IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Issue-2, Feb 2019 E-ISSN: 2347-2693

To Control Mobile Web Services Access Using Fuzzy Logic

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DOI: https://doi.org/10.26438/ijcse/v7i2.760764 | Available online at: www.ijcseonline.org

Accepted: 16/Feb/2019, Published: 28/Feb/2019

***Abstract*—** Now a day's mobile computing is becoming very popular and web services are new forms of software platform having standard protocols. Web services can be universally deployed and invoked using specified protocols. Implementing web service on Smartphone's is a tedious process because of several physical restrictions in Smartphone's. Smartphone's are physically constrained devices with different operating systems like Android, iOS, blackberry, Symbian and many others. Physical constraints in Smartphone's are limited memory, low processing power, intermitted wireless connection and limited battery. This factor needs to be considered while implementing web services for mobile devices. In this paper, we evaluate the RESTful web service for Smartphone's. When picking a service to execute business logic transactions efficiently, we need to consider availability, accessibility, response time, and scalability as quality attributes. While taking into consideration of physical constraints of mobile devices we implement a controlled web service using fuzzy logic.

***Keywords*—** *Smartphones, web service, business logic, iOS, Android, Symbian, blackberry, RESTful, fuzzy logic*

I. INTRODUCTION

The idea of using smart mobile phone as a web service provider had been started during the last decade without disturbing basic functionality of mobile phone. In recent years advancement in mobile device capabilities in terms of processor speed, memory, display screen size and advancement in communication technologies and web technologies, it changes the role of mobile devices from web client or web service consumer to web service provider. Moreover, today 90-93% of the world population owns a cell phone and day by day transmission rates have increased by 3G, 4G and LTE as well as Wi-Fi enables the mobile device to access Internet anywhere, anytime. Latest smart phone with advanced capability with Internet connectivity is true Mobile pervasive computing.

Mobile pervasive computing is new era to provide services to end user everywhere, anytime, anyway. In future wireless network support anytime, anyplace and anything connection support. End user expecting mobile pervasive web services should be flexible, interoperable, reliable, and discoverable and support different QoE and QoS parameters. Mobile pervasive computing relies on the convergence of advanced wireless technologies, advanced smart mobile phones and the Internet. The goal of researchers is to take advantages of pervasive computing, Smartphone's with mobile web services to create smart web services to fulfill end user requirements

Web Service provisioning is the ability of mobile devices of hosting and offering different types web services so that users from different types of background can access it like a normal web server. This is possible due to advancements in mobile devices and wireless communication ability. Mobile devices containing advanced features like 3G or 4G support and fast processing speed allow to use mobile devices as host for deploying web service on it shown in figure 1.

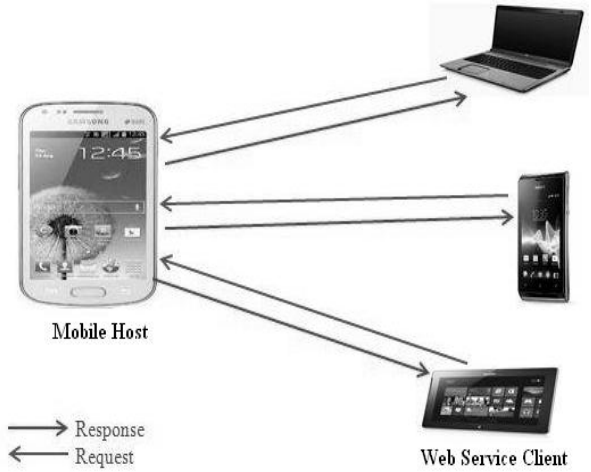

Figure 1. Communication between mobile web server and client devices

Open source Android mobile platform becoming a popular platform for mobile app development, anyone can easily deploy web service on android mobile. Evolution of mobile

web services influence internet era on lots of levels for example everyday advancement in web service model and mobile devices captured not only regular users but also average users. A mobile device in the role of a service provider enables, amongst others, entirely new scenarios and end-user services and advancement in mobile devices reduces the physical restrictions like memory, CPU speed and all other physical parameters. The research with providing web services from smart phones is still sparse because of physical restrictions that mobile devices have. In spite of these physical restrictions how one can make web service perform better and provide quality of service.

The use of fuzzy inference systems enables the evaluation of the measured physical parameter values which helps deciding whether the requested service should be provided or not. Experimental results show significant improvements in the web service performance in both worst case and best case scenario and providing energy consumption.

In this paper, we present the description of a Hybrid framework using fuzzy logic that allows providing web services from android mobile device under real life settings and using current available technology. Rest of paper organized as follows: Section II describes the details of mobile web service provisioning section III provides related work, section IV discusses the results. Finally, last section concludes the paper and highlights our future research direction

II. MOBILE WEB SERVICE PROVISIONING

Web Service provisioning is the ability of mobile devices of hosting and offering different types web services so that users from different types of background can access it like a normal web server. This is possible due to advancements in mobile devices and wireless communication ability. Mobile devices containing advanced features like 3G or 4G support and fast processing speed can be easily used as a standalone web server by deploying web service on it. Web service provisioning is the art of deploying web service on a mobile device. Due to web services it has changed the role of mobile devices that is from web service consumer o web service provider.

For Mobile web service provisioning two architectures used. These are service oriented architecture and REST based architecture. The main differences between these architectures are how web service host communicates with web client and different forms of massages are transmitted. In SOAP based send request in XML and Response also getting XML but in REST request is HTTP and response may be in XML, JSON, etc. In our proposed extended REST architecture mobile host supports HTTP and SMS protocol to access web services from GPRS, non GPRS mobile web service clients and even access web services from non-JAVA enabled mobile web service clients.

The proposed mobile host deployed on Android Smartphone and it uses the short messaging service for an alternative response method, i.e. unavailability of GPRS or any non-Java or multimedia mobile won't be an issue the HTTP request for client side. Although there have been many traditional solution deployment approaches, each of them mainly focuses on a particular product. This paper introduced novel hybrid framework for mobile web services.

Mobile Hosts enable federal integration of client specific services to the enterprise, by maintaining the web service designing protocols, also maintaining resources in resource constrained mobile devices. While developing web services for resource constrained mobile device encounter several technical challenges, like the quality of service (QoS). The role of mobile devices as a Web service consumer is fundamental.

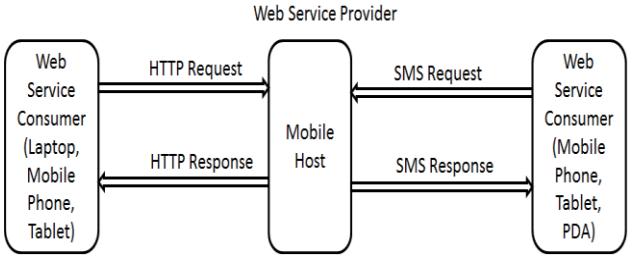

Figure 2. Proposed REST based Mobile web service provisioning architecture

The major difference between previous web service provisioning architecture and the proposed architecture is that the previous architectures are based on XML and HTTP only. SOAP based architectures uses for communication XML or HTTP tunneling and REST based architecture uses for communication simple HTTP protocol, but proposed architecture is based on HTTP as well as SMS (Short Message Service) as an alternative to access web service from a Smartphone. The approach presented here follows a different from a technical and communication point of view, the mobile Web Service provider communicates as a Web Service client with a dynamically generated Web Service with the help of HTTP protocol or SMS mobile service. Proposed Web service provisioning system architecture for mobile host.

III. RELATED WORK

Now days there are many standard frameworks and approaches exist to host web services on mobile devices. Mobile devices have some physical restrictions like low processing power, limited memory and short battery life. Provisioning of web services on Smart phone is not new and

it has been introduced by [1] in 2006. Author was developed mobile host based on SOAP protocol and integrated user specific photo album web service on radio link and via resource constraint smart phone. The improvements in mobile manufacturing, wireless communication, web service domain and reduced cost of smart phones proposes new architectures for enabling the communication between web client and mobile host. In 2000 [2] author introduces REST new architecture style not a protocol in his PhD desertion. In [3] author presented a concept of REST based Mobile Web Services (MobWS) provisioning and its comparison with a similar SOAP architecture in terms of HTTP payload. Author analyzed based on payload in a mobile device environment he found that direct implementations of SOAP-based Web services may introduce a significant and an unacceptable performance overhead on the resource-constrained mobile devices due to the increasingly thick SOAP messages and its expensive parsing requirements which demand for high resources (processor power, memory, battery and bandwidth).

In [4] author provides a comparison between SOAP-based frameworks and RESTful based frameworks. Each and every framework has its own advantages and disadvantages. Author conducted tests on a Nokia N80 mobile running Symbian OS. According to [5] author proposes partitioning frameworks for mobile web service provisioning. Author presented a distributed mobile service provisioning framework that partitions the execution of resource-intensive Web services between the mobile provider and a back-end server. The framework offers a distributed execution engine where tasks that require real time access to local resources are executed on the mobile devices, while the remaining processing is offloaded to a remote server. The framework does not offer options based on potential performance benefits and current context. In some cases, it might turn out that local execution yields better performance than remote execution, especially when a large amount of data transfer is required.

As per our previous preliminary comparative study in [6] and Android Mobile Host performance evaluation of SOAP and REST in [9], it showed that REST is a more suitable architecture for provisioning web services on mobile smart phones. The RESTful approach enhances the performance of mobile Web services also described by many researchers. In [7] author discussed offloading and migration mechanisms that facilitate provisioning of adaptive and distributed mobile Web services from mobile host. For performance evaluation uses fuzzy logic rule sets are to trigger and control offloading schemes of the web service provider. In our paper [9] we deployed web services on the Android mobile host and compares results of both SOAP and REST framework.

In [10] author designed a secured model (S-Rest) over RESTful web services with 3-level security services at communication, Application and Management web services.

In [11] Tusha Agarwal and Abhishek Saxena, discussed load balancing approach to distribute load dynamically among the all the nodes in the cloud. Load balancing avoids the occurrence of such a situation where some virtual machines are heavily loaded or in ideal situation. Dynamic load balancing approach reduced the amount of data used for recovery to almost half and maintains a secure access control mechanism for authenticated user only.

IV. FUZZY based hybrid framework

With the rapid progress in web services infrastructure and use in various industries, deploying one on best suited mobile device is a repressive task, because there are some attributes which needs to be considered when it comes to deploying web service on mobile device, attributes like limited memory or slow processing power unlike traditional server configuration. So while it comes to web service performance on mobile device it kind of underrated for obvious reasons. Web service performance on mobile device can be improved on some extend by controlling mobile device resources in real time environment which also results in resource consumption, as such it is natural to expect some automation of the process. A promising automatic resource restrictions method for improving service performance and resource consumption is to evaluate the suitability of service with respect to aforementioned attributes, in particular, attributes whose values change over time like network speed which is a dynamic attribute and constantly fluctuate which is why difficult to measure.

Fuzzy control approach proposes a situation-aware framework for providing services with respect to calculated resources in a proactive manner. Current situation of available resources of mobile device is calculated and provided to fuzzy class which then loads the FCL file. FCL file contains some contextual rule and conditions which is handled by defining legitimate linguistic variables through the Fuzzy Control Language (FCL).

Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean logic on which the modern computer is based. Fuzzy logic includes 0 and 1 as extreme cases of truth (or "the state of matters" or "fact") but also includes the various states of truth in between. Fuzzy logic seems closer to the way our brains work. We aggregate data and form a number of partial truths which we aggregate further into higher truths which in turn, when certain thresholds are exceeded, cause certain further results such as motor reaction. A similar kind of process is used in artificial computer neural network and expert systems. It may help to see fuzzy logic as the way reasoning

really works and binary or Boolean logic is simply a special case of it shown in figure 3.

The goal of proposed architecture is to create an efficient and reliable Android mobile host as a web service provider that includes web services deployed on the mobile host and clients access the content. The main aim is to create lightweight weight framework for Android host that takes care of resource limitations and battery life.

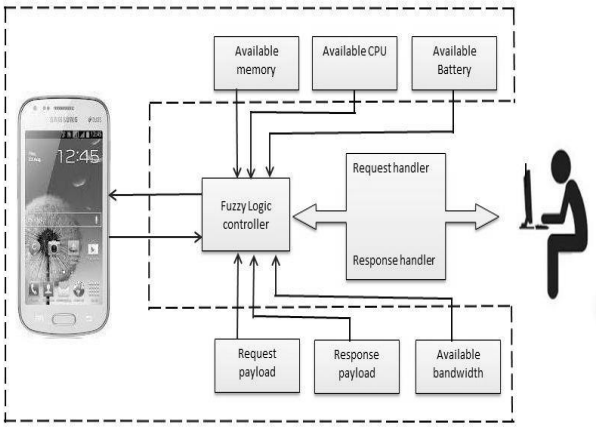

Figure 3. Fuzzy Control on resources of android device

Fuzzy performance evaluation

Samsung Galaxy S Duos (GT-S7562)

Speed: 1 GHz

Card slot microSD, up to 32 GB

Internal 4 GB (1.8 GB user available), 768 MB RAM

GPRS	Yes
EDGE	Yes
Speed	HSDPA, 7.2 Mbps; HSUPA, 5.76 Mbps
WLAN	Wi-Fi 802.11 b/g/n, Wi-Fi hotspot
Battery	Li-Ion 1500 mAh
Stand-by	Up to 445 h (2G) / Up to 330 h (3G)
Talk time	Up to 13 h (2G) / Up to 7 h 25 min (3G)

Input parameters for fuzzy control logic

```
FUZZIFY Available_MEM
   TERM small := (0, 0) (50000, 1) (200000,0);
   TERM passable :=(70000, 0) (349524,1) (524286,0);
   TERM large := (500000, 0) (699048, 1) (786429,0);
END_FUZZIFY

FUZZIFY Available_BAT
    TERM poor := (0,0)(2,1)(4,0);
    TERM moderate := (3,0)(5,1)(8,0);
    TERM excellent := (6,0) (9,1) (12,0);
END_FUZZIFY

FUZZIFY Available_CPU
    TERM low :=(0,0)(33,1)(66,0);
   TERM generic := (65,0)(200,1)(400,0);
   TERM high := (300,0) (500,1) (1000,0);
END_FUZZIFY

FUZZIFY Request_PAY
   TERM short := (16, 0) (64, 1) (256,0);
   TERM long := (128,0) (1024,1) (2048,0);
END_FUZZIFY

FUZZIFY Response_PAY
        TERM short := (16, 0) (64, 1) (256,0);
        TERM long := (128,0) (1024,1) (2048,0);
END_FUZZIFY

FUZZIFY Available_NWSPEED
        TERM weak := (0, 0) (26, 1) (52,0);
        TERM average := (15,0)(40,1)(60,0);
        TERM strong := (24,0) (62,1) (100,0);
END_FUZZIFY
```

Defuzzyfication method prototype

```
DEFUZZIFY RESPONSE

        TERM ResponseOFF := (0,0) (5,1) (10,0);

        TERM ResponseON := (10,0) (15,1) (20,0);

    METHOD : COG;// Use 'Center Of Gravity' defuzzification method

    DEFAULT := 0;       // Default value is 0 (if no rule activates defuzzifier)

END_DEFUZZIFY
```

Rules for controlling web service access

```
RULE 1 : IF (Available_CPU IS generic) OR
(Available_BAT IS excellent) THEN RESPONSE IS
ResponseON;
RULE 2 : IF (Available_MEM IS small) AND
(Available_BAT IS poor) AND (Available_CPU IS low)
THEN RESPONSE IS ResponseOFF;
RULE 3 : IF Available_NWSPEED IS weak AND
Available_CPU IS high AND Available_BAT IS poor
 THEN RESPONSE IS ResponseOFF;
RULE 4 : IF (Request_PAY IS long OR Response_PAY IS
long) AND Available_NWSPEED IS weak AND
Available_BAT IS poor
THEN RESPONSE IS ResponseOFF;
```


RULE 5 : IF (Request_PAY IS long OR Response_PAY IS long) AND Available_CPU IS low
THEN RESPONSE IS ResponseOFF;
RULE 6 : IF Available_MEM IS passable AND Available_CPU IS generic AND Available_BAT IS moderate THEN RESPONSE IS ResponseON;

V. RESULTS AND DISCUSSION

The rule-based mobile host implemented with a input and output system. Six rules were established and outputs were chosen based on the desired linguistic decision making rules as demonstrated in above section. The rule determines the how many web services provided to web client and when stop web services for HTTP web client and SMS web client. Setting the decision making rules is a very critical stage and should be chosen carefully to obtain accurate decisions. For example, if the request is from HTTP web client then it required more amount of resources and battery power, if battery is low then stop sending the response and only provide services to SMS client. If battery is very low then stop automatically mobile host working.

VI. CONCLUSION

Today's modern powerful Android mobile devices can be used as web service provider and fuzzy concept improves its functionality and provides automatic control of accessing web services from mobile host.. The Android Mobile Host processes service request and send the response to the web clients. The web client access the Mobile Host services via HTTP protocol or SMS. In this scenario Mobile Hosts that can themselves offer services in a true mobile client-server setting. A Web Service provider demonstrated the technical feasibility of this approach in terms of resource consumption, standard compliance, and performance. The approach truly paves scope for the client-server and distributed mobile information networks.

The proposed framework is used to deploy very simple web service. In future plan to implement web services provider for SOAP and REST based protocols.

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Authores Profile

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