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A Survey: Approaches to Web Service Composition for the Semantic Web

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Abstract-Service composition is gaining popularity because a composite service can perform functions that an individual service cannot. There are multiple web services available on the web for different tasks. The semantic web is an advanced form of the current web in which all contents have well-defined meanings due to nature, allowing machines to process web contents automatically. A web service composition is a collection of web services that collaborate to achieve a common goal. They reveal the established methods for web service composition in both syntactic and semantic environments. In this research, to begin, make a list of the existing composition techniques. These approaches were classified based on how the service descriptions were processed, which could be syntactic or semantic-based service processes. This study reviewed over 14 articles in this field and concluded the merits of the methodologies used to implement web service composition.

Keywords— Semantic Web, Web Service Composition, Semantic Service Discovery, Service Oriented Architecture.

I. INTRODUCTION

Web services are well-defined, self-described, and reusable software components that can use over the web using the most silent and stable technologies and variable that can be defined remotely by its URL and is heterogeneous [1]. The different specifications XML, SOAP, WSDL, and UDDI [2] use to define and access these components. Web services are built using the Service Oriented Architecture (SOA), as seen in Fig. 1., and deployed around the web to support a variety of business applications. Web systems are used to implement enterprise applications that provide operations data requests request preprocessing, service matching, service identification, service delivery, and service composition [3]. Composition language, information reuse, automation, tool support, execution platform, and target users are six dimensions of a web service composition problem. It's still figuring out how an automatic method can perform [4]. Preliminary identification, further collection, and refining were all steps in the process of selecting the approaches. The module in the general framework of a web service composition is a process generator, which depends on the external and internal service specifications of a service client and supplier, respectively. EFLOW, FOREMSYS, INTALIO BPMS, SELF-SERV, SHOP2, SWORD, TAVERNA, XL, Yahoo! Pipes, YAWL, Java Business Process Model, JOPERA are the 12 platforms in [5].

Integration of web services into composite services or applications is a highly practical and conceptually challenging task that is recognized in both the business and customer sectors [6],[7]. The criteria-based web service selection methods often used to achieve the objectives of the domain, which classified as: service-ranking approach, linear programming method, fuzzy model, QoS -based service selection method, hybrid models, and ANP [8].

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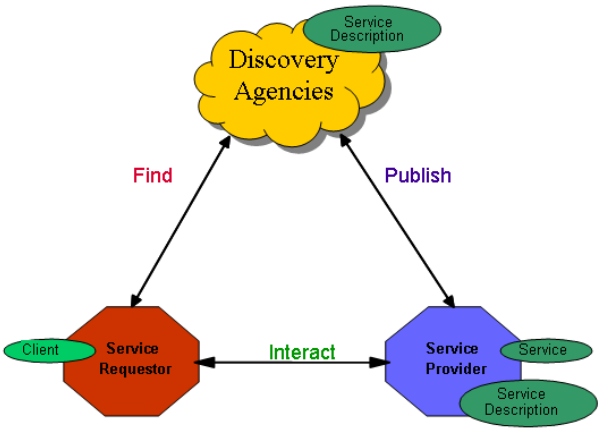

Fig. 1. Components of SOA

II. Semantic Web

The Semantic Web is a collaborative initiative to create a universal medium for transmitting information over the World Wide Web in a way that machines can comprehend and analyze [9]. The Semantic Web's goal is to make a lot of data available on the internet meaningful, comprehensible, and processable by machines [10],[11]. To provide this useful information to machines, it is necessary to create Meta data, which is data that defines data on the web [12-14]. Semantics is a mechanism for machines to process the meaning of things provided by metadata. As a result, computers with semantics can tackle sophisticated semantic optimization issues like delivering relevant search results. issues like delivering appropriate search results. Bottom-Up and Top-Down techniques are used to creating massive volumes of data on the internet usable information for computers [14-16]. The material on the web should be annotated with descriptions and relationships in the bottom-up or classic approach to the semantic web. However, because there are billions of unstructured HTML pages available without Meta data or annotations, annotating data is an extremely hard process that is still far from being solved [17-19].

The World Wide Web Consortium (W3C) has developed a collection of tools and standards for representing data in a way that computers can understand. The XML-based languages Resource Description Framework (RDF) and Web Ontology Languages (OWL) should provide a conceptual description of information and publishing ontologies that is implemented in web resources using various syntactic notations and data serialization formats [20-23].

The below is how the whole article is structured: The introductory definitions are found in Section 1. Section-2 provides an outline of the different interventions, benefits, and consequences, and Section-3 ends the paper with the review's conclusions.

III. Literature Review

Web service integration is an important task of any automation of the business process [24]. The method of discovering a suitable web service for a particular mission is known as web service discovery. The technologies used for composition approaches, modeling, and service management are all part of the semantic web services composition are the life cycle [25].

Web Service has a range of composite services composition is the process of combining associated web services. There are two approaches to finding, selecting, and composing web services: syntactic and semantic [26]. The alternative techniques for composing dynamic web services have been described. The dynamic web service composition process has evolved to meet the user's needs for the on-demand distribution of personalized services. Realizing dynamic web service composition in a dynamic environment is complex. Transactional help is also incomplete, according to the evaluation. Self-Healing Web Service Composition also missing the verification of compositional correctness [27].

The semantic-based discovery model is explained in [28]. The reliability calculation method is the objective of the Petri Net-based approach. It implements the Fuzzy Reasoning Colored Petri Net (FRCPN), Service-Oriented Architecture (SOA), Supercomputing Cloud Platform (SCP); Sequential Linked List for Filling Reliability Value (SLLFRV), Ontology, Web language for Services (OWL-S), and a tool known as T to measure the reliability of a repairable device [29-31].

G. Markou *et al.* in [32] explains non-deterministic preparation approaches for automatic

web service composition. By reducing the response time of a web service composition, the efficiency of the web service composition can be increased. Response Time, Execution Time, Reputation, Availability, Accessibility, Throughput, and Scalability are examples of QoS properties [33]. Consideration of e-government services and its service composition is discussed with semantic features. It encompasses information and communications technologies (ICT) with a customer-centric approach. It is a Semantic Web (SW) supported Multi-Agent System (MAS), Autonomic Computing, especially self-healing propriety, Artificial Intelligent Planning (AIP), ONTOGOV (Ontology-enabled e-Gov Service Configuration), WEBDG, and EGOIA (Electronic Government, Innovation, and Access) EMAYER [34].

N. M. Salih *et al.* in [16]. Illustrated how a genetic algorithm may accomplish efficient web service composition in the work, developed new strategies for chromosomal initialization, selection, and crossover functions. The results of the experiments reveal GA is substantially faster than other random search strategies in finding an appropriate composition plan. May deduce from trials that the method produces an optimum composition plan in an acceptable amount of time.

S. Garg in [35] proposed map the method to the ontology to improve the construction of semantic services, concentrate on combining GA with a non-evolutionary approach to improve web service creation and performance, Dynamic Web Services Composition optimizes outcomes by combining QoS parameters with a genetic algorithm, as defined in [35].

P. El-Kafrawy *et al.* in [36] proposed a framework for writing a web service that is based on its reliability. The simple observation is used to create a graph that represents the web service that took part in the service composition. Petri nets, OWF-nets, Labeled Transition Systems, and Opacity of a Labeled Transition System are some of the common concepts used to represent the graph. Criteria-based service selection approaches have been adopted, and this approach considers a variety of factors such as service quality, user preference, and scalability [8]. There are many challenges in semantic web service exploration, including the tools to be used, such as OWL-S, WSMO, WSML, WSMX, and SAWSDL, as well as the activities that must be completed by the discovery process, such as writing, mediation, storage, order, matchmaking, negotiation, and collection [26].

The privacy data distribute across the web for standard medical data. These data are to be shared using web services and its composition. This type of composition is disused in [37]. The level of privacy is determined by the rules defined in the composition architecture. Clustering Web services is very much important to facilitate service discovery. It can be done in many ways, one of based on the parameters used in the web service invocation [38-41].

M. Allamehamiri *et al.* in [42] Proposed a new composition plan optimizer with constraints based on a genetic algorithm. The proposed method can find the composition plan that satisfies user constraints efficiently. The performance of the manner evaluates in a simulated environment. There were several novel concepts for chromosomal generation, selection, and crossover functions offered. The experimental findings revealed that the offered concepts had the potential to overcome local optimums. GA may identify an appropriate composition plan significantly quicker than other random search algorithms, according to experimental data, because it is a K beam search. As a result, it can be stated that using genetic algorithms to solve such issues has a significant impact on reducing computing time. The paper proposes that future research look at the effects of alternative fitness function formulations, QoS - based web service composition based on Genetic Algorithm (GA) is introduced in [42]. This GA-based approach is considering QoS parameters. Business Process Execution Language (BPEL) based composition uses a behavioral approach by verifying the concurrent properties [43]. Web service composition process can employ either manual or semi-automatic or automatic methodologies. Automatic web service composition is used when a dynamic composition is required [44].

Firefly approach is the which provides optimal solutions for dynamic service composition [45] and another web service composition framework provides the solution for the composition problems on the fly that is dynamically called User-Centric WS-Mediator framework for on-the-fly Web Service Composition [46]. A Workflow-based Optimization Method the Web Service Composition Model is a numerical model that determines QoS before forming the composition [47].

Researchers, software engineers, experienced experts, report authors, and customers working in the Web resources domain for QoS forecasts are mostly looking at web databases [48-50]. The patterns of web service access and composition identified used log-based mining techniques. It's a re-engineering approach for service composition, and a query-by-example approach [51] is another comfortable web service exploration approach. The goal-based methodology for Web service composition can be used for a well-defined business method [52]. The context-conscious strategy is optimal for the domain-specific problem and delivers better results, whereas a linear classification for web service composition uses QoS parameters and produces transactional aware results [53]. The methodologies can be used in post-composition, and a theorem proving process for the systematic testing of web services composition has been demonstrated [54].

Using the Performance Index (PI) for optimization and ranking of web service composition [55]. Many resources in the repository lengthen the time to pick, find, and compose. Parallel processing should improve the composition framework's efficiency [56]. Several web services have been carried out on cloud computing, including performance analysis, market-oriented graph Semantic Web Services, management tool, workload balance, dynamic selection, etc. [57-59]. Semantic I/O information of the services. Performing the non-functional characteristics of the software systems and services. Client-side (e.g., response time, throughput, etc.) or server-side (e.g., price, availability, etc.) QoS of cloud providers can be calculated. Quality-of-service (QoS) can be assessed from both the server and client sides. Client-side QoS properties allow for more precise evaluations of the user's experience.

The most widely deployed client focuses on predicting the rating of client-side QoS assets, which are likely to vary among different users (or user applications) of the same cloud service. Composite Web Service Definition and Execution SELF-SERV [60] is a project that aims to help people help themselves. The SELF-SERV project aims to provide middleware architecture and tool support for the definition and implementation of composite Web services. Aspects of the SELF SERV scheme, Composition of declarative services the number of services to be composed can be huge, and the highly dispersed nature of services is constantly changing. The process model in SELF-SERV is described as a state diagram, which includes states and invocations to Web services, as well as events, situations, and variable assignment operations. SELF-SERV makes use of the idea of a service community. Web services are declaratively composed in this prototype framework, and the resulting hybrid services may be orchestrated in a complex context either peer-to-peer or centralized. SELF-SERV is a research project that aims to provide tool support and middleware architecture to make composing Web services easier in massive, autonomous, heterogeneous, and complex settings. Several roadblocks still stand in the way of streamlined Web service provisioning in mobile environments.

The SELF-SERV architecture to support service provisioning in mobile environments. The issues are Context-sensitive service selection and Handling disconnections during composite service execution. The usage of Symbolic Observation Graphs was proposed in [33] research to abstract and check the opacity and composition of Web services, and so establish privacy. There are two advantages to using SOGs. It's a WS (public version) abstraction that lets broadcast just enough information (the language projected on collaborative actions, such as sending and receiving messages) to identify partners while hiding any local actions enclosed in the SOG's aggregates. It's an abstraction that allows analyzing the opacity of the composite service without having to know the original local models, ideally by confirming the obscurity on the composite primary

mode, where the composition of abstractions checked and got an equivalent result. In the research future studies, the same concept will apply to additional opacity types, such as K-step weak opacity and K-step strong opacity, and comparing experimental data will strengthen conclusions.

M. Vukovic *et al.* in [61], provides a system architecture for building context-aware applications based on the concept of dynamic Web service composition in work, which solves the growing complexity that context-awareness necessitates. Contextual changes may cause further recompositing during service execution, leading the application to evolve dynamically. For the composition, definition, and performance of the composite service, the framework uses SHOP2 planning technology, BPEL4WS, and BPWS4J, respectively. The assumptions that the state of the world (i.e., application domain) is always accessible, unchanging, and deterministic underpin SHOP2 and Temporal Planner perfect planning and execution.

All the technical explanations are thorough, accurately describing all the outcomes. Information incompleteness characterizes the actual world and the ubiquitous operational environment. (For example, the planet may be unreachable) and inaccuracy (e.g., world may not match the model of the planner). As a result, a technique to convey non-determinism is suggested in the design of context-aware systems. The application of non-HTN plan developing strategies for run-time recompositing will be investigated in the future, with scalability difficulties. To test the framework, create a more sophisticated and context-rich application.

The following Table 1 lists the methodologies, outcomes, and features of those approaches. The primary task of any web service composition can be started with service discovery.

TABLE 1: APPROACHES TO WEB SERVICE COMPOSITION

Ref.	Approach/Methodology	Outcome	Features
[8]	Criteria-based service selection methods.	Determines the weights of criteria based on user preference and takes into consideration decision-makers confidence levels.	The estimate the weights of criteria based on trust and reputation.
[28]	Ontology-based model	A semantic model for web service discovery and description.	Implemented similarity matching of web services through the summarization of semantic similarity values.
[29]	Fuzzy approach	The composition is returned as an SLLFRV linked list with an FRCPN reliability rating.	The number of web services and the range of reliability transition values are related to the dependability of the Web service composition.
[32]	Web service composition methods: Deterministic methods Middle ground methods Nondeterministic and contingent planning methods	The deterministic method generates all feasible solutions based on the service graph.	Fully automatic and Graph-based composition
[33]	QoS Normalization	Based on QoS properties	QoS score and user requirements. Optimized response time.
[34]	a customer-centric approach, Multi-Agent System (MAS)	A dynamic way to provide a personalized service that improves the satisfaction of the citizen and thus increase the quality	Citizens can dynamically construct services based on the aims and access through a single point of access using e-government Web services. Its faster, cheaper, more personalized, and more efficient delivery services
[35]	QoS Parameters and Genetic Algorithm (GA)	Optimal composition.	Dynamic web services composition uses QoS parameters and GA.
[36]	Diversified Service Rank (DSR). Web service reputation update algorithm. Reputation module discovery approach	Returns a list of services that fit the criteria.	Consumers supply more accurate reputational evaluations. The nominated web services in the returned list are the ones that are most relevant to the consumer's request.

[42]	QoS approach. The GA-based algorithm has 2 constraints: there is just one web service the service composition must satisfy user requirements when choosing among potential web services for a task.	GA, plan optimizer with constraints	It overcomes local optimums with less computation time. GA is a K beam search that is substantially faster than other random search methods in finding an appropriate composition plan.
[45]	In semantic Web service composition, a hybrid firefly technique is used to find the optimal solution.	In semantic Web service composition, a Firefly-inspired technique for selecting the best or near-best solution.	Biological systems have aided in the development of effective strategies for solving optimization challenges.
[51]	WSQBE is a new search strategy for Web services. Providers can choose a category for services manually from a list of predefined alternatives.	Web services and queries are represented as a collection of vector subspaces.	UDDI registries with search facilities
[54]	Within a higher-order logic theorem prover, a formal framework for the construction of Web Services.	Approach: The proofs-as-processes paradigm allows Classical Linear Logic (CLL) inference rules to be transformed into pi-calculus processes.	Classical Linear Logic (CLL) proofs are used to define Web Services compositions using the pi-calculus.
[56]	Graph-based approach. DAG to represent web service composition	The composition algorithm is designed to make the most of multiprocessor platforms' capabilities. The design of the framework has been tweaked to allow parallel processing of a single data structure.	Preprocessing necessitates a significant amount of computing. Multiprocessor systems are supported. Immediate response to queries.
[62]	Symbolic Observation Graphs (SOGs)-verification of the abstractions.	Abstract and evaluate the opacity of Web Services and the composition to demonstrate usefulness.	Symbolic Observation Graphs are used for privacy.
[61]	Web service composition using SHOP2 system architecture: BPEL4WS.	SHOP2 and BPEL4WS for web service composition to facilitate context-awareness.	Scenario: mail replication system- 2 sub-processes Retrieve mail Send mail

IV. Discussion

Discussed several approaches have for the composition of semantic web services. Those researchers who worked on Approaches to Web Service Composition, discovery, and selection showed evaluation in the service-oriented architecture domain. Describe each article by the Methodology, Outcome, and Features. Most syntactic strategies that have employed QoS parameters for composition and semantic methods are domain-specific, requiring fundamental domain knowledge, semantic descriptions, ontologies, and composition processor duties.

V. Conclusion

An overview of research in the semantic web composition approached is discussed in this paper. The existing works classify into two categories; approaches with QoS support and without QoS support. Aimed to summarize the recent trends in the development of various web service composition approaches. These approaches classify according to the processing of the service descriptions, which can be syntactic or semantic-based service processes. However, comprise the methodologies used for composition and the parameters used for selection and matching processes. Every composition approach has its own merits and demerits. Most of the syntactic techniques that have used QoS parameters for composition and semantic approaches are domain-specific the need basic knowledge about the domain, semantic description, ontologies, and composition engine tasks.

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