A Comparative study of cloud computing through IOT

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Abstract

Cloud computing and Internet of Things (IoT) are two very different technologies that are both already part of our life. The Internet of Things (IoT) allows billions of devices to be connected and communicate with each other to share information that improves the quality of our daily lives. On the other hand, Cloud Computing provides on-demand, convenient and scalable network access which makes it possible to share computing resources Many works in literature have surveyed Cloud and IoT separately and, more precisely, their main properties, features, underlying technologies, and open issues. However, to the best of our knowledge, these works lack a detailed analysis of the new Cloud-IoT paradigm, which involves completely new applications, challenges, and research and security issues. In the paper we have explored cloud based IoT applications and their roles in smart cities as well as in the field of medical environment. We have also focused on the security issues of both technologies. The integration of Cloud Computing with the IoT is the most effective way on which to overcome several issues. The vast number of resources available on the Cloud can be extremely beneficial for the IoT, while the Cloud can gain more publicity to improve its limitations with real world objects in a more dynamic and distributed manner. Thus this report shall also analyse recent research work that seeks to improve upon the traditional IoT implementations in the aforementioned areas of interest. We also take a look at some of the most popular IoT cloud integration platforms and compare their features and capabilities. In addition, we have investigated a variety of related technologies and anticipated future developments.

Keywords: keyword, keyword, keyword, keyword

1. Introduction

The Internet of Things (IoT) paradigm is based on intelligent and self-configuring nodes (things) interconnected in a dynamic and global network infrastructure. Internet of things is usually refers to the real world and little things limited storage and processing ability, and the important problems about reliability, performance, security and privacy. On the other hand, cloud computing has the almost unlimited capacity of storage and processing power which is a more mature technology at least to a certain extent to solve the problem of most of the Internet of things. Thus, a novel IT paradigm in which Cloud and IoT are two complementary technologies merged together is expected to disrupt both current and future world. The focus of this paper therefore is to discuss cloud computing in relation to the operations of Internet of things. The paper will examine the relevance of IoT and how cloud computing can be leveraged upon. Thereafter, the current IoT developments as it relates to cloud computing from industries perspective will be examined. This paper will contribute to the understanding of the developments in IoT and cloud computing The paper also focuses on the two major applications : Role in Smart Cities and in the Medical Field. Cloud-based Internet of Things (IoT) applications could help smart cities that contain information gathered from citizens, devices, homes, and other things. This information is processed and analysed to monitor and manage transportation networks, electric utilities, resources management, water supply systems, waste management, crime detection, security mechanisms, proficiency, digital library, healthcare facilities, and other opportunities. A cloud service provider offers public cloud services that can update the IoT environment, enabling third-party activities to embed IoT data within electronic devices executing on the IoT With the rapid development of Internet, cloud computing and Internet integration of medical monitoring and management platform is to provide new opportunities for the hospital, even in social fields. This research paper summarizes the health information technology in the field of cloud computing and Internet of things, especially in health monitoring and management application fields of the current study situation. In this article, we put forward and analysis model of medical information architecture of remote monitoring and management platform (RMCPHI) clouds. Then an efficient PSOSAA algorithm of medical monitoring and management of cloud computing applications is proposed The IoT normally includes a number of objects with limited storage and computing capacity. It could well be said that Cloud computing and the IoT will be the future of the Internet and next-generation technologies. However, Cloud services are dependent on service providers which are extremely interoperable, while IoT technologies are based on diversity rather than interoperability. This paper provides an overview of the integration of Cloud Computing into the IoT; this involves an examination of the benefits resulting from the integration process and the implementation challenges encountered. Open issues and research directions are also discussed. With the advent of the IoT, gigantic amounts of data are generated in real-time, and this poses a major concern for traditional cloud computing network topologies. A traditional cloud infrastructure condenses all processing, storage, and networking

into a limited set of data centers, and the distance between remote devices and remote data centers is relatively wide. This challenge could be addressed by edge computing since it provides access to computing resources that are closer to IoT edge devices and may lead to a new ecosystem for IoT innovation

2. Understanding cloud along with IoT

The internet of Things is starting to transform daily tasks are completed. The Internet of Things (IoT) consists of everyday objects – physical devices, vehicles, buildings etc. with embedded electronics, software, sensors, and network connectivity, allowing them to collect, send and receive data. The IoT generates a vast amount of Big Data and this in turn puts a huge strain on Internet Infrastructure. As a result, this forces companies to find solutions to minimize the pressure and solve their problem of transferring large amounts of data. Cloud computing has entered the mainstream of information technology, providing scalability in delivery of enterprise applications and Software as a Service (SaaS). Companies are now migrating their information operations to the cloud. Many cloud providers can allow for your data to be either transferred via your traditional internet connection or via a dedicated direct link. The benefit of a direct link into the cloud will ensure that your data is uncontended and that the traffic is not crossing the internet and the Quality of Service can be controlled Cloud computing, as well as IoT, work towards increasing the efficiency of everyday tasks and both have a complementary relationship. On one hand, IoT generates lots of data while on the other hand, cloud computing paves way for this data to travel. There are many cloud providers who take advantage of this to provide a pay-as-you-use model where customers pay for the specific resources used. Also, cloud hosting as a service adds value to IoT startups by providing economies of scale to reduce their overall cost structure. In addition to this, cloud computing also enables better collaboration for developers, which is the order of the day in the IoT space. By facilitating developers to store as well as access data remotely, the cloud allows developers to implement projects without delay. Also, by storing data in the cloud, IoT companies can access a huge amount of Big Data. So, in a bid to lay down the relationship between IoT and cloud, here is a table that will let you know how they fit into each other like a glove.

Parameter	Internet of things	Cloud computing
Big Data	Acts as a source for big data	Acts as a way or a means to manage big data
Reachability	Very limited	Far spread, wide
Storage	Limited or almost none	Large, virtually never ending
Role of Internet	Acts as a point of convergence	Acts as a means for delivering services
Computing capabilities	Limited	Virtually unlimited
Components	Runs on hardware components	Runs on virtual machines which imitate hardware components

3. Secure connection of cloud with IoT

There is a rapid and independent evolution considering the two words of IoT and Cloud Computing. To begin with, the virtually unlimited capabilities and resources of Cloud Computing in order to compensate its technological constrains, such as processing, storage and communication, could be a benefit for the Internet of Things technology. Also, the IoT technology extends its scope to deal with real world things in a more distributed and dynamic manner and by delivering new services in a large number of real life scenarios, might be beneficial for the use of Cloud Computing technology. In many cases, Cloud can provide the intermediate layer between the things and the applications, hiding IoT and Cloud Computing integration. all the complexity and functionalities necessary to implement the latter. Through the integration of IoT and Cloud Computing could be observed that Cloud Computing can fill some gaps of IoT such the limited storage and applications over internet. Also, IoT can fill some gaps of Cloud Computing such the main issue of limited scope. Based in motivations such those referred previously and the important issue of security in both technologies we can consider some drivers for the integration. The security issue of this integration has a serious problem. When critical IoT applications move towards the Cloud Computing technology, concerns arise due to the lack of trust in the service provider or the knowledge about service level agreements (SLAs) and knowledge about the physical location of data. Consequently, new challenges require specific attention as mentioned in surveys. Multi-tenancy could also compromise security and lead to sensitive information leakage. Moreover, public key cryptography cannot be applied at all layers due to the computing power constraints imposed by the things.

4. Applications

4.1. Cloud-Based IoT Applications and Their Roles in Smart Cities

From industrial systems to emergency deliveries, public transportation, public safety, city lighting, and other metropolitan applications, the IoT has made its way into every commercial and public sector initiative. Cities are becoming connected as the IoT advances, allowing them to improve infrastructure installation efficiency and the reliability and responsiveness of emergency services. In the coming years, researchers are excited to explore new ideas for smart cities employing IoT solutions.

"Smart cities" are a collection of enterprises that include city lighting, traffic, wastewater management, emergency services, tourism management, and so forth. Inventive new city occupations are likely to become more widely adopted and technology focused based on the needs of specific use cases.

1. Lighting Systems in Smart Cities:
   Light sources are one of the most ubiquitous IoT applications for smart cities, with several governments currently relying on IoT to save money and energy. The system provides connectivity and authentication for transferring numerous device nodes to a smart pole. The smart lighting may be used for a range of tasks, as follows:
   - Controls for lighting;
   - Cameras for surveillance;
   - Electronic billboards;
   - Electric vehicle charging stations;
   - Access to wireless technology.

The use of IoT in smart houses makes street light maintenance and management practical and cost-effective. The lighting can be synchronized by equipping streetlights with sensors and linking them to a cloud management service. Smart lighting systems monitor light, people, and vehicle movement, then integrate it with old and contextual data (e.g., unique functions, public delivery system, time and year, etc.) and analyze it to enhance the lighting schedule. When pedestrians cross a road, the lights around the crossing could be turned on, when a bus is about to arrive at the bus stop, the streetlights could be brightened, and so on.

2. Transportation:
   Transportation infrastructure is another rapidly expanding component of smart city applications. Transportation businesses and smart cities stand to gain considerably in cost savings, security, route management, and advanced passenger experience. While many communities have seen a reduction in shipping in recent years with the advent of buses and trains and wireless passenger links, many are now experiencing additional improvements.
   - The vehicle circuit system and a wireless connection are between the motors and the smarts dispatch center. This increases concerns regarding the transition from the existing analog network to IP-based voice-to-voice communication
   - Collection of comfortable fares and mobile ticketing
   - With online service, we can track and maintain our groups and devices, including crowd updates and vehicle monitoring—these enhancements aid transportation employees, couriers, and passengers in feeling safer in their communication and development

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3. Water Management:

   Water management software in smart cities is used for various purposes, including wastewater solutions, water tracking, and environmental restoration projects. IoT packages are becoming more common in locations such as state-owned companies and nearby municipalities. It improves access to aging infrastructure, increases efficiency, improves visibility of remote tanks and water management plans, and lowers the cost of tracking and assisting their facilities. The gateway connects to a network of services that can help with various issues, such as tank pressure and water levels.

4. Smart Tourism:

   Finding ways to boost site traffic is one of the most challenging difficulties that big cities face. Sensors embedded in the pavement feed real-time traffic crash updates to a critical traffic control platform, analyzing the data and adjusting the site visitor lights to traffic. Simultaneously, past data is used to predict where traffic will travel, with none of these tactics requiring human intervention. Smart cities ensure that their citizens move as accurately and efficiently as possible from one place to another. Municipalities imposed IoT development and compelled visitor reactions to the smart site to achieve this goal. In addition to collecting GPS data on smartphones, smart traffic solutions use sensors to help drivers determine cars' range, location, and speed. Simultaneously, intelligent visitor lights connected to a cloud control platform allow for the measurement of time and management of the lights, based on the present status of the visitors, to avoid traffic congestion. Furthermore, by analyzing past data, intelligent traffic management responses can predict where people will cross and take precautions to prevent power outages.

5. Smart Parking:

   Cities also employ smart parking solutions that detect when a vehicle has departed from a parking space. Sensors embedded in the ground notify the driver of available parking spaces via a smartphone application. Smart parking is an authenticity, requiring no specialized infrastructure or significant expenditure. Smart parking responses check if parking spaces are available and construct a real-time parking map using GPS data from drivers' smartphones (or road level sensors embedded in the ground in parking lots). Drivers are told when the nearest parking space opened and, instead of relying on memory, they can make use of a map on their phone to find a parking space. IoT sensors can be utilized to send messages to the connected devices. Public transportation operators can use this information to improve visiting data, resulting in increased safety and punctuality.

6. Waste Management:
   Waste management solutions help to increase the efficiency of the waste chain and reduce operating costs, while, at the same time, dealing with any environmental concerns associated with an inefficient waste chain. In these responses, the waste container receives a stage sensor; while reaching the boundary, the truck driver's management platform gets a notification by their phone. The message helps them to avoid empty drains by performing the related task. Many open garbage collection operators can follow these procedures. IoT-powered city-based responses help increase waste collection schedules with the help of waste tracing and the introduction of methodology and performance analysis. Each waste field

receives a sensor that collects records about the level of waste in the area. The waste management solution detects sensor data, evaluates it, and sends a notification to the truck's mobile application. Similarly, the truck driver pours out the entire container to empty it. IoT smart city solutions in the surrounding region allow tracking of the crucial factors required for a healthy environment. A major city, for example, may incorporate a sensory community across the water grid and bring them together on a cloud management platform to reveal the most significant waste.

7. Air Control Platform:
   Smart cities are also valuable tools for detecting and forecasting pollution in real-time. Cities can get to the source of their emissions problems and consider strategic approaches to reduce air pollution. Monitoring the amount of greenhouse gases in the air is essential; regulatory systems follow the rules and can be used to, for example, take control of tourists' local flights. Before that, there may be a need to ensure that visitor changes do not cause accidents in other areas. This is possible because of the combination of the way visitors control the air quality control system.

8. Smart Infrastructure:
   Building infrastructure must be planned carefully and effectively. Virtual technology is becoming increasingly important for cities to maintain growth conditions. Cities should invest in electric motors and self-propelled vehicles to cut carbon dioxide emissions. Smart technology is being leveraged to create energy-efficient and environmentally friendly infrastructure. For example, smart lighting provides light while someone passes through a smart lighting area, reducing energy expenditure. Artificial intelligence could perform a key role in enabling wireless connectivity to the IoT infrastructure. Smart cities will improve individuals' lives and can lead to a new age of efficient and data-driven decision-making, ranging from enhancing transport flows and allowing interconnected and affordable services, to wireless connections, mobile edge computing, and the IoT. A tracking system for people, for example, designed to track children or the elderly in crowded environments using mobile applications for smart cities is discussed in. The data processing in smart cities using blockchain-based big data integrity service is discussed in.

4.2. Combination of Cloud Computing and Internet of Things (IoT) in Medical Monitoring Systems

Medical information technology and healthcare service are closely related to the national welfare and the people's livelihood. Cloud computing and Internet of integration in the application of modern medicine would be a great breakthrough. Because in large scale cloud computing has its advantages such as high reliability, virtualization, high efficiency and scalability, the construction of public cloud in hospital and the patients can promote resource sharing, cost savings, build medical monitoring and management system with high efficiency. Internet as an important support to realize the safe, efficient and high quality of the medical monitoring and management, the main technology of RFID and photos and other acoustic electromagnetic sensors which can achieve breakthroughs in medical information transmission, intelligent health monitoring and precise location.

IoT also brings great convenience to hospital, especially in the patient monitoring and tracking management. With the rapid development of Internet, cloud computing and Internet integration of medical monitoring and management platform is to provide new opportunities for the hospital, even in social fields. This research paper summarizes the health information technology in the field of cloud computing and Internet of things, especially in health monitoring and management application fields of the current study situation. In this article, we put forward and analysis model of medical information architecture of remote monitoring and management platform clouds.

5. Challenges in integration

Despite the diverse applications of IoT in relations to cloud computing, there are numerous challenges that must be overcome.

1) Protocols

Utilization different sensors on IoT will affect the compatibility based on specific protocols. For different things to be connected to the Internet, different protocols will be required. Sensors may be working on different protocols such as ZigBee, IEEE1451 etc. The protocol support will depend on the sensor and the gateway; hence there is no guarantee that a sensor on a device can be successfully on figured.

2) Energy Consumption

A large number of sensors will require more computing resources leading to more power consumption in cloud data centres. Wireless systems comprise the sensing out, processing unit, transceiver and power unit, while video sensing involves encoding and decoding. In both instances, power plays a major role. Cloud data centres are already contending with high cost of energy consumption, which can be aggravated by the application of IoT.

3) Privacy/ Access Control

The utilization of sensors everywhere for everything in IoT implies the possibility of eroding privacy. The sensors utilized in connection with the cloud is out of user's control. Hence the issue of privacy will be further worsened.

4) Resource Allocation and Scalability

As the 'things' increase in IoT, so also will be the demand for cloud computing resources. It may sometimes be difficult to know how much resources are needed for particular applications of IoT. Billions of objects are expected to be connected to the cloud through IoT and this will likely make storage on the cloud over -stretched.

5) Identity Management

Currently, the issues of identity and access management have not yet been completely resolved on the cloud. Several devices connecting to the cloud through IoT will also require proper identity management. Without adequate identity and access management for things on the cloud, security will be breached.

6. Future scope and research development

Although this field is still in a developmental stage, researchers are working on integrating domain, security, and QoS to develop a more secure and efficient system. Meanwhile, we investigated a large number of relevant studies on this domain. However, we could not find extensive research in the domain of integration of IoT and cloud. Although a countable set of researchers working on this domain, they have revealed some unavoidable research gaps regarding this field. Therefore, more research on this field is the pressing need of the hour. This study explores the current state of the art in this domain. The motivation for the review of the integration of IoT and cloud computing are as follows:

1. With the vast amount of data produced by IoT devices, it is becoming increasingly difficult to manage and analyze this data effectively without the use of cloud computing. So, the need for better data management and analysis motivates me to explore in this direction.
2. By storing data in the cloud, it is feasible to utilise the security features provided by cloud service providers.
3. Any IoT-device-reliant application must have the capacity to dynamically scale up or down as needed. In this regard, increasing scalability is one of the factors motivating me to pursue this path breaking technology.

7. Conclusions

The integration of cloud computing and IoT is indicative of the next big leap in the world of internet. New applications brimming from this combination known as IoT Cloud are opening newer avenues for business as well as research. Let us hope that this combination unveils a new paradigm for the future of multi-networking and an open service platform for users. Accurate information could be accessed, analysed, and controlled by cloud-based enabling technologies to assist experts, businesses, and people in making smarter policies to enhance the standard of peoples' life. People interact in smart city environments using their mobile devices through linked vehicles and smart homes. When devices and information are connected to a city's physical systems and facilities, expenses may be reduced and efficiency improved. Through the assistance of the Internet of Things, cities could enhance resource transmission, expedite garbage collection, reduce accidents, and remove pollutants. The author explored and discussed the cloud-based IoT applications and their roles in smart cities in this paper. The author also covered IoT and cloud convergence, cloud-based IoT solutions, and cloud-based IoT applications for smart cities. More applications can be discovered, and their importance in smart cities discussed, in future research.

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