Digital Twin Enabled Fuzzy Inference Based Process for Determining Trust Value of Cloud Service Providers

1. Technology:

The objective of this research is to implement a digital twin model for cloud service provider which will use Fuzzy inference system to establish a simple and useful trust model for cloud systems. In this research, we propose a method for calculating the trust value of a cloud resource in terms of QoS requirements including security, privacy, performance, and data integrity. Also, this research examines at how machine learning methods are applied to trust-based evaluation.

This research proposed a fuzzy logic-based trust assessment model, which enables Cloud Service User (CSU) to select the most secure CSP (CSP (optimal)) based on feedback and the trust evaluation method. Moreover, fuzzy logic will be more efficient than a mathematical model for complicated nonlinear systems. Creating a digital twin for a cloud service provider entails digitally reproducing the infrastructure, services, and operations of their cloud platform. This can assist the provider in better effectively monitoring, managing, optimizing, and troubleshooting their services. The architecture for a digital twin for a cloud service provider with Fuzzy logic used for the computation of trust score is given in the diagram. In general cloud service provider consist of various components which include compute services, storage services, networking services, identity and management , security and compliance services etc. Whenever a cloud customer requests a service it will connect to the physical cloud service provider and the same inputs will be provided to the digital twin model. This will execute the same services and will also analyze the various trust parameters in each transaction. The trust parameters value will be passed to the Fuzzy inference system attached to the digital twin. The Fuzzy Logic Designer elements that were initially constructed for each parameter can be mapped to all the parameters selected for the computation of the trust value using Simulink. Each sub-parameter will calculate its value based on the input values and send that value to the parameters at the next level.

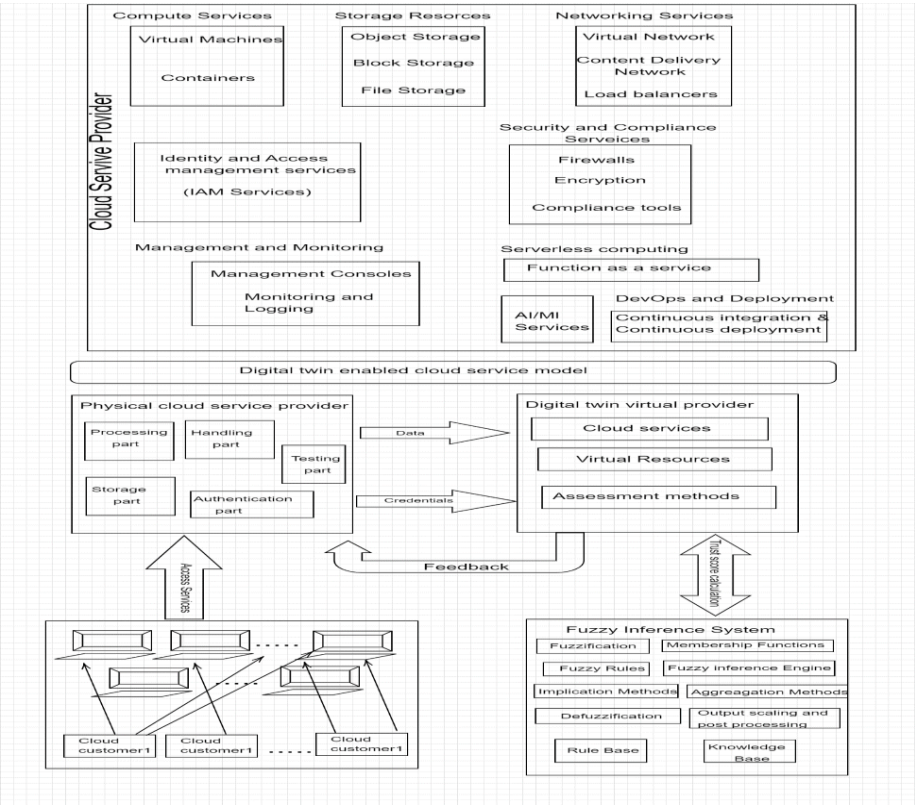

Figure 1: Digital twin based Fuzzy inference system model

2. Problem Addressed:

A real time monitoring of the cloud service provider is very necessary to troubleshoot all the security and performance related problems that occur in each transaction in each second. Due to the diverse range of security models and methods available in cloud computing, it is crucial to analyze the service using a precise methodology in order to select the best cloud service for different user types. To achieve that, it is essential to identify a wide range of comprehensive elements that are both necessary and sufficient for assessing any cloud service. In order to access a service from a vendor, two factors are to be considered. To determine whether the vendor can offer a quality service, the authors first assess their current skills. The vendor's prior qualifications are the basic concern which is to be examined. In other words, the two criteria that constitute the selection process for a vendor are the firm's current capabilities and historical credentials with security. The resource's prior reputation and service history are described by its prior credentials. It comprises data integrity, turnaround time, availability, and reliability. All these are described by the cloud resource's current capabilities.

3. Industrial Applications:

Its applicable in any CSPs in market like GoogleCloud, Microsoft Azure, AWS etc for various aspects like,

- Cloud Infrastructure Management: Real-time trust scoring improves resource allocation and reduces downtime in data centers.
- Enhanced Security Monitoring: Enables proactive detection and mitigation of security issues (e.g., DDoS, insider attacks).
- QoS Assurance for SLA Compliance: Ensures compliance with SLAs, crucial for industries like IoT, online retail, and analytics.
- Trust-based Cloud Vendor Selection: Aids enterprises in selecting reliable CSPs for better continuity and security.
- Incident Response and Forensics: Helps industries assess and respond to security incidents quickly.
- Data Compliance and Regulatory Audits: Streamlines compliance checks, reducing manual audits and ensuring regulatory compliance in sectors like finance and healthcare.

4. Patent Application Number: 202441021724