Research Paper Engineering

Review and Future Prospects of Ubiquitous Computing

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ABSTRACT

Ubiquitous computing is a post-desktop model of human computer interaction in which information processing has been integrated to common objects and interactions there by integrating computers to the world. It includes nomadic and omnipresent computing. It is often called pervasive or invisible computing. In this paper we discuss about the future emerging trends in Ubicomputing. It also discusses the present usage of these systems in varied fields. It also discusses about its evolvement in India \n the form of smart city. Finally the 1paper talks about the benefits, demerits and its impact on the society and a case considering India as a vast scope for Ubiquitous Computing.

KEYWORDS IoT, Ubicomputing pervasive, RFID.

1. Introduction

Ubicomputing is the emerging area in the field of computing carrying the intention of having computers in things. The father of introducing this technology was Mark Weiser. He coined this term in 1988 and outlined a set of principles to which he called "*calm technology*" meaning "that which informs but doesn't demand our focus or our attention" also called as the "third wave" of computing that is still new and is developing with momentum which is developing reciprocal to virtual reality, in which user is asked to be in a computer generated world, whereas "Ubicomputing" sets "virtual objects" to perform in real world, oblivious to the user as well as the environment.

In 1991, Mark, shaped the vision of ubiquitous computing as an omnipresent infrastructure for information and communications technologies.

Ubicomputing has a vision of people and environments being augmented with computational resources that provide desired level of information and services.

The size of such devices would be in accordance with its wearing as well as handling capacity. Moore's law states the number of users would increase in manifold top of the size going smaller.

2. Literature Review

Kevin Ashton was the first person to coin the term Internet of Things. He emphasised on the trend of Ubiquitous computing and was the one who had foreseen the development in this field.

Gregory et al. said that Ubicomputing provides easy access to computers to all fraternity. It churns new paradigms of interaction like constant access to information and computational capabilities. Three interaction themes in ubiquitous computing are: natural interfaces, context-aware applications and automated capture and access.

Smart cities emphasised on the importance of Ubicomputing in its realization.

M. Satyanarayanan discussed the challenges posed by the emerging field of extensive and prevalent computing. He examined the relationship of the new field with its ancestors i.e., with Distributed systems and Mobile computing and concluded with discussion to develop the above mentioned capabilities.

J.Bohn et al. stated the necessity of the embedded systems and their repercussions on the effects of pervasive computing in its interdisciplinary fields.

3. Ubiquitous computing views

The necessary elements of IOT are:

(a) Hardware
(b) Middleware
(c)Presentation
Ubiqutous computing has two fold view:

- **Technology View**: Is the embedded systems like fridges, washing machines, door locks, furniture, intelligent environment, mobile computing, cars, devices, wireless communication.
- **User View**: It includes oblivious human interaction with the system through pervasive computing and artificial intelligence. Person would be unaware of using a particular technology in daily use.

4. Intelligence involved

This can be seen through computing technology and mobile computing:

4.1 Computing technologies

It includes the three mentioned technologies in table 1:

Technologies	Description
Pervasive	Also called as nomadic computing, involves embedded systems in nonliving objects and act as smart devices. Eg. RFID& embedded systems.
Wearable	Wearable technology also known as tech togs or fashion electronics is worn over clothes. Eg. Google glass, Apple gear watch etc.
Ambient	Exists in immediate surroundings i.e., invisible intelligence in our vicinity. Here objects are sensitive towards an electronic activity and the devices are very small and integrated to the environment.

Table 1: Computing Technologies

It is interesting to observe about wearable Computing which has become a boon to an individual in the form of following devices mentioned in the table 2:

Wearable devices	Features
Lechal shoe	It navigates the user by using vibrations and has a Bluetooth enabled insole.[15]
Duo Fertility	It is wireless wearable sensor which continuously monitors minute changes in the body; it is very small, safe and comfortable wear. It is used for infertility treatment where ovulation alert is given 6 days prior by monitoring body temperature.[
Google Glass	It is a wearable glass with an optical head mounted display produced for mass market ubiquitous computer by Google.[16]

Table 2: Wearable computing devices

4.2 Mobile computing aspects

Change in the networks, their type and other properties also change when a person moves from one place to another. This means that for ubiquitous computing managing the heterogeneity of networks is a crucial task. The mapping of various types of networks, location sensing, data transfer are few of the concerns to look upon. This implies the nomadic computing i.e. it specifies how computation occurs during motion of objects, specially the user of the technology - we humans.

5. Ubiquitous Computing future Trends

As stated by Gordon Moore microprocessor performance doubles approximately after every eighteen months. Also other technology parameters, such as rate of data transfer in both guided and unguided media has increased. This trend indicates future computers would shrink further and hence be easily available to the masses in much easier forms and types.

In the present era devices like PDAs, smart phones, palmtops and notebooks have started augmenting to some extent and substituting traditional computer such as workstations, PCs and servers. Computers are integrated to everyday devices and hence expanding their efficacy and executing capacities using embedded technology in which a chip is being implanted(GPS) into the daily use object making it a "smart object".

Ubiquitous computing is one of the newly emerged fields of technology, and also is an emanating application of information and communications technology (ICT) that is embedded in everyday life. The goal is to meet the assertion of everything, always, everywhere for data processing and transmission through the ubiquity of ICT systems. Having characteristics such as:

1. Miniaturization: reducing size of ICT components for their mobility with ease of access.
2. Embedding: ICT components are embedded into everyday objects, converting them into smart objects
3. Networking: ICT components are linked to each other for communication via radio, Infra or Micro Waves, and are designed to work simultaneously.
4. Ubiquity: since embedded ICT components are ubiquitous, they are oblivious or even invisible too, to user.

1. Ubiquitous Computing Scope

Various attributes and capabilities describing the scope of its functionality are:

(i) Mobility and *ad hoc* networking which is popular in the real world today.
(ii) Contextual awareness and embedded systems are the most definitive and formative characteristics of ubiquitous computing.

Establishment of ubiquitous computing will be gradual and step by step in the advent of market oriented applications.

2. Limitations of Ubiquitous Computing

Environmental sustainability, resource consumption and legal regulation are some of the minor limiting factors for successful deployment of ubiquitous computing.

Power consumption: impossible to change batteries to many Ubicomputing devices frequently.

Standardization, however, is of prime importance as the functional interplay of individual components is a key requirement of ubiquitous computing.

Balance of HW/SW feature: display, network, processing, memory, storage capability, multitasking, etc.

The relevance of individual data protection and privacy varies depending on the specific application. While privacy is not a primary concern in production and military applications, but is an important limiting factor in security, communications and medicine.

3. India and Ubiquitous Computing

India as a developing nation, requires quite high and adequate electricity and internet continuously. But frequent power cuts, makes it difficult to manage ubiquitous computing in India as for ubiquitous computing internet and electricity are the pillars.

Therefore, the dream of Smart City requires setup of smart objects and needs to offer economic activities and employment opportunities to a wide section of its residents, regardless of their level of education, skill and income levels. Since rapid migration of people from rural to urban areas is in process, there is a need to develop these cities and make room for the new populace. In this perspective more building and other reforms have to be taken into consideration.

Smartness in a city means different things to different people. It could be smart design, smart utilities, smart housing, smart mobility, smart technology etc. People migrate to cities primarily in search of employment and economic activities besides better quality of life.

Without these, India would lag behind , where other Countries are at a great "IT WAR" & trying to achieve maximum success through research and Intellectual Property Rights.

Isher Ahluwalia Hpec in 2011, said the migration statistics shown in figure 1 regarding urban population employment requirement and enhancement of living standard.

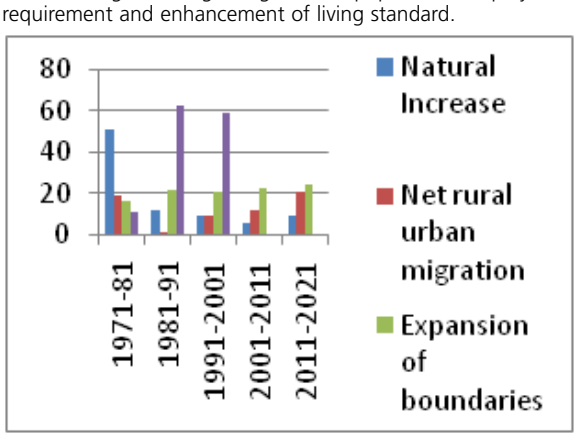

Fig.1 Increase in Urban Population

In India several Projects are taking shape, by some popular ones such as n by CDAC and by Department of Electronics and Information Technology for:

- Interface Establishment of National Ubiquitous Computing Research Centres

- Design and Development of Ubiquitous Computing Test Bed and UC Applications
- Wireless Sensor Network for Real-Time Landslide Monitoring Development of Multimodal User

9. Future prospects of IOT

Computers have been evolved from the first generation vacuum tubes to the super computers. Now a third wave of computing has emerged in the last decade of hand held technology. It has made a great progress in palm tops, cellular smart phones, tablets and is now trending towards Internet of Things. The integrated Sensor–Actuator–Internet framework [11] would be the crust of the technology used in the Ubiquitous computing. Cloud computing and big data would be the most important elements of IoT.

10. Conclusion and Future Work

Although ubiquitous computing is a fancy dream coming true with a lot of challenges and unsolved issues that are coming across to implement this technology. Moreover, in a developing country like India, major reforms are pending that pave the way to the nomadic computing. Setting up of smart cities and implementing the future technology is a bit challenging, where basic needs of the masses are yet to be achieved and still a scope of major steps is remaining. Keeping these factors in mind we have proposed the future prospects of Ubiquitous computing in the world with a special scenario of India.Overall, ubiquitous computing is not expected to produce any negative rebound effects, which would offset or even negate its positive effects.

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