

# Ubiquitous sensing spatial sensor networks



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## **Abstract**

This paper will give you an in-depth understanding on how a sensor network makes use of sensors, embedded in devices to achieve a specific task in our environment.

### 1. Introduction

The global and technological advancement in the world has made it possible that people rely greatly on having easy access to information, data etc. This in turn has led to services like information, data etc to become Ubiquitous. Ubiquitous is when something exists everywhere, anytime or being universal so that they more or less exist or are everywhere especially at the same time - More like making these services omnipresent.

In respect, to information technology, ubiquitous computing are the use of electronic devices programmed with sensor nodes embedded in them in order to detect or locate anyone or object at anyplace and anytime instantly via internet or satellite in a wireless ubiquitous networked environment.

Ubiquitous sensing is the use of sensors to detect and monitor the environment. (Patterson, Bamieh and El Abbadi, Environmental Tomography: Ubiquitous Sensing with Mobile Devices 7-12 April 2008) (Zhu, Jin and Feng 12-14 Oct. 2008) The aim of ubiquitous computing is to be able to provide the important information needed, in the exact place, time and structure. (David Ley 2007)

The initiative is not being able to think about the use of these embedded computers before using them but think about it works for us by adjust to

human needs and preference and remaining in the surroundings until when needed. Data is received and disseminated using sensor nodes which possess the capability to sense their environment, collect the sensed data and transmit it to the base station which sends it to the final destination (client). A group of these sensor nodes sharing a common goal to achieve these purpose is called Sensor Networks. (T. C. Dilip Kumar 4 March 2009) (David Ley 2007)

## 2. Literature Review

### 2. 1. Ubiquitous Sensing

The technology of Ubiquitous computing is growing rapidly and its views are actively and usefully accepted. When you think about computer vision, you think about ubiquitous computing. The two are related to Artificial intelligence. Imagine a world where you have robots, these programmed computers will be making decisions for you, paying your bills, monitoring your movement and so on without any human interference. This is what Artificial intelligence is about. Our world today is gradually substituting human man-power for machines, making things that are previously invisible visible just at the tip of our fingers using electronic devices. (David Ley 2007) (I. F. Akyildiz 2002)

If devices and objects can distinguish and know about your location and automatically recognise devices and resources, then the possibility for delivering the accurate timely information increases. for example: the use of sensor devices to track people wherever they are, use of finger prints scanning to detect who you are and monitor your daily position, use of the <https://assignbuster.com/ubiquitous-sensing-spatial-sensor-networks/>

satellite to monitor missiles target etc. Critically speaking, these machines that are being used are not adequate enough to make decisions on behalf of human beings for instance in cases which involves life and death.

Irrespective, of the kind of knowledge embedded in these machines such as experiences gained from humans, they just cannot function adequately as human beings would. Having a computerized machine containing human data is not safe because we are not aware of who has access to this data and what it will be used for. Ubiquitous computing technology can either be Explicit or Implicit. Explicit in the sense of being conscious the way things are done, while Implicit by doing things unconsciously without any interference. (David Ley 2007) (I. F. Akyildiz 2002)

## 2. 2. Fundamentals of Ubiquitous Computing

There are some essentials elements needed by objects, nodes or devices in a ubiquitous computing environment. These are identification, location, sensing and connectivity. (David Ley 2007)

### 2. 2. 1. Identification

For devices and objects to become part of existing network for information sharing, it is essential that an individual identity is given. There are two technology used for identification. These are Radio Frequency Identification (RFID) tags and Visual barcodes. (David Ley 2007) This technology has been useful in various ways in our daily activities. In some cases, we agree that it has contributed positively in our environment. For instance, easy identification of product in shopping mall, the tracking objects and devices for credit card system control and a lot more.

### 2. 2. 2. Radio Frequency Identification (RFID)

This technology is able to identify objects, people and locality using radio waves. Over the years a new form of technology associated with radio frequency identification (RFID) has emerged called radio frequency identification (RIFD) Tags. (David Ley 2007) These (RIFD) tags are insignificant microchips containing data attached to transponders. This data can only be read by a transceiver, which is responsible for transporting the data to the system. Furthermore, we have two categories of radio frequency identification (RFID) tags, which are active and passive.

It can be active because it generates its power and passive when it generates power from the reader. (David Ley 2007) These days we have printable tags frequently used. The capability of locating this RFID tags embedded on objects and devices which we use in our environment that brought an immense change in technology. These are the several areas where such technology can be applied: card security doors, road tolls, RFID enabled passport, library tagging for books, card systems for door entry in train and bus services and a lot more. (David Ley 2007)

### 2. 2. 3. Visual barcodes

This technology is common to our environment and can be spotted on products that we purchase from shops around us. It is a way of identifying an object using its identity code, thus making it easy for users to relate with its data pictures through a visual barcode. (David Ley 2007) Visual barcodes are found on product, business cards, advertising etc. For example QR (quick

response) codes are being used by teachers in Japan to dispense resources to students. (David Ley 2007)

### 2. 3. Location

The use of satellite technology to find out the geographic position of people, object, resources and devices is an amazing technology. This technology makes use of global positioning system (GPS) chips to present better coverage. These chips are embedded in mobile phones, cars, pagers and other effects. (David Ley 2007)Currently, a European satellite positioning system called Galileo is being built to provide a better accuracy and reliability. In some part of the world, global positioning system (GPS) and phones are used to track students in order to keep parent abreast with their whereabouts. (David Ley 2007)

### 2. 4. Sensors Nodes

Sensor nodes are minute, inexpensive chips embedded on devices or objects to sense, collect and transmit data. (Archana Bharathidasan, Sensor Networks: An Overview n. d.) Sensors can be densely or spatially deployed in a location. (T. C. Dilip Kumar 4 March 2009). The various kinds of sensors are seismic, low sampling rate magnetic, infrared, radar, thermal, acoustics and visual. (I. F. Akyildiz 2002)The essential components of a sensor node are processing unit with limited computational power and limited memory, a radio transceiver or other wireless communication device, an energy source (battery). (Wikipedia contributors 2009)

### 2. 5. Wireless Sensor networks (WSN)

A sensor network is a collection of sensor nodes that cooperatively work to collect and disseminate data to a central processing station in an environment. Moreover, the focus is more on wireless, distributed sensing nodes. (David Ley 2007) (I. F. Akyildiz 2002). Recently, the wireless sensor network is becoming an exciting network technology knowing that it can be deployed with communication infrastructure. (T. C. Dilip Kumar 4 March 2009) Wireless sensor network (WSN) is a wireless network consisting of spatially distributed independent devices using sensors in a group to observe, track and control environmental conditions. For example vibration, temperature, sound, pollutants and pressure at different locality. (I. F. Akyildiz 2002) A Sensor networks normally constitutes a wireless ad-hoc network meaning that individual sensors can use multi-hop routing algorithm which supports several nodes forwarding data packets to the base station. (Wikipedia contributors 2009)

## 2. 6. Architecture of a Wireless Sensor Network

Figure 1: Diagram of a Wireless Sensor Network. (J. C. Xianghui Cao March 2009) p. 580

Architecture: The dashed arrows indicate the interactions between the Server, the WSN, and the Clients, although they are actually indirectly connected.

Note that Data and Data<sup>1/2</sup> are different, but the latter is from the former. (J. C. Xianghui Cao March 2009)

Figure. 1. consists of three tiers – rows, which are: Hardware, Server and Client. The different rows have their basic functions in the network, in order to achieve a common task. (J. C. Xianghui Cao 2009)

### 2. 6. 1. Hardware row

In a communication network such as the figure. 1. (J. C. Xianghui Cao March 2009) The data is encoded in order to enhance the possibility of a successful transmission by avoiding and amending slight errors. The encoded data that is generated by the sensors are framed into packets and released from the wireless sensor network (WSN) to the base stations and sent to the server by the use of internet. This packet containing the encoded data are information such as: tracking report and so on. (J. C. Xianghui Cao March 2009)

### 2. 6. 2. Server row

The Server row is to interpret the packet that is sent for proper evaluation, which is transmitted through the internet. This information is made available to the client using their communication devices. See fig. 1. (J. C. Xianghui Cao March 2009)

### 2. 6. 3. Client row

Whenever a request is placed on the server by the Client, the server processes the request and makes it available to the client. (J. C. Xianghui Cao March 2009)

## 2. 7. Application of a sensor network



In our environment, there are a number of areas that we can apply the wireless sensor network technology which include: environmental monitoring, health care application, military application, industrial application . e. g. pressure , noise level, temperature, event detection, lightning condition, motor vehicle condition, location sensing, mechanical stress on objects, objects tracking, detection, traffic monitoring, nuclear reactor control. (I. F. Akyildiz 2002) (Eric Sabbah March 2008)

## 2. 8. Environmental monitoring

Environmental monitoring is a common application of a wireless sensor network. sensors are deployed densely or spatially in a locality to sense, monitor and collect data which are sent to the base station and later to the internet or satellite . Critically, we should not be monitored without our approval, the data obtained could be used for threat reasons, on the other hand, our lives could be danger (no security). The discovery of computers is a fascinating technology, which has aided us achieve so much in a short time without thinking too much about how to achieve such task. Our lives are being monitored everyday using sensors that are embedded in devices such as cameras, which are communicated on the computers, satellite and others. Thus making the previously invisible visible in our environment. (Eric Sabbah March 2008) (J. C. Xianghui Cao March 2009)

## 2. 9. Urban Gaming technology

We have children growing up in our community that are fascinated by playing either indoor or outdoor games. These games can be played in groups or as an individual. Games could be computerized or non-

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computerized. Computerized in the sense that software are created and used in devices in order to function in a specific manner and achieve a goal. While non-computerized games are games played with the individuals physically present but they are all fun to play. Our bingo and casino games that are played in group are examples of our traditional urban games. (Harkin 2005)

While games like “uncle Roy All around you”, “Pac-Manhattan” game, Gizmondo game, Conquest Minneapolis etc are examples of our recent urban games that are computerized. (Grabianowski, “How Urban Gaming Works.” 2005) . Urban gaming combines the virtual world and the real-life geography of the present city, played in localized public spaces as a social activity using wireless internet connection. Think about a group of gamers set against each other in a “treasure hunt” game that unfold in the real world. (Harkin 2005) These games have sensors embedded in them, which can be used to track an individual in a location while playing the game.

## 2. 10. Real-time traffic

In our working environment, we will admit at least once we have had to submit task before the set deadline dates, also this can be experienced in homes. In addition, machines and computers we have nowadays are focused to deliver task inputted into them. In computer, real-time computing can be described as a study of software and hardware systems restricted to operational deadlines from the time of the event to the systems response time. The process of using both software and hardware to retrieve immediate processed information. A real-time system is assessed by its

predictability and not on performance standard. We have hard real-time systems and soft-real-time systems. Hard real-time system can be used when an event should be urgently handled within a constrained time frame e.g. medical system used for heart pacemakers and Vehicle control system. Whilst, soft real-time systems are used when problems like concurrent access arises and the need to keep an update of some connected systems e.g. Software used to update flight schedules. (Wikipedia contributors 2009)

## 2. 11. Legal Implication on Privacy

The threats experienced by a wireless sensor network are directly influenced by its application. (Wikipedia contributors 2009) Therefore, it is important to consider these threats before building a network. In a wireless sensor network, the data forwarded are encoded to support confidentiality. In addition, Authorization, privacy and authentication should be considered. This concept is applicable to various areas like environmental monitoring, medical application, and so forth. For instance in the medical field, the patient preference is not only considered but the legal decree which has been made in their country e.g. Europe stated from European Data Protection Act 1998. (Stoneb 2001 )(Wikipedia contributors 2009) Considering who has access to the data that are sent via internet and satellite should be a reason to question the security of the network.

## 2. 12. Characteristics of a wireless sensor network

Scalability

The quantity of sensor nodes being deployed in a certain locality may rise from hundreds, thousands depending on the density and application of these nodes. (I. F. Akyildiz 2002) (Archana Bharathidasan, Sensor Networks: An Overview n. d.) (Wikipedia contributors 2009)

### Environmental Condition

Most times, Sensor nodes are deployed direct or close to the object to be observed. They are always unattended to . Also, it is important to consider the risk involved when sensors are exposed to high risky areas such as noise, proper visual capture of the object, human congestion and change in weather. These sensors nodes may be working in places like: large warehouses, attached to fast cars, animals and so on. (I. F. Akyildiz 2002)

### Cost of production

It is important to have an estimated cost of the number of sensor nodes that will be used in a certain network before starting the deployment itself. The complexity requirement of an individual sensor node should be considered when building a network. (Wikipedia contributors 2009)

### Hardware restraint

Building a wireless sensor network, with the essential components intact. Consider when a problem arises on its power supply unit, this alerts us of the challenge the network is facing and being in the middle of completing a process can cause the breakdown or shut down the whole network. These issues should be addressed in order to avoid such lapses. (I. F. Akyildiz 2002)

## Dynamic Network Topology

When building networks we should consider if it can adjust to changes.

Evaluate that it can be expanded? These are what we need to think about. In order to have a functional system, it is important to broaden the lifetime of the system and its robustness. (Archana Bharathidasan, Sensor Networks: An Overview n. d.)

## Unattended Operations

Once a sensor network is setup, all interference from human beings is avoidable. The Nodes are solely responsible for everything that goes wrong in case changes arise for example need for a reconfiguration. (Archana Bharathidasan, Sensor Networks: An Overview n. d.) (Wikipedia contributors 2009)

## Ad-hoc Deployment

The deployment of sensor nodes in an area with no infrastructure put in place can be discouraging and expensive. In cases, when problems like inability of a node to sense the object, power failure, proper positioning of the sensor nodes arises in a network region, it will be difficult to actually point out what the problem might be from your location. (Venkata C Giruka 12 september 2006)

## Heterogeneity of nodes

Introducing heterogeneity nodes in a wireless sensor network is useful in order to prolong the lifetime of a network, decrease latency of data

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transportation and its reliability. Heterogeneous Clustered Scheme can be used to maximize the lifetime of a wireless sensor network intended for electing the head of cluster in a dispersed approach in a hierarchical wireless sensor network. Thus, the cluster scheme makes it possible for nodes with high energy to be used to process and transmit information, while, nodes with low energy is used to execute the sensing in the proximity of the target.

### Power Supply

The life span of a wireless sensor network is dependent on the power supply using a battery. It is important that the energy that is been used in a network and the lifetime is prolonged. The only way this can be achieved is to initiate energy awareness in the design and operation of the sensor nodes, individual nodes and on the whole network.

### 3. 0. Conclusion

Wireless sensor network is an evolving area with a lot of opportunity for expansion. The diversity of a wireless sensor network and its several security threats can put at risk the success of application. (David Ley 2007)

This paper reviewed sensor networks, considering environmental monitoring, urban gaming, real-time traffic and legal implications on privacy. The use of this wireless sensor network has registered some challenges which have been discussed in this paper.

Further work is still been researched on in order to enhance the power supply and security issues due to the rapid demand on the use of it.

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