ABSTRACT

Web services are an essential part of the world wide web which simplifies automation in each business domain. The popularity of web services are increasing day by day with a sudden shift of people into the digital lifestyle. Web Services paves the way into automation of every functionality around us. As the scope for automation increases, the total number of web services developed also increases in an exponential fashion. Every company strives to become a global leader of automation which leads to increased competitiveness across them which in turn leads to an increase in functionally similar web services across the web. The presence of numerous amount of web services increases the challenge involved in the retrieval of web services for a user query. This research work aims in formulating a framework that makes the retrieval of web services efficient.

Web services are granular in nature and hence a complex user query in most cases cannot be satisfied by the retrieval of a single atomic service. Hence, it becomes necessary to identify a collection of services which when executed in a particular order satisfy the user query. To facilitate this process of service composition, the framework is divided into three sequential phases namely Web Service Discovery, Web Service Selection, and Plan Generation. This research work aims in contributing towards each phase to ease out the process service composition.

Web Service Discovery is the initial step for composing the services where every service has to be functionally detected accurately, such that it can solve an aspect of the user query. The researchers have employed various techniques like Match Making Algorithms, Optimization Techniques,

Classification methods, and Clustering methods in conjunction with different ontologies to discover relevant services. It is observed from the literature that, the key point in increasing the efficiency of the discovery phase is to efficiently organize the semantics of the web services. This research work employs the utilization of Formal Concept Analysis (FCA) to organize the semantics of the web services by incorporating Lexicon Ontology. Also, Lexicon Ontology driven Concept Lattice (LOCL) framework which incorporates a novel match-making algorithm capable of discovering the web services based on different types of the user query is proposed. Intensive experimentation is performed to analyse the efficiency of the framework in comparison with significant literature works. It is found that the proposed LOCL framework outperforms the significant methods taken for study. It is also noted that the precision and the recall values of the framework are balanced which makes the framework more robust and reliable for real-time service discovery. The output obtained from the service discovery phase is given as an input to the second phase of the service composition known as the Web Service Selection phase.

In the Web Service Selection phase the non-functional aspects of a web service such as Quality of Service (QoS) and Quality of Experience (QoE) values are utilized to rank the functionally similar web services. From the literature, it is observed that ranking of web services based only on QoS or QoE values leads to a decrease in user satisfaction level. Hence it is necessary to enrich the existing non-functional aspects of a web service. The researchers have employed Qualitative, Quantitative, and Psychological methods for hybridization of QoS and QoE values. This research proposes a novel combination of QoS and QoE values resulting in Quality of Service and Experience (QoSE) values which reflect the behavior of the web service in conjunction with user experience. These QoSE values are utilized in the process of service selection. Web Service Selection involves the ranking of

web services based on multiple Non Functional parameters and hence the web service selection can be formulated as a Multi Criteria Decision Making (MCDM) problem. From the literature, it is observed that different MCDM techniques are utilized to date in the due process of web service selection. This research work proposes an improved version of the Reference Ideal Method (RIM) named Improved Reference Ideal Method (I-RIM). The proposed method incorporates personalization into the ranking scheme to increase user satisfaction level. Thus the research work employs selection of web services based on QoSE values by utilizing the I-RIM method. A novel load balancing framework called Personalized Web Service Selection Framework (PWSSF) is proposed which incorporates Graphical Processor Unit (GPU) parallelized QoSE and GPU parallelized I-RIM to efficiently select the web services. The PWSSF is capable of adjusting to variable service count where GPU parallelization is adopted only if the count of web services are massive. It is found that the proposed framework outperforms most of the literature works in terms of time efficiency. Also, the performance of I-RIM is found to be better than RIM and hence the framework can be incorporated for real-time service selection. The ranked web services are given as input to the third phase of service composition known as Plan Generation.

The Plan Generation phase composes the web services based on Input parameters and Output parameters (IO). The researchers have utilized various methods like Evolutionary techniques, Reinforcement Learning techniques, Graph based methods, and various others to chain the web services in the correct order. From the literature, it is observed that most of the composing strategies lack time efficiency due to the high search space involved in the chaining process. Hence, this research work employs the utilization of a filtration engine that separates the functionally unique services from the alternate services thereby drastically reducing the search space. The

research work employs the utilization of Expected State–Action–Reward–State–Action (SARSA) a Reinforcement Learning based method to compose the services after extensive experimentation. A novel reward model is devised to facilitate the learning process. Experimentation of composing web services by utilizing IO parameters and Input parameters, Output parameters, Precondition and Effect (IOPE) parameters are analyzed and it is concluded that composing web services using IO parameters is sufficient. Thus a novel framework called Reinforcement Learning based Action Planner (RLAP) framework is proposed which employs both the filtration engine as well as IO parameter based Expected SARSA to compose the web services. It is found that RLAP outperforms multiple literature methods in terms of accuracy and execution time making it more suitable for real-time composition.

Thus an overall framework named AI powered GPU enabled Semantic Web Service Composition Framework is proposed which combines the efficiency of LOCL, PWSSF, and RLAP. The proposed framework is tested for a sample E-Commerce based case study and it is found that the framework is efficient in terms of execution time and Accuracy. Also, the overall precision and recall of the framework are balanced making it more reliable and robust. Thus, the proposed framework is highly efficient with an accuracy of 95.7% and is found to be more suitable for real-time service composition.