IoT and Cloud Computing

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Abstract: **This paper investigates the use of cloud computing and the Internet of Thing (IoT) in the context of digitalization. The aim of this report is to give a clear explanation about the meaning of cloud computing and IoT technologies and their relationship. This paper shows the functionalities of cloud computing and IoT beside the positive impact of their provided services in current (2022) and future life.**

Keywords: **cloud computing, IoT technologies, future life.**

I.   INTRODUCTION

There is a rapid change in current life (2022) upon accelerated technological innovation and development. The spread of artificial intelligence applications, cloud computing and Internet of Things (IoT) innovation are extremely impacting and change on the overseas' vision.

Continuing with the fast advancement of technology has complexed storing, analysing, and retrieving massive volumes of data from variety of sources. The significant sources on that are the IoT and cloud technologies, which will be able to apply strong processing of sensory data streams in conjunction with new monitoring services if they are used together.

This paper articulates the impact of two technologies, which are cloud computing and IoT.

II.   CLOUD COMPUTING DEFINITION

Cloud computing is the on-demand availability of computer system resources. Particularly, it is data storage and computing power, excluding immediate backend management and troubleshooting by the user. Cloud computing provides a wide variety of computer services over the internet as utilities where customers pay for only the services they use. Examples of these services are Infrastructure-as-a-Service (IaaS), Platforms-as-a-Service (PaaS), and Software-as-a-Service (SaaS).

III.   CLOUD COMPUTING FUNCTIONS

1.   Performing regular backup and restore of data.

When the data is stored in the cloud, then the provider guarantees doing backups on a regular basis and saves many copies of each backup in different places to lower loss of this data backup.[1]

2.   Increased the effectiveness of the teamwork

Cloud computing resources can be accessed by each member in the team. The collaborative cloud applications promote cooperation by enabling groups of people to swiftly and quickly exchange information in the cloud via shared storage resources.[2]

3.   Easy access to the property

The cloud enables access and saves information from any location, at any time, in any part of the globe that has an internet connection by guaranteeing that data is constantly available. Further, data can be accessed quickly. Accordingly, cloud computing boosts the productivity and efficiency of an organization's operations with easy reach to its data.[3]

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4. Low upkeep and maintenance costs

One of the powerful cloud computing functions is helping users save money by reducing hardware and software maintenance expenses. This allows users to focus on their business rather than troubleshooting hardware or software issues.

5. Ability of moving

Cloud computing enables users to effortlessly access all cloud data from anywhere at any time through mobile devices. Therefore, users need only an internet connection to use cloud computing services.

6. Services provided on a pay-per-use basis

Cloud computing provides customers with Application Programming Interfaces (APIs) that allow them to access cloud-based services. The user is charged based on the total time spent on using these services**.**

7. There is no limit to the amount of storage space available.

The cloud provides users with a massive amount of storage space to keep vital data in one location, including documents, photos, audio, video, and other media types. And the user is paid only for the amount of storage needed.

8. Data protection and privacy

One of the significant aspects of cloud computing is protecting personal information. Cloud computing has several sophisticated security measures and guarantees that data is stored and handled safely and securely.[4]

IV.   CLOUD COMPUTING NETWORK OPTIONS

1. Public Cloud Computing

Company-owned facilities are managed and accessible to users via the public network.

2. Private Cloud Computing

A private cloud is similar to a public cloud, except that only an authorized organization, a single corporation, or an individual user can access it.

3. Hybrid Cloud Computing

A private cloud is used for some services, but it also gives public access to other cloud services.

V.   IOT DEFINITION

Internet of Things (IoT) is the interconnection through the internet of computing devices embedded in every object, enabling them to send and receive data.

The word "things" means unique hardware devices that use wireless communications or cellular connectivity to communicate with each other. In the other words, IoT offers many connection choices, meaning a significant amount of network access.

VI.   IOT FUNCTIONS

1. Data Monitoring

Monitoring data is the primary and extremely important benefit of the IoT. It not only assists with knowing the exact number of, or the quality of, something. It provides additional data that has not been feasible to obtain or read in the past.[5]

For example, oil and gas IoT sensors, on offshore rig and plants, improve employee awareness of an issue before it becomes a severe occurrence that harms people and the environment if there is a gas leak problem. IoT monitoring devices help with understanding issues before they occur, which increases profits and safety while decreasing adverse events.

2. Ease of Obtaining Information

Today (2022), technologies facilitate an ease of accessing the necessary information in real time from nearly any place where the user is located. IoT is one of these technologies that accelerates and mitigates obtaining information through mobile devices and applications that are connected to the internet.

For example, Google Maps enables uses to find where they are located rather than having to ask someone for directions. Indoor localization through mobile applications navigates blind and visually impaired people to safely reach a desired location. Booking tickets is easier than it has ever been through mobile applications. Further, information is readily available, including the most recent scientific findings and corporate forecasts and analyses.[6]

3. Quick Operation

IoT has a quick processing data time with the help of one technology called edge computing. Edge devices are physical hardware placed in the remote locations at the edge of the network with sufficient memory, processing power, and computing resources to collect data, process that data, and execute it in real time with limited help from other parts of the network. The data produced by IoT devices has to react fast and mitigate issues. Therefore, this data needs to be analyzed with edge computing hardware located near to these IoT devices instead of by users who have to travel back to a central site.[7]

In sum, edge computing is the local source of processing, storage and computing for the data generated by IoT devices.

4. Improvements in Time Management

Smartphones applied IoT technology. Users can look up the latest news on the smartphones during daily life, read a blog about her/his favorite hobby, or buy an item from an online store. Practically, IoT helps the user do many things within a short time**.**

5. Automation and Control

Automation and control are two terms used to refer to the same thing. Because material things are being linked and managed digitally and centrally via wireless technology structures, there is a significant level of automation and control in the working environment. The machines interact with each other without human intervention, resulting in quicker and more timely production.

6. Save Money

Another significant benefit of the IoT is saving money. One of the reasons why the IoT has been so extensively accepted is that the cost of applying monitoring IoT systems is less than the amount of money saved. For example, IoT helps industrial areas to predefine the issue before it occurs and causes severe damage, which may cost the industry a lot of money. Another example is smart houses, which reduce the amount of energy expenses.

VII.   RELATIONSHIP BETWEEN CLOUD COMPUTING AND IOT

Cloud computing is one of the components that contributes to the success of the IoT. The IoT cannot work without access to the internet, and cloud computing allows users to complete computer activities using services made available through the internet. Using IoT in combination with cloud technologies has served as a catalyst, and this linkage will maximize gaining advantages of both these technologies' functions.[8]

Technically, developers may enhance IoT applications easier through use of cloud computing on an as-needed basis. In other words, cloud computing is the web service that may be accessed without the need for any special permission or assistance to develop the IoT applications.[9]

In sum, IoT devices produced data. And these generated data need cloud computing for storage, scale and speed access. Cloud computing for the IoT is convenient since the user will accurately receive what he/she paid for from the provider. The supplier keeps track the user consumption data, which means user charges will change based on how much she/he uses.

VIII.   CONCLUSION

The IoT and cloud computing will together have a profound impact on the way people live. Particularly, in terms of how information is handled and maintained, cloud computing is the sole technology capable of analysing, storing, and providing access to IoT data. The nature of on-demand information means that cloud computing is accessible from any device with an internet connection at any hour of the day or night. Four major components of the cloud are fundamentally empowering use of the IoT, which are the ability of compute, storage, scalability and speed of access.

Cloud computing will continue to bring up new possibilities for the Internet of Things for the foreseeable future.

Special Note

Edge Computing technology has no illustration in this paper but the author mentioned it in the third function of IoT to only explain the *Quick Operation* feature of IoT.

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