

Survey on Context Aware Computing and IoT Environment

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Abstract

Context awareness enables the system to collect the information about the environment at any time and act according to it. It makes use of hardware as well as software to collect and analyze the data automatically. The mobile users particularly the smart phone users are mostly focused by context due to its pliability and is often used as a part of ubiquitous and wearable computing. The Internet and upcoming technologies combine to transform every object into smart objects. Where this can be applied to user's activities on the device or to the physical environment in which the device is being use. Here we survey the context awareness from an IoT perspective to help users by automating the task of selecting the sensors according to the problems/tasks at hand.

Keywords—Context Awareness, Architecture, Internet of Things (IoT)

I. INTRODUCTION

Context aware computing is software that inspect and reacts to a user context. It aware of its user's state and environment to adapt its behavior. The term context is a Knowledge that plays an important role in determining the environment such as where, who, what is taken into an account regarding the relationship between the user as well as an application. Context is divided into three categories.

1. Computing context is about connectivity, band width and resources.
2. User context involves user profile, location, nearby people, social situation, and activity.
3. Physical context refers temperature, lighting, noise, traffic.

Context aware system gets inputs from explicit or as implicit. Applications that come under recognized context, intellectual, and better understanding of context are the factors that cover context aware systems. Major context-aware systems depend on external context factors which gives useful data, such as location information. However, external attributes are easily sense by using off-the-shelf sensing technologies.

The Internet of Things (IoT) is the emerging phase of the evolution of the Internet. The evolution of internet starts from very few computers that communicates each other to billions and now it is growing in a fast rate and reached to billions of mobilephones. Now it is developed and extended to the state where the things that surround's us can be connected via internet and communicates with each other. With increasing usage of WiFi and 5G wireless Internet access, the evolution toward ubiquitous information and communication networks is already apparent nowadays. Furthermore, for the Internet of Things vision to appear success, the computing standard should go beyond conventional mobile computing scenarios that use smartphones and portable and grow in developing the relationship among the emerging objects and immerse intelligence into our environment. The Internet of Things demands the following for the technology to fade from the recognition of the user demands: (1) users and appliances understanding, (2) conveying the contextual information at an applicable environment with pervasive communication networks and (3) the computational device in the Internet of Things that aims smart behavior.

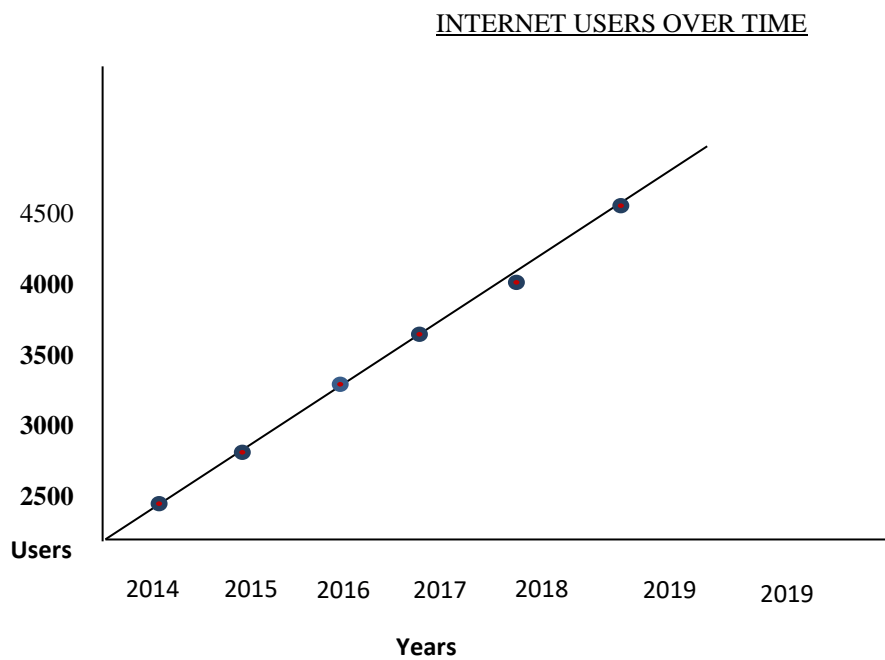


Figure 1. Growing number of things connected to the Internet

In Figure 1 it is shown that the number of objects connected to the internet is increasing day by day. It is assumed the usage level may reach 100 billion by this year. Some of the devices that make itself as an intelligent by connecting with the internet are sensors, modems, actuators. G. D. Abowd and team researches.

Found that these devices find it's application in many fields. Sensor networks acts as a backbone of IoT. The high-level task like collecting the information's, storing, querying and understanding sensor data.

The traditional technique of using large number of sensors is improbable. In order to solve this problem middleware components are introduced to have recognition on ubiquitous networks, sensor networks [2],[3],[4],[5]. There are many middleware components available to find the solution. Based on the problem the solution it concentrates on device management, interoperability, portability, security and privacy.

The only way to avoid the confusion is finding the solution to favor the users or clients to discover the sensors automatically according to the requirements.

The summary of this survey paper is as follows: After giving a brief introduction Section two describes the working principles. Section three is about what context and what are context aware is computing concepts and design principles. In fourth section tells about the growth of Context Awareness. In section five the evolution of IoT and layers in sensor networks are discussed. Finally, it is concluded that a good context modeling approach must have the ability provide the modeling of context information to deliver a good formalism to reduce the complexity of context-aware applications and to improve the security.

II. WORKING PRINCIPLE

Sensors are getting more powerful due to it's features and because of it's portability and cheaper cost that stimulates large scale deployments. Finally, now-a-days it is said that large number of sensors have been deployed and this will increase rapidly in upcoming years [1]. These let to increase in generating big data [7]. The collected data are supposed to do the process such as understanding, analyzing to make it meaningful. Context-aware computing plays a major role in overcoming the challenges in previous difficulties such as mobile and pervasive. It allows in saving the information that is linked to sensor data to make the interception easily and meaningfully. In IoT vision machine to machine communication are performed well with the clear understanding of context.

The traditional approach of connecting the sensors directly to applications individually and manually is impossible if huge numbers of sensors are deployed. To overcome these inefficiency researchers introduced the middleware solutions. Where each solution focuses on Different aspects like security, privacy, device management, context awareness. A unique middleware solution addressing all required aspects of IoT are yet to be designed. Middleware solution is the key task

Our objectives in this literature are as follows

- 1) to have better understanding about the techniques to develop solutions in the past.
- 2) to know the procedures to apply the techniques in solving the problems in future.
- 3) to point out the open challenges and to discuss future research directions.

III. CONTEXT AWARE COMPUTING

In ubiquitous computing world schilit introduced context awareness. It is an intelligence environment that adapts itself to the places around the people, frames and use of hardware and software. The IoT based sensor devices communicates with the real world to intelligence. The smart devices such as TV's, wearable's, mobile phones, and cameras will monitor the traffic and signals and collect the data in real time. Based on the machine learning techniques feature extraction, learning and inference provides the way to make a decision with the collected real data's. Among those data's methods like feature extraction, behavior pattern is analyzed to make the decision in consideration with the environment. Security is the major issue, in order to maintain the client's sensible information that has been collected from multiple data sources. In computer science field many studies have been done to label these drawbacks.

The research paper contains the trending topics like Context Computing for Internet of Things, Device context Discovery System for Context-aware systems in Ubiquitous Environment, Sensing as a Service and Big Data, A Survey of Middleware for Sensor Network and Challenges, Knowledge mining, Context Modeling and Reasoning Techniques and Ambient Intelligence.

A. DEFINITION OF CONTEXT

The term context is defined as the state of operation that exists between input state and output state. Contexts are able to identify the changes around the environment. It focus on the location, identity and the surrounding objects. Context holds a relationship between certain conditions where it is not easy to find the important element [8]. It is also defined as the changes in the system expect problem and the solution.

Context is information that distinguishes the condition of the system. It may be a place or things or a place interacting with user and the application. Without considering the different views it can identify the elements of the context. Context gives the complete information about the task that set on the circumstances. The term context is enriched with state of the user, physical environment, computing system and history of user computer interaction. The classifications of context are as follows:

1. Computing Context
2. Environmental Context
3. User Context
4. Physical Context

Context Information are used to produce highly integrated computing and to grant the service to the users. It is also defined as activity of finding the difference between the raw data and contexted data. The unprocessed data called raw data from the sensor's are collected directly from the source cannot be used directly so context information are used for consistency. The data's that are retrieved from the source are not context information.

It requires applicable data's in real world environment. The information has to be represented in a specified model and uncomplicated to share the information. Contexts are defined based on the user and the application. Several technologies are introduced to sense, and represent.

B.Context Awareness

Context Awareness has different definitions based on the researchers view. Context Awareness is defined as the capability of the system that sense and react to the information according to the circumstances such as situation, time and location. The goal of the context awareness is on computer application and systems. It is described as any data that is used to distinguish the state of the attributes, where the attributes exists relationship between the user and the application. The following describes the frameworks of context:

4. Location of the user.
5. Objects or Things.
6. Changes over time.

It is an inter-connected condition where an event occurs or exists. According to the circumstances it can sense and react. Three types of context aware application are discussed here

- No application level context model: Here applications perform tasks such as pre-processing of the raw data's, security issues and application outlines.
- Implicit context model: It come up with certain protocols to built the application. It uses toolkit to perform acquisition.
- Explicit context model: This type of model uses middleware component to perform the process outside the application boundaries. Everything is done independently.

IV. LIFECYCLE OF CONTEXT AWARENESS

There are some common protocols called context lifecycle is followed. Time plays a very important role here. Life refers the time period such as the time taken to complete or the time taken to recover the task and so on. In figure 2 the considerable parts of context awareness are clearly shown.

It start's with the acquisition that is classified into physical and virtual context. Where modeling includes formalization, Ontology based modeling, spatial modeling. Reasoning are done based on different algorithms like fuzzy logic, supervised learning, unsupervised learning and probabilistic logic rules. To adapt and manage the context. Dissemination mechanism stores for future use and query solving.

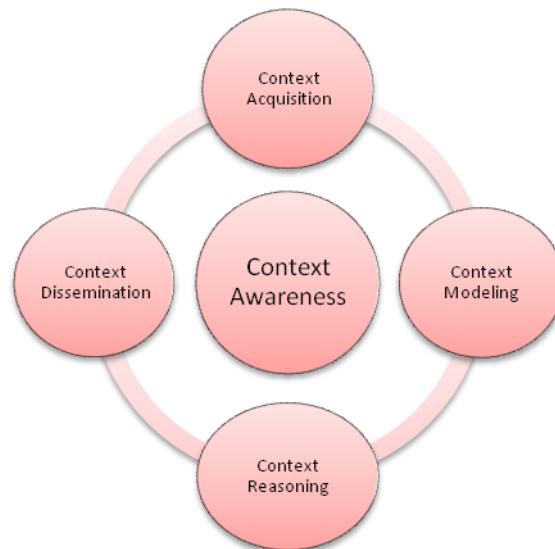


Figure 2: Lifecycle of Context Awareness.

A. Context Aware Computing Architecture

The lower layer is sensor that retrieves the raw data. Sensors collect the information about the task in real world. Algorithms make sense of categories in the environment into context. The actions are triggered with the obtained system.

Accession of data from sensors supports the behavior of multiple applications. The architecture divides into multiple layers, where each holds its own process.

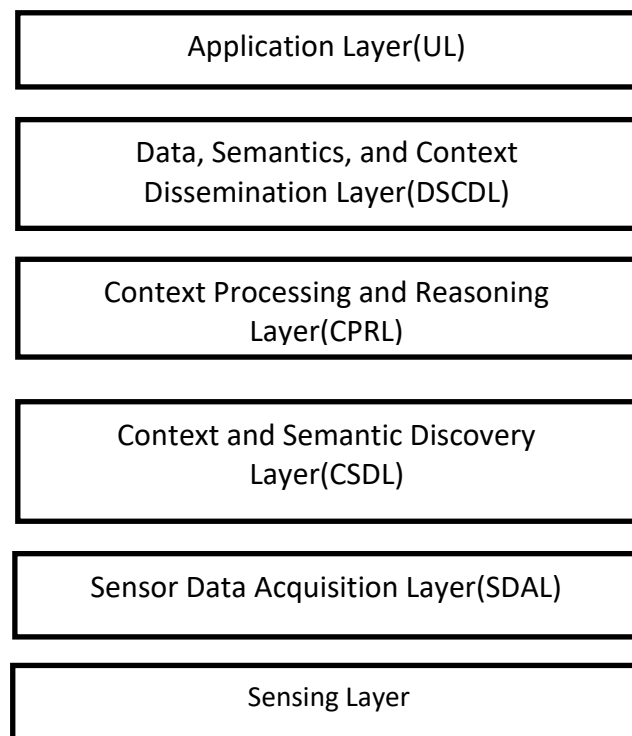


Figure 3: Architecture of Context Aware Computing.

The layers are listed below:

- Acquisition layer is the principal part that collects the information from sensors such as sensor device definition and SDD cloud repository. Various context data are obtained here.
- Discovery layer locates context and semantic data's. Thinking sub system involves semantic generator, semantic discovers and repositories. Frame work module provides the service.
- Processing layer collects the important functions like interpreting, filtering and time stamping. Modules are classified as high level and low-level abstraction.
- Dissemination layer sends request through multi-model interfaces. The decision supporting module is classified into reasoning, learning and adaptation.

Application layer consist of management module that manage context aware applications. It is also called as acting sub system. Storage and management acts as a broker. Data's from the sensors and queries are represented in XML format. More technical components like context abstraction, process, and dissemination are considered. Implementation of middleware is missing in displaying a simple use case.

V. THE INTERNET OF THINGS PARADIGM

The intention of IoT is to connect the physical devices over the internet to communicate with the end user. Paradigm is the combination of many technologies such as tracking, actuator's, distributed intelligence to improve the communication among the objects. The architecture differs based on different aspects like communication, security, networking and so on. Architecture are designed in order to face the developing challenges such as bandwidth, latency and security. It has it's own ideas and characteristics. Various standardized protocols are introduced and it is classified as application protocol, service discovery protocol and infrastructure protocol. IoT travels different technologies like RFID, Bluetooth, Wi-Fi, Cellular, Zigbee to build it's vision. It takes it's step towards the growth of internet.

A. Internet Evolution

Internet is a worldwide public network where people can make use of it in multiple ways. The term internet becomes a key element for human success. The internet research was started in 1960 by ARPANET[1]. It is used in military, government and educational institutions in US. Later in 1980's the protocols TCP/IP was introduced for commercial use, it is fixed network to send and receive SMS. HTTP/HTML protocol's begins in 1990. It find it's application in e-mail. Internet become more popular with the Mosaic Web Browser and stimulates the rapid growth and crossed 1million internet host with 50 web pages in 1995 and this time period was called Internet Information.

Later mobile components are started to connect and communicate with internet. That was called internet of relationship. Web 2.0 was the major development here. The major application of web 2.0 is e-commerce and e- productivity. Social media like You Tube,

Facebook, Skype, Twitter etc. was introduced which can create social groups and users started to connect over internet. It is known as Internet of people. Machine to Machine communication through internet made possible with block chain. It is beginning in use everywhere in identification, tracking, monitoring and automation. The things near the environment is able to communicate through internet is simply named as Internet of Things (IoT).

The future of communication transformed the things of real world into smart devices. It creates an tiny and intelligent network to sense and communicate directly or indirectly [10]. The diagrammatic representation of the growth is shown in figure 4. Initially the communication between the computers called pre-internet. World Wide Web (www) was the major part in the evolution of internet connecting millions of people that provide service for the people. With the unique identities user's joined in social medias through internet. Now a days it moved towards Internet of Things (IoT) . Millions of people in the world cannot describe their lives without internet [10].

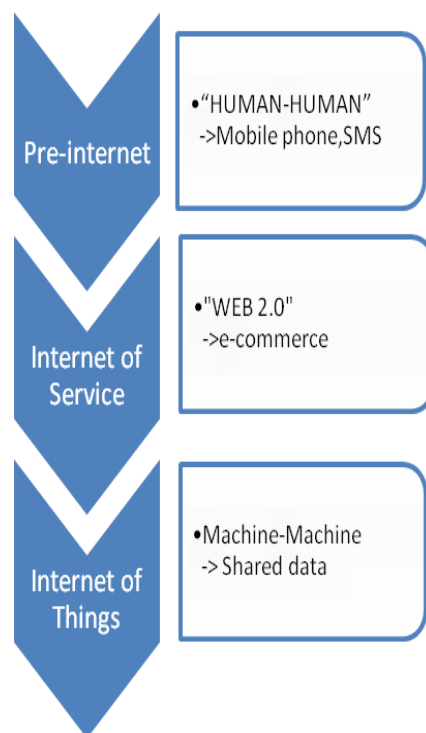


Figure 4: The evolution of Internet.

B. *Internet of Things*

In simple words Internet of Things can be defined as it is all about things and noting else. The Internet of things (IoT) is a network that connects the objects to collect and exchange data that provides unique identifiers (UIDs) and the capacity to transfer data over a network without necessity of human-to-human or human-to-computer interaction. An IoT system contains sensors/device s that communicates with the cloud via connective devices once

when the data gets in to the cloud, software processes the data and then it decides to carry on an action, alerting or automatically adjusting the sensors/devices without the need for the user.

The IoT encloses a remarkable amount of technologies that take away to its innovation. IoT was invented by a team of Radio Frequency Identification (RFID). Internet of Things is a collection of two or more physical objects that forms network. Internet can be defined as follows.

- 1) Human to Human
- 2) Human to machines or objects
- 3) Machine to Machine

To reach the familiar goal IoT is a pattern interacts through wired or wireless connection in ubiquitous environment with unique address that can be applied in new fields [12].

It is also defined that IoT is a concept that involves lot of technologies and goals. The point of view is changing dynamically with respective phenomenon. In the world of internet service with the help of smart phones the things can be integrated into network through internet.

In global network Internet of Things is intelligent to interoperate on basis of standard protocols where objects have unique identity combine with information network. In business IoT unites the people to process the things to get more value by transforming the data into actions [13]. Machine to Machine interaction without the interaction of human is made possible with IoT that have control over the objects in ubiquitous environment.

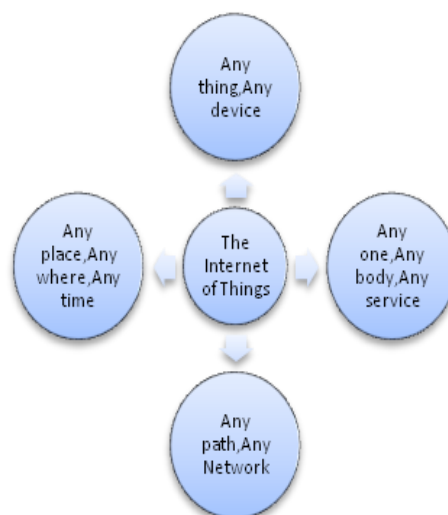


Figure 5: Defining Internet of Things

The networks and the connectivity is available with irrespective to the environment. Smart phones make the universal possible to communicate with the things anytime and anywhere through any path with the help of any service[13].

C. Sensor Network Layers

The structure of the sensor network is clearly represented in figure 6. The sensor networks consist of more than one sensor devices that have capability of sensing and computation with wireless communication [9]. Sensor nodes collect the data and send to the base station. It works like a gateway the data's are systemized via internet. Each and every node is provided with the transceiver or other communication devices to communicate with near by node. The sensor nodes collect's the information from the sink nodes in low-end computational devices. Taking these data's to the high level computational devices performs the remaining tasks. If needed sensor nodes can also receive the data from other sensor nodes. The requirements refers memory, energy capacity, processing. An intelligent system must know the capacity and manage accordingly. Cloud stores the data that can be shared and processed significantly with minimum management and security purpose [11].

The challenges faced in sensor networks are energy source, clustering. IoT researches need to make the network efficiency and effective by collecting, data management and distributing [14]. The sensor nodes are constructed in such a way that network system can change the connectivity and environment due to the failure of topology [10].

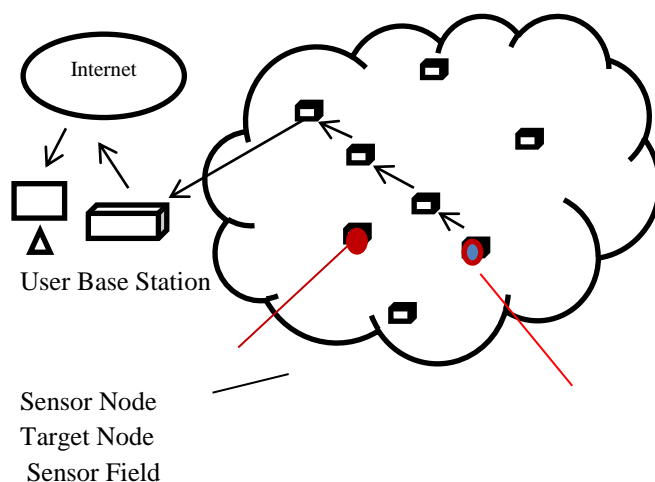


Figure 6: Sensor network Layer

VI. CONCLUSION AND FEATURE WORKS

The above survey work allows us to frame the issues of context-awareness on IoT such as relevant information's about various situations, mobility results of continuous updates, handling uncertainty, privacy control, common understanding of implications, effective usage of context with restrictions. Hence after many discussions we aim to target one particular problem and find solution for the same. Where many other securities issued projects can make use of these architectures and principles.

To represent the context uniquely it must have the ability to model different types of context such as physical, computational context. The ideology should come up with the quality to support the context to reduce the complexity and improve the maintainability, security and resolvability.

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