Detailed Dominant Approach Cloud Computing Integration with WSN

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Abstract. The maximum benefit out of the recent developments in sensor networking can be achieved via the integration of sensors with Internet. The real-time specific sensor data must be processed and the action must be taken instantaneously. This distributed architecture has numerous similarities with the wireless sensor networks (WSN) where lots of motes, which are responsible for sensing and preprocessing, are connected with wireless connection in the real-time. Since wireless sensor networks are limited in their processing power, battery life, communication speed and storage resources , cloud computing offers the opposite , which makes it fetching for endless observations, analysis and use in different sort of environment.

In this paper we proposed an architecture, which integrates the Cloud computing technology with the wireless sensor network. In this paper we also discussed some research challenges with respect to cloud computing and wireless sensor networks, and important key component of sensor cloud

Keywords: Cloud computing, Distributing computing, Wireless sensor networks, Sensor cloud, Research challenges of cloud computing and Internet.

1 Introduction

Cloud computing is a technology that uses the internet and central remote servers to maintain data and applications. It allows consumers and businesses to use applications without installation and access their personal files at any computer with internet access, with more efficient computing by centralizing storage, memory, processing and bandwidth. It can be securing immense amounts of data which is only accessible by authorized users. Cloud computing in broad way is shows in Figure 1 and Figure 2.

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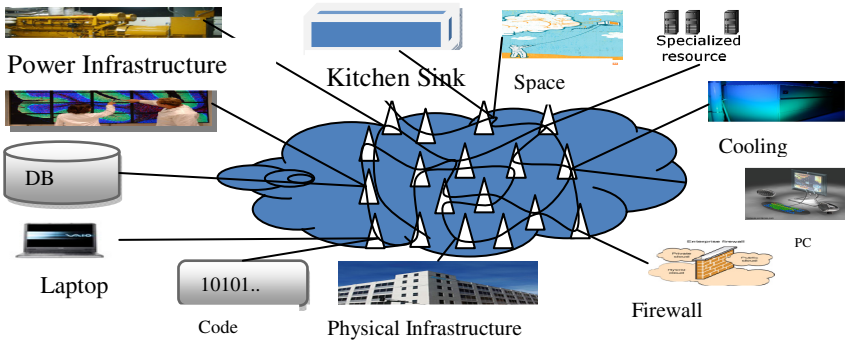

Fig. 1. Cloud Computing

Cloud computing is the technology that enables functionality of an IT infrastructure, IT platform or an IT product to be exposed as a set of services in a seamlessly scalable model so that the consumers of these services can use what they really want and pay for only those services that they use (Pay per use) [2].

"Cloud computing is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [16]. "

Wireless sensor network consists of a large number of such sensor nodes that are able to collect and disseminate data in areas where ordinary networks are unsuitable for environmental and/or strategic reasons. Each sensor node comprises sensing, processing, transmission, mobilize, position finding system (Such as GPS) and power units [8].

The system architecture of wireless sensor network is shown in Figure 3. In other ways Wireless sensor a network is seamlessly couples the physical environment with the digital world. Sensor nodes are small, low power, low cost, and provide multiple functionalities sensing capability, processing power, memory, communication, bandwidth, battery power. Useful in many application domains.

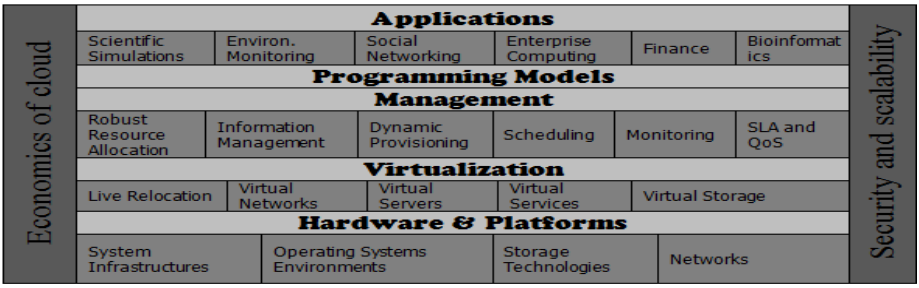

Fig. 2. Architectural Level Cloud Computing

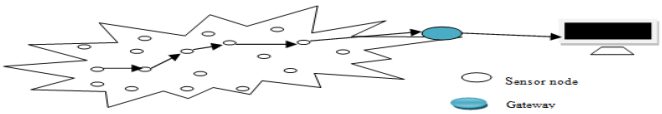

Fig. 3. Architecture of Wireless Sensor Network

The organization of our paper is as follows. In section 2, section 3 and section 4 we have discussed key features of our interest and Limitations of cloud computing and sensor networks. In section 5 describe need to integrate cloud computing with wireless sensor networks? In section 6 we describe research challenges, where some research works can be done in these areas. In section 7 we present a proposed architecture of cloud computing with WSN. In section 8 point out some key components of the proposed architecture and Section 9 conclude and future work.

2 Key Features of Our Interest

There are some key features that are useful for everyone to use internet. i) Immense computational and storage resources that are collocate. ii) Very high speed data processing and movement. iii) Accessibility over the Internet Service-Oriented Architecture and virtually from any platform.

3 Limitation of Cloud Computing

Cloud computing is limited – as of now: i) The immense power of the Cloud can only be fully exploited if it is seamlessly integrated into our physical lives. ii) It is providing the real world's information to the Cloud in real time and getting the Cloud to act and serve us instantly so it need to add the sensing capability to the Cloud.

4 Limitation of Sensor Networks

Sensor networks are limited too: i) It is very challenging to scale sensor networks to large sizes with proprietary vendor-specific designs, which is difficult for different Sensor networks to be interconnected. ii) We know sensor networks is operate in separate silos, so sensor data cannot be easily shared by different groups of users. iii) Sensor network is used for fixed and specific applications that cannot be easily changed.

5 The Missing Piece

The missing piece of cloud computing is shown in the Figure 4. In which cloud computing is would be integrate with sensor networks.

5.1 A Scenario

A scenario is a description of a flow of messages in the network via cell phone shown in the Figure 5. An Insight into the Scenario has some steps shown on next page.

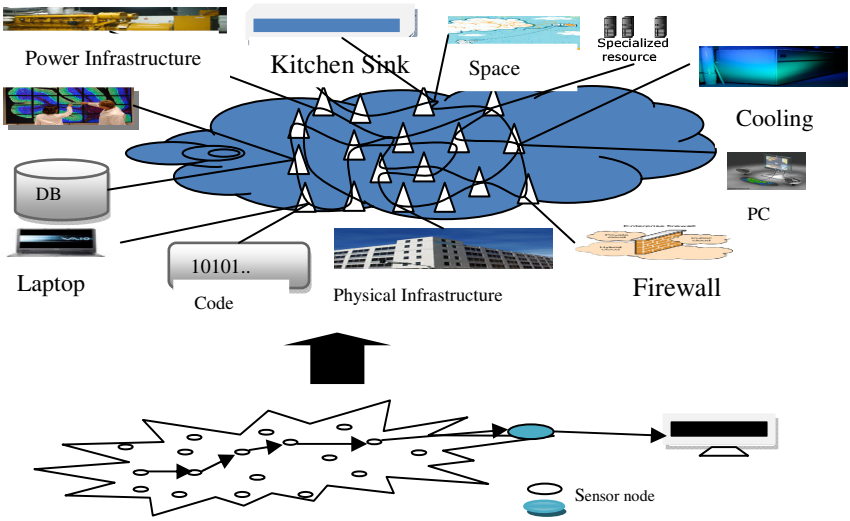

Fig. 4. The Missing Piece

Step 1. Cell phone records the tourist's gestures and activates applications such as camera, microphone, etc.
Step 2. The cell phone produces very swift responses in real time after: i) Processing geographical data. ii) Acquiring tourist's physiological data from wearable physiological sensors (blood sugar, precipitation, etc) and cross-comparing it with his medical records. iii) Speech recognition. iv) Image processing of restaurant's logos and accessing their internet-based profiles. v) Accessing tourist's social network profiles to find out his friends.
Step 3. Fact: the cell phone cannot perform so many tasks!

5.2 Need to Integrate Cloud with Sensors

These are the some point why need to integrate cloud with sensors : i) Acquisition of data feeds from numerous body area (blood sugar, heat, perspiration, etc) and wide area (water quality, weather monitoring, etc) sensor networks in real time. ii) Real-time processing of heterogeneous data sources in order to make critical decisions. iii) Automatic formation of workflows and invocation of services on the cloud one after another to carry out complex tasks.

5.3 The Sensors Cloud

"An infrastructure that allows truly pervasive computation using sensor as interface between physical and cyber world, the data compute cluster as the cyber backbone and the internet as the communication medium."

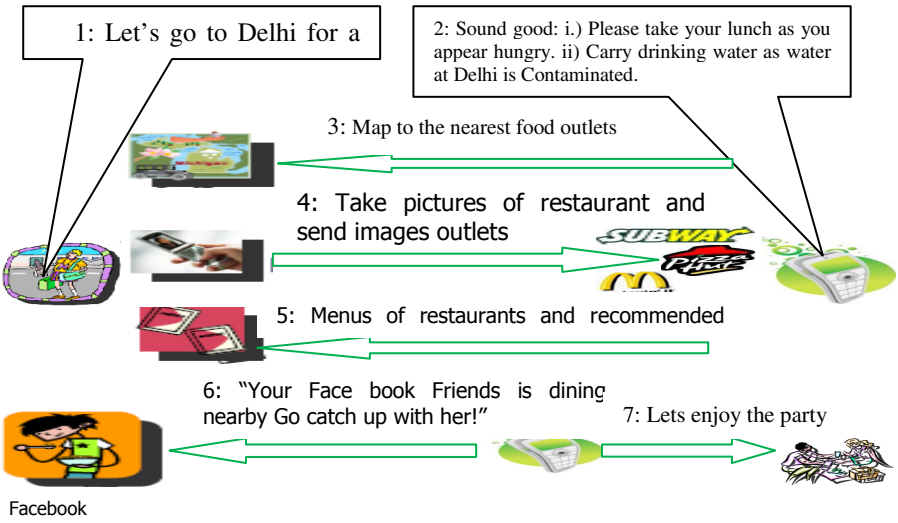

Fig. 5. A scenario

Sensor cloud integrates large-scale sensor networks with sensing applications and cloud computing Infrastructures , which collects and processes data from various sensor networks, that will enables large-scale data sharing and collaborations among users and applications on the cloud, then it will delivers cloud services via sensor-rich mobile devices, which allows cross-disciplinary applications that span organizational boundaries, enables users to easily collect, access, process, visualize, archive, share and search large amounts of sensor data from different applications. It also Supports complete sensor data life cycle from data collection to the backend decision support system.

6 Research Challenges

Research challenges in which areas research works can be done: i) Complex Event Processing and Management. ii) Massive Scale and Real Time Data Processing. iii) Large Scale Computing Frameworks. iv) Harvesting Collective Intelligence

7 The Proposed Architecture of the Cloud Computing with Sensor Networks

The architecture of the cloud computing with sensor network is shown in the Figure 6 [1], this architecture Enables users to easily collect, access, process, visualize, archive, share and search large amounts of sensor data from different applications. Supports complete sensor data life cycle from data collection to the backend decision support system. Vast amount of sensor data can be processed, analyzed, and stored using computational and storage resources [3] of the cloud.

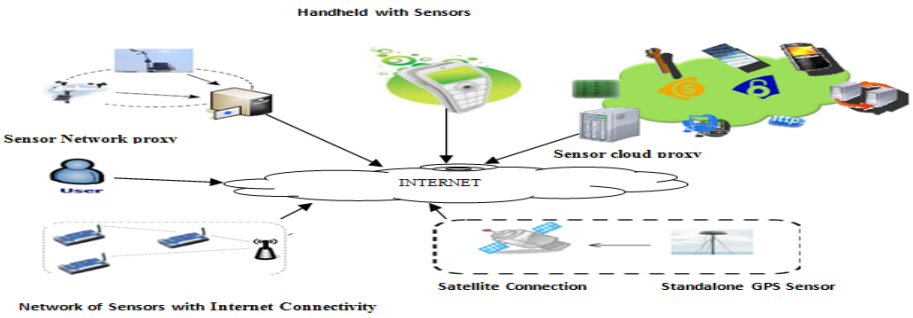

Fig. 6. Sensor Cloud Architecture

7.1 Requirements for the System

Cloud computing model is mainly based on pipes and filters [17] .The pipes and filter design (see Figure 7) is used in digital processing applications, which also used in wireless sensor networks [18].

Pipes are used to buffer data and provide uniform interconnection mechanism of filters. Filters process and transform input data and deliver it to an output port.
The general system architecture, which integrates cloud computing with wireless sensor networks, contains several basic services.

The main requirements for the system are: i) Receive and manage sensor data from heterogeneous motes. ii) Manage a set or chain of filters that perform on-line analysis on sensor data. iii) Run filters offline on a given set of sensor data. iv) Permanently run filters on a given set of sensoric data. v) Provide different, user definable views and visualizations on the sensor data and calculation results. vi) Provide an interface for changing existing filters or to develop new filters out of an existing domain specific modeling tool. vii) Provide an interface for data export, so that the stored data can easily be taken from the Cloud storage and to be used in non-cloud solutions. viii) Provide a notification service, e.g. a filter or machine learning component identifies a specific situations or has finally calculated a specific result. ix) Provide data access

rules x) Provide configuration capabilities for filter chains, (web) services, notifications, and data access rules. xi) Provide a management console for the configuration of the whole system.

7.2 Proposed System Level Architecture of Cloud Computing Integration with Wireless Sensor Network(WSN)

The system level architecture of cloud computing integration with wireless sensor network in Figure 8 shows the collection of base services provided to the user as SaaS (Software as a Service), PaaS (Platform as a Service), and IaaS (Infrastructure as a Service) applications as cloud service providers. The Wireless Sensor Network Analytical Services and Cloud groups all services that are necessary to fulfill the requirements that are integrate cloud computing with wireless sensor networks. The following main services are necessary to collect and analyze sensor network data within the cloud: Necessary Services for wireless sensor network and Cloud

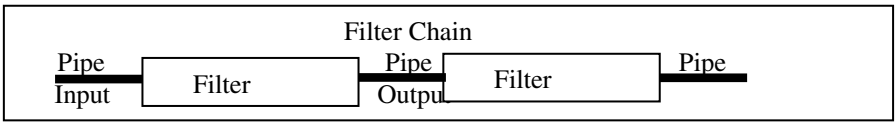

Fig. 7. Pipe, Filter, and Filter Chain

Global Sensor Data Management or Sensor Metadata Management or Cloud Based Management System: It is responsible for the management of the sensor data within the Cloud Computing environment. Since the cloud computing environment provide several ways for storing data, e.g.: Google AppEngine offers Bigtables [4,15] for data persistence and Microsoft Azure provides BLOBs, queues and tables, it's necessary to have a flexible data access layer, which raises the level of abstraction, so that persistence mechanism can be easily exchanged to the global sensor networks.

Provide Runtime for Filter Chains: Filters are usually configured for a specific filter chain. A filter chain is a reliable runtime environment for filters and it executes various user defined filters.

User Interface via Web Browser: A user interface provide the interaction between people (users) with a machine via Web Browser. The user interface includes hardware (physical) and software (logical) component.

Filter Chain and Management of the Filter: Filters and filter chains we need some management. This management service allows the administration of filters, so that a user is able to add new filters, delete filters and aggregate existing filters to combined filters. Since many filter chains are executed in parallel, it is necessary to offer a flexible configuration mechanism.

Visualization / Views for Data Analysis: The visualization service provides various predefined and user-defined views on the data and analysis results. The visualizations and views can be implemented with languages like data warehouses, OLAP, The

spatial OLAP Visualization and Analysis Tool (SOVAT), NET Reporting and Heat map. So a powerful visualization is necessary to manage the sensor data.

Notification Service: This service is a mechanism to inform external applications and services about specific situations, where it fires an event. This could be for example, an indication that a gas pump failure is approaching

8 Key Components of the Proposed Architecture of the Cloud Computing with Sensor Networks

There are some key components of the cloud computing with sensor Networks as follows

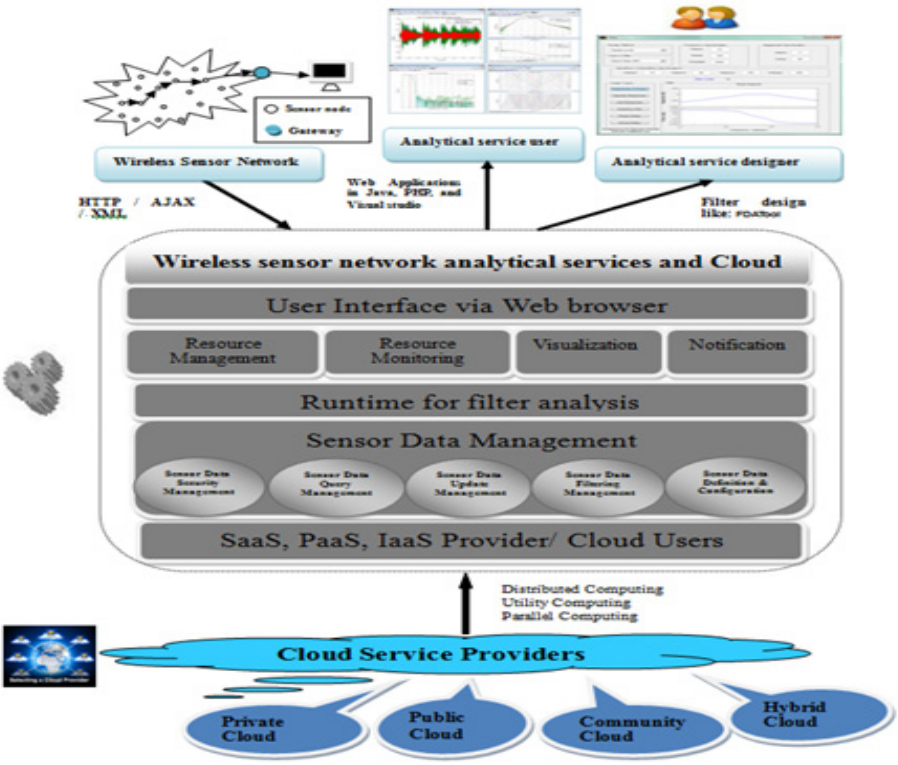

Fig. 8. Proposed System Level Architecture of Cloud Computing Integration with Wireless Sensor Networks

8.1 Sensor-Cloud Proxy

Sensor cloud proxy provide the interface between sensor resources and the cloud fabric, which Manages sensor network connectivity between the sensor resources and the cloud., that exposes sensor resources as cloud services, to manages sensor resources via indexing services. Cloud discovery services used for resource tracking. for manages sensing jobs for programmable sensor networks, manages data from sensor networks, data format conversion into standard formats (e.g. XML).

8.2 Sensor-Network Proxy

Sensor network proxy provides the connection to sensor resources that do not have direct connection to the cloud, sensor network is still managed from the Sensor-Cloud Interface via Sensor Network proxy, which collects data from the sensor network continuously or as and when requested by the cloud services to enhances the scalability of the Sensor Cloud, finally sensor cloud proxy provides various services for the underlying sensor resources, e.g. power management, security, availability, Quality of Services(QoS).

9 Conclusion and Future Work

The communication among sensor nodes using Internet is a challenging task since sensor nodes contain limited band width, memory and small size batteries. The issues of storage capacity may be overcome by widely used cloud computing technique with sensor networks. Cloud integration with WSN mechanism may provides dynamic collaboration between clouds to enable many services. We also conclude that the cell phone cannot perform so many tasks! There for cloud computing is useful with sensor networks. As we know “Sensor networks are distributed across extended terrain so they open up an entirely new scope of applications. Another critical feature of this technology is that it has a very light footprint, it can be installed using fairly non-intrusive methods, and as a result, we do not impact the environment we are trying to observe.” Everyone should interest to discuss about the use of cloud computing for real-world applications, and explore opportunities for collaboration which lead to the intelligence integration into the Internet. This solution has been extended to sensor clouds, which leads to high availability and hence reliability is achieved.

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