from our participants and their sustainable practices are not necessarily widely practiced among average users. Accordingly, we may face limitations in supporting

sustainable practices discussed here such as nostalgia, to the general population.

The lesson that we take away from this study is the need to move away from sustainable design as being embedded within the design features. Rather, in thinking about SID, it is valuable to pay attention to users' constant reinterpretation of what a product can do and the consequences of it that affect sustainability: e.g., prolonging the life of the product thereof.

DESIGN IMPLICATIONS

There are two ways in which we can suggest sustainability, specifically reuse, could be achieved by the users. One is *social sharing of resources and knowledge in re-appropriating older computing products*. P10 mentioned people often did not realize how old computers could be re-appropriated for many useful purposes. And P2 and 3 were getting their knowledge on Newton from an online Newton community. A community-based infrastructure could allow users to socially share knowledge about how a product can be re-appropriated. Second is *recommendation system for reuse*. Another way to engage casual users into reuse may be through a recommender system. For example, when users look for particular products in the search engine, the search engine could recommend users with cheaper options of re-appropriating used PDAs for a GPS or ebook reader as our participants did.

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