# Ubiquitous Computing: A Review

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*Abstract*— Ubiquitous computing and other contemporary technologies, evolving since late 90s have penetrated into day to day human life. The newly ushering technologies like 'Internet of Things', 'Machine to Machine communication', distributed-context aware computing, distributed-location aware computing, mobile computing, wireless sensor networks etc. greatly incorporate these evolved concepts. Ubiquitous computing in next 50 years, is going to take us in a world that we can hardly imagine now. This paper will discuss the challenges faced by ubiquitous computing in serving the society.

***Key words:*** Context Aware Computing, iHCI, Sensor Networks, IOT, Mobile Computing

## I. INTRODUCTION

Ubiquitous computing is also addressed as Pervasive computing, which means existing everywhere. These types of devices are completely connected and continuously available. Ubiquitous computing involves a study of various topics, including distributed computing, mobile computing, location computing, mobile networking, context-aware computing, sensor networks, human-computer interaction, and artificial intelligence. Complete connection and continuous availability is possible by embedding computing devices into things that connect and communicate. The aim of ubiquitous computing or UbiComp is to embed a computer system so seamlessly into our environment that we use it without even realising its presence. In ubiquitous computing, computers become a helpful but invisible force, assisting the user in meeting his or her needs without getting in the way.

## II. LITERATURE SURVEY

Mark Weiser a research scientist at Xerox Palo Alto Research Center (PARC), was the first person to coin the word ubiquitous computing. He expressed his ideas of ubiquitous computing saying that the best computers are quiet, invisible servants. He also believed that computers should extend your unconscious and technology should create calm. He as a research person believed that UbiComp has tremendous potential to serve mankind but will have to face a number of challenges till it proves its abilities.[1]

Ubiquitous computing must exhibit properties like Distributed computing, iHCI, Context Awareness, Autonomy, and Artificial Intelligence to meet the challenges of tomorrow as stated by Stefan Poslad[2]. We will discuss some of the properties of ubiquitous computing.

### *A. Context Awareness*

Context is any information that can be used to characterize the situation of a person, place or object. Contexts supported by an UbiComp System may be:

- Physical environment context: related to physical world parameters (e.g. location, body temperature of user).
- Human context (or user context): pertaining to the user such as user's identity, habits, to- do-list etc.
- Information Communication and Technology (ITC) context or virtual environment context: wherein a device in the distributed system knows whether a service is available locally or remotely.

The approach to context-aware application development is to obtain information about the context, or situation, through automated means, take decisions on behalf of the user (or with minimal intrusion to the user) and accordingly modify the environment. Can a ubiquitous computing system imitate such an intricate behavior peculiar to mostly humans? As mentioned in the article "Intricacies of ubiquitous computing" [3] this is a challenging task. Hence, the following issues emerge:

- How to represent context internally? – For example: how to process sensor (a context source) data?
- Where to store? - Locally or in the network or both?
- How often to update and consult context information? – For example, if the user location is changing then context needs to be updated frequently.
- How to track location? – For example, GPS in smart phones.
- How to sense the surroundings? – Use sensors (e.g. how much ink is there in printer's cartridge).
- How useful is historical context? – depends on application e.g. appropriate when the user follows the same daily routine.

Figuring out the answers to the above 'How's', will help the application designers select the most suitable of the available context& structure the same in applications.

*B. Adaptation Strategy*

As mentioned in the article "Intricacies of ubiquitous computing"[3] Adaptation Strategy in certain scenarios may force an UbiComp system to rework itself. One good example of this is the ever changing Supply- Demand imbalance. UbiComp applications may require locking horns for resources like Bandwidth, Energy, Memory & so on and forcing an increase in supply to meet the application's demand as per some reservation. This might involve suggesting a corrective action to the user. E.g. going to another location for plenty of resource if there is shortage of supply in current location. Though helpful, these adaptation strategies result in more questions than answers. To mention a few:

- What drives the choice between these strategies?
- How to make switching amongst them effortless?
- What reservation policy to follow?
- Will corrective actions be annoying to the user?
- How to implement them?

The fairly advanced fields of Mobile Computing and Distributed systems may become the guiding light for the developer in his quest to find answers to the above & many more such intricacies of the UbiComp world.

Context aware applications and seamless adaptation can be achieved using technology like autonomous agents. Autonomous agents can enable spontaneous interaction by representing users, as well as services. These agents act on behalf of users while they are disconnected, or represent services available in the environment.[5] Autonomous agents that act on behalf of the user reside on a server and maintain a limited user presence, execute commands or make decisions while he is disconnected.

*C. Implementation Issues*

Actual realization of a ubiquitous computing system will require addressing many complicated design and implementation problems. As stated in "Intricacies of Ubiquitous Computing" [3] some design concerns are discussed.

1) Microelectronics, embedded systems and sensor technology should achieve smaller size, higher speed, less power consumption and lower cost.
2) Information and communication technology should provide strong and resilient communication networks. Global adoption and deployment of IPv6 should be spread over all types of networks to support machine to machine communication including all types of wired as well as wireless machines.
3) Localization technology including GPS should provide a higher range and smaller size equipments.
4) Bandwidth issues related to Internet of things and other networks should be resolved by using appropriate media and sophisticated communication technologies.
5) Human Computer Interfaces should be able to understand human languages inherently.

*D. Security*

Being Ubiquitous comes with a price, and although the systems we work on do provide some level of security, it is important for us to be vigilant and alert while interacting with the systems. Ubiquitous computing systems should be robust and secure. The potential that they bring is enormous, so is the threat.[3]

## III. CONCLUSION

To understand the intricacies of Ubiquitous computing, research needs to be done in all fields of computing like iHIC, IOT, Machine learning, context aware computing, sensor networks etc. The collaborative efforts of all these varied fields together will define the success of ubiquitous computing in future.

## REFERENCES

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