A report on Integration of Wireless Sensor Network with Cloud Computing

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Abstract

Nowadays, wireless sensor community (WSN) commitments were used in a number of fundamental areas, comparable to healthcare, military, major infrastructure monitoring, atmosphere monitoring, and manufacturing. However, as a result of the limitations of WSNs in terms of memory, energy, computation, conversation, and scalability, efficient management of the huge number of WSNs information in these areas is a predominant dilemma to handle. There is a need for a powerful and scalable high-efficiency computing and big storage infrastructure for actual-time processing and storing of the WSN information as good as analysis (on-line and offline) of the processed understanding under context making use of inherently intricate models to extract events of interest. In this situation, cloud computing is becoming a promising technological data to provide a flexible stack of massive computing, storage, and software services in a scalable and virtualized method at low cost. Therefore, in present years, Sensor-Cloud infrastructure is fitting preferred that can furnish an open, flexible, and reconfigurable platform for a couple of monitoring and controlling purposes. In this paper, we present a comprehensive study on Sensor-Cloud infrastructure, so one can furnish general readers and summary of the Sensor-Cloud platform together with its definition, structure, and applications.

Keywords: Cloud Computing, Sensor Network, WSN

I. INTRODUCTION

The expansion and application of wireless sensor networks grow to be an unbeatable trend into the more than a few industrial, environmental, and business fields. A typical sensor network could encompass a number of sensor nodes appearing upon collectively to monitor a area and fetch data in regards to the surroundings. A WSN comprises spatially distributed self-regulated sensors that may cooperatively display the environmental conditions, like sound, temperature, stress, motion, vibration, pollution, and so on [1, 2]. Every node in a sensor network is loaded with a radio transceiver or every other wireless communication device, a small microcontroller, and an energy source most often cells/battery. The nodes of sensor network have cooperative capabilities, which might be mainly deployed in a random manner. These sensor nodes basically encompass three ingredients: sensing, processing, and communicating [3]. One of the most common sensor gadgets deployed in sensor network is one of the most common sensor devices deployed in sensor network as sensor nodes are digital camera sensor, accelerometer sensor, thermal sensor, microphone sensor, and so on. Presently, WSNs are being utilized in a number of areas like healthcare, defense similar to army target tracking and surveillance [4, 5], govt and environmental services like typical disaster remedy [6], hazardous atmosphere exploration, and seismic sensing [7], and many others. These sensors may just furnish various valuable data when they are intently hooked up to every of their respective functions and services immediately [8]. Nevertheless, sensor networks need to face many disorders and challenges concerning their communications (like short communication range, security and privacy, reliability, mobility, and so forth.) and resources (like power issues, storage potential, processing capabilities, bandwidth availability, and many others.). Apart from, WSN has its own useful resource and design constraints. Design constraints are software exact and based on monitored environment. Founded on the monitored environment, network dimension in WSN varies. For monitoring a small area, fewer nodes are required to form a network whereas the coverage of a very tremendous discipline requires a significant quantity of sensor nodes. For monitoring huge atmosphere, there may be restricted communication between nodes due to obstructions into the environment, which in turn affects the overall network topology (or connectivity) [9]. All these obstacles on sensor networks would most likely obstruct the provider performance and fine. In the course of these issues, the emergence of cloud computing is noticeable as a relief.

II. RELATED WORK

When a user requests, the service circumstances (e.g., virtual sensors) generated by cloud computing services are routinely provisioned to them [11, 12]. Some prior reviews on physical sensors interested by routing, clock
synchronization, data processing, power management, OS, localization, and programming [10]. There are very much less work had been carried out which listenon physical sensor management for the reason that these physical sensors are sure intently to their exact application as well as to its tangible users directly. However, users, rather than their irrelevant sensor services, cannot use these physical sensors directly when needed. As a result, these physical sensors should be supervised by using some distinctive sensor-management schemes. The Sensor-Cloud infrastructure would subsidize the sensor process administration, which ensures that the data-administration usability of sensor assets can be particularly accelerated.

There exists no application that can make use of every variety of physical sensors in any respect occasions; as a substitute, each and every utility required pertinent physical sensors for its fulfillment. To realise the notion, publish/subscription mechanism is being employed for selecting the appropriate physical sensor [10]. Server-Cloud infrastructure supplies the power to user to create the template/virtual specific group of sensor nodes whose data will likely be collaborated for the designated applications. These service templates/virtual agencies are reconfigurable consistent with the users’ wants. Once provider situations end up unsuccessful, they are able to then be deleted speedily by way of users to avert the utilization costs for these assets. Each sensor node, software sense the application and sends the sensor data again to the gateway within the cloud instantly via ofthe base station. Sensor-Cloud infrastructure supplies service situations (virtual sensors) routinely to the top clients as and when requested, in this kind of approach that these digital sensors are part of their IT resources (like disk storage, CPU, memory, and so forth.) [13]. These templates/services/digital agencies’ situations and their associated right sensor data can be used by way of the top users via a user interface through the web crawlers as described in Fig.1.

The physical sensors are ranked on a basis of their sensor readings as well as on their actual distance from an event. The authors of [14] proposed a technique (FIND) to locate physical sensors having data faults by assuming a mismatch between the distance rank and sensor data rank. However, the study led by FIND aims at the assessment of physical sensors’ faults, and there is a close relation between the virtual and physical sensors and hence a virtual sensor will provide incorrect results if their relevant physical sensors are faulty. Since the cloud computing enables the physical sensors to be virtualized by creating templates or virtual grouping, the users of the Sensor-Cloud Infrastructure need not to worry about the status of their connected physical sensors.

The basic disadvantages of a WSN and cloud computing are almost the same and energy efficiency of sensor nodes is lost due to the limited storage and processing capacity of nodes. The authors of [18] have proposed a system for health monitoring using the textilesensors, which work much better and give more accurate results. These textile sensors can
be easily sewed and are even washable. Although the proposed system of textile sensors is performing well in the majority of aspects, the battery can last only 24 hours after continuous monitoring and data transmitting regarding user's heartbeat rate, movement, respiratory conditions, and so forth. The gathered accumulated data can then be visualized in charts using some web applications and the results are received at user end through alert message remotely on user's smartphone. But in order to extend system independency, energy efficiency of such systems (textile sensors and microcontroller based) is a primary issue that has to be handled.

Data caching mechanism [15] can be used to reuse bygone sensor data for applications that are tolerant to time, for example, an application related to variant room temperature. If this bygone sensor data is used to satisfy the various requests for a common sensor data, the energy consumption will be reduced [16]. Still more work is needed to overcome the energy consumption.

To improve the energy efficiency and memory usage in a Sensor-Cloud infrastructure, there should be a middleware which can tackle the adverse situation in case of continuous and long-duration monitoring of data. This can be done through the gateway that is acting as a middleware and collects the huge sensor data from sensor nodes [17]. This middleware should be able to compress the sensor data to avoid the transmission load and then transmits it back to the gateway acting as a middleware on cloud side which intum decompresses and stores it there. When the transmission overload reduces, the energy consumption of sensor nodes improves automatically due to less processing.

III. COMPARISON OF DIFFERENT APPROACHES IN SENSOR-CLOUD INFRASTRUCTURE

In this section, we first present the advantages and disadvantages of Sensor-Cloud infrastructure in terms of agility, reliability, portability, real-time, and flexibility. Next, we provide a technical comparison of different messaging approaches and algorithms used in several existing research on Sensor-Cloud.

Pros of Sensor-Cloud Infrastructure:

(i) Service requesters or end users can control the service instances freely.

(ii) End users can examine the eminence of their relevant virtual sensors.

(iii) Service requesters can use the virtual sensors without worrying about the implementation details.

(iv) The client/users need not to worry about the exact locations and comprehensive description of their sensors.

(v) The service instances are automatically provisioned whenever a request is made.

(vi) The three sources and sensors are released as and when the required job is over, which means that users can delete them when they become non-useful.

(vii) Usage of physical sensors can be tracked by the sensor owner.

(viii) Sensor data are available all the time for a number of various applications until the connection is provided.

(ix) The Sensor-Cloud architecture provides an extensible, open, interoperable, and intelligent sensor network for service provisioning in health care.

(x) The cost of IT resources and WSN infrastructure is reduced when integrating with Internet/Cloud.

(xi) End users can also create the sensors group dynamically in the form of virtual-sensor groups to innovate the new services.

Besides these advantages, the Sensor-Cloud infrastructure also has some drawbacks and these are as follows.

Cons of Sensor-Cloud Infrastructure:

(i) The IT resources and physical sensors should be prepared prior to operation of the Sensor-Cloud infrastructure.
(ii) The Sensor-Cloud infrastructure will not providemuch accurate data as in the case of direct sharing ofphysical sensors data.

IV. APPLICATION SCENARIOS

Combining WSNs with cloud makes it easy to share and analyze real-time sensor data on-the-fly. It also gives an advantage of providing sensor data or sensor event as a service over the internet. The terms Sensing as a Service (SaaS) and Sensor Event as a Service (SEaaS) are coined to describe the process of making the sensor data and event of interest available to the clients respectively over the cloud infrastructure. Merging of two technologies makes sense for large number of application. Some applications of sensor network using cloud computing are explained below:

A. Transport Monitoring

Transport monitoring system includes basic management systems like traffic signal control, navigation, automatic number plate recognition, toll collection, emergency vehicle notification, dynamic traffic light etc. [19]. In transport monitoring system, sensors are used to detect vehicles and control traffic lights. Video cameras are also used to monitor road segments with heavy traffic and the videos are sent to human operators at central locations. Sensors with embedded networking capability can be deployed at every road intersection to detect and count vehicle traffic and estimate its speed. The sensors will communicate with neighboring nodes to eventually develop a global traffic picture which can be queried by users to generate control signals. Data available from sensors is acquired and transmitted for central fusion and processing.

This data can be used in a wide variety of applications. Some of the applications are – vehicle classification, parking guidance and information system, collision avoidance systems, electronic toll gates and automatic road enforcement.

In the above scenarios, both the applications require storage of data and huge computational cycles. They also require analysis and prediction of data to generate events. Access to this data is limited in both the cases. Integrating these WSN applications with the cloud computing infrastructure will ease the management of storage and computational resources. It also provides an improvement on the application data over the

B. Military Use

Sensor networks are used in the military for monitoring friendly forces, equipment and ammunition, battlefield surveillance, reconnaissance of opposing forces, targeting, battle damage assessment and nuclear, biological and chemical attack detection reconnaissance etc. [20]. The data collected from these applications are of greatest importance and needs top level security which may not be provided using normal internet connectivity for security reason.

Cloud computing may be one of the solution for this problem by providing a secure infrastructure exclusively for military application which will be used by only Defense Purpose.

C. Weather Forecasting

Weather forecasting is the application to predict the state of the atmosphere for a future time and a given location. Weather monitoring and forecasting system typically includes - data collection, data assimilation, numerical weather prediction and forecast presentation. Each weather station is equipped with sensors to sense the following parameters – wind speed/direction, relative humidity, temperature (air, water and soil), barometric pressure, precipitation, soil moisture, ambient light (visibility), sky cover and solar radiation. The data collected from these sensors is huge in size and is difficult to maintain using the traditional database approaches. After collecting the data, assimilation process is done. The complicated equations that govern how the state of the atmosphere changes (weather forecast) with time require supercomputers to solve them.

D. Health Care

Sensor networks are also widely used in health care area. In some modern hospitals, sensor networks are constructed to monitor patient physiological data, to control the drug administration track and monitor patients and doctors around a hospital. In the above scenario, the data collected from the patients are very sensitive and should be maintained properly as collected data are required by the doctors for their future diagnosis. Intradimensional approach the patient's history database is maintained in the local nursing home. So reputed doctors who are specially invited from abroad to handle critical cases cannot analyze the patient's disease frequently. They will only make diagnosis when they visit the particular nursing home. This problem may be solved by forming a cloud where the critical data of the patients can be maintained and authorized doctors sitting abroad can analyze the data and give proper treatment.

V. CONCLUSION
In this paper, we surveyed the use of Sensor-Cloud architecture in the context of several functions. The Sensor-Cloud structure allows the sensor data to be classified, stored, and processed in such a manner that it turns into cost-effective, well-timed available, and quite simply accessible. Previous, most WSN systems that have been incorporated to a couple of controlling/monitoring schemes were closed in nature, zero, or less interoperable, specific utility oriented, and non-extensible. However, integrating the prevailing sensors with cloud will permit an open, extensible, scalable, interoperable, and convenient to make use of, reconstructible network of sensors for numerous functions. In this paper, we've mentioned the opportunities of imposing the technology to manage more elaborate situations of a real world through the provider innovation capability of Sensor-Cloud infrastructure.

REFERENCES

BI O D A TA

Author Profiles

Chandrasekhar Nagula received the M.Tech in Electronics & Communication Engineering from JNTU Hyderabad and from 2007 to 2009; he was a Research Scholar from JNTU, Hyderabad. He is currently working as a Associate professor & HOD, Department of ECE in Khammam Institute of Technology & Sciences, Khammam. He has published 3 international Journals. His current research interests include Wireless Sensor Networks, Network Simulators & Cloud Computing.

Dr. Y. Venkata Narayana, was born in a tiny village, West Godavari, Dt. A.P. State, India, way back in 1968. His brilliant academic record won him a seat in B. tech, ECE, JNTU College of Engineering, Anatapur and passed out of it in flying colours in 1991. He pursued his ME in Electronic instrumentation from college of Engineering, Andhra University during 1997-1999 and secured second rank. He followed it up with research in the same university, which finally culminated in the award of Ph.D in the area of communications on “Investigations on Beam Conversions using arrays by phase only control.” He has put up a total of twenty years of service – 16 years in teaching and four years as senior engineer, instrumentation in Power Plant Rain Calkiming Limited, Visakhapatnam. He was actively associated with erection and commissioning of 53.5 MW co-generation plant. Presently, he is the principal cum professor in Tirumala Engineering College, Jonnalagadda, Narasaraopet. Prior to it he had worked in various capacities at different engineering colleges across A.P. To his credit, he has presented twenty six papers at various national and international conferences, and have four of them published in international journals. He is the fellow member of IETE.

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