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A Green-IoT Healthcare and Agriculture Application

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ABSTRACT- In the fields of agriculture and healthcare, the usage of two very common prominent and emerging technical knowledge, Cloud Computing i.e., CC in short and the Internet of Things or IoT in short, is currently a trending topic. Motivated by a desire to create a more ecological world, the authors in the paper examines a number of technological aspects and concerns related to eco-friendly CC and IoT, and expands on the argument by examining the fall of electric power intake of the two listed techniques when used together either in farm or health related work. It will be addressed in the paper - the idea of the ecological ICTs (Information and Communications Technologies) and its past that are responsible for empowering Green-IoT. Eco-friendly or green computing is introduced initially, followed by a discussion of current research on the discussed two very fast developing knowledges in farming and medical care. Furthermore, this article adds by proposing a sensor-cloud integration paradigm for Green-IoT Healthcare and Agriculture Application (GHAA). Finally, the benefits, difficulties, and future research prospects for green application design are listed. Our study seeks to expand the green area and contribute to a more sustainable future.

KEYWORDS- Agriculture Application, Cloud Computing, Green-IoT, Healthcare Application, Internet of Things, Sensor-Cloud.

I. INTRODUCTION

There are many objects or things in today's world. As one of the smart world enablers, the internet of things (IoT) aims to link numerous items (e.g., mobile phones, computers, automobiles, and appliances) with unique addresses, allowing them to communicate with one another and with the rest of the world [1]. The Internet of Things concept is being realized as a rising number of physical things are linked to the Internet at an unprecedented rate. Industrial automation, transportation, healthcare, agriculture, and emergency response to man-made and natural disasters where human decision-making is challenging are just a few of the uses. Agriculture and healthcare are two examples of the Internet of Things (IoT) applications that can be used in this study. Interconnected sensing devices, whether a bodysuit or integrated in the human being's living spaces, enable the collection of detailed data on our physical and mental health. By allowing physical things to "speak" to one another, share information, and coordinate choices, the Internet of Things allows them to see, hear, think, and execute tasks. In the smart world, all parts of folks' computer-generated, corporeal, societal, and intellectual worlds will eventually be interrelated and smart. At a later point in the history of the human being, the smarter ecosphere is attracting a lot of attention from academia, industry, government, and other institutions. Green-IoT also aims to create a more sustainable smart world by lowering IoT energy usage.

Cloud computing is a prominent developing technology, a compelling alternative perspective that provides computation as a service. It allows consumers to purchase services by paying for the same before it is used and provides technology utilization services, information storing and accessing services, and many other kinds of data handling via the Internet. Clienteles are only charged for what they have consumed. As a result, it's very much inexpensive. The major benefit of CC is that it allows customers to receive computer and data storage services on demand without having to invest heavily in computing infrastructure. According to Jain et al., the world's data centers utilized more than twenty nine billion units of electrical energy in 2012, which is the equal of the energy generated by twenty nine nuclear reactors [2]. In one year, enough electricity to power 5 million households is required to cool these computers and data centers. As a result, we must look for innovative techniques to reduce the electric energy consumption of the cloud based datacenters. Eco-friendly computation is usually demarcated as computation that is ecologically friendly. It is basically the reference to maximize the use of energy consumption and efficiency while lowering costs and CO_2 emissions.

Sensor based cloud architype combines cloud set-ups along with the networks consisting of sensing devices, allowing for instantaneous observing of applications that are often scattered throughout several sites. Sensing devices based networking set-ups are commonly utilized to deploy applications relating to human health e.g., level of blood sugar and blood pressure monitoring, as well as checking the pattern of sleep duration. In this case, the hospitals makes the required judgments based on the data gathered from patients. When a patient wanders about at random, it's tough to keep track on his or her health from afar. As a result, an effective computational system is required to track patients' health condition while they are on the go. Sensor networks' data-intensive, time-varying requirements might profit from the cloud computing applications' sophisticated integration of compute and storage resources for handling the data at such a huge level. As a result, sensor-clouds are becoming progressively more widespread. The sensor-cloud integration concept is used in this research to propose a Green-IoT agriculture and healthcare system.

By utilizing underlying technologies such as ubiquitous and pervasive computing, embedded devices, communication technologies, sensor networks, Internet protocols, and applications, the IoT turns these things from traditional to smart. Despite the fact that the IoT and CC are two very distinct expertise, they both together are currently the essential portion of human's lives. IoT is characterized by real-world tiny items that are widely distributed and have limited storage and processing capacity, posing dependability, performance, security, and privacy problems. Cloud computing, on the other hand, offers almost infinite storing capability as well as the processing capacity, is kind of a far better established expertise, and has partially solved almost all of the concerns relating to IoT. As a result, any application that combines cloud and IoT as complimentary technologies is likely to disrupt both the present and future internet.

II. LITRATURE REVIEW

A. Ubiquitous Computing

The father of ubiquitous computing, Mark D. Weiser, defined it this way. It marks a significant change in computation, in which common person live, perform daily activities, and enjoy in a computation atmosphere that is seamlessly interwoven. Ubiquitous computing envisions a society in which individuals are hemmed in by computer hardware along with a computation set-up which usually aids the person in their daily activities [3,4]. Individuals will be surrounded by many networked, spontaneously cooperating computers in ubiquitous computing, some of which will be worn or carried, some of which will be encountered while on the move, many of which will serve dedicated purposes as part of physical objects, and all of which will be used in an intuitive, hardly noticeable way with limited attention. To put it another way, ubiquitous computing will usher in a new age in which numerous computers surround a solitary person and be a visible component of the material world, with its mechanisms spread throughout daily life and able to be used for uniquely mundane purposes. Wearable devices, configurable sensor nodes, networked appliances, and smart labeling are the four key components of ubiquitous computing. Availability, Transparency, Seamlessness, Awareness, and Trustworthiness are the so-called five objectives of ubiquity that must be met in order to establish ubiquitous service. We'll require the following five criteria to evaluate a pervasive operation out from standpoint of interconnected devices [5].

- Adaptability.
- Connectivity.
- Ease-of-use.
- Liability.
- Scalability.

B. Truly Pervasive Cultivation and Medical Care Usage Requirement

As per a website, the usages mainly have following three goals: minimize time lost due to latency, lower medium costs, and improve accuracy in old-style medicinal flow [5]. The interval necessary in letter pressing and delivering paper, or for individual-dependent information transfer, generates lag, which can result in significant revenue loss. The time between when the data is captured and stored in a system and when the same is accessible for captured data handling would be reduced if the lag was reduced. Furthermore, omnipresent agricultural and healthcare customers will transmit data from a variety of sources, get actual statistics, facts, and pertinent skills, and exploration for significant and valuable data. If all of the aforementioned requirements are met, the app will be really widespread.

It will be an embedded system that performs either one or plurality of specific purposes. It will be ubiquitous, linking hardware & integrated in a manner that the connection between the hardware is both inconspicuous and constantly available. This would be contextually conscious, allowing it to relate environmental changes to computer systems. It will be mobile, allowing for the use of technology while on the go. It will be wearable, allowing users to utilize gadgets while actively engaging with the physical world with their hands, voice, eyes, or attention. It will be sentient, able to sense and respond to its surroundings. This would also be an ambient, employed together to assist folks in executing daily activities, chores, and rites in a simple manner, utilizing evidence and acumen buried inside networking used in linking of such gadgets.

C. Green Computing

According to the IFG (International Federation of Green ICT), green computing or green ICT is the study and practice of ecologically friendly computing or IT. Green IT, according to Murugesan, is the study and practice of efficiently and effectively designing, manufacturing, using, and disposing of computer systems, servers, and accompanying subcomponents such as monitors, printers, storage systems, and networking and communications systems with negligible or no environmental impact [8].

III. DISCUSSION

D. Frameworks for Green-IoT Healthcare and Agriculture Applications (GHAA)

Until now, we've been concentrating on addressing pervasive computing, needs for genuinely pervasive applications, and eco-friendly computation foundations in order to connect them to the GHAA. The essential ideas of ICT empowered ecological IoT equipment relevant to GHAA are discussed in this part, as well as the architecture of GHAA employing the sensor-cloud integration concept.

1) GHAA Architecture

The basic technological solutions for cultivation and medical care surveillance systems is sensor-cloud computing. Sensor-Cloud is a novel CC paradigm that gathers data from physical sensors and communicates it to a CC set-up. This effectively manages sensing device data too, which is utilized in a variety of monitoring applications. First, we'll look at several GHAA architecture and sensor-cloud definitions, as shown below in Figure 1. "An architecture that enables fully ubiquitous computation utilizing sensing equipment as an crossing point between the corporeal and virtual realms, data computation groups as the virtual support, and the wireless technology as the communication medium," as per IntelliSys.

It is a unique sensor data storage, visualization, and remote management platform that leverages strong cloud computing technologies to enable outstanding data scalability, fast visualization, and user programmable analysis," according to MicroStrains. Sensor-Cloud is a web-connected third-party device, sensor, or sensor network that was originally developed to enable long lasting setting out of MicroStrain cordless sensing units. It currently provisions any online 3rd party hardware, sensing devices or networks using a simple OpenData API.

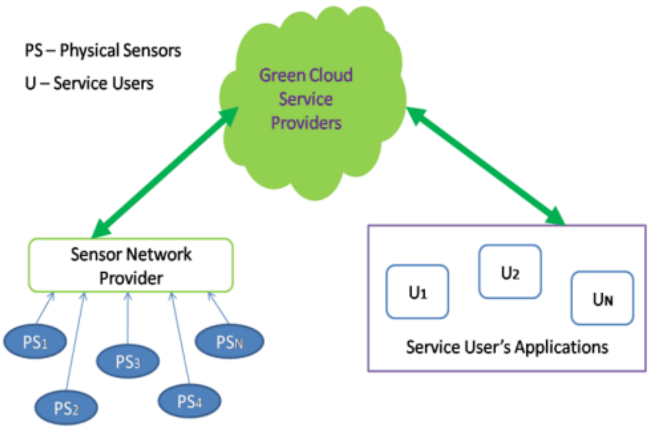

Figure 1: Eco-friendly IoT Healthcare & Agriculture Usage Architype [9]

2) GHAA Requirements

The following are the general green ICT criteria for GHAA architecture, which are simply summarized as follows:

- Send just the data that is required: Data transmission (for example, large-scale multimedia data) requires a significant amount of energy. Sending only the data that consumers require can drastically reduce energy use. One way to give just necessary data to consumers is to utilize an extrapolative data conveyance centered on user conduct investigation.
- Turn off any equipment that isn't in use: It will take a lot of energy if the facilities are continually on. The energy consumption will be decreased if the facilities are only switched on when they are needed. For example, making sensor nodes dynamically awake and sleeping is one of the most commonly utilized strategies for reducing energy usage in WSNs.
- Minimize the length of the data path: Another simple way to save energy is to reduce the length of the data path. Routing systems that take into account the length of the chosen data path, for example, might be energy-efficient. Furthermore, network functioning methods (such as routing) that cater to the routing need are viable approaches to obtain a significantly shorter data path.
- Communications trade-off processing: Compressive sensing is a novel technique of sensing the signal with a significantly fewer number of linear measurements if the underlying signal is sparse. It can also improve energy efficiency.
- Reduce the length of the wireless data path: Energy-efficient architectural solutions (for example) for wireless communication systems might be explored to reduce the length of the wireless data channel. Furthermore, cooperative relaying for wireless communications has the potential to save energy by utilizing relay nodes to overhear transmissions and transmit them to the target node, resulting in considerable diversity advantages.
- Renewable green energy sources: Unlike traditional resources, renewable resources (such as oxygen, fresh water, solar energy, wood, and biomass) are replenished naturally and may be used again. As a result, adopting renewable and eco-friendly sources of power must have a significant influence on reducing oil reliance and CO2 emissions.
- Advanced communication techniques: Advanced communication strategies are emerging as a means of achieving green communications. For example, a cognitive-radio (CR) system that is aware of its surroundings and can change its modes of operation (operating frequency, modulation scheme, waveform, transmitting power, and so on) via software and hardware manipulation can improve spectrum-usage efficiency and reduce spectrum overcrowding.

3) Using ecological IoT in GHAA

We have seen different definitions of IoT before addressing Green-IoT, and it is well thought-out and planned trend in the period of computation that is anticipated to go outside the boundaries of traditional desktop. In accordance with such understanding, a separate prototype called to be the IoT has detonated in admiration in past few decades. IoT is a "comprehensive network of linked devices individually accessible based on typical message etiquettes" with the World Wide Web serving as its focal point. The core notion is that objects that usually measures, surmises, comprehend, and even alter the environs are everywhere nearby humans. IoT is fueled by several of the current advancements in a series of devices and communication technologies, but it encompasses not only complicated gadgets like mobile phones, but also common objects. These items, which function as sensors or actuators, can communicate with one another to achieve a common purpose.

Without a question, the most important characteristic of IoT is its influence on potential consumers' daily lives. IoT has amazing impacts in both work and home settings, and it has the potential to show a major part in the future. Important ramifications for business are predicted too. Figure 2 depicts the features of an IoT ecosystem. Identification, sensing, communication technologies, computing, services, and semantics are the six building elements of the Internet of Things.

Figure 2: Building Blocks of IoT for GHAA [10]

When it comes to identifying and matching services to demand, identification is critical. Electronic product codes (EPC), ubiquitous codes (uCode), and other IoT identification technologies are examples. Sensing is the process of gathering data from numerous things and delivering it to a database, data warehouse, data center, or other location. The information obtained is then analyzed in order to create specifications based on the services that are required. Humidity sensors, temperature sensors, wearable sensing devices, mobile phones, and other sensors can be used. Communication technologies link disparate items to provide specialized services. Wi-Fi, Bluetooth, Near Field Communication (NFC), IEEE 802.15.4, Z-wave, LTE-Advanced, ultra-wide bandwidth (UWB), and other IoT communication protocols are available.

4) Ecological-IoT for GHAA

In order to allow an eco-friendly IoT, the IoT must be efficient in terms of energy. Particularly, as all of the agricultural and healthcare equipment are expected to be supplied with extra sensor based communiqué add-ons in order to make them feel and interact with one another, they will consume more energy. Furthermore, as a result of growing interest and support from numerous groups, energy consumption will skyrocket. All of this makes Green-IoT, which focuses on decreasing IoT energy usage, a requirement in terms of achieving a sustainable smart world. Green-IoT may be characterized as follows, with energy efficiency as a major factor in the design and development of IoT.

5) GHAA Components

This section begins with an overview of ICT, followed by a discussion of GHAA-enabling green technology. ICT refers to any information and communication capability, technology, or usages that allows people to store, access, send, and alter a range of data. Identification, sensing, connectivity, and computing are all IoT components, and we've listed them here.

- Wireless sensor network (WSN): A system or setup of geographically dispersed independent sensing device that work together to observe corporal or ecological factors such as temperature, pressure, and so on.
- RFID (Radio-Frequency Identification): A tiny electric equipment with a chip and a transceiver that by itself recognizes and tracks labels or tags bonded to things.
- WPAN (Wireless Personal Area Network): short-range wireless system used to link devices in a single person's workspace.
- HAN (Home Area Network): A form of an interconnected device linked using local area network (LAN) that connects digital devices that are located inside or near a house.
- WBAN (Wireless Body Area Network): A cordless networking system made up of manageable and wearable computer devices such as sensing devices, actuating devices, and other components that are placed on or in the body.
- M2M (Machine-To-Machine): A scientific knowledge which usually permits wireless and wired devices to connect with one other.
- NAN (Neighborhood Area Network): This is a subset of Wi-Fi hotspots and wireless local area networks (WLANs) that allows users to connect to the internet fast and cheaply.
- Data center (DC): A physical or virtual repository for data and information storage, administration, and dissemination.
- CC (Cloud Computing): A new computing model that allows users to access a shared pool of customizable resources on demand (e.g. networks, servers, storage, applications, services). Mobile based cloud computing (MCC) could transfer most of the data handling and storing chores from remote devices to the cloud by integrating CC into a mobile environment.

IV. CONCLUSION

We spoke about pervasive computation, prerequisites for genuinely pervasive applications, and eco-friendly computation in this article. After that, we went over to examine scientific knowledge such as ecological ICT empowering knowledges, and then we showed the GHAA design utilizing sensor-cloud computing integration, as well as the benefits of sensor-cloud integration to GHAA. Sensor networks have certain inherent problems that sensor-cloud architectures can address:

- Data management
- Resource utilization

- High utility cost.

The sensor-cloud infrastructure is a cost-effective solution that makes use of an existing cloud platform. Finally, future prospects for GHAA architecture with sensor-cloud convergence are discussed, including:

- Application design should be viewed from the standpoint of overall system energy consumption, with a focus on providing a satisfactory service, high quality, and performance.
- It is necessary to have a deeper grasp of the characteristics and use requirements of various applications.
- There is a need for realistic energy consumption models of various GHAA components.
- Concerns about costs.

Both the sensor service provider and the cloud service provider are required for sensor-cloud service access. They do, however, have their own user management, service management, payment options and methods, and pricing.

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