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INTERNET OF THINGS (IOT) IN E-COMMERCE FOR PEOPLE WITH DISABILITIES

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ABSTRACT

The Internet of Things (IoT) perceives and recognizes the physical world by taking advantage of smart devices. The world's largest minority are people with disabilities. IoT can lower barriers for the disabled people in accessing information. Increasing Internet accessibility can help to make that happen for both social and economic benefit. This paper presents the proposed integrated framework of the IoT and cloud computing for people with disabilities such as sensory (hearing and vision), motor (limited use of hands) and cognitive (language and learning disabilities) impairments in the context of business-to-consumer (B2C) e-commerce context. We conclude that IoT-enabled services offer great potential for success of disabled people in the context of e-commerce.

Keywords: e-business, electronic commerce, internet of things, disable user.

INTRODUCTION

An online vendor seeks to offer positive online purchasing experiences for online consumers of all ages. According to the World Health Organisation [22] a billion people in the world, which is 15% of the total population has disability that limits their participation in the community. People with disabilities have limitations for going shopping, which put them at inconvenience because of their physical handicap. However, disabled people can gain a sense of emotional stability by online shopping. Therefore, e-commerce need to be accessible to all consumers, including those with disabilities. Though, if e-commerce websites are inaccessible, consumer with disabilities do not have the equal access they are guaranteed by law. Many online consumers may have various types of disabilities, such as sensory (hearing and vision), motor (limited use of hands) and cognitive (language and learning disabilities) impairments. Because of the Internet availability, online shops give consumer the ease of buying and selling products. Inclusion of people with disabilities and the aged in mainstream society has improved significantly through the continuous development of guideline and assistive technologies together with the use of Information and Communications Technology (ICT). Such as World Web Content Accessibility Guidelines (WCAG) developed by Wide Web Consortium (W3C) have to reduce the barrier for accessing information. WCAG provides recommendations to make web content more accessible for user of all ages and with disabilities. For that reasons, the Web Content Accessibility Guidelines (WCAG 2.0) [20] helps to make the website accessible for users of all ages and with disabilities such as color blindness, deaf users, and age related vision problems. The required web technological infrastructure is either insufficient or does not exist in terms of web accessibility for disabled people [17]. Though, in [11] the authors found that 78.9% of the webmasters were aware that there are automatic tools to check web accessibility. This means that the missing knowledge is not the main reason for the absence of development of accessible websites. Web accessibility is particularly important since blind or color blind consumer have much more difficulty browsing the web [3]. The accessibility evaluation in e-commerce has been limited, in particular for disabled people in the context of business-to-consumer (B2C) consumer.

One new technological trend that will impact on society (and thus people with disabilities and the aged) is that of the Internet of Things (IoT)[5]. IoT is the interconnection of every physical thing (digital objects) that is networked smart devices [15]. The smart devices are able to understand, sense and respond to the environment through Internet and Radio-frequency Identification (RFID), context awareness or embedded sensors technologies [1]. This technological development of IoT enables new ways of communication between smart objects and people and between objects themselves [10][18]. It is highly desirable that e-commerce firms should make greater efforts to ensure that the consumers with disabilities have equal access to online shopping. The IoT can enable people with disabilities the support they need to attain a good quality of life and allows them to participate in social life. Therefore, the purpose of this research-in-progress paper is to analyze how people with sensory (hearing and vision), motor (limited use of hands) and cognitive (language and learning disabilities) impairments can benefit from the IoT in the context of online shopping. To the best of our knowledge, this is the first study that discusses the IoT for people with disabilities in business-to-consumer (B2C) e-commerce context.

BACKGROUND AND RELATED STUDIES

Barriers for People with Disabilities in E-commerce

The following examples may help to explain the types of barriers that can be encountered by an online consumer with a disability. For-example, e-commerce websites that use flashing images could trigger symptoms for those with seizure disorders [8]. Such as the use of screen readers cannot read images, animations, navigational buttons, as well as some difficulties with reading layout tables and charts [6]. In addition, a color-blind consumer making online purchase will not differentiate the red font highlighting the discounted prices. Also, if recorded product information available to consumer on website as an audio clip. Then consumer who has difficulty in hearing or deaf cannot hear to buy the product. The website page is written in unnecessarily complicated language. Then it may present serious difficulty for consumers with language, learning or cognitive disabilities (for-example, reading disabilities, thinking, remembering, sequencing disabilities). Image interactivity technology will represent a barrier for a

consumer who cannot grip the mouse to imitate actual experiences with the product. For-example, consumers with various forms of motor impairments may have increased difficulty using a mouse or keyboard. Such as, rollovers and drop- down menus are difficult to use without a mouse.

Internet of Things (IoT)

The basic idea of IoT is to connect a variety of things around us to interact with each other, For-example Radio-Frequency Identification (RFID) tags, sensors, actuators, tablets and smart phones etc. The work by [7] provided an overview of the IoT architecture for people with disabilities. It is divided into three main layers: Perception layer, Network layers and Application layer. In [12] and [14] , the authors proposed systems to help visually impaired people in brick and mortar shopping for product identification and search. In addition, [23] proposed real time product detection using actual video stream. In [24] the authors discussed IoT technology applications and their integration in e-commerce inventory, logistics and online payment. In addition, industry experts agree that the IoT has a great potential to bring benefits to people with disabilities [2].

Cloud Computing

Cloud computing is a model for big data storage, visualization, computation and analytics etc. The integration of cloud/mobile cloud computing and IoT and has great potential for success in e-commerce. Mobile cloud computing is similar to cloud computing, where data storage takes place in the cloud through wireless networks by mobile devices [16]. Cloud Computing includes three different service models, which are Platform-as-a-Service (PaaS), Infrastructure-as-a-Service (IaaS) and Software-as-a-Service (SaaS) [16]. Cloud computing that offers utility-based model will enable businesses and users to access applications on demand anytime, anyplace and anywhere [4]. In [9], the authors proposed a cloud centric framework for worldwide implementation of IoT. The authors presented a cloud implementation using Aneka (which is based on private and public clouds interaction) to provide the capacity for utilizing the IoT.

Electronic Product Code

Electronic product code (EPC) has become one of the main research interests for academics and also in several industries in recent years [1]. The increasing diffusion of the EPC was first proposed by the Auto-ID Center, founded in 1999 at Massachusetts Institute of Technology (MIT) [23]. The purpose of EPC technology is to create an IoT that consist of various components (hardware and software) including open-standards to bridge the gap between the physical and virtual worlds [13]. Radio-frequency Identification (RFID) technology is a major development in the embedded communication paradigm to help in the automatic identification of anything they are attached to acting as an electronic barcode [21]. In [1], the author developed eCloudRFID framework for mobile devices to enable the development process of the integration process of EPC network instances and embedded RFID and business applications.

ONLINE SHOPPING FRAMEWORK FOR PEOPLE WITH DISABILITIES

People with disabilities and aged can now use improved accessibility features in smart devices (such as smartphones/tablets etc.). Many manufacturers have developed smart devices with easier user interfaces. These user interfaces enable use by disable users whose usage of smart devices may otherwise be affected by vision or hearing loss or reduced mobility. These accessible smart devices are already in use for smart cities, smart homes, smart transportation or e-health, giving disable person a new and flexible control to participate more fully in the economic environment. We propose an integrated IoT and cloud computing application to enable the creation of smart devices (such as smartphones or tablets) to be able to support a large number of disabled people for online shopping in a reliable manner. Figure 2 shows the use of IoT and Cloud computing for e-commerce. The proposed integrated cloud and IoT conceptual framework for people with disabilities is shown in Figure 3.

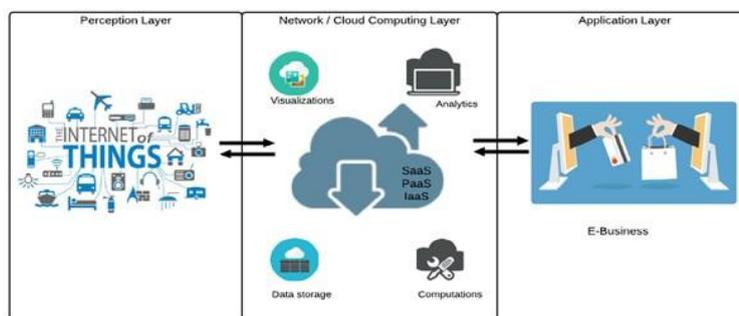


Figure 2. Integrated Conceptual IoT and Cloud framework

Smart devices are able to work in wireless network environments without the fear of limitations such as access devices or data sources with limited power and unreliable connectivity. In particular, we propose an iAccess service to provide the user-driven service modeling process. The cloud based iAccess service will allow disable consumer to compiles a digital shopping list of item(s) using a speech recognition or text, scanning the barcode or using RFID reader through smart device and deliver it to IoT

cloud portal. The created list of item(s) is stored and registered in the service repository to be detected in the IoT cloud based service web portal. The IoT service abstracts the service modeling result to deliver to the e-commerce service platform. The web portal will display the required item to the user. Online payment can also be completed using RFID. Such as RFID chips embedded in smart devices or RFID credit cards. A conceptual framework integrating the IoT sensing devices, cloud computing and the applications is shown in Figure 3.

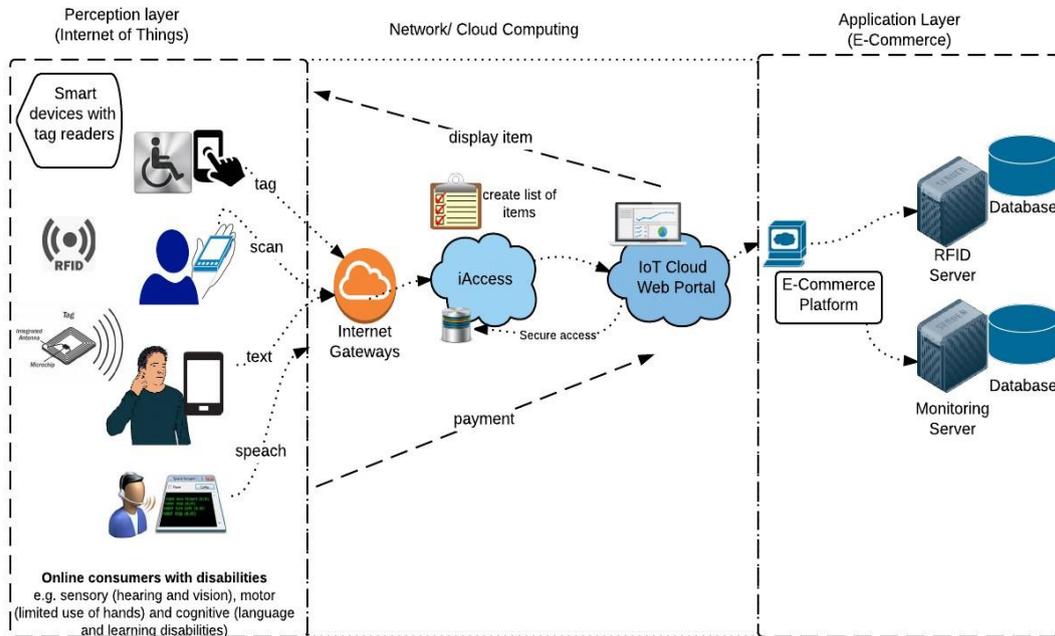


Figure 3. Proposed framework on online shopping scenario for disabled users

CONCLUSION AND FUTURE WORK

The main strength of the IoT is the high influence it will have on several aspects of everyday-life and behavior of disabled people. IoT creates an integral part of future Internet. On the other hand, cloud computing is a more mature technology offering several advantages. We propose a framework of the integration of IoT and cloud computing to enable great potential for success of disabled people in the context of e-commerce. The proposed framework is an environment aimed at lowering barriers for the disabled people. Increasing Internet accessibility can help to make that happen for both social and economic benefit.

F-commerce firms need to make accessibility a priority for disabled people. This study is intended as a starting point for the e-commerce firms to work together to make change for people with disabilities. Online store manager can use the proposed framework in this study to increase the chances for an online business to succeed globally with diverse degrees of Internet users. Practical implications extend to business firms to make changes to their online business strategies to trigger their online sale better by targeting consumers with disabilities.

In future work, the implementation of our proposed framework is required to ensure accessible e-commerce for people with disabilities. In addition, motivation for future work includes the development of Augmented Reality (AR) in our proposed framework on smart devices for users of all ages and with disabilities.

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