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QUALITATIVE FEATURES OF SOA: RESEARCH VACANCIES AND MULTIDISCIPLINARY RESEARCH APPROACHES

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Abstract— This service era's primary architectural style is known as Service-Oriented Architecture (SOA), which enables heterogeneous distributed systems to communicate with one another by exposing their application functionality as a service. SOA offers a number of advantages, including high interoperability, loose coupling, low cost, and agility. Moreover, it fosters the development of legacy systems and the rapid integration of those systems. The growing popularity of this architectural style encourages the utilization of the quality attribute conception in the process of developing and managing services that are based on quality. Since this technology is not dependent on any one platform, businesses and academic institutions are working together to create more intriguing transdisciplinary solutions that make use of the integration and interoperability capabilities of service-oriented architecture (SOA). The primary objective of this work is to examine the gaps in research and to highlight the multidisciplinary breakthroughs that have occurred in SOA Quality Attributes.

It is becoming increasingly popular to use service-oriented architecture as a design because of the benefits it offers in terms of flexibility and reusability. Through a discussion of service-oriented theory and associated techniques, this study constructs a service-oriented system modeling approach of a petroleum company on energy consumption. The methodology is founded on the concept of energy consumption. Service users are able to invoke the services that are released on the enterprise service bus of the architecture model based on their specific business requirements. This is accomplished by releasing the services on the enterprise service bus. According to the findings of the system's deployment, the proposed architecture of the system that is presented in this article is feasible.

INDEX - service-oriented, architecture design, energy consumption, enterprise service bus Quality of Experience (QoE), Quality of Protection (QoP).

I. INTRODUCTION

The most challenging process that must be completed during the development of an application is the transformation of the needed specification into the application architecture. In order to create a productive application architecture, it is necessary to take into consideration both the functional requirements of the system and the non-functional criteria. In order for Service-Oriented Architecture (SOA), which is based on the Service Orientation paradigm, to be successfully implemented, quality attributes are an essential component that cannot be separated from such an architecture. Ser- vice Orientation is a famous design paradigm in software engineering that exposes system capabilities to end-users or other applications in the form of a service in order to maximize efficiency [1]. The concept of a service is a component that is goal-oriented and reusable, and it represents a commercial or operational activity [2]. It is discoverable through networks, which is an essential unit of service-oriented architecture (SOA). These Services simplify the process of designing the mobile system, and comparable to software agents, they can be replicated and moved around in different locations. Over the course of the past decade, a substantial amount of research on the deployment of SOA has been published extensively.

The research literature places an emphasis, either directly or indirectly, on the quality aspects of success as well as the functional needs for success. "Quality attributes needs like performance, security, modifiability, dependability, and usability have a substantial impact on a system's software design." [3] Increasing the quality of the features that are supplied can bring in a greater number of users [4]. Analysts, developers, architects, service providers, and end users are the individuals who play the most significant roles in the process of creating, executing, and deploying services in the context of service intelligence. In this study, we will be discussing the challenging concepts of SOA Quality Attributes, as well as the trends that have been observed in research pertaining to this field. As a means of accomplishing this objective, the current study is broken up into four distinct sections. Section II is where the SOA Quality qualities are presented to the reader. In Section III, we will be discussing the challenging concepts that are associated with SOA quality attributes. A presentation of the key research trends on SOA quality attributes may be found in Section IV. The final section of this paper is going to be the very last one.

II. SOA QUALITY CHARACTERISTICS

It is the lineament that has an impact on the quality of a software system and explains the non-functional requirements of the system that is referred to as the quality attribute. It addresses a wide range of issues, including architectural, technical, and business-related factors, which contribute to the enhancement of the aesthetic value of a system. To ensure that this architectural architecture is completely satisfied, service-oriented architecture (SOA) takes into account the value-oriented output of quality criteria. The scope of SOA has been expanded beyond the boundaries it initially established [5]. Initially, this notion was only utilised for an asynchronous document-based message exchange technique that was primarily intended for the alignment of business applications and IT infrastructure, but it is currently being applied to a larger collection of distributed systems with higher quality standards [6].

It is demonstrated by the SOA quality attribute how SOA validates the non-functional criteria of the service-oriented system. When it comes to achieving organizational goals and living up to the expectations of customers, the software architecture must be able to fulfill these quality attributes. "Because service-based systems lack central control and authority, have limited end-to-end visibility of services, are prone to unpredictable usage scenarios, and support dynamic system composition, obtaining quality attributes in service-based systems is crucial." Seventh.

QoS is an abbreviation that stands for quality of service, which is the total of quality attributes. The quality of service (QoS) is evaluated using quality metrics. In addition to varying from one consumer to the next, the standards for quality characteristics can also vary from one company to the next. Considerations such as performance, dependability, security, availability, accessibility, and maintainability are some of the criteria that can be utilized in the process of quality of service evaluation. For the purpose of quality attribute classification, a great number of quality models have been presented up until this point. A thorough mapping of quality models was carried out by [8], which took into consideration 47 different quality models derived from 65 different investigations. There are eight characteristics, with 31 sub-qualities, that the authors investigate while describing SOA quality standards. These characteristics include functional appropriateness, portability, usability, performance efficiency, compatibility, maintainability, dependability, and security.

III. RESEARCH GAPS

Even though Service-Oriented Architecture (SOA) is widely recognized as a mature idea, there is still a great deal of material to cover. The foundation of the service, the composition of the service, the design of the service, and the development of the service each have certain challenges [9]. During the

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implementation process, further work is required to guarantee that the Service Oriented Architecture (SOA) meets the proper quality level and to overcome these challenges. The following is a condensed presentation of the problems that are linked with quality attributes: The first step is to improve the qualities that have a positive influence on quality, and the second step is to lessen the negative impact that occurs when quality is diminished by other qualities and contributing variables. Priorities for the challenges need to be determined by the organization that is implementing the plan. For the purpose of defining the concerns, the ISO 25010 model is utilized. The criteria of functional appropriateness and portability have been purposefully omitted from the definition because they are addressed indirectly by the Usability definition.

The term "performance efficiency" refers to the quality of a service's performance, which may be evaluated by employing well-known measures such as throughput, latency, complexity, execution time, bandwidth, and so on. As the complexity of the services developed, the performance of the service system became increasingly unsatisfactory [10]. Minimising the negative influence that other attributes have on a performance attribute is the part of that attribute that presents the greatest challenge. A problem that has not yet been solved was discovered by O'Brien, and it was related to the requirement for a performance model that is capable of operating in a runtime environment that is highly complex, as well as performance parameters for that model [11].

There are two sub-characteristics that fall under the umbrella of compatibility: coexistence and interoperability. Comparatively, interoperability is concerned with technical and operational independence from platform dependency and enables users to invoke and compose services in a seamless manner. Coexistence, on the other hand, is concerned with the degree to which a service system can be integrated with other services and perform well under shared resource policies. When it comes to the fields of efficient service composition and orchestration, these characteristics have received little research. A number of significant challenges include the coexistence and interoperability of mission-critical applications (such as healthcare, stock trading, and air traffic control) [12], the semantic modeling of quality of service categories and the requirement for a matching methodology between desired and provided quality of service [13], and the interconnection of heterogeneous physical devices (through the use of RFID technology and wireless sensor networks).

Usability is the evaluation of the experience that a user has been having with a service. This is the only quality that immediately leads to client satisfaction, which in turn leads to an improvement in the reputation of both the service and the supplier of the service. Some of the usability hotspots include Quality of Experience (QoE) and Quality of Protection (QoP), the development of QoS-aware middleware, QoS negotiation protocols, QoS monitoring, Mapping global to local service level agreements (SLAs), Automatic QoS controller algorithms, Self-Managing system for Quality of Service (at various resource systems), and Workload forecasting [14].

To ensure the safety of a software system, security is always the most important concern. In service-oriented architecture (SOA), where machines interact with one another, security is of the utmost importance because of the decentralized and loosely coupled nature of SOA. Injection flaws, XML Denial of Service issues, insecure communication, information leakage, reply attack flaws, insufficient authentication, inadequate testing, insecure configuration, and insufficient logging are all examples of SOA web service security vulnerabilities, according to the statement made by the National Security Agency (NSA) [15]. It is possible for issues such as dynamic trust relationships between service composing partners to be of assistance in the implementation of service-oriented architecture (SOA). Additionally, the Balanced Security Mechanism describes nine aspects that become more challenging for SOA security.

The actualization of the required functionality of a service in a condition that is not overstated is what is meant by the term "reliability." There are a number of challenging areas that fall under the category of reliability. Some of these areas include optimized fault tolerance strategies, data provenance during dynamic composition, service level agreement (SLA), service monitoring, self-configuration, self-healing

[16], adaptive metric measurement for service monitoring, automated governance, and multi-organizational implementations.

The fundamental sub-characteristics that make up this quality are modularity, reusability, modifiability, and testability. Maintainability is sometimes known as maintainability. Updates to a service in a runtime environment that is extremely sophisticated are the most challenging feature of service-oriented architecture (SOA) maintainability.

IV. MULTIDISCIPLINARY RESEARCH PATTERNS

Furthermore, the additive technique is expanded beyond its current limitations in order to make advantage of quality of service (QoS). This technique is utilized in service-oriented architecture. Because of its many beneficial characteristics, SOA can be utilized for research that spans multiple disciplines. In light of this, the following section provides a concise overview of the most important research subjects that span multiple disciplines.

When it comes to healthcare solutions, utilizing SOA: Among the most important application areas of SOA is the development of decision support systems for the diagnosis of diseases. Clinical decision support [17] and neuron-based molecular communication are two of the most prominent aspects of the healthcare solution. Examples of SOA-based healthcare ecosystems include healthcare information exchange systems that are based on the HL7 document standard. In this particular circumstance, the security aspect is of the utmost importance; hence, additional research into the security of healthcare information is currently being conducted.

The development of applications that are based on the environment is another topic of interest for SOA researchers, as environmental problems and potential solutions are becoming increasingly prevalent. New developments in recent years include a remote sensing product production system for geostationary operational satellites and flood forecasting based on numerical weather prediction. Both of these innovations are examples of recent advancements.

Evaluation and Management of Quality: In order to ensure that SOA is utilized in an efficient manner, quality improvement research is carried out on a consistent basis. Monitoring frameworks, quality parameter evaluation using fuzzy models and agents [18], Zigbee, hybrid diagnosis and Bayesian diagnosis, fault configuration, SOA design defects on quality attributes, and QoS-aware work-flow in various environments (such as virtualization environments and real-time environments) are some of the new trends in service-oriented architecture (SOA) quality management.

The Internet of Things (IoT) is a vast network of interconnected sensory devices that are able to communicate with one another. SOA-IoT is an acronym for the Internet of Things. "SOA is thought to be a useful way to enable heterogeneous device interoperability in a variety of ways." These are two examples of this. "It allows applications to use heterogeneous objects as compatible services," according to the SOA-IoT specification, which "allows applications to use heterogeneous things as compatible services." The creation of a service-oriented architecture (SOA) for the Internet of Things (IoT) that possesses quality qualities will be the focus of future research. Other areas of interest include things-as-a-service-oriented architecture, wireless sensor networks, and strategies for optimizing network performance [16].

Considering that it deals with Machine-to-Machine interaction with services, the Self-Adaptive Service Oriented Architecture (SOA) is an essential component in dynamic networking for the purpose of recovering from network crashes, transient connection failures, and other challenges. Such circumstances on a network will be able to be managed by service systems that are capable of self-adaptation, awareness of the context, and semantically based functionality. Despite the fact that it is challenging to build a self-adaptive SOA system that possesses quality qualities, researchers are continuing to work on it by utilizing innovative SOA methodologies such as. Methods that are more efficient are required in order to get SOA to become self-adaptive [13].

Using Service-Oriented Architecture (SOA) for Business Automation: The fundamental concept of SOA, which is to align business and IT infrastructure, has now been extended to real-time industrial automation, chain-based business alliance building, business process execution, and financial sectors such as e-banking and e-resource planning.

Systems of Architecture (SOA) and Cloud Computing: SOA is the fundamental architecture that underpins the Cloud environment. One of the possible paths that SOA could take is the direction of cloud computing. Computing in the cloud is predicated on the concept of everything being provided as a service, in which quality-oriented service computing is taken into consideration for the purpose of enhancing performance [14]. The service-oriented architecture (SOA) is being extended to private cloud computing as a service, which will give cloud computing a new direction.

V. Conclusion

A discussion of the challenging challenges and research trends around SOA Quality Attributes is presented in this written work. The one-of-a-kind way of integration that SOA offers is currently being utilized in a wide variety of applications. SOA quality attributes encounter some serious difficulties that, if not solved, would eventually limit not only the quality of services but also the popularity of this design pattern. These obstacles are in addition to the numerous opportunities for expansion that are available.

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