Novel Framework for Integrating Mobile Computing and Wireless Sensor Networks

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Abstract
Wireless Sensor Networks (WSN) is processing the ways to the Internet of Things by combining it with the mobile Computing. Nowadays, wireless sensing based technology is changing into powerful tool as well as in lower prices by encouraging the large-scale application of WSN in daily life. However, important analysis work has to be done in order to enhance the network support for wireless sensor based network and its applications. For this process, a new method of combining the Mobile computing along with the wireless sensor networks is proposed in this paper. This methodology acts as a backend work for combination of machine-to-machine (M2M) solutions on mobile computing platforms. The various virtualizations of resources brought by the mobile computing platforms raises new opportunities for the preparation of infrastructure in real world applications of mobile computing like giant scale preparation of mobile based sensors, which act through mobile wireless networks. An extensive review and the possible solutions for combining the WSN along with the mobile computing, that is vital for supporting the growing communication process on metropolitan areas is proposed.

Keywords:
Mobile Computing; Wireless Sensor Networks; Large-Scale Sensing; Storage and Processing;

1. Introduction

In recent years, a revolution within the trade of sensors has been triggered because of the progresses created due the shrinking of applications of electronics. Currently, it's attainable to create sensors based applications that are more capable of performing more works, creating it easier to create sensor based networks. A sensor network [1] consists in a very range of nodes, that get together to complete their task of grouping data and returning it to an application side or throughout a distributed platform. Each and every sensor based elements could be a node of the network. Whereas, separately every node present in the sensor is autonomous in nature and contains a short vary, once used jointly, they're cooperative and effective over massive areas.

Nowadays, applications of wireless based sensor networks are vast and these are being deployed at various real world applications [2] such as medical, military, transportation, town management etc. Instead, there should be a good method for the user to save, alter and access the information created by the sensing element network. Due to this combination, sensing networks cannot operate as a complete network by combining it with mobile computing. This article analyses the information storage and process solutions for supporting the combination of WSN along with the mobile computing based technologies. One of the important challenges for this combination of WSN with mobile computing based infrastructure is that the lack of physical property in the resources of various machines that was used in this combination. Hence this combination could be a success to integrate sensing element networks with the mobile Computing paradigm. This combination of WSN along with the mobile computing methodology is self-scalable and also guarantees that all the information present within the mobile computing environment is protected through various encryption methods which will be used with totally different mobile Computing suppliers.
The remainder of the paper is organized as follows: section 1 depicts the introduction and various analysis works done by various researchers on WSN and mobile computing respectively. Section two proposes the overall design and the combination of WSN and Mobile Integration, whereas combination of the proposed technique and its implementation details for various mobile based networks are shown in section 3. Section 4 ends this paper with the closing remarks and future work proposals.

2. Literature Review

Various researches on WSN have been done earlier which provides the in-network based support for the applications based on it. Due to this, various Operating Systems based on a special-purpose task has been created. Various Sensor nodes, such as: TinyOS [3], Contiki [4], Squawk [5] and Lorien [6] have been developed because of this. Programming abstractions for wireless sensor networks is also developed which results in specialized component models such as NesC [7], OpenCom [8] and LooCI [9] along with various other programming approaches such as TinyDB [10] and Kairos [11] etc. Research on Backend of the WSN was performed by various researchers. One of

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the properties of the nodes of a sensor network have very limited storage and processing capabilities. Also, the sensor networks are rarely operated in an isolation condition and it is also usually connected to a backend modeling infrastructure. Some of the Examples from real world sensor-network based applications include computational models of flooding [12], pollution [13] and hurricanes [14].

Recent WSN's have been designed to allow various processing based on in-network architecture. The authors in [15] depict such a type of network where it is introduced. The concept of collector nodes proposed in [15] proposes a methodology with better equipped better processing, storage and battery capabilities when compared to the ordinary sensors. In these kinds of networks, the collector nodes receive the data from the spatially distributed sensors and perform complex computations in in-network based on the needs of applications.

WSN based in-network processing combined with the mobile-agents is proposed in [16, 17]. In this methodology, the authors explained the service to identify how it is owned by the server. In their methodology, most of the resources are located at the client's side. Using this methodology, the sensor based networks results in architecture of having a processing center in order to send out the mobile agents. Also, the carrying service knows how, where it will be migrated to each node and performs the data processing until it is returned to the processing canter with the complete results. However, even if the WSN is designed in a way to allow some processing within the network, the results are usually stored outside the network where they can be further analysed. Further, the combinations f WSN with other methodologies were not effective for achieving the gals in an effective manner. Hence, an efficient framework for enhancing the wireless sensor network is framed on this paper for enhancing the various challenges which were analysed in this paper by combining it with the mobile computing architecture.

3. Types of Computing

Computing technologies can be classified in to various types as given below:

3.1 Computing based on Cluster

Computing based on cluster is a form of distributed computing where some sets of machines are used to increase overall processing output of the computations. These clusters are the combinations of multiple computers, multiple storage devices, and redundant interconnectivity circuits, from which it acts as a single high performance system. The cluster in these systems can be increased in size or number as the traffic or availability assurance increases. The authors in [18] depict the benefits of the combination of cluster and grid computing in solving several parallel based problems.

3.2 Computing based on Grid

Computing based on Grid refers to the collection of computer resources from domains of multiple administrative capacities in order to reach a common goal. Recent researchers proposed lots of literatures referring to the combination of computing based on grid and the wireless sensor networks in [19-23] which depicts how to enhance the advantages of computing based on grid when combined with the wireless sensor networks.

The grid can act as a distributed system with workloads of non-interactive in nature that involve a vast computer based processing cycles and in order to access large amounts of data. In general, the grid computing technology requires the application of software's which can divide it in to portions of a program in order give it to several computers.

3.3 Computing based on High Performance

Computing based on High performance combined the administration of a system and the parallel programming into a multidisciplinary field which consists of digital electronics, programming languages, algorithms and other computational techniques.

In general, supercomputers are in the used high-performance computing in order to solve the problems which are occurring in the advanced computation paradigm. However, because of the changes in the computing paradigms, many high performance based systems have been changed from the supercomputing towards the computing technology based on clusters and grids.

High performance based computing technologies are proposed in [18] and [24] in order to use sensing systems. However, the user should also keep in mind that most of the recent computing based applications are not proposed for High performance based computing based technologies. But it can be tested for scaling in order to give more powerful machines. Recently, the networking based on cluster computing and grid computing uses multiple processors and computers, these applications can be used in various systems in future supercomputing techniques.

3.4 Mobile Computing

Mobile Computing is defined as the technology which allows data, voice, and video transmission through a computer or any other devices wireless-enabled without being connected to a fixed physical link. The mobile computing technology involves the process of communication between mobile devices, mobile hardware's, and along with the software which is present

inside the mobile. These communication issues include the ad hoc as well as the infrastructure based networks and the properties of communication, the protocols necessary for the transmission, data formats and other technologies.
The ability of this mobile technology is the data has to be transferred through a computer in such a way that a computer can get the data which is not physically connected to an external link. Since the connection is not established through a physical link, the mobile computing activity requires to be connected without wire either through the internet or through any private network. This connection connects various mobile devices in a central path which is located remotely and the information is transmitted by a device mounted by a powered battery, and wireless communication devices such as smartphones, Super computers, and laptops with wireless LAN etc.

4. WSN and Mobile Integration

Though the mobile computing is still an advanced and recent technology, its many research works has been on-going for the collaborating the wireless sensor networks and the mobile computing technology.

4.1 Proposed Architecture

A novel architecture for integrating the mobile computing along with the wireless sensor networks is proposed in this section. The proposed architecture is intended to be self-scalable taking advantage of the resources provided by the mobile computing since it is modular by design so that new applications and functions can be easily included. This technology is flexible since it can be easily adaptable to several mobile based devices.
An overall architecture which is shown in Fig. 1 shows the developed methodology in order to meet the goals of mobile and WSN combinations named as Mobile Sensor Services. It is implemented using C# platform. The proposed architecture explains how sensors communicate with the Mobile Sensor based Services and how these services are deployed. In general, the mobile based Sensor Services expose an endpoint in which sensors connect through an HTTPS based communication channel. Various operations given by the mobile based Sensors Services can be grouped into the following categories:

Space for Storage: It is the process interconnecting or allows inter-connecting the sensors with the storage space. It also allows creating the operations which can be done on the storage space and delete the unwanted and out dated files in order to find the available storage spaces.

Information Sensor: It alters the information present in the sensor which can be used by the mobileSensor Services. It also issues the tasks in order to register or unregister a list which is registered in the sensors and inquires about whether a particular sensor is registered or not.

Properties of Sensor: It is used to issue some functions in order to download or upload sensor extended properties. Various numbers of extended properties can be there in the sensor which included the level of battery, position, etc.

Data Sensor: It provides functions in order to upload or download sensor data, whatever that may be. It included the record of temperatures based on hours, information about the traffic, security camera's video stream etc.

Mobile Sensor based services and its operations are done by a mobile based adapter. It can be classified in to four major modules. This mobile adapter defines the set of operations that are available to the sensors. In order to provide the above said operations, the mobile adapter requires the existence of four major modules shown in Fig.1.
The proposed design depicts one of the important tasks of the solution, which is to make it usable with different mobile Computing providers. The idea is that the mobile adapter will provide a basic architecture and it acts as a common logic between mobile computing providers, and the WSN modules. It also finds the logic which is required in order to establish an adapter for performing the available sensor operations.

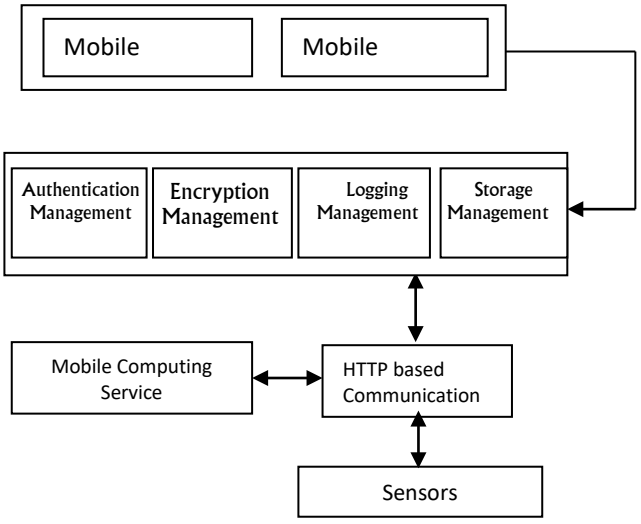

Fig. 1 Overall Architecture of the proposed system

5. Mobile Adapter Implementation

One of the main goals of the proposed solution is to be extendable to virtually any a mobile computing based provider. This solution is proposed not only to perform the

above said process it also performs the way to minimize the required work. The building blocks of the architecture has the mobile Adapter and its four modules, detail steps are required to build an implementation of the sensor services by a particular mobile Computing provider. To support multiple mobile Computing providers we chose to use the Inversion of Control pattern. This pattern id usually defined by the developer using the C# programming platform which is is called as a Container for Inversion of Control. This methodology works in two steps. Initially, it needs to add the class/interface to the container and afterwards it can ask the container for instances of the class/interface. The sensor choses only interface of register because it cannot be tied to particular implementations, or it would be very hard to support different mobile Computing based providers.

6. Conclusion and Future Work

Major task of this method is to propose a solution that would facilitate Wireless Sensor Networks Systems. This methodology is completely automated and since it can be accessible easily by any platform, it can make sure that data which is stored in the securely of the mobile server can be be easily extendable and should be challenge to the mobile Computing provider. It can be understood that the proposed solution proved to be novel in all points as demonstrated by the discussions in the above sections. This methodology proposed that the mobile computing technology is not only a viable solution for the combination of sensor networks as it most probably can best fit for such systems. The proposed methodology proved that it can assure the advantages of various resources in order to guarantee the systems output and response time when the overall load of the entire system increases. It also ensures the reduction of cost whenever the resources for the system do not need them. Since the wireless sensor based networks can be data intensive in nature, the performance of the proposed system can be improved by using some kind of compressing protocol. Moreover, in order to validate the proposed methodology, various tests can be done by using a large number of real time sensors and it can also be done by interacting with the services of more than one provider based on mobile Computing.

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