Exploration of Ubiquitous Computing and its Applications in Various Arenas

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Abstract—Ubiquitous Computing is all about how people can interact with heterogeneous devices such as computer, mobile, Personal Digital Assistants (PDAs), tabs, small sensors without explicitly instructing these gadgets and few of such gadgets are invisible to the user. Ubiquitous computing is all about to make a computer so implanted, so appropriate and so natural which fulfil every requirement of the user what he/she is desired of. It provides more facilities to make people life easy and more comfortable due to intelligent sensor environment. Intelligent sensors work similar to the working of human being to accomplish a specific task. Ubiquitous Computing mainly deals with intelligent sensors, which are sometimes also known as ubiquitous sensors. Fundamentally Ubiquitous Computing involves four most important notions which are Context Awareness, Natural Interaction, Nano-Technology and Wireless Technology. In this paper we emphasis on exploring the ubiquitous computing architecture and intelligent sensor, which is the major fundamental component of ubiquitous computing. We have discussed Ubiquitous Intelligent Sensor Network Architecture and with this also emphasized on the applications of ubiquitous computing in various arenas.

Keywords- Sensors, Intelligent Sensors, Ubiquitous Computing.Abbreviations-Positioning Engine (PE), Service Oriented Architecture (SOA), Manufacturing Execution Systems (MES), Warehouse Management Systems (WMS), Location Based System (LBS).

I. INTRODUCTION

E- Ubiquitous Computing means how user interact with heterogeneous devices such as computer, mobile, Personal Digital Assistants (PDA), tabs, small sensors without the use of it and such devices are not visible in front of the user, without seeing these devices the users can utilize its resources according to their requirement at anytime and anywhere. In such case user can easily interact with technology without actually seeing or touching it, so Ubiquitous Computing makes people life more comfortable and more advanced with technology.

Ubiquitous computing is all about to make a computer so implanted, so appropriate and so natural which fulfils every requirement of the user what he/she is desired of. It provides more facilities to make people life easy and more comfortable due to intelligent sensor environment. Intelligent sensors work similar to the working of human being to accomplish a specific task. Ubiquitous Computing mainly deals with intelligent sensors, which are sometimes also known as ubiquitous sensors. Ubiquitous computing technology works in only intelligent environment, which has been developed by intelligent sensor. It comprises mainly four concepts that are Context Awareness, Natural Interaction, Nano-Technology and Wireless Technology. Recent days Ubiquitous computing is mainly deals with various industrial arenas; it is also very effective in the field of U-healthcare for providing very advanced healthcare system.

II. SENSOR

Sensors are defined in terms of centre point (heart) of any assessment system. Basically a sensor is a convertor or finder which measure physical magnitude and transforms it into a specific indicator who can be recited by viewer or any inspection system, (todays mostly these system are electronic systems). We take an example of sensor, in mercury glass thermometer the temperature is measure and it converts into extension and shrinkage of a liquid, which is readable by glass tube. The sensors give very well reply at comparatively stumpy (less) frequency for the construction of sensing system at very low cost.

There are three categories in which sensors are classified:

- Electromagnetic Sensors
- Mesh
- Inter-Digital

All these three sensors are very much capable and well suitable for designing any type of inspection systems for evaluates their properties in terms of non-invasive and non-destructive.

III. INTELLIGENT SENSOR

Intelligent sensors are those who take the input to perform predefined acts by sensing these inputs such as motion, sound, light, touch, heat etc. Intelligent sensors are works similar to the working of human being to accomplish a specific task. It is act like a man. Computers, robots both are come under these criteria. Intelligent sensors have the capability of observation, to finalize any task. . Recent days it mainly used in industrial areas for better development in tough atmosphere in several mining procedures and it also helpful where safety is major issue of people.

Figure1. An Intelligent sensor

A. Intelligent Sensor Network Architecture

In Fig. 2 we can see the Architecture of Intelligent Sensor Network in which intelligent sensors are distributed in four sectors which are as follows: (i) Manufacturing (ii) Distribution (iii) Corporate and (iv) External System. In manufacturing unit thousand or hundreds sensors are used to work on various devices such as hand held scanner to produce a product. It has been done via many layers. All of these layers are interacting with each other. Hardware Abstraction and control layers are connected to event processor and management module. The event processor is working in cooperation with location processing system and both of these must follow some protocols defined in business rules module. The location processing system operates in coordination with secure messaging SOA layer and Service oriented architecture (SOA) layer. The secure messaging and SOA layer is interacting with Manufacturing Execution Systems (MES) to retrieve and store the information [5].

The distribution unit has almost same infrastructure as of manufacturing unit. In this unit, the only difference is that the secure messaging and SOA layer is interacting with Warehouse Management Systems (WMS). Both of units, Manufacturing and distribution, must incorporate processing elements (PE1, PE2) which are connected to location processing system. There is an external processing element (PE3) which is independently communicate with Manufacturing and distribution units through Message based communication. In corporate unit the enterprise business rules and reporting functionality is defined and this unit has an integrated ERP system. External system unit is made up of customers and trading partners. All these above discussed four units communicate with each other through a Message based communication.
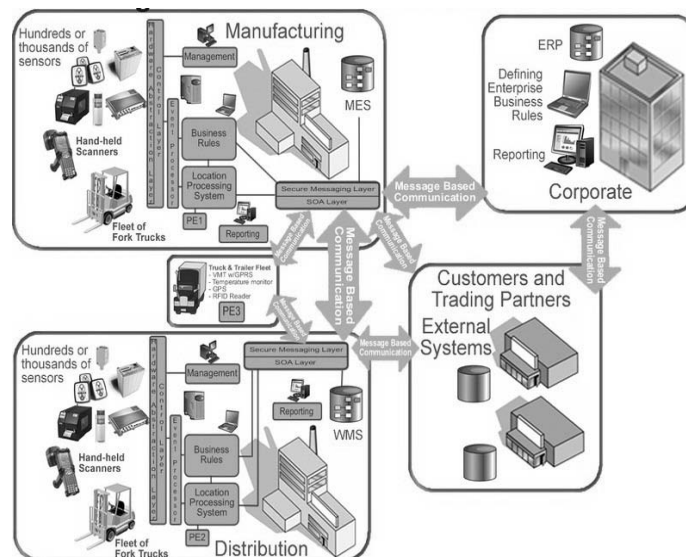

Figure2. Intelligent Sensor Network Architecture

B. Elements of Intelligent Sensors

The following is the list of basic intelligent sensor elements:

(a) Primary sensing element (b) Excitation control

(c) Amplification (d) Analogue filtering

(e) Data conversion (f) Compensation

(g) Digital information processing

(h) Digital communication processing

IV. UBIQUITOUS COMPUTING

Ubiquitous Computing means how we can interact with heterogeneous devices like computer, mobile, Personal Digital Assistants (PDA), tabs, small sensors without the use of it and such gadgets are invisible in front of the user. So ultimately, ubiquitous computing makes people life more easy and comfortable. Ubiquitous computing is all about to make a computer so implanted, so appropriate and so natural which fulfil every requirement of the user what he/she is desired of [2].

A. Architecture of Ubiquitous Computing

The Architecture of Ubiquitous Computing is basically a combination of four below listed revolutionary concepts:

  1) Context Awareness

  2) Natural Interaction

  3) Nanotechnology

  4) Wireless Technology

B. Ubiquitous Intelligent Sensor Network Architecture

Ubiquitous Sensor Networks (USN) can be defined as a real time network of intelligent sensors which will be ubiquitous in the future.
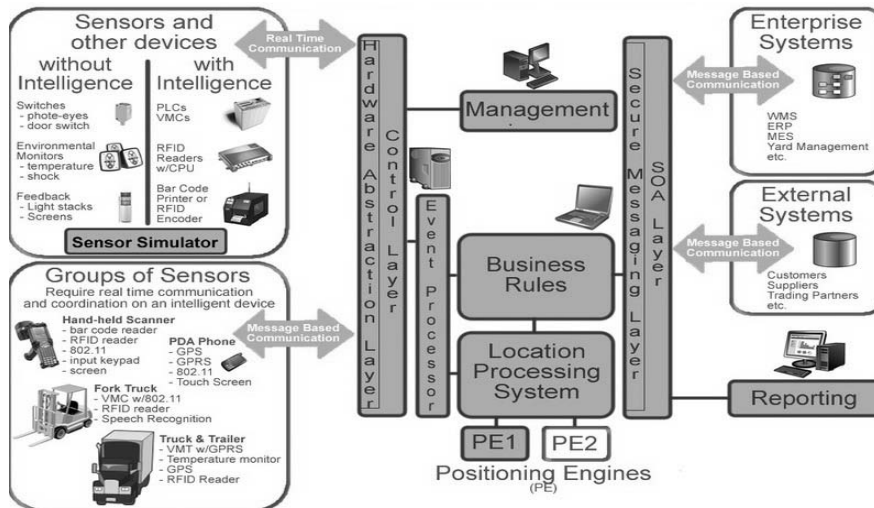

Figure3. Ubiquitous Intelligent Sensor Network Architecture

As you can see in Fig 4 Ubiquitous Intelligent Sensor Networks is made up of various sensor simulators, which include sensors and other tracking devices. All these devices can be with or without intelligence. The devices with intelligence can be RFID Reader with CPU, Barcode printers, RFID Encoder etc. and the devices without intelligence can be switches and environmental monitors. There is a group of sensors which includes hand-held scanners, PDA phones, ford truck and trailer [7]. This group needs real time communication and coordination on an intelligent device. The sensor simulators directly interact with Hardware abstraction layer trough a real time communication, while the group of sensors coordinate with the same via message based communication.

The Hardware abstraction layer is associated with a control layer which is connected to an event processor. This event processor further deals with location processing system and predefined business rules. The enterprise and external systems work with secure messaging and SOA layer through a message based communication. These two layers connect enterprise and external systems to business rules. The Ubiquitous Sensor Networks (USN) also contains a reporting system.

V. UBIQUITOUS COMPUTING APPLICATIONS

Ubiquitous Computing will enable diverse wireless application including business scheduler in which Ubiquitous Computing is able to manage and plan business meetings, presentations and many more, monitoring pets and houseplants and other operations of appliances to keeping track of books and bicycle, and much more. Ubiquitous Computing will be able to handle smart devices without to instruct them. In the same manner it will be helpful for doing smart wear, smart marketing as well as home networking also [3]. Ubiquitous Computing is also helpful in managing home activities like monitoring on home appliances and it provides home security solutions. Now-a-days a new term called U-Learning (abbreviation for Ubiquitous Learning) is getting buzz in the market. It provides many applications in the business arena like managing business meetings, arrange appointments.
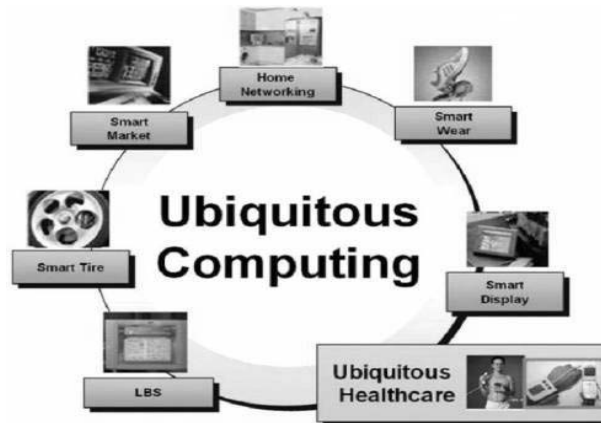

Figure4. Applications of Ubiquitous Computing

A. Home Networking

Ubiquitous computing is being used primarily in home networking to construct a smart home. In such ubiquitous home the complete interaction among various electronic appliances and intelligent sensor is implemented through a ubiquitous intelligent sensor network. A solid data network must be constructed to provide real time information among sensors and between the control units and different appliances installed in a ubiquitous home [12].

The provision for context-aware services is being maintained wonderfully here. Ubiquitous Home is sensor embedded and extremely networked home and is consider as the unconscious type robot that will be not visible in front of the user and automatically handles all appliances on the network as per many types of sensor information. In this manner the home networking in ubiquitous home follows a different approach than that of a visible type robot where the user must use a robot for interfacing between human and appliances [10]. For example in such ubiquitous home various type of electronic appliances such as Plasma display on the wall, coffee wending machine, water geyser are being used as per the requirement of user. All of these electronic appliances are controlled by Camera and microphone in ceiling, Floor pressure sensor, and Infra-red sensors which are installed at various monitoring points at Ubiquitous home.

B. Smart Market

Ubiquitous are used in smart marketing for purchasing a product by using smart marketing it makes people life more easy and more continent. In such smart market ubiquitous computing provides useful instant market analysis [6]. The user can easily use smart marketing facility anytime, anywhere in the whole world. Suppose a user is away from market and he/she wants to purchase a product without visiting the market physically. He/she might get a suggestion from the ubiquitous enable gadget and then can place order for best suitable deal. In this scenario the user not go to market for purchasing but he gets a product at that very time due to ubiquitous computing so the smart marketing is quite helpful for people.

C. Smart Display

When public displays are positioned at various public places then such environments can be called as Ubiquitous display. If someone desires to retrieve information related to people who live in that particular surrounding area, this information contains data related to the regular residents of that area and of visitors as well. All of such displays must be developed to handle multidisciplinary assignment that should be a proper blend of technical characteristic with social, aesthetic and lawful characteristics. As the research is envisioned to discover only a restricted portion, it mainly emphases on particular characteristic even it ignores others. It should be decided quite initially that how different characteristics should be addressed and incorporated so that it can support people in present and future ubiquitous display environments[10].

We can discuss Smart Home Environment in this context for a better understanding of smart display. There are various perceptible media and ambient displays present in a Smart Home environment to provide better comfort in people's life. Such environments contain ambient interface system with some computer based digital devices. The smart home user interfaces must be designed and developed keeping the essential human concerns in mind such as, observation, responsiveness, and metallic depiction. We all know the importance of our home, as nowadays most of the urban crowd is in hell of stress and need some relaxation. So the home must provide relax and rest. One example is of a Tea Place which is a swing lamp ambient display. This display actually provides the feeling of real nature to the user through some abstract LED animation pictures, vocals and breezes. In real life, generally people used to take a cup of tea or coffee to provide rest to their body.

D. Ubiquitous Healthcare

Based on the concept of Ubiquitous Computing, a location based U-Health System has been developed and becoming quite popular nowadays. The same is being shown in the Fig. 6 and as we can see such systems are equipped with all latest technology equipment. This system uses satellite and communication service providers for global coverage. The bio signal measurement instruments are used in home and outdoor healthcare are in sync with communication service providers.
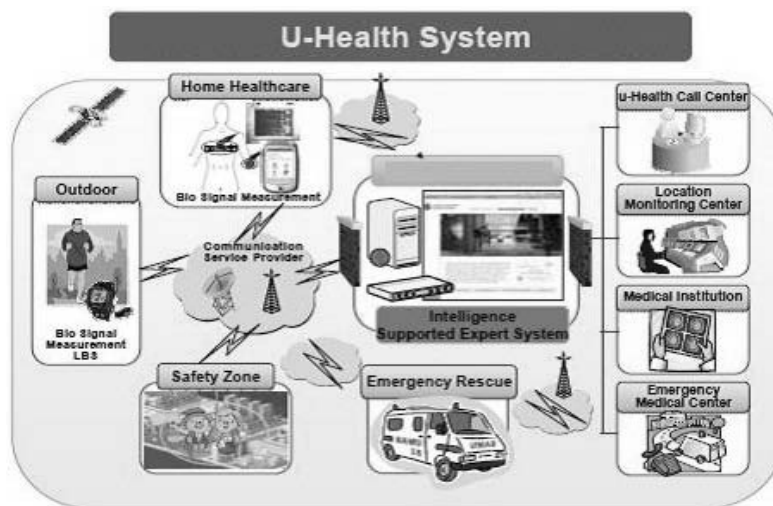

Figure5. Ubiquitous Health System

An emergency rescue is also in sync. All of these amenities are wonderfully controlled by an intelligence supported expert system. This expert system provides coordination between all these amenities and a group of medical facilities which consists of a U-health Call Centre, a Location Monitoring Centre, a medical Institution and an Emergency Medical Centre. All of the above discussed components of location based U-Health System works excellently in coordination with each other.

E. Smart Wear

Smart wear is all about to create smart cloths for people, and this is made possible due to fibre and weave material as well as the components belongs to the electronic mechanism which are completely responsible in the making or designing of smart cloths. The smart cloths are more comfortable for people due to its intelligent mechanism; they easily suits in every climate to people and can be convert according to the different situation. Designing process of smart cloths includes various technologies that are based on textile material, electrical, non-electrical and electronics base.

In smart cloths almost all possible mechanism are available, which are helpful for user in every situation. Communication and positioning benefits are present here too. So in the case of any kind of catastrophic situation, it is very helpful to overcome such situations. The testing of smart cloths is successfully done in freezing environment. It is a combination of wireless communication as well as computing in terms of personal solicitations, which involves the safety of people in any miserable condition and also capable to provide comfortless.

F. Ubiquitous Location Based Service (LBS)

Ubiquitous location based service is basically founded on web service. The web service provides appropriate method for collection of tiseful information over the internet. The given architecture of Location based service incorporate with open location based service over the internet. And it also gives exact information about the external environment in which essential data is stored. By the use of web service in ubiquitous computing, we will be provided with more flexibility to the user over the world of internet [13].

VI. CONCLUSIONS

The Ubiquitous Computing is having an extraordinary growth nowadays because of its huge number of intelligent sensor network applications in various fields. Both context-awareness and natural interaction, provides an intelligent environment in which user can easily avail desired services in an intelligent manner such as identification of user, likings, place, time etc. These technologies offer lifetime and permanent learning, which might provide advantage from a great level of personalization, as it supplies the client with the appropriate learning material, at a suitable location, and at the correct time. Among the evolving environments of natural interaction, context-aware computing, communication, and sensor-centered instruments are must be embedded and flawlessly combined into client's daily life resulting in immersive service experiences. In this paper, we highlighted the two major concepts of Ubiquitous Computing.

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