Effectiveness of Pervasive Computing in Diverse Areas

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Abstract— Pervasive computing is a recent computing technology available everywhere in diverse fields where human and machines can interact with each other. These machines can be computer system, mobile, PDA, Laptop, Tablet, smart devices and terminal. Pervasive computing is capable enough to provide a better and faster communication between human and machine. Such form of computing is able to interact with the devices mentioned above and to work according to the given instructions by human. Pervasive Computing can work with any device at any time in any place. It supports all kind of data format across the network. It is one of the technologies, which can work according to the human requirement if a person can give any instruction to the device then it work accordingly. Pervasive computing is the combination of decentralized and distributed computing in which deferent computing devices are allowed to work via internet. In this paper, the authors examine the importance of pervasive computing in diverse areas and how pervasive computing provides quick solution to specified task. Also, the authors investigate the security issues associated with pervasive computing.

Keywords- Pervasive Computing; Networking; Middleware; Smart Home; Smart Clothing

I. INTRODUCTION

Today's computing world runs on a faster technology where the desktop computers are outdated. Nowadays people are over surrounded with portable and movable devices such as mobile phones, smartphones, laptops, PDAs etc. This new concept of computing is called as Pervasive Computing. This recent trend in the field of computing defines that the environment where a large range of portable devices carries the information and processes the tasks on behalf of users, also providing wide connectivity in gigantic network [2]. Pervasive Computing means the systems, networks and services are available everywhere.

A completely diversified perception is believed and followed in the network structure in Pervasive Computing. According to this, a terminal in the network neither need not to be maintained by a user, nor it is a storage space just to store some software; in fact, that terminal is going to be used as a gateway into a space consisting data and application [4]. The user can accomplish everyday jobs with these applications and the computing atmosphere here is not a virtual one just used to accumulate and execute software, but it is an information augmented physical zone.

II. DISTINCTIVE FEATURES OF PERVASIVE COMPUTING

With the help of a collection of characteristics and the proficiencies of Pervasive Computing which actually adumbrate the degree of its utilitarian aspect, we can categorize the pervasive computing. Talking about the proficiencies which may and are anticipated to emerge quite soon in the near future, includes portability and ad-hoc networking proficiencies. While there are other proficiencies which are going to take more or less a decade to spread their effectiveness over the everyone's everyday life. If we talk about the eventual and promising features of pervasive computing, then the at the top of the list, the primary features are: Context Awareness and embodiment in the objects of everyday life. Whereas the list of secondary features is topped by the feature called as the freedom of terminals in the pervasive computing network and the participating parts.

The pervasive computing is spreading its legs progressively and establishing itself in a slow but steady manner, and it has become possible due to the fact that it has isolated features which also develop progressively not rapidly. Although the complete freedom of the participating devices has a long way to go and not expected for at least a decade from now, but in next three to six years are going to be crucial for pervasive computing as there is a possibility of bombarding of / pervasive computing business-friendly application in this time duration. And one more noticeable thing is that an individual feature has a change in its implications if used in a diversified manner in different areas of application.

III. PERVASIVE COMPUTING COMPONENTS

The Pervasive Computing environment is built around the four components namely: Devices, Networking, Middleware and Applications. The brief idea about above mentioned components is illustrated further in the discussion below.
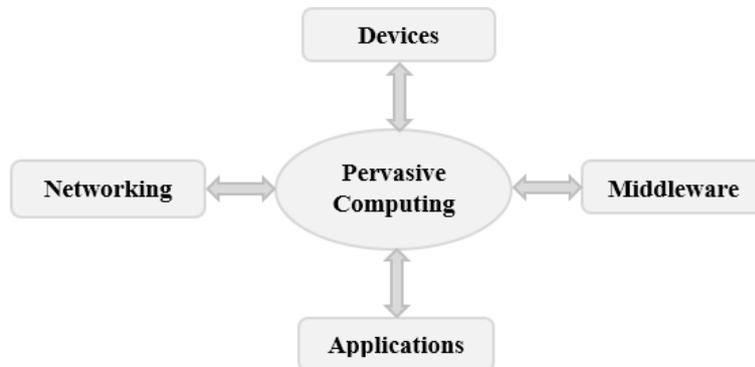
Figure 1. Components of Pervasive Computing

A. Devices

There are numerous diverse varieties of input and output devices in the Pervasive Computing entourage. In that the sensors automatically collect the information about the environment and feed this input directly to the pervasive network.

There can be three categories of computing devices in pervasive computing on the basis of intercommunication between the devices:

- *Input Devices:* which include Sensors.
- *Processors:* which are used to translate and evaluate the data.
- *Output Devices:* which include Actuators.

B. Networking

All the Pervasive devices are connected with other pervasive or any other communication devices through the distributed network. Why this pervasive device connected through distributed network means, because of the global accessibility of the device. The pervasive devices can be connected through the Local Area Network (LAN) or through Metropolitan Area Network (MAN) or through Wide Area Network (WAN) for the global availability.

C. Middleware

A middleware, often known as the kernel, is generally required in the pervasive network to establish an intercommunication among the users and the machines [1]. This kernel can be a software suite or a web page of a website, and if it is a software suite then the execution mode for the suite is either peer-to-peer or client-server.

D. Applications

If the pervasive computing is compared with the cloud computing or mobile based computing, then it is proved to be more atmosphere-based. The kernel, middleware for pervasive computing, is responsible for processing of the data collected by the pervasive surroundings and on the basis of current environmental inputs, the output is achieved.

IV. APPLICATIONS OF PERVASIVE COMPUTING

Although there are various applications available nowadays based upon pervasive computing, due to the extensive features provided by this computing technology, but here the authors are discussing the following four major application areas.

A. Smart Clothing

Smart clothing deals with the creation of smart attires for individuals. Such smart attires are factory-made using fibre and interlace substance which are later combined with electronic circuits which actually providing and behind the smarter behavior of smart attires, and also such smart attires are manufactured and/or designed with in accordance with the above-mentioned components. The smart attires are having the intelligent mechanism which makes people more comfortable while wearing these smart attires because of their adaptability to environment

temperature in every season of the year which helps these attires to transform as per the temperature condition in the environment [7]. The blueprint of these smart attires is imprinted with the amalgamation of different technologies which are based on the material of clothing fabric, electronic circuit design, voltaic and non-voltaic technological approaches.

Apart from the environmental temperature adjustment capabilities, the smart attires are designed to be used in other circumstances as well. If someone finds himself in a calamitous circumstance, then using the communication and location based features, available in the smart attire, he or she may overcome out of such circumstances with absolutely no or minimum damage. All these smart attires are well tested by the scientists and professionals in ice-cold atmosphere. The smart attires also can be set as a very good example of the amalgamation of wireless communication and computing altogether, which not only provides comfort to people, but also ensures the safety and security of people in any unfortunate circumstances.

B. Healthcare Monitoring System

A full-fledged Healthcare Monitoring System constructed upon the concept of Pervasive Computing is no more a perception now, in fact it has become a reality now and becoming pretty popular. Such systems are armed with all the instruments based on advanced technology and have worldwide coverage using high end communication service providers and satellite. It also has a catastrophe recovery feature and all such features of this healthcare systems are managed by a proficient system which is backed by intelligence [4]. To establish a communication and synchronization among all these facilities, in the pervasive computing based healthcare monitoring system, and a well-organized cluster of medical services which includes a GPS based positioning hub, an emergency medical point, a medical academy or university and a dedicated Call Centre.
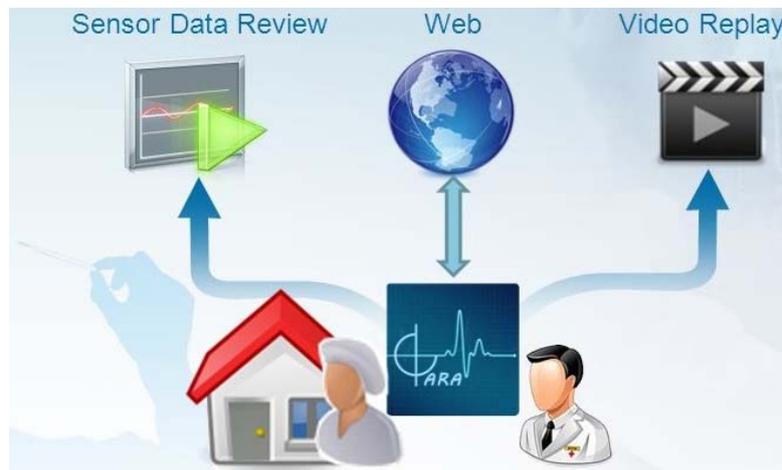

Figure 2.   Pervasive Computing Healthcare Monitoring System

The technology solutions constructed upon pervasive computing has a wonderful applicability in the field of healthcare as such technology solutions are serving aid to monitor patient in real time in accordance to his or her timely improvement. In emergency situations also, such pervasive computing based healthcare solutions are providing suitable responses with rapid assistance [9]. Such healthcare solutions make the patients free from remembering their medical schedules, especially for aged people. The eminence of life of aged people, who are caught by some enduring ailment, can be heightened as well as their freedom.

The existing medicinal computer technology based systems are just being used to store patient archives only and that too only at infirmaries and/or workplaces; the point here is that such systems are not being used to accomplish any medical job by storing no archives at any sort of operational theatre and/or at patient's system. But with the implementation of pervasive computing based healthcare monitoring system these deficits can be overcome. The information, about the significance of patient's fitness and/or about any type of consequence caused by the treatment undertaken, can be provided to the patients by reinforcing medicinal packages into the healthcare monitoring system based on pervasive computing. These systems also send report over the medicinal appointments time, and the authenticity of the treatments of aged patients is also being communicated to their families.

C. Smart Home

The blueprint of the architecture of a smart home is predominantly based over the utilization of Pervasive Computing in the same. A pervasive intelligent sensor grid arrangement is created to implement the comprehensive communication between the numerous electronic instruments and the intellectual sensor in such pervasive smart homes. The real-time information must be inter-communicated between the sensors and among the device controllers and numerous electronic instruments equipped in the pervasive smart home. And for this purpose, there must be a concrete data grid arrangement fabricated.

Figure 3. Smart Home

The pervasive smart homes are fully equipped with the context-aware amenities. Because such smart homes are entrenched with so many sensors and an extremely condensed communication network, it may be considered as an invisible robot to the people who is exceptionally capable of handling all the electronic instruments in the home over the well-defined communication network in accordance to the information supplied by the interconnected sensors [8]. And this is where the pervasive smart home concept is a more or less different than that of a traditional visible robot, where the interaction must be performed with the visible robot in an imperative manner. The controlling of electronic instruments installed in the pervasive smart home is maintained by the sensors such as infra-red and floor-pressure sensors, with the microphones and cameras in the home ceiling, and all such devices are mounted at numerous observing points in the home.

D. Smart Cars

Smart Cars is a very revolutionary field of application for pervasive computing. With the application of pervasive computing in automobile domain, there can be smart cars which are capable of catering an expedient, comfortable, secure and noninterfering zone which can pervasively acquire the service and the real-time information. The general structure of a smart car is fabricated using four major components as shown in the figure. These components are:

- Telematics: it takes care of Navigation, Insurance, Diagnostics, Prognostics and Emergency Services.

- Infotainment and Content: it supports Web Browsing, Communications, Media and Entertainment.

- Vehicle-to-X-Communications: it deals with the communication of a Smart Car to an infrastructure such as toll plazas, traffic signals; and to other vehicles to avoid crashes.

- Autonomous Operations: this component is responsible for the management of autonomous features in the smart car such as Cruise Control, Lane Detection, Auto-Park, Collision Avoidance and Self-driving mode.
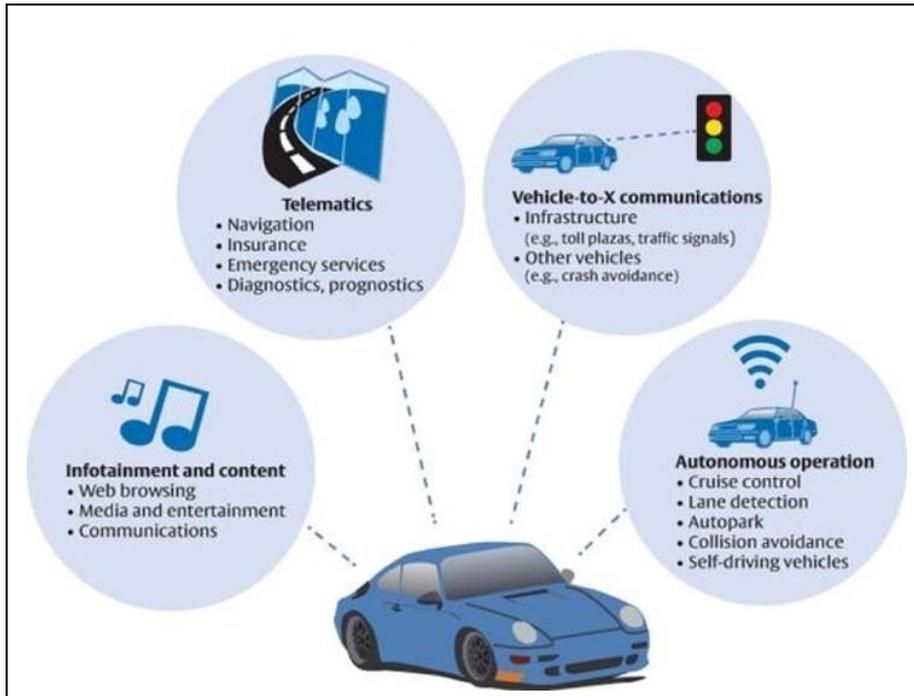
Figure 4. Smart Car

V. CONCLUSION

As we have seen that the advancement in the field of Pervasive Computing is remarkable and its applications are growing in numbers in all diversified areas in the world. In this particular research paper, the authors have congregated information about the pervasive computing discussing the features, components and applications of this revolutionary form of computing technology. With the help of this extraordinary technology the user is surrounded by an intellectual atmosphere in which he or she is able to use the looked-for services in an intellectual style. Looking at the increasing number of application of the pervasive computing, it is not much to say that it is the technology of the future and the world will see one day that pervasive computing will be the inseparable part of everyone's day to day life.

ACKNOWLEDGMENT

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