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Designing Appliances for Mobile Commerce and Retailtainment

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Abstract. In the emerging world of the new consumer and the "anytime, anywhere" mobile commerce, appliances are located at the collision point of the retailer and consumer agendas. The consequence of this is twofold: on the one hand appliances that were previously considered plain and utilitarian become entertainment devices and on the other, for the effective design of consumer appliances it becomes paramount to employ multidisciplinary expertise. In this paper, we discuss consumer perceptions of a retailtainment commerce system developed in collaboration between interactivity designers, information systems engineers, hardware and application developers, marketing strategists, product development teams, social scientists and retail professionals. We discuss the approached employed for the design of the consumer experience and its implications for appliance design.

Introduction

To be a consumer is to know about needs and how to satisfy them by searching for, selecting, acquiring, using and enjoying objects and services. Which particular objects individuals perceive as necessary and why, is an issue open to argument: needs are frequently seen as natural and self-evident or more commonly as arbitrary and subjective. But need is also a fundamentally social concept, not in the trivial sense of social influences and socialization, but rather in two important ways: first, in the sense that needs are dictated by a particular choice of lifestyle, social interests as well as politics and second, in the sense of setting a claim on particular social resources. Indeed, modernity has witnessed the manifestation of consumer culture as a major shaping force of social structure and for this reason, it is frequently judged by its

ability to sustain desired ways of life and meet perceived needs [11, 20]. More importantly, consumer culture has emerged as a social system for resource allocation that is evaluated on the basis of its ability to meet the conflicting needs defined by autonomous social groups and communities for themselves. Indeed, consumer culture can be valued on its effectiveness to relate questions of lifestyle to questions of social organization and its implications for everyday life: where and how we live, the food we eat the cloths we wear, the scarcities and inequalities we suffer, leisure and employment.

Moreover, continuous innovation in manufacturing and distribution fuelled rapid changes in consumer culture during the past century and the trend is accelerating: the widespread adoption of Internet and mobile telecommunication technologies has triggered a seemingly fundamental transformation to consumerism. As a result, introduction of new technology-intensive products and services has to be viewed as part of the so-called *whole product* design process [8] where ancillary products or services augment the core product so as to fulfil the value proposition expected by the consumer. In this context, appliances are situated exactly at the point of friction between product design and consumer needs. Hence, the success or failure of a whole product depends heavily on the design of appliances, which effectively act as the primary channel of interaction between supplier and consumer.

In this paper we discuss user perceptions of MyGrocer, a second-generation ubiquitous retail system, and its associated appliances. In this case, the motivation for the development of a ubiquitous retail system has been the investigation of supply chain optimisations: the study of the effectiveness of ubiquitous computing technologies in augmenting and rationalizing the organization of production and distribution of goods. However, research carried out during design and development illustrated the fact that the system -although indeed efficient in addressing the problems it was designed to solve— transforms grocery shopping into a retailing entertainment or *retailtainment* experience. Hence, the design of systems and supporting appliances alike, should be approached from the point of view of entertainment service provision. This shift in focus represents an essential break from the established approach to the design of grocery retail environments, which views in-store shopping carts as utilitarian and mobile telephones as primarily communication

appliances. In particular, the functionality of modern mobile telephones depends heavily on software components and thus leaves room for significant customisations. One of the main developments of this work was the understanding that system co-design for retailtainment depends heavily on partnerships between providers of diverse backgrounds, including information systems designers, hardware and application developers, marketing specialists, product development teams, social scientists and retail professionals.

Ubiquitous Retail

IBM was first to introduce ubiquitous computing in the context of retail [5, 11, 14] and the concept was further developed by the ESPRIT project ALBATROS [22]. At the same time at the AT&T Bell Laboratories ubiquitous retailing features were introduced in the supermarket environment with the development of the Personal Shopping Assistant [2]. Our aim has been to extend the reach of such information and communications environments in two ways: to include the consumer on the move and at home through mobile and ambient intelligence devices as well as to provide a richer shopping experience on the supermarket floor. There are two main infrastructure components required for this: wireless connectivity for mobile devices with broadband characteristics inside the store and grocery products tagged electronically with unique identifiers following a global classification scheme. The development of associated technological components has been discussed in detail elsewhere [18]. A usage scenario of the MyGrocer system on the supermarket floor can be seen in Figure 1 and a usage scenario of the system on the move can be seen in Figure 2. A more detail discussion of the advantages of ubiquitous retail from a business perspective may be found in [16].

In designing and deploying ubiquitous retail we anticipated that we could remove inefficiencies of the fast moving consumer goods (FMCG) supply chain that can be found in both its upstream and downstream directions [4, 17]. Upstream inefficiencies result in high out-of-stock conditions, high returns rate as well as long lead times. Downstream inefficiencies affect demand forecast accuracy, low on-shelf availability and thus loss of revenue despite the fact that products are available on site. Furthermore, information-sharing ineffectiveness between trading partners reduce the

accuracy of demand forecast and the scheduling of the replenishment process. A direct effect of low demand forecast accuracy is that trading partners have to maintain increased inventory levels to address unpredictable increases, thus resulting in increased logistics costs. Common practice today is forecasting consumer demand by processing historical point of sale data, using decision support systems that utilize data warehousing and data mining techniques. However, using historical results on which to base forecasts result in low accuracy because demand patterns are constantly changing [3]. Although it is reasonable to assume that consumption patterns will be repeated fluctuations within the patterns themselves make such forecasts of little use for optimising logistics. For example, historical forecasts do not effectively take into account the influence of promotions and other marketing instruments since their success rates are generally hard to quantify, while at the same time competitive pressures in the supply chain might not offer enough time for effective in-depth analysis.

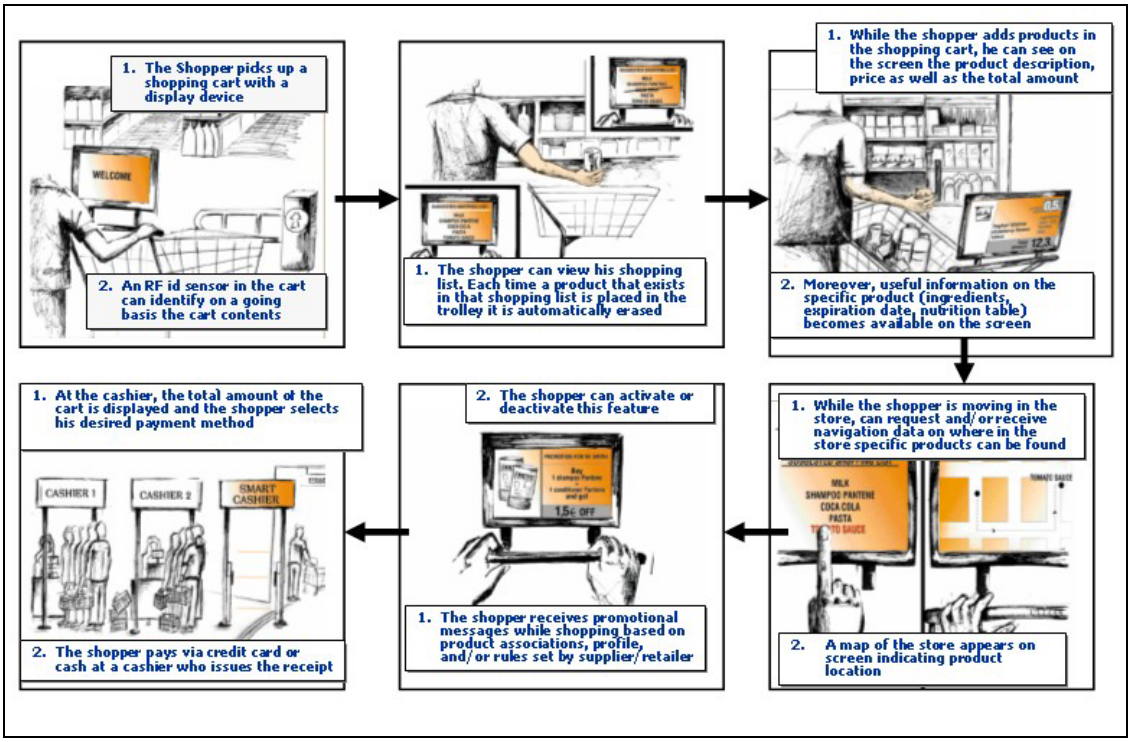

Figure 1: A in-store usage scenario of ubiquitous retailing. The sketches are taken from the material used in the focus groups during initial user requirement capture.

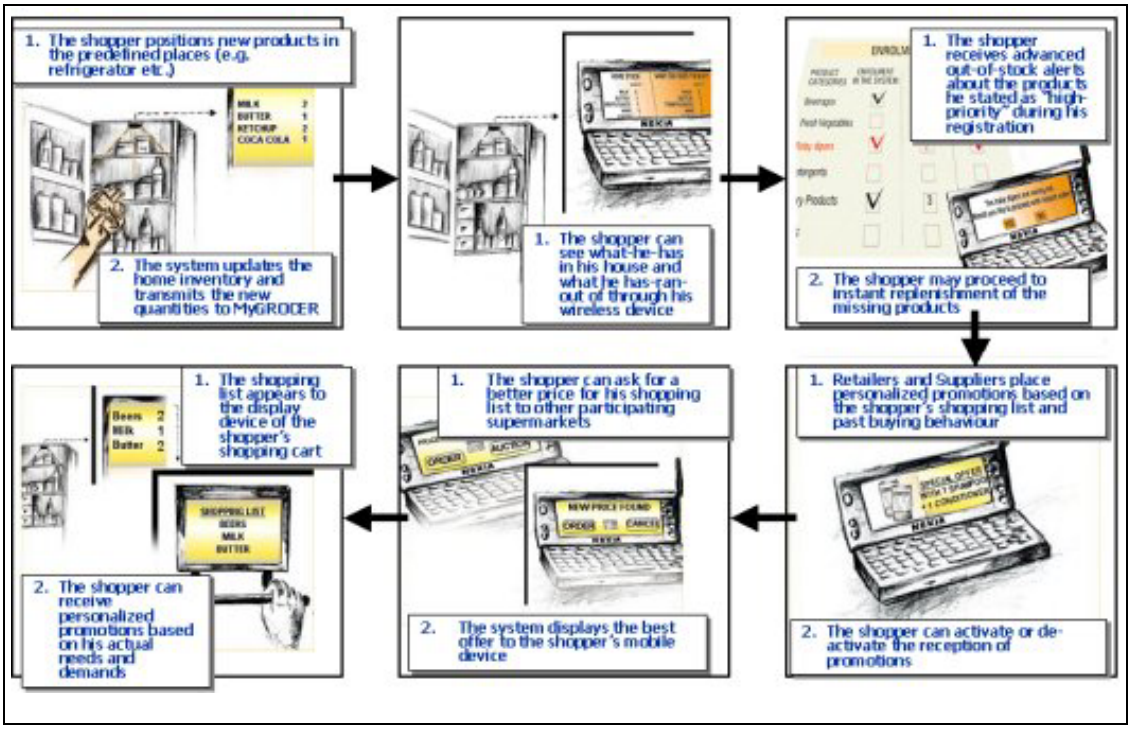

Figure 2: Ubiquitous retailing on-the-move. The sketches are also taken from the material used in the focus groups during initial user requirement capture.

Indeed, per store replenishment strategies are typically based on centre level estimates and not driven by true consumer demand data. To cope with this limitation, grocery stores usually hold high levels of anticipatory inventory to prevent out-of-stock conditions. A direct consequence of this fact is high supply variability as a consequence of unstable process cycle times. The difference between true and estimated product demand is compensated through time, inventory and capacity buffers at the cost of additional capital investments. To alleviate this problem specific inventory policies such as just-in-time (JIT), vendor-managed inventory (VMI), and so on have been established [24] but have small effect in FMCG due to the low availability of real-time information about individual store as well as warehouse inventory levels. A quantitative description of this situation according to a recent study by Andersen Consulting, a market research firm, estimates that 53 percent of out of stock conditions are due to store replenishment inefficiencies. Even worse, a further 8 percent of on the floor out of stock conditions occur despite the fact that the necessary supplies are in storage on site.

Our view of the importance of improvements in supply chain efficiency is corroborated by research suggesting that there is a need for new ways of food shopping. A major study carried out for the Coca-Cola Retailing Research Group [6]

suggested eight drivers: underlying consumer problems with the existing food shopping process which is frequently seen as a chore, frustrating and unenjoyable; the emergence of realistic new modes of shopping, including remote shopping and home delivery as well as internet shopping; heightened external competition for supermarkets primarily in favour of eating out; intensification of internal competition within the existing system due to the domestic saturation of European markets which forces national competitors to look at each others territories for expansion; the long-term erosion of mass-marketing and its replacement by mass-customisation which is becoming a necessity for the so-called new consumers; the certainty that established and foreseeable consumer trends will make the food-retailing environment more challenging especially as divisions between haves and have-nots and the aging population are bringing new threats to superstores legitimacy; the possibility of more radical socio-economic fracture lines opening up with the possible development of extreme consumer militancy or environmental; and finally, the challenging regulatory and political environment which place significant of constraints on the current model. Different features of ubiquitous retail seem to give answers to some of these issues and may be seen as a differentiation factor between competitors.

Several issues had to be addressed for the design and implementation of the system including (a) the design of a compelling interface enabling seamless interaction between shopper and system, (b) the implementation of a product scanning mechanism that would minimize the shopper involvement and (c) the design of an integrated information system that would enable the provision of retail services. The technical development of the system has been detailed elsewhere [18] and here we will only touch upon the design of two of the main elements of the user interface that is the shopping cart and the sensing of product related actions (for example, placement and removal of an object in the shopping cart, consumption of goods at the home and so forth). The shopping cart was modelled around a touch-screen mounted on the shopping cart (Figure 3). Five distinct areas were identified to facilitate the shopping experience:

- Shopping cart content: lists products placed in the shopping cart;
- Total cost: shows the total value of products in the cart and the total amount of reductions due to promotions and offers;

- Shopping list: lists products that are marked as regular buys and those that have been indicated as for replenishment due to consumption;
- Offers and promotions: details offers and promotions for the particular shopper;
- Additional information: displays either detailed information on the last product scanned (for example weight, cost, nutritional value and so forth) or on the terms and conditions of the last triggered promotion.

Unlike general-purpose product browsing appliances where the design should address all possible user cognitive processes, adopting the so-called appliance argument offers several benefits. The consumer may still perform all the activities usually associated [19] with web browsing and shopping that is, finding products, information and general browsing, transacting and communicating. However, the particular focus of the system implies that all of the user goals may be achieved much more efficiently. Whenever additional computing power or storage resources are required such problems may be offloaded to a central server and results exchanged wirelessly.

Product related events are sensed via the use of radio frequency identification (RFID) technologies. Contrary to barcode, the current most commonly used technology for product identification which requires significant involvement on the part of the user RFID (a) senses events and captures related data in a way that does not require line of sight visibility between the tag and the reader, (b) is more resistant to hostile environments and can survive the effects of excessive levels of dust and moisture, (c) can store more information and thus it may be programmed to hold a unique product identification number, and finally (d) provide for anti-theft capabilities. On the other hand RFID is a relatively new technology and thus more expensive and more difficult to produce in large quantities. This is a significant limitation and has restricted our ability to field test the system with multiple concurrent users. Indeed, the initial design was for the RFID field to fully cover the volume defined by the shopping cart sides (80x40x60 cm). However, this was deemed economically unfeasible with regard to the cost of the shopping cart as well as the recharging of the cart batteries we opted for a single RFID reader. Thus, the shopper has to bring each product within the range of the RFID reader to register the product identity. Although this solution does not provide a completely seamless experience it still has several advantages over barcode

scanning (no need to search for the barcode label and align it with the scanner to register it, anti-theft mechanisms).

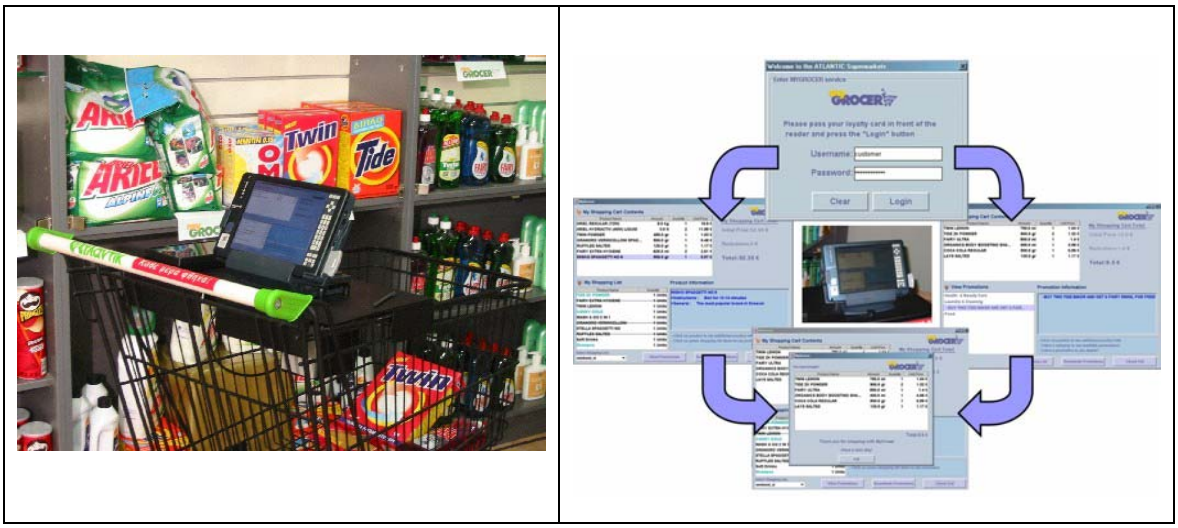

Figure 3: Prototype shopping cart implementation: Shopping cart with tablet PC, wireless network and RFID reader (left). User Interface: Login screen, shopping options including shopping cart content monitor, shopping list, total shopping cart content cost, offers and personalized promotions, additional product information and finally, fast check-out (right).

Product Development

Collection of user requirements aimed at understanding both how to integrate ubiquitous retail with the systems of the supply chain actors as well as how to cater for the needs of the end users. To this end research was carried out to assess the appeal of ubiquitous retail as a value proposition to the consumer as well as to identify barriers to acceptance. The approach adopted was qualitative in nature and used focus groups. Market Analysis a market research firm, was commissioned to conduct the field research. The target audience consisted of: women between the age of 25-34, responsible for grocery shopping within their household who demonstrated some familiarity with information and communication technologies, either as regular users of personal computers and mobile telephony at home or at work; women with the same background but from the 35-50 age range; married couples with both partners between the ages of 25 and 34, both responsible for shopping and with similar background as groups one and two; and, couples as in the previous group but from the 35-50 age range. During the discussion the participants were first introduced

to ubiquitous retail concepts through a presentation based on concept drawings with explanatory text, which the moderator used to discuss selected usage scenarios. Following the introduction, participants were encouraged to discuss their thoughts, feelings and reactions to this novel approach to retail as well as to express their response regarding attitudes and purchase behaviour in this environment. The discussions of all groups were recorded in audio and video with the permission of the participants. At the end of the discussions participants were given a voucher for one of the retailers participating in the project. The complete details of the field study may be found in [17].

The ubiquitous retail proposition attracted significant interest from most participants as a shopping option in addition to the ones available today. In particular the in-store scenario received the most favourable response with the main benefits perceived to be the improvement of the shopping experience which was understood to be faster, easier and offering better value for money. The features that proved most attractive were:

- constant awareness of the total cost of the shopping cart content which offers to the opportunity to accurately control spending during a shopping trip,
- access to complete and accurate descriptions of products including price, size, ingredients, suitability for particular uses and so forth,
- the ability to compare the value of similar products,
- the provision of personalized, targeted promotions that reflect the individual consumer profile in addition to the usual generic promotions as well as the fact that they could access all offers available in the specific supermarket at a single contact point,
- the proposed in-store navigation system especially in the case of hypermarkets where orientation is particular complex,
- the smart checkout and the ability to bypass queues and reduce waiting time.

However, the findings highlighted one of the main concerns of the participants to be the use of personalized purchase statistics by the retailer and collaborating service providers. A large number of participants were particularly concerned about the collection and storage of personal data, even though they were aware of the provisions (albeit not the practicalities) of the data protection act. Their negative reaction to data

collection was triggered primarily after the eponymous authentication during the initial use of the shopping cart when, after entering personal identification credentials, they were presented with a personalized shopping list derived through the analysis of their purchase history. The two main issues arising related to the immediate recognition of the fact that for the construction of the personalized shopping list their data is recorded, preserved and processed. This reaction was more pronounced when trust of third parties was also involved -a core property of fourth generation systems. The main source of concern was that private data, collected in the sheltered space of the home could be delivered to external sources without the explicit consent of the consumer. The vast majority of participants did not trust a service provider to protect their privacy, irrespective of whether it was a contractual obligation or not.

Another major concern related to the overall shopping experience, which was perceived to point towards a technology controlled, fully standardized life-style. Two issues interrelate on this point. On the one hand, participants rejected the claim that a software system could predict accurately their wishes just by collecting historical data and monitoring habitual purchases. Indeed, due to its ability to pre-empt their wishes, this aspect of the system appeared patronizing and overtly rationalized but most importantly contrary to the experience of being human. In fact, the majority of participants discarded the possibility of a computer system that could successfully predict their wishes, while some of them were offended by this suggestion. On the other hand, the participants of the study perceived that the ubiquitous retail system reviewed promoted primarily the interests of the supplier while the consumer only received marginal benefits.

Figure 4. Access to retail m-services via cellular wireless mobile devices: user authentication (left) and shopping list editing (right) on wireless enabled personal digital assistant and cellular mobile telephone (both Java 2 Micro Edition capable).

Finally, several participants observed that adoption of ubiquitous retail would result in a fundamental transformation of the traditional family roles. They emphasized that product selection and maintenance of appropriate home inventory levels are a means to establish roles within the family unit and the responsibility to carry out these activities an integral part of the identity of the person or persons in charge. Elimination of this responsibility was perceived to undermine the status quo and ubiquitous retail was consequently treated with mistrust and hostility.

Implementation

Following the results of the design-stage research, extensive modifications were made and the supermarket scenario was selected as a more feasible alternative to be considered for system implementation. A new study was conducted focused on the particular characteristics of this scenario. The aim of the study was to understand how ubiquitous retail influences the shopping experience compared against the traditional supermarket environment. Members of the supermarket loyalty club were selected to take part to the study. The participants were sixty men and women responsible for shopping in their families from the 25-65 age range with varying degrees of expertise in using personal computers and mobile telephones. Loyalty club members are familiar with the terms of use of their personal information by the supermarket and have accepted it in a trade-off for better value through discounts, gifts and so on. The trials were carried out in one of the stores of the supermarket chain that participated in the project be separating two isles and clearly indicating that a research study was taking place. A selection of products was equipped with RFID transponders and the systems infrastructure was installed in the back end room. Participants were contacted over the telephone and 45-minute slots were booked for each individual. Upon arrival participants were introduced to the system by and then invited to use the system independently. They were able select products placed in the two aisles used for the study and receive offers and promotions according to their profile. Finally,

participants were asked to complete a questionnaire to evaluate the system services, express their views of their experience and compare it against traditional shopping.

Several aspects of the system received favourable responses especially the features that help save time and money. Minimizing checkout time appears to be the most attractive feature with second the capability to continuously monitor the total value of the shopping cart content. Other services that attracted significant interest were the ability to inspect additional product information and the automated construction of a regular shopping list. Indeed, the ease of access to offers and promotions and the navigation features of the system were valued highly by the vast majority of participants who, at the same time, considered the expedited checkout features to be particularly desirable and they considered waiting time to be a significant factor in their decision to shop at a particular store (too long). Moreover, the display of the cumulative value of the shopping cart and detailed information about offers and promotions was seen as improving the effectiveness of the shopping experience.

Figure 5: Prototype ubiquitous retail application: Log-in (top-left), product selection (top-right), scanning (bottom-right) and fast checkout (bottom-left).

Participants expressed their perceptions of different aspects of the system including usefulness, usability, trust, intention to use and service quality. The majority (49 out of 60) of participants regarded ubiquitous retail as a useful addition to current supermarket shopping options, expressed the view that it significantly improves the

shopping experience and found the system to be user friendly and intuitive to use. Having resolved the issues of fair use of personal information by selecting members of the loyalty club no other significant issues relating to trust were raised and, in fact, a significant number of the participants stated that they would trust the system to do their shopping and that they would trust it more than they trust Internet shopping. Overall, participants were satisfied with the service quality of the system and the majority (54 out of 60) expressed their willingness to use it when it becomes available.

The most interesting results related to the changes of the shopping experience of the participants. The most striking response was that ubiquitous retailing has a high entertainment value with the majority (53 out of 60) of participants stating that they found the experience enjoyable while more that half considered ubiquitous retail an exciting activity. In addition to this, participants overwhelmingly considered that the use of the system reduces their stress level and sense of time pressure while shopping. We will return to this point later but, first, we would like to point out that the entertainment value of ubiquitous retail makes it a particularly good candidate towards new ways to shop since it addresses most of the eight drivers for change in food shopping discovered by [4] and listed in the previous paragraph.

Discussion and Conclusions

Advances in manufacturing, distribution, information and communication technologies combined with the urbanisation of modern society have created the so-called *new consumer* [10]. The new consumer is more knowledgeable about comparable product costs and price; more changeable in retail and brand preferences; showing little loyalty; self-sufficient, yet demanding more information; holds high expectations of service and personal attention; and is driven by three new currencies: time, value, and information. A direct consequence of this is that grocery shopping is transformed to retailtainment that is, an enterprise not uniquely aimed at satisfying basic needs but rather a leisure activity similar in essence with other entertainment options. This work provides evidence that ubiquitous retail offers better entertainment value and in many cases provides for an exciting shopping experience, tailored to the

individual preferences of the particular shopper. In fact, we argue that ubiquitous technologies are the appropriate channel through which to deliver massively customized goods and services in a cost efficient manner. Overall, ubiquitous retail is seen as a superior value proposition in terms of time, value and information.

Following the experience of MyGrocer, we anticipate that ubiquitous retail will offer the opportunity to reduce the negative effects on the shopping experience of several factors encountered in today's supermarkets and reduce the levels of stress associated with replenishment shopping. Moreover, there is strong indication that the primarily consumer oriented nature of ubiquitous retail will significantly reduce anxiety levels and significantly improve the shopping experience through purpose built appliances that cater for continuous awareness of total cost of the shopping cart content, information-enabled spatial navigation of the supermarket and opportunities to maximize the value of a shopping trip by context aware offers and promotions. Even so, consumer expectations about their shopping experience are not fully met due to dependencies on store ambience (for example, environmental conditions, scents, background music and so on), service quality, application functionality and branding [3]. We assert that these shortcomings cannot be addressed individually but the whole retailtainment experience must be created under a single vision and directed accordingly, in an approach much like that encountered in other entertainment industries (for example cinema and orchestral music). Even when specific consumer appliances with predefined form factor have to be used --as is the case for mobile telephones-- there are still opportunities for in-situ customisation, since a substantial part of their functionality is controlled by software and can be modified in non-trivial ways.

Furthermore, the introduction of ubiquitous shopping refocuses the shopping experience around the appliance rather than the store selves. Indeed, MyGrocer represents a strong case in favour of the “appliance argument” that is, to focus on streamlined systems with a particular purpose within a well-defined set of user activities. On the other hand, it becomes evident that to cater for the rapid development lifecycles of electronic and mobile commerce more functionality should be transferred to the software rather than the hardware components. Last but not least, wireless connectivity opens up the possibility to remove some of the constraints of the

small form factor of mobile appliances by unloading storage and processing functions to a central server.

Finally, one of the major challenges in designing successful consumer experiences for retailtainment lies in achieving effective communication between the different participating disciplines. Software application developers have a radically different culture to consumer product development teams but the expertise of both is required for a successful outcome. Understanding each other's language, their priorities and their concerns requires continuous contact and uninterrupted communication as well as strict adherence to a single vision so as to transform requirements to design.
Even so, there are still several technical and social challenges before the wider deployment of ubiquitous retail, especially relating to issues of personal identity, security and privacy but also standardisation and engineering. However, this research has indicated that consumers would accept ubiquitous retail systems when they become financially viable provided that they offer high quality retailtainment over appropriately designed appliances.

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