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IOT Based Approach for Neurologic Impaired People

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Abstract*— Technologies supporting the Internet of Things are having atremendous advance in important IoT technical fields, becoming each day more accessible, available and versatile, allowing a faster grow of the things interconnected through Internet. These technical advances are opening a new world of different ways to communicate, empowering human and machine data communication capacities. The IoT technologies are expanding to specific application domains, evolving towards a fully IoT World. One example are the technical innovations for people with special needs in order to assist them in their daily activities, improving this way, their quality of life. This could be achieved with the help of well adapted and specific IoT technology for this sort of people. To illustrate the proposed architecture for people with disability, it wasconsidered two use cases applications. A use-case application for visual impaired people and a use-case application for neurologic impaired people.

***Keywords*— Internet of Things, Embedded Systems**

I. INTRODUCTION

One new concept associated with the "Future Internet" is called an "Internet of Things" (IoT). The "Internet of Things" describes a vision where objects become part of the Internet. Where every object is uniquely identified and accessible to the network, its position and status known, where services and intelligence are added to this expanded Internet, fusing the digital and physical world, ultimately impacting on our professional, personal and social environments. An Internet-of-Things (IoT) is the convergence of Internet with RFID, Sensor and smart objects. The world around us is full of objects, smart objects and the existing service provider known as Internet. The convergence of the sensors like smart objects, RFID based sensor networks and Internet gives rise to the Internet of Things.

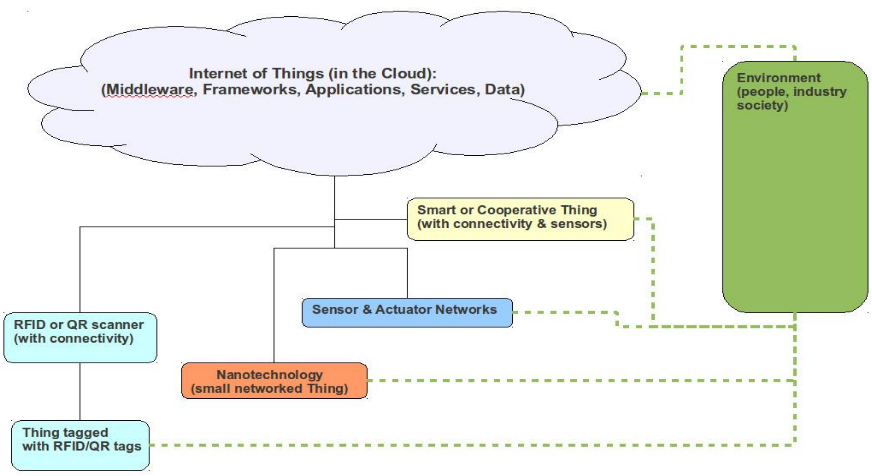

Figure 1: Components in the Internet of Things

1.1.1 Components of an IoT

Figure 1 provides a view of the IoT ecosystem. Things could be tagged, and through scanners, identified, and the relevant location information could be communicated. Similarly, networked things with sensors become smaller, weaving themselves into our daily lives, while sensor and actuator networks act on the local environment, communicating status and events to a higher level service. Smart things sense activity and status, linking it to the IoT. Middleware and frameworks enabling application and service development which utilize data as received from (or about) things, most often living in the cloud provide the capability to add intelligence resulting in better services, which ultimately impact on the environment. It is projected that almost everything will be connected to the network, even individual objects will be tracked, its condition and location communicated in real time to a higher level service.

1.1 Problem Statement

Technologies supporting the Internet of Things are having a tremendous advance in important IoT technical fields, becoming each day more accessible, available and versatile, allowing a faster grow of the things interconnected through Internet. These technical advances are opening a new world of different ways to communicate, empowering human and machine data communication capacities. The IoT technologies are expanding to specific application domains, evolving towards a fully IoT World. One example are the technical innovations for people with special needs in order to assist them in their daily activities, improving this way, their quality of life. This could be achieved with the help of well adapted and specific IoT technology for this sort of people. To illustrate the proposed architecture for people with disability, it was considered two use cases applications. A use-case application for visual impaired people and a use-case application for neurologic impaired people.

The Internet of Things is the result of a technical revolution in many technological areas, a technological revolution that demands further technical advances in a number of important IoT areas, which range from wireless sensors to big data processing. Focusing in a more technical perspective of view, we can say that what is need is

1) Data collection technologies that sense changes in physical status of things for then stored and shared this information.
2) Embedded intelligence using different communication patterns (request/response and subscription notification) in things accompanied with nano-technology that will supply the ability of things communicate and interact in order to accomplish some main purpose for a user application.
3) Connect everyday objects and devices to Internet, with cost-effective system identifications such as RFID.
4) Develop appropriate software for hiding the heterogeneity (e.g hardware and operating systems) from application layer.
5) a set of data mining / big data / semantic-based enablers to allow extracting information from large sets of data.
6) Applications that links users with things.

The solution to the problem is an Internet of Things can offer people with disabilities the assistance and support they need to achieve a good quality of life and allows them to participate in the social and economic life. Assistive IoT technologies are powerful tools to increase independence and improve participation. People with Visual impaired, hearing and physical impairments can get benefit from the IoT.

The objective of this project is to analyze the problem statement carefully, propose architecture for visually impaired people and analyze the Perception, Network, Application layers of the proposed IoT architecture of Visually Impaired people.

II. LITERATURE SURVEY

Future Vision of Internet of Things: The Internet of Things is a vision which is underdevelopment and there can be many stake holders in this development depending upon their interests and usage. A simple and broad definition of the internet of things and the basic idea of this concept is the pervasive presence around us of a variety of things or objects such as Radio-Frequency Identification (RFID) tags, sensors, actuators, mobile phones, etc.particular visions are:

- Things Oriented Vision
- Internet Oriented Vision
- Semantic Oriented Vision

Things Oriented Vision: This vision is supported by the fact that we can track anything using sensors and pervasive technologies using RFID. It is important to appreciate the fact that future vision will depend upon sensors and its capabilities to fulfill the “things” oriented vision. We will be able to generate the data collectively with the help of sensors, and sensor type embedded system.

Internet Oriented Vision: The internet-oriented vision has pressed upon the need to make smart objects which are connected. The sensor based object can be converted in to an understandable format, which can be identified uniquely and its attributes can be continuously monitored.

Semantic Oriented Vision: This vision is powered by the fact that the amount of sensors which will be available at our disposal will be huge and the data that they will collect will be massive in nature.

Assistive devices: The identification and sensors technologies could co-operate and work together to assist people with disabilities in their daily activities. The junction of these two technologies enable the design of assistive devices for disabled people. The basic components for designing an assistive device for visually impaired people are body sensors and RFID tags and readers for localization. A very useful application for blind people is a navigation system, to help them move in indoor spaces and unknown areas. A simple RFID based assistive can be used to provide an effective systems navigation for blind people. The assistive device can be implemented with RFID tags spreaded along the possible paths, a RFIDreader mounted in a cane and a monitoring station, such as, smartphone, TabletPC, IPad, etc. In outdoor spaces, the typical navigation system underlies on Global Positioning System (GPS), therefore to have a complete solution for all type of spaces, indoor and outdoor, the integration of these both technologies RFID and GPS, could be a good solution.

Benefits of the IoT for disabled

- Environments can foster the participation and inclusion of disabled individuals in social, economic, political and cultural life (World Health Organization (WHO),
- The IoT creates enabling environments by offering people with disabilities assistance in building access, transportation, information and communication.

Perception layer information flow operation mechanism description

Assume that sensing nodes, actuator nodes and coordinator node all have independent intelligentdecision-making ability, then the information flow chart of perception layer for measurement and control system (MCS). Internal flow operation mechanism model for sensor nodes, actuator nodes and coordinator node is discussed below by the time automaton (TA) method.

(1) Sensing node model: Assume that the *i*th testing time of sensor node is expressed as *ti*, the internal operation cycle of sensor node is expressed as *Ta*, the maximum of testing time is expressed as *max*(*Ta*), the *i*thoperation of relevant information event is expressed as binary group (*aix*， *ti*). In *ti*, *g1* represents data detection state, *g2* represents data pre-processing state, *g3* represents local decision state, *g4*represents data transmission state. Then the internal flow operation mechanism of sensor node can be described by information flow operation state evolution TA model

i=i+1

(2) Actuator node model: Assume that the *j*th execution time of actuator node is expressed as *tj*, the internal operation cycle ofactuator node is expressed as *Tb*, the maximum of execution time is expressed as *max*(*Tb*), the *j*thoperation of relevant information event is expressed as binary group (*bjx*， *tj*). In *tj*, *z1* represents receiving command state, *z2* represents decision-making state, *z3* represents action execution state.

(3) Coordinator node model: Assume that the *n*th operation time of coordinator node is expressed as *tn*, the internaloperation cycle of coordinator node is expressed as *Tc*, the maximum of operation time is expressed as *max*(*Tc*), the *n*th operation of relevant information event is expressed as binary group (*cnx*， *tn*). In *tn*, k1 represents state of acquiring sensor nodes information, k2 represents state of data processing, k3 represents state of information saving, k4 represents decision-making state, k5 represents state of sending control command.

Localization algorithms

We now describe our proposed localization algorithms for estimating positions of stationary and mobile objects.

Tag localization algorithm II: Binary Search

In this localization algorithm, we start at a mid-value power level, and then step-up or step-down the power, based on the reader's ability to detect any tags at that stage. This binary search-based approach will tend to converge faster on the minimum power levels required to detect tags. We control the direction of the power level increment by using the variable 'TagFound'. While the Binary Search algorithm searches for tags in an exponentially converging manner (as opposed to linearly), it requires less time to terminate than the Linear Search algorithm.

Input: Unique tag ID TagID

Power varying step PowerStep

Output: Minimum tag detection power level TagPower

TagPower = MaxPowerLevel + 1

TagFound = False

repeat

Power = (MinPowerLevel + MaxPowerLevel) / 2

set reader power level to Power

search for tags until successful or time-out

if (TagID is found) then TagFound = True

if (TagPower> Power) then TagPower = Power

end

end if (TagFound) then MaxPowerLevel = Power

elseMinPowerLevel = Power

end

if ((MaxPowerLevel – MinPowerLevel)) ≤ PowerStep) then

returnTagPower end

end

Tag localization algorithm III: Parallel Search

The Linear Search and the Binary Search algorithms search for only a single tag per execution cycle (i.e. they operate in a serial manner). This algorithm addresses this limitation by determining the minimum tag detection power levels in parallel, for all the An RFID-based object localization framework 15 tags in the reader's vicinity. This 'Parallel Search' strategy is analogous to running the Linear Search algorithm in parallel for all the tags.

Input: Set of unique tags TagIDSet

Power varying step PowerStep

Output: Set of minimum tag detection power levels PowerSet

set all tags in TagIDSet to MaxPowerLevel

Power = MaxPowerLevel

repeat till Power ≥ 0

set reader power level to Power

search for tags until successful or time-out

update power levels in PowerSet for all detected tags in TagIDSet

check for tags in TagIDSet with no power level update in PowerSet

Power = Power – PowerStep

end

returnPowerSet

Energy Efficient Algorithm for Object-Tracking Wireless Sensor Networks

- One of the most important applications in WSN is tracking of mobile objects. Tracking of enemy, animals, humans and cars in highways are few examples of object tracking. In object-tracking, sensor nodes are deployed in different regions.
- We proposed an automated sleep and wake-up schedule for the boundary nodes itself to make their life-time longer, which can be achieved using T-MAC protocol.
- T-MAC protocol is used so that the boundary nodes will automatically start a scheduled sleep based on their location as boundary node, while the interior nodes will remain sleep till they receive a wakeup call from one of the outer nodes in case of object detection

Use-Case Application for Neurologic Impaired People

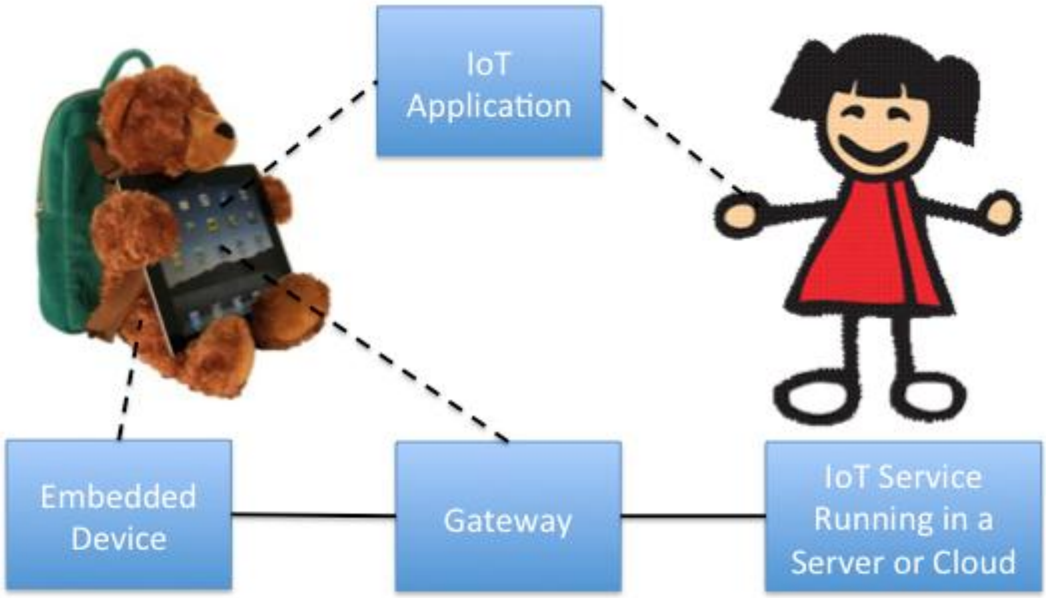

Figure 1: Use Case Diagram

Normally, children with cerebral palsy need the help of other persons to perform daily activities, such as, moving up, learning and communicating. In this use-case application, the disabled child interacts with her toy through a mobile device (i.e. tabletPC or smartphone) which has installed the learning game in its Android operating system. The learning game uses the scanning method to facilitate communication interaction of children with her toy and with the caregiver. In this IoT application, the Wireless Sensor Networks (WSNs) will be used to enable the communication with real world, which in this case will be the children toy. The children interaction with virtual world will be reflected in the sensors embedded inside the toy in real world, giving "life" to the toy.

CONCLUSION

IoT describes the progression of Internet utilization, from computers, to people and now to things, allowing for many new applications and services. An overview of the IoT for people with disabilities is provided. This work proposes an IoT architecture specific for people with disabilities that addresses the technological challenges of the current Internet and identifies and describes the most relevant technologies and standards for the first four layers of the proposed architecture. Here mainly concentrated on People with visual impaired disability, provided proposed IoT architecture for these disabled people and discussed various services and applications which are provided by an IoT.

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