TELKOMNIKA, Vol.11, No.3, March 2013, pp. 1119 ~ 1124
ISSN: 2302-4046

Abstract Model Study of Sensor Network Complexity Analysis Method

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Abstract

Sensor Network Composition is a new area involving important technological need. Some of the main difficulties are to correctly describe Interaction Framework and Complexity of Sensor Network Systems. Abstract interaction logic can be seen as a new technique for representing fuzzy Complexity mechanism. In this paper, we have presented a solution to use Complexity of Sensor Network Systems in Sensor Network analysis. We have proposed methods for analyzing Sensor Network based on an abstract interaction definition. The user's logics are formalized as abstract concepts.

Keywords: *Sensor Network, Analysis, Abstract Interaction, Composition Mechanism, Complexity*

1. Introduction

In recent years, several service providers offer Composition mechanism features to there customers. Then, multiple providers may provide similar functionalities with different values of non-functional properties.

Their non-functional properties need to be considered during service analysis. In many practice cases of business applications, it is recommended to be taken into account during the provider analysis.

Sensor Networks are modular, self-contained, self-describing software components which are distributed over the Web. They can be readily located and checked-out online and dynamically, using a new directory and corresponding search mechanism known as Universal Description, Discovery, and Integration (UDDI).

The requester accesses the description using a UDDI or other types of registry, and requests the execution of the provider's service by sending a SOAP message to it.

SOAP and HTTP provide exactly what they were designed for a simple, lightweight mechanism for inter operability and distributed communication. However, SOAP and HTTP do not provide the traditional enterprise qualities of service typically needed for an enterprise.

Furthermore, SOAP was designed to be extensible, and it can be extended to support any desired Composition mechanism feature by adding SOAP headers to the SOAP messages and adding Composition mechanism features to the basic SOAP run-time facilities.

The human faculty of cognition and perception is very complex, but it possesses an efficient mechanism for information processing and expression [1,2].

This paper applies the Abstract Interaction decision making approach in the process of analysis and choice of the most appropriate Sensor Network with respect to quality of service criteria.

We enlighten our Composition mechanism requirement description model exploiting Abstract Interaction logic in order to deal with the imprecision of Composition mechanism constraints values.

2. Composition Mechanism of Sensor Network

Many Sensor Networks are appearing on the Web, several requesters are presented to a group of service providers offering similar Sensor Networks. Different service providers may have different qualities of service.

Received September 25, 2012; Revised January 4, 2013; Accepted January 14, 2013

Composition mechanism is one of the most important factors for user's choice of Sensor Network. This will require sophisticated patterns of analysis process. It is necessary to provide an appropriate negotiation mechanism between clients and service providers to reach mutually-agreed Composition mechanism goals.

Composition mechanism management in Sensor Network architecture includes the definition of Composition mechanism attributes and the definitions of the following processes: Composition mechanism publication, discovery, validation, and monitoring. Many works have studied Composition mechanism management on Sensor Network. Several Composition mechanism languages and architectures are proposed.

The proposed approaches for Composition mechanism management can be classified into two groups: one based on extending Sensor Network technologies including SOAP, WSDL and UDDI to support Composition mechanism [3-5]. The second group use independent entities to perform Composition mechanism management [6].

Quality of service is defined by the ability to provide different priorities to different applications, users, or data flow, or to guarantee a certain level of performance to a data flow. A Composition mechanism property may include several sub-properties representing different evaluation criteria, e.g. availability, performance, accessibility. In addition, a Composition mechanism property can be evaluated by many metrics and therefore it is necessary to define the units of measurements.

Composition mechanism in Sensor Network architecture is a combination of several qualities or properties of a service, such as:

Response time: the interval between a user- command and the reception of an action, a result or a feedback from the service.

Availability: availability is the percentage of time that a service is available for use;

Accessibility: Accessibility represents the degree that a system is normatively operated to counteract request messages without delay.

Throughput: It means the max number of Sensor Networks that a platform providing Sensor Network can process for a unit time.

Reliability: Reliability is the quality aspect of a Sensor Network that represents the degree of being capable of maintaining the service and service quality. The number of failures per month or year represents a measure of reliability of a Sensor Network.

Price: represents the money that the customer should pay for this service. It is always associated with the value of the service's functionality, i.e. the more a service costs, the more complicated functions it provides.

Security Level: represents the security level of a service. It includes the existence and type of authentication mechanisms the service offers, confidentiality and data integrity of messages exchanged, non-repudiation of requests or messages, and resilience to denial-of-service attacks.

3. Related Work

With the strong popularity of the development of service oriented application, quality of service becomes a central interest of more and more researchers and enterprises. Composition mechanism values are proportional to the reliability degree and performance of service and thus play a very important role in the provider choice. A large number of Sensor Networks are exposed constraint information's for comparison providers.

Many researches [5] have studied Composition mechanism issues to improve two processes of discovery and analysis of Sensor Networks. Several Composition mechanism aware Sensor Network analysis mechanisms have been developed in recent years in order to perform the Sensor Network composition and to improve performance applications based on Sensor Networks. This mechanisms' main objective is how to how properly select a concept of providers that most satisfy the constraints defined by the user in his business processes.

John. Smith studies the problem of finding Sensor Networks that minimize the total execution time. It presents an optimized heuristic algorithm that finds the optimal solution without exploring the entire solution space. The solution provided in [6] covers only the important case of execution constraints but not all Composition mechanism properties.

Fredi proposed an abstract logic based model for representing any kind of non-functional service properties. This representation of user preferences enables the fast evaluation of the requested service composition by an abstract multiplication of the service composition properties. Thus service composition' properties are measured during or after execution.

Other works have been done in abstract logic based Sensor Network analysis. In [5] various methods have been proposed for specifying abstract Composition mechanism constraints and for ranking Sensor Network based on their abstract representation.

There is a more suitable technique to quantify functional properties: Linear Programming. These properties are not fitting well for measuring the non-functional attributes, because the majority of them are not easy to be quantified in numerical form. In the meantime, user's Composition mechanism constraints regularly remain fuzzy or ambiguous due to various human mental states, and it is very difficult to distinguish the priority order among Composition mechanism criteria.

Furthermore, in Sensor Network analysis, the applied Composition mechanism constraints are not explicitly defined. It is necessary to relax the constraints to make an optimal solution. The use of abstract logic offers improvements in the overall satisfaction level. The Composition mechanism information's represented at abstract level such that it could efficiently select the best Sensor Networks.

However they are still initial efforts which need further investigation for more complete solutions. In the following, we specify several open issues that can be solved:

When we use some kinds of abstract numbers like triangular abstract they may not be easy to be defined by end users.

It is very important to correctly define the Composition mechanism properties that we use in the analysis process. The Composition mechanism has important effects on ranking methods.

How to improve abstract based Sensor Network discovery and the representation of Composition mechanism to achieve effective Sensor Network analysis?

How to automatically concept the weight of service providers attributes?

4. Complexity Analysis of Sensor Network Systems

Abstract Interaction technique is the combination of two artificial intelligence (AI) methods: abstract logic techniques and abstract interaction networks. Abstract Interaction system has the ability to handle the nonlinear and complex systems. It is constructed based on the learning algorithm of abstract interaction networks technique to adjust the appropriate parameters for abstract logic system.

In this paper, we aim to solve the analysis of web Sensor Networks in a global and flexible manner by introducing an Abstract Interaction way. For this purpose, we have developed a abstract interaction system based on the Sunny Approach. This is known as the ANIIS (i.e., Adaptive Abstract Interaction Inference Systems). We assume that semantic match-making has taken place to identify functionally equivalent Sensor Networks. When several of them are available to perform the same task, their quality aspects become important and useful in the analysis process.

An ANIIS is a multi-layered feed forward network, in which each layer performs a particular task. The layers are characterized by the abstract operations they perform.

Abstract Interaction Framework influences the structural aspects of the system and the perceptual complexity of the Sensor Network system. Structural complexity deals with the measurable characteristics of the resulting Sensor Network system such as the number of classes and the interconnections between the classes whereas perceptual complexity deals with the ability of the developer to understand the problem, the structural components of the Sensor Network system, the use of Sensor Network techniques, and how to integrate these ideas to create an Sensor Network system.

As per this model, structural complexity identifies four levels of describing complexity of Sensor Network systems: variable, method, Service, and system. At each level, measures are identified that account for the cohesion (Intra) and coupling (Inter) aspects of the system. Thus, the structural complexity of Sensor Network-oriented mechanism may be expressed as:

$$SC_{Fr} \propto \sum_{i=1}^{N} CO_{Intrai} + \sum_{i=1}^{N} CO_{Interi} \quad (1)$$

Where

$$CO_{Intra} \propto CV_{Intra} + CM_{Intra} \quad (2)$$

And

$$CO_{Inter \propto} CV_{Inter} + CM_{Inter} \quad (3)$$

where,
N = Total number of Sensor Networks in the mechanism
SC_{Fr} = Structural Complexity of the mechanism
CO_{Intra} = Intra Sensor Network Complexity in the mechanism
CO_{Inter} = Inter Sensor Network Complexity in the mechanism
CV_{Intra} = Intra Variable Complexity in an Sensor Network
CV_{Inter} = Inter Variable Complexity in an Sensor Network
CM_{Intra} = Intra Method Complexity in an Sensor Network
CM_{Inter} = Inter Method Complexity in an Sensor Network

It is very clear that mechanism Complexity Analysis is inversely proportional to its structural complexity. Therefore, using Equation (1) we can write,

$$Tb_{Fr} \propto \frac{1}{\sum_{i=1}^{N} CO_{Intrai} + \sum_{i=1}^{N} CO_{Interi}} \quad (4)$$

It for sure that $\sum_{i=1}^{N} CO_{Intra.i}$ and $\sum_{i=1}^{N} CO_{Inter.i}$, in the above model, will never be zero together. Because total number of Sensor Networks in the mechanism will always be >= 1. In case when N = 1, the value of $\sum_{i=1}^{N} CO_{Inter.i}$ may become zero but the value of $\sum_{i=1}^{N} CO_{Intra.i}$ will not be zero then also.

5. Interfaces Complexity Analysis Model

A mechanism may have its interfaces linked to external entities like other mechanisms, components, or library functions etc. known as external interfaces. More the number of other entities to be integrated with the mechanism, the more effort are required for their integration testing. This effort increases with the number and complexities of the constituent interfaces.

A mechanism Complexity Analysis model, considering complexity of mechanism interfaces, may be expressed as

$$Tb_{Fr} \propto \frac{1}{\left[1 + \sum_{i=1}^{N_{FItf}} C_{FItf.i} + \sum_{i=1}^{N_{CInf}} C_{CInf.i} + \sum_{i=1}^{N_{LInf}} C_{LInf.i}\right]} \quad (5)$$

where,
C_{FItfi} = Complexity of mechanism's ith interface with other mechanism
C_{CInfi} = Complexity of mechanism's ith interface with component
C_{LInfi} = Complexity of mechanism's ith library interface
N_{FItf} = Total number of interfaces with other mechanisms

N_{CInf} = Total number of interfaces with other component
N_{LInf} = Total number of library interfaces
It is very clear that mechanism Complexity Analysis is inversely proportional to its structural complexity. Therefore, using Equation (1) we can write.
Complexity Analysis of a frame-let-based mechanism depends upon the Complexity Analysis of constituent frame-let and the coupling among them. So, we may write,

$$Tb_{Fr} \propto \sum_{i=1}^{N_{Fmlt}} \left[\frac{1}{COUP_{Fmlti}} \times Tb_{Fmlti} \right] \quad (6)$$

Where
Tb_{Fr}=Complexity Analysis of the mechanism.
N_{Fmlt}=Total number of constituent frame-let.
$COUP_{Fmlti}$=Sum of measure of coupling of ith frame-let with other frame-let.
Tb_{Fmlti}=Complexity Analysis of ith frame-let..
Since, a frame-let is nothing but a small mechanism, consisting of not more than ten classes and very lean interfaces with other frame-let, so any discussion or metric model regarding mechanism's Complexity Analysis will be applicable for estimating Complexity Analysis of a frame-let.
Our Abstract Interaction system allows classifying service providers in several categories. It allows automating the analysis process in the dynamic composition of Sensor Networks.
According to the Composition mechanism requirements of Sensor Network providers and the functions of Abstract Interaction system, we believe that each service invoked is appropriate candidate to increase the composition ability of Sensor Network and to decrease the burden of composition cognition and the minimal development cost.

6. Comments and Recommendations

In Abstract Inference System (AIS), The MF of the consequent of each rule is a constant of an abstract MF. There are two steps to construct this system: the definition of an appropriate number of input/output and the definition of the shape of MFs. The main problem is that structure identification requires human expertise to solve the parameter estimation. In our selector system we used a different approach, which take advantage of adaptive abstract interaction networks algorithms during fitting procedures. MF parameters are fitted to a data concept through a learning algorithm.

A significant number of samples of service providers are needed in order to have better result and to avoid having Sensor Network many defect values during analysis process. The database must be as complete as possible, including samples of providers attributes over a broad range. The number of samples depends on the context and on the runtime environment.

On the other hand, abstract logic concepts are based on transparence, linguistic rules and establish a framework to include human expertise into modeling. The number of rules is decided by an expert who is familiar with the system to be modeled. In our work, however, no expert is available and the number of membership functions assigned to each input qualities is chosen empirically by examining the desired input-output data.

We merged the abstract logic approach with the ability of learning algorithms from abstract interaction networks to adjust the model.

7. Conclusions

Sensor Network Composition is a new area involving important technological need. Some of the main difficulties are to correctly describe Interaction Framework and Complexity of Sensor Network Systems. Abstract interaction logic can be seen as a new technique for representing fuzzy Complexity mechanism. In this paper, we have presented a solution to use Complexity of Sensor Network Systems in Sensor Network analysis. We have proposed methods for analyzing Sensor Network based on an abstract interaction definition. The user's logics are formalized as abstract concepts.

Abstract Interaction logic can be seen as a promising formal technique for representing fuzzy Composition mechanism constraints. In this paper, we have presented a solution to use Abstract Interaction approach in Sensor Network discovery and analysis. We have proposed methods for ranking and selecting Sensor Network based on an Abstract Interaction definition of abstract Composition mechanism constraints. The user's constraints are formalized as abstract concepts and the Composition mechanism criteria's are expressed as abstract expressions.

This model can be seen as a contribution towards a more complete solution for Sensor Network composition integrating fully Composition mechanism features.

References

[1] J Epstein, S Matsumoto and G McGraw. "Software Security and SOA: Danger, Will Robinson". *IEEE of Security & Privacy*. 2006; 4(1): 80-83. doi:10.1109/MSP.2006.23
[2] HF EL Yamany, MAM Capretz and DS Allison. "Intelligent Security and Access Control Framework for Service-Oriented Architecture". *Journal of Information and Software Technology*. 2010; 52(2): 220-236. doi:10.1016/j.infsof.2009.10.005
[3] R Kanneganti, P Chodavarapu. "SOA Security". *Manning Publications* Co., Greenwich, 2008. http://www.manning.com/kanneganti/
[4] G Yee. "Privacy Protection for E-Services". *IGI Publishing*. Hershey. 2006. doi:10.4018/978-1-5914-914-4
[5] Hu Ruo. Channel Access Controlling in Wireless Sensor Network using Smart Sensor Network System. *Applied Mathematics & Information Sciences*. 2012; 6(3S): 807-814.
[6] Hu Ruo. Stability Analysis of Wireless Sensor Network Service via Data Flow Methods. *Applied Mathematics & Information Sciences*. 2012; 6(3S): 787-792.