How Pervasive And Mobile Computing Can Help Organizations To Include People With Visual Disabilities On Their Client-Approach Strategy?

Carlos Rompante Cunha, Polytechnic Institute of Bragança – EsACT, Mirandela, Portugal, crc@ipb.pt
João Pedro Gomes, Polytechnic Institute of Bragança – EsACT, Mirandela, Portugal, jpgomes@ipb.pt

Abstract

Organizations have in-built social responsibility to society. The evolution of technology have enable organizations to interact in an innovatively and more close approach to their clients. But this evolution has not included people with special needs like blind people. And, even those organizations that have enable some kind of support-approach to blind people, have typically disjointed, incomplete and typically parallel approaches; compared to their mass-client standard approach. This paper discusses the potential of Pervasive and Mobile Computing to support, not just an innovative and unified approach, but also a real possibility of promoting real inclusion of blind people in what concerns to the delivery of information and services organizations offer. This paper also represents a reflection and a mind shaking attempt, while the authors are working in allowing blind people an autonomous buying process, in hypermarkets, supported by the use of wireless networks and modern mobile devices, with multiple technologies support, like Wi-Fi and inertial and magnetic sensors.

Keywords

People with disabilities, contextualization, mobile devices, client-approach strategy.

Introduction

Promoting an open and inclusive society that accepts and respects difference and perceive the social inclusion of people with disabilities as one of the duties of citizenship, is a duty of each and every one of us (ACAPO 2011). In pursuit of this goal has been, in many countries, produced legislation in the sense of that inclusion, having been created several working groups , technical and scientific multidisciplinary, in which the component technology has proved been an important enabler of the presented solutions. One of these examples has been the development of Access mechanisms to Web sites contents (Ramakrishnan et al. 2008). Among these, one of the most interesting are the mechanisms in the field of electronic commerce, capable of enabling the purchase of products by blind people (Pontelli & Son 2003).

This trend towards the inclusion of blind people has, in our opinion, an approach that is not as inclusive as we may think. If we analyze the approach that organizations have used to deliver their services to blind people, we easily realize that these are disjointed approaches, incomplete, and typically parallel to the strategies used for people without visual impairments, Fig1. In part these differences can be explained by the difficulty that organizations face in getting their strategy equally spread by their customers, when they constitute a heterogeneous public. In fact, blind people do not meet many of the conditions necessary to use the traditional channels of organizational information and services distribution and, organizations indicate a high technology cost for blur constraints faced by blind people. For organizations represents a high financial cost and a benefit-cost ratio very unfavourable (despite the social responsibility that fit organizations) to include the special needs of blind people in their strategic relationship with the client.

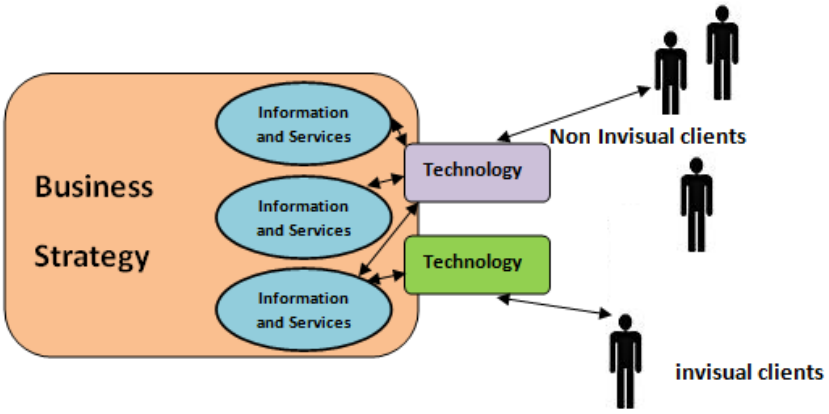

Fig 1. Typically disjointed, incomplete and parallel approach for delivering information and services

Those organizations that are inclusive, as noted above, de strategy has been a specific and differentiated approach for the blind people. However, these approaches are often less comprehensive or even limited and deserve organizational low priority. Obviously this reflects the overwhelming power of "quantitative": fortunately the overwhelming majority of organizations clients are not blind. The question we ask is if organizations do not currently have instruments and technology to have a unique approach to their clients, be they blind or do not.

In our opinion the maturity stage of Pervasive and Mobile Computing (PMC), opens a window of opportunity to revolutionize the way that organizations can define their strategic relationship with their client, as well as in the form and set of services that may be available in future. Another key issue, and that is the basis of our research, is the discussion and understanding of the intrinsic ability of the PMC to support strategies for dissemination of information and services to blind people who, we think , there is no longer the need to be translated into different approaches. Why? Because the paradigm of PMC involves a wide range of technology usable by everyone whether or not blind, and allows, using the same channels, to provide wide and ubiquitous information and services. Finally, it should also be noted that mobile technology such as mobile phones and smartphones are technologies with a very high degree of penetration and lower identified barriers to users. Additionally, technologies like 802.11 networks, RFID tags or visual tags, are promising results for inclusive and easy access to information and services through mobile devices that have long been part of our daily routines.

In this paper, we characterize the potential of PMC and a set of technologies that can support new ways of organizations engage with their customers and, within the same approach, without additional costs, people with visual impairment, contributed to a deepening of the social role and responsibility of citizenship that organizations can not overlook and that society has long complained.

The potential of PMC and contextualization-enabler technologies

The PMC model aims to break with the traditional PC-centered interaction model and to give users the opportunity to interact with the digital world through their surrounding environment elements, at any time and using any device (Hernandez 2009; Saha 2005; Han et al. 2004). To achieve real ubiquitous computing, it is necessary to address several issues and challenges, outlined by many researchers, like: the integration of physical and virtual spaces (Kindberg & Fox 2002; Lee et al. 2010) spontaneous interoperation (Kindberg & Fox 2002) and contextualized interactions (Raento et al. 2005; Christian et al. 2008).

While wireless public (typical 802.11 networks), and many times free, networks, are growing and enabling user to be always connected to the Internet, currently common mobile-devices, with Java and web connectivity support, are progressively trying bridge the gap between users

and information and organizational services. In this process, contextualization approaches to rich information and services are still in its early stage, being, for most common applications, mainly based in position supported by the Global Positioning System (GPS). However, there are growing new approaches using context elements such as: barcodes, visual tags or radiofrequency tags. Those can be easily and inexpensively embedded in real-world objects and their decoding systems are based on image recognition algorithms or radio waves technologies. Because of their ability to handle more data per tag area, visual tags and radiofrequency tags are suitable candidates to replacing the well-known EAN13 barcodes. A common everyday device that can perform this kind of decoding is a mobile device, like a smart phone, with a built-in camera (for visual tags) or for instance, Near Field Communications (NFC) smartphones compliant. Putting together those tags with information storage capabilities and mobile-devices as decoding systems we have an approach that represents a reliable mechanism to quickly look up information or initiate an object-specific action.

PMC is an area of Information Technologies and Communication in rapid growth, which will leverage the development of user oriented technologies. Several technologies are required to create a ubiquitous computing environment, including devices, applications and communication solutions. Considering the scenario on which this article focuses, we will briefly describe some of these technologies.

RFID (Radio-Frequency IDentification)

This technology allows a reader to get, through radio waves, the information stored in RFID tags existing in the proximity. This, not only enables automatic identification of objects associated with these RFID tags, but also, indirectly, enables its positioning. His scope of use is quite extensive, namely, inventory management systems, payment, and inventory tracking.

NFC (Near Field Communication)

NFC enables the rapid establishment of wireless connections and the simplified exchange of data between two very close devices. This technology allows applications in areas such as payments, data exchange and access control, having many positive features such as the simplicity of use, versatility and security, both by natively supporting secure applications, either by the short range transmissions characteristics, limited to only a few centimeters. Despite its potential, its implementation in mobile phones has been extremely slow.

WLAN (namely IEEE 802.11)

The IEEE 802.11 is currently a widely deployed technology, suitable for intensive data transmission. Being present in most laptops today, it is becoming increasingly a reality in mobile phones, particularly in smartphones. Due to the limitation of GPS in indoor environments, the signals from their access points are often used in positioning systems for people and/or objects in their coverage area.

Bluetooth

Short-range (few meters) and low power consumption wireless transmission technology, it is very common in mobile devices, being used to transfer data between them. Besides this peer-to-peer data exchange, it also can create personal area networks (PAN) allowing the simultaneous connection of multiple devices. It is often used to connect to peripheral devices, and can also be used in positioning systems.

Mobile Devices

The massification of mobile devices makes them today a key element in PMC. Not only for their ability to communicate, but also for their components and sensors, each time in highest numbers, that boost their use, such as camera, microphone, accelerometer and digital compass.

Contextualization

One of the aims to be achieved in a ubiquitous computing environment is contextualized interactions. For this, it is necessary to know the position of the user. In indoor environments, several approaches have been used, including multilateration techniques through the IEEE 802.11 networks signals usually present in commercial spaces, or the use of context elements as visual tags (e.g., barcodes, QR-codes) and radio-frequency tags (NFC, RFID).

A unified client-approach architecture for delivery information and services

In order to materialize a unified approach so that organizations can deliver information and services to its clients, and also fully addressing blind people, is presented an architecture, illustrated in Fig 2. The approach is based on the premise that mobile devices, which are widely disseminated by users, now have a high potential to support different approaches in terms of information transmission and access to services. Its highly sensorial component and the support to multiple network technologies makes them excellent tools to access the services offered by organizations.

The increasingly materialization of smart-spaces, which in practice reflects a process of introducing technology in the environment, allows you to customize and contextualize the information delivered to customers. Much of this technology is possible to use today by mobile devices. As a complement, they allow that a given set of data/information can be available to the user in several formats (e.g. text, image, audio or video). This fact presents, in the context of this article, a key element, since it reflects the possibility of adjust the data format in the best interests and capabilities of end users (eg a blind person will be able to recognize data in audio format while a person without the visually impaired can do it in video format).

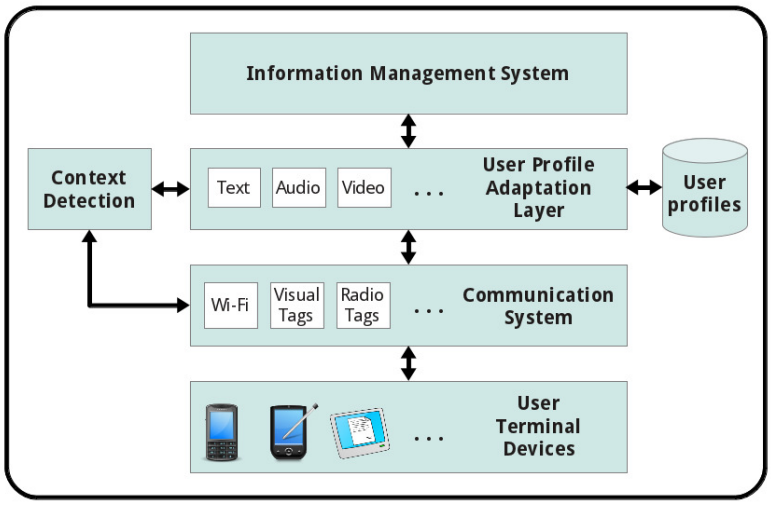

Fig 1. Unified client-approach architecture for delivery information and services

The architecture illustrated in Figure 2, shows a unified approach where, through the use of mobile devices, we can use/receive contextualized information suitable to the user profile. This profile will reflect the best combination between the interests of the organization on how to delivery/use the information and services, the capabilities of the user mobile device and, finally, the best format for information to delivery and/or to access a given service. Thus, we present an adaptation profile layer that, in fact, differentiates the process of data delivery, without changing the strategy to implement in the lower layers of architecture.

Discussion and final remarks

The proposal architecture represents an approach to enable a unified solution to delivering information and services to customers according to user's profile and best suitable data

format. This not only support innovative ways of interaction with users, but, for our goal, it also represents the possibility of fully include blind people in the organizations business strategy. Understand the best ways to adequate the information and services delivering mechanism to the users profile should be the next steep of our research. The authors also like to state that this paper is a piece of a major effort to promote the access of blind people to daily routines, that common, non-disabilities people have access, enabled by mobile devices, wireless networks and contextualization mechanisms, where an experimental prototype is being developed to allow blind people to make purchases, autonomously in hypermarkets (Gomes, Cunha & Mansilha 2010; Mansilha, Gomes & Cunha 2011).

Bibliography

ACAPO (2011), "A história da ACAPO" [online], *ACAPO* [Retrieved June 4, 2011], http://www.acapo.pt/index.php/acapo.

Christian, F., Philipp, B., Friedemann, M. and Wolfgang, K. (2008), "The sensor internet at work: Locating everyday items using mobile phones", *Pervasive Mobile Computing*, 4 (3), 421-447.

Gomes, J. P., Cunha, C. R, Mansilha, R. (2010), "Orientação de invisuais em espaços fechados combinando técnicas de multilateração, inerciais e magnéticas, usando redes 802.11 e dispositivos móveis", 5ª Conferência Ibérica de Sistemas e Tecnologias de Informação, 16-19 June 2010, Santiago de Compostela, Espanha.

Han, S. W., Yoon, Y. B., Youn, H. Y. and Cho, W. (2004), "Software technologies for future embedded and ubiquitous systems", Proceedings of 2nd IEEE Workshop on Software Technologies for Future Embedded and Ubiquitous Systems, ISBN: 0-7695-2123-1, 11-12 May 2004, Vienna, Austria, 117-121.

Hernandez, E. A. (2009), "War of the mobile browsers", *IEEE Pervasive Computing*, 8 (1), 82-85.

Kindberg, T. and Fox, A. (2002), "System software for ubiquitous computing", *IEEE Pervasive Computing*, 1 (1), 70-81.

Lee, J. Y., Seo, D., Song, B. Y. and Gadh, R. (2010), "Visual and tangible interactions with physical and virtual objects using context-aware RFID", *Expert Systems with Applications*, 37 (5), 3835-3845.

Mansilha, R.; Gomes, J. P.; Cunha, Carlos, R. (2011), "Um protótipo para orientação de invisuais em espaços fechados combinando técnicas de multilateração, inerciais e magnéticas, usando redes 802.11 e dispositivos móveis", Actas da 6ª Conferência Ibérica de Sistemas e Tecnologias de Informação, ISBN: 978-989-96247-4-0, 15-18 June 2011, Chaves, Portugal.

Pontelli, E., Son, T. C. (2003), "Designing intelligent agents to support universal accessibility of E-commerce services", *Electronic Commerce Research and Applications*, 2 (2), 147-161.

Raento, M., Oulasvirta, A., Petit, R. and Toivonen, H. (2005), "ContextPhone: A prototyping platform for context-aware mobile applications", *IEEE Pervasive Computing*, 4, 51-59.

Ramakrishnan, M. I. V., Mahmud, J., Borodin, Y., Islam, M. A., Ahmed, F. (2008) "Bridging the web accessibility divide", Electronic Notes in Theoretical Computer Science, vol. 235, Proceedings of the 4th International Workshop on Automated Specification and Verification of Web Systems, 4 July 2008, Siena, Italy, 107-124.

Saha, D. (2005), "Pervasive computing: A vision to realize", *Advances in Computers*, 64, 50.