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Cloud Computing for Remote Sensing

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Abstract:- Multi-faceted remote sensing (SAR) and multi-area datasets are widely adopted because of the up-to-date resource information and global and regional monitoring environment. Remote Sensing (RS) data processing involves a multi-step processing sequence, which includes independent processing steps depending on the RS application type. RS data processing for environmental monitoring and regional disaster is computationally recognized and has data demand. The combination of High-Performance Computing and cloud computing propose an efficient method to solve the problems through large-scale RS data search processing for several applications. The elastic, ubiquitous, and high transparency level of cloud computing enables them to run massive RS data management and monitor the dynamic environments on the cloud through the web interface. The cloud service core provides the parallel file system for large-scale RS data and as an interface to access RS data to improve data localization.

Keywords:- *Edge Computing; Fog Computing; IoT devices; Multi-faceted and multi-area remote sensing (SAR) datasets; High-Performance Computing; Hilbert-based data indexing.*

I. INTRODUCTION

Cloud computing facilitates scientists with the paradigm to utilize computing applications and infrastructure. The computing algorithms and resources are delivered as on-demand services for the application requirements through virtualization. (Aouad Siham; Sabri. et al., Dec 2021) The Cloud paradigm is widely used for large-scale RS applications like the Matsu project for flood assessment. Clouds joining the HPC systems act as the platforms research-based. Scientists could customize the HPC environment and access high computing infrastructures in the cloud environment. (Aouad Siham; Sabri. et al., Dec 2021) In this regard, pipsCloud, a cloud-enabled High-Performance RS data, incorporates the Cloud computing paradigm to address the system's architectural View. Cloud computing possesses massive distributed and dynamic services, storage resources, and computing power available for users on the internet. (Afandi; Mohammed Al Masarweh; Tariq Alwada'n. et al., 2022) Cloud computing resources located at the center of massive data storage are controlled and managed by a third party that provides computing infrastructures for the cloud users present anywhere across the internet. The above environment allows the exploitation of the hardware and software managed at the third parties' remote locations. Such a cloud would include online file storage, webmail, and social networking. (Afandi; Mohammed Al Masarweh; Tariq Alwada'n. et al., 2022) Cloud computing is an overall comprehensive network system used as it reduces user costs, is cost-efficient and increases profit for cloud providers.

II. CLOUD COMPUTING MODEL

Cloud computing is the massive distributed and dynamic resource for services, storage, and computing power soliciting available to users through the internet. Cloud computing resources are unearthed as a large storage center. They are controlled and managed by a third party, offering computing infrastructures for cloud users anywhere through the internet. (Afandi; Mohammed Al Masarweh; Tariq Alwada'n. et al., 2022) The diagram below illustrates the model for cloud computing, allowing the users for the software and hardware exploitation managed by the third parties' remote locations. Examples include social networking, webmail, and online file storage. Cloud computing is a widely used network system capable of better user costs, cost efficiency, and profitability.

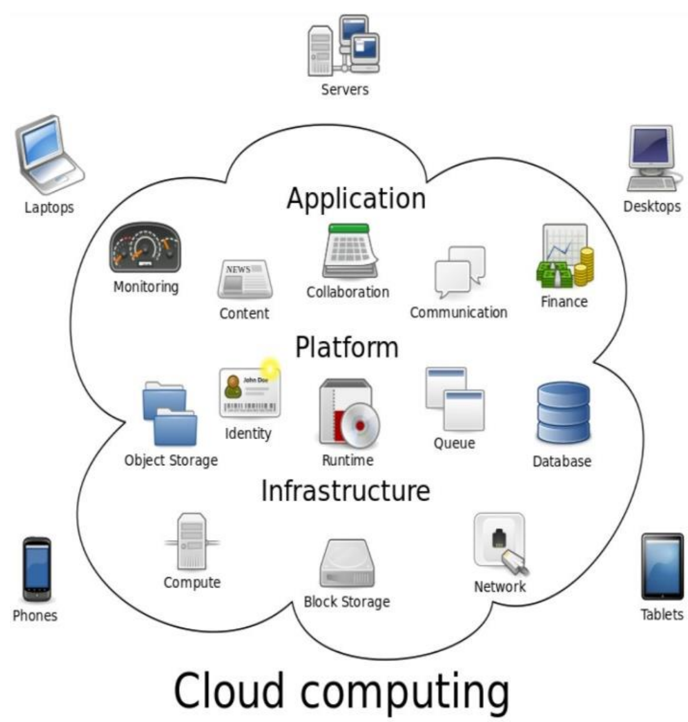

Fig. 1. Cloud Computing Environment

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III. FOG COMPUTING

Fog refers to how computation and data tasks effectively attach the computing capabilities within the local area network consummate on the cloud. The data must be clustered and filtered in the fog before the data is transmitted to the cloud. The way IoT and cloud interconnect for performing the processing through fog computing. (Jyotsna; Nand. et al., 2021) The layer comes in between the cloud computing and IoT devices operating the data from the devices to fog nodes locally and is, in turn, sent to the cloud. Fog nodes possess their own computing, storage, and networking services. (Jyotsna; Nand. et al., 2021) Computing performs the activities like Edge computing but maintains more distance from the sensors enabled through IoT devices. Fog computing characteristics are illustrated through the diagram shown below.

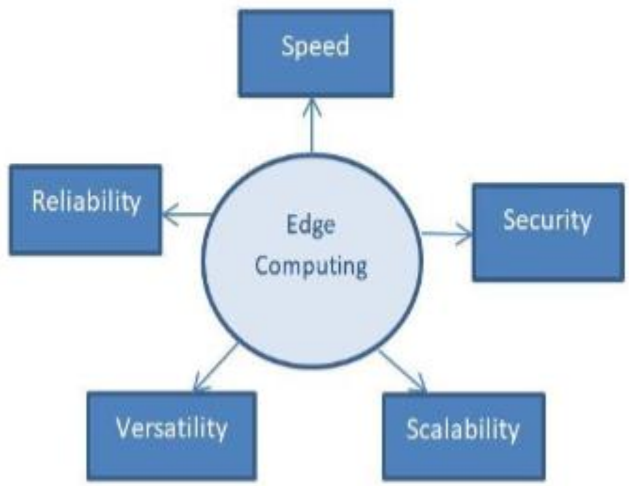

Fig. 2. Fog Computing Characteristics

Latency keeps the analysis closer to the data source, preventing the manufacturing line from shutting down, system failures, and other critical issues. The capability for conducting real-time data analysis means faster user alerts and less danger with the lost time for users. (Jyotsna; Nand. et al., 2021) The data generated from IoT devices are transferred among multiple locations for further processing. The massive data transmit through the Fog technology saves the bandwidth requirement. The data generated from IoT devices are locally processed, conserving the network bandwidth and reducing operation costs. (Jyotsna; Nand. et al., 2021) Fog computing provides security as the acquired data are processed with different numbers, and the node's computation occurs locally, thereby enabling system security. Fog computing improves the reliability of IoT devices installed under other environmental conditions, decreasing data load transmission. Instead of data risk sent to the cloud, the sensitive data are analyzed through the machines locally, and data are collected and stored.

IV. SALESFORCE CLOUD DATA PROCESSING

Salesforce is the product built through the company termed Salesforce.com, the PaaS service platform entirely cloud-based. The complicated installation of the additional software is optional in these circumstances. (Marańda; Poniszewska-Marańda; Szymczyńska. et al., 2022) The platform allows the creation of its applications through the existing infrastructure extension. Salesforce.com can't be configured but is often perceived as the SaaS model product. Salesforce.com allows the data process in different ways. Standard data manipulation language operations are completed during one transaction through 150 DML operations like new records insertion, deleting or operating new records, and the operations to modify new records and joining records operations. Applications built on the above platform using Model-View-Controller (MVC) pattern. (Marańda; Poniszewska-Marańda; Szymczyńska. et al., 2022) The various layers in the above pattern are enumerated below. Under the Model layer, the Custom Object termed as Project_item_c is created in the platform—the methods of data processing operation on the object. The second object, StatisticWrapper_c, collects the data processing statistics under the Salesforce cloud. (Marańda; Poniszewska-Marańda; Szymczyńska. et al., 2022) The second layer is View, where the Visualforce page is called DataManipulation.vfp allows data processing operations to add or delete the data and view the collected results during the processing. The page is divided into View, Process, and View Statistics. The pictorial representation is shown below,

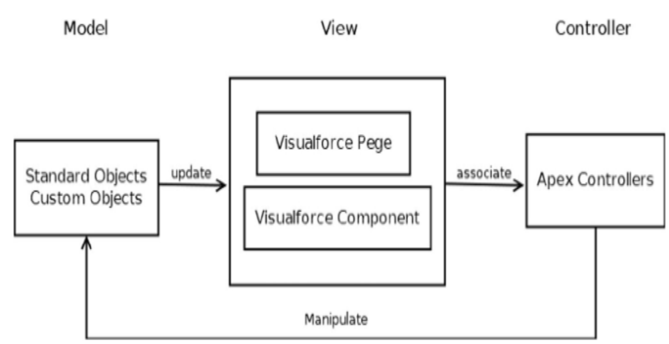

Fig. 3. MVC Pattern

V. SIMULATION ARCHITECTURE

The cloud computing simulation environment is spitted into two parts. The first part comprises the elements to simulate the Wireless Sensor and Actuator Networks (WSAN); the second part includes the components deployed in the cloud platform. (Salvachúa, Joaquín. et al., 2021) The concerns about the distributed application model are addressed through elements following the reactive manifesto principles. The principles design the reactive applications using observable models, stateful clients, and event streams. The diagram below shows the architectural components and the relationships. The architecture possesses real-time features essential for meeting the IoT application's needs.

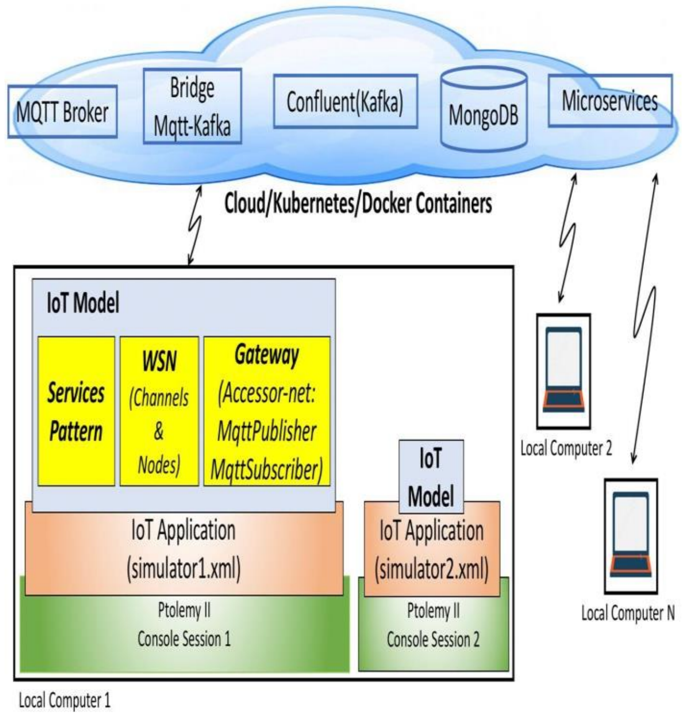

Fig. 4. Simulation and Modeling architecture for the smart city IoT applications

VI. CONCLUSION

The technology layers are needed to satisfy the IoT application requirements for cloud-based services. The IoT system scalability is simulated effectively. Compared with other IoT simulators, the architecture is provided, covering the technology layers flexibly to model and simulate the cloud-based applications. The approach uses cloud computing like Docker and Kubernetes for a realistic simulating environment to promote open-source technology usage. Ptolemy II simulation tool allows the simulation of IoT applications through the hierarchical model capacity having the computational models.

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