Towards an IoT Architecture for Persons with Disabilities and Applications

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Abstract. Internet of Things is revolutionizing human being daily life with the emerging of a huge number of connected devices. The potential benefits of connected things are limitless especially for persons with disabilities. Indeed, the number of disabled persons in the world today is considerable and their need of special care and adapted solution is a vital need. In this paper an IoT architecture for persons with disabilities is proposed and an IoT system dedicated to the visual impaired persons is implemented ensuring their assistance and security.

Keywords: Internet of things · Persons with disabilities · IoT architecture for PwD · Connected cane

1 Introduction

Internet connected devices offer a real potential to transform person's quality of life, particularly for persons with disabilities. This is also the subject of many researches and solutions. For instance, [1] propose a solution based on IoT architecture with mobile and M2M communication to help persons with disabilities to park. Also, [2] present an approach based on IoT in medical environments to achieve a global connectivity with the elderly and disable persons, sensors and everything around it to make their life easier and the clinical process more effective.

Persons with Disabilities have special needs and they require adapted solutions. So, dedicated solutions shall take in consideration their specific constraint such as mobility, safety of their connected devices. In this paper, an IoT architecture for persons with disabilities is proposed and a specific solution is implemented for the visually impaired persons.

2 IoT Persons with Disabilities Architecture and Components

As shown in Fig. 1, the proposed IoT architecture for persons with disabilities consists of six layers: Perception Layer, Networking Layer, Middleware Layer, Application Layer and two vertical layers: Management Layer and Security Layer.

In the Perception layer, devices are equipped with sensors such as temperature, humidity, etc. It collects data and send it to networking layer. The Networking Layer transfers the collected data from perception layer to the data processing system through

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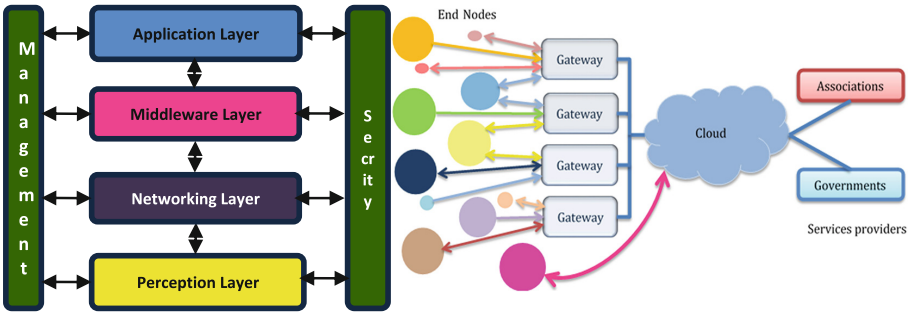

Fig. 1. IoT PwD architecture proposal and components

a specific medium. The medium can be wired or wireless. Middleware Layer provides facilities to applications to consume information received from the Networking layer. And finally the Application Layer, it implements a variety of IoT applications for many handicaps such as blindness or low vision, deaf, physical disabilities, etc. Management layer is responsible for the management of the four layers' components. The second vertical layer of the proposed architecture is the Security layer.

The components of the PwD IoT architecture, as shown in the Fig. 1, are End Nodes, Gateway, Cloud and services providers. End nodes are sensor nodes. We identified three types: active nodes, passive nodes and autonomous nodes. Gateway are devices that serve as link between the network of End nodes and the IP network. Because of the mobility of the disabled persons, the gateway can be a Smartphone or an embedded device in the PwD objects. The cloud contains a management platform of PwD and database server. Its main objectives are data storage and filtering, which will be used by web and mobile applications. And finally, services providers which are PwD Associations and government. The PwD Associations are suppliers of several web and mobile applications for the PwD and their family members. The government guarantees the efficient use of collected data to assist its different entities in planning of dedicated infrastructures such as roads, traffic lights, parking places, etc.

3 Implemented Use Case

The target handicap in this scenario is the blindness. The visually impaired persons face many challenges in navigating in many environments, which are often designed without taking them in consideration. In fact, the main used devices in Fig. 2 are connected cane, staircase beaconing device and connected traffic light. A web application is also implemented for visually impaired tracking by their family members. To receive alerts from the connected things (cane, staircase beaconing device and traffic light), the users are equipped with a Smartphone.

The connected cane in Fig. 2, is considered as an autonomous node in our introduced architecture. This cane provides several services to the visually impaired: obstacle detection, GPS tracking and water flanges detection. Obstacle detection is adaptable on two levels: up or down. Two different sounds are produced for each level.

Fig. 2. Use case

The embedded board (RaspberryPi card) of the cane contains a GPS receiver. If the visually impaired person is lost, family members, who have the permission, will be able to find out his location through a mobile application. Finally, in case of cane loss, the owner can use an implemented Smartphone application to detect its location.

4 Conclusion

This paper proposes an IoT architecture for persons with disabilities and describes its different layers and components. In this work we also implemented a scenario for the visually impaired persons. Our work is still in progress as a lot of issues needs to be resolved related to the energy management and security.

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