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Research of dynamic context modeling method oriented resource based on petri network and ECA model

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ABSTRACT

Context information modeling capable of supporting context-aware application, improve the ability of intelligent and personalized service. Selection of modeling method is not easy, however, need to solve the problem of unified operation interface, reflect the dynamic relationship between the context object, formalization and graphical methods. And provide granular packaging to support reuse and aggregation, design a kind of machine readable modeling language (uml) to support the execution and so on. Such difficult problem should be solved. The Web of Things (WOT) is one such iot application architecture, straight through the open sensor. And other resources to provide a unified interface style and be applied aggregation. Its method is to follow the REST of a resource-oriented (Representative State Transfer representation State transfer) architectural style, the network things are treated as resources and give corresponding identification, and take share of connector interface to achieve the convenience of operation, and finally through the network can be connected with the hypermedia relations. At the same time based on Petri net and the design of the ECA model of dynamic context modeling method, to achieve the graphical and equipped with formal and execution environment. The results of this method applied is to reduce the heterogeneity of the context data, better solved the problem of the context and unified logo and interface. Along with the demand of the market and the development of technology, of course, this kind of method in practical application process inevitably occurred problems, needs to be further research and development in the future.

KEYWORDS

Resource oriented; Petri nets, ECA model; Dynamic situation; Modeling method.



INTRODUCTION

In general in the field of computer application, how to realize users' management better. And in turn, have the flexibility to adapt to the characteristics is the main direction of context-aware computing research and target. The contextual information modeling is the important research field of context-aware computing technology and the important link, can effectively reduce the complexity of context-aware application and improve the sustainability of the application. The reusable can be shared, context model can also reduce assessment and maintenance costs, so the context model of the design is good for context-aware computing is extremely important. At present about the context modeling methods in spite of the many. For example, the key value configuration model of modeling, markers, graph model, the object-oriented model, the formal graphical model based on Petri net and so on. But there are problems and challenges exist, this needs a kind of symbol, networking, modeling method based on rules and procedures to ensure that the resources reuse and executable context. The resource oriented dynamic situation based on Petri net and ECA model modeling method is able to meet this demand, namely the Petri net for graphical and formal modeling, workflow engine and through ECA rules execution environment, so as to better design context model provides the solution^[1].

CONTEXT MODELING AND DESIGN PRINCIPLES

The definition of context and context modeling

In general, the context is the pervasive computing environment, interact with the user or application entities (including physical and virtual entity) can be used to describe the state express or implied by any of the information. For space attribute of the entity, virtual entity for broadband network and software such as this can carry a certain information of virtualization entity, not to speak of a physical entity, such as room of occupies space object in the realistic society. For real time property, entity not only points to the current state (such as temperature, humidity, etc.), but also to historical status (e.g., the temperature of a few days ago). Accordingly, having certain dynamic context, the dynamics of context model needs to pay attention^[2].

For now, the context modeling method applied in the pervasive computing environment mainly exist the following kinds:

(1) Tag configuration model

The model commonly used in equipment hardware and software parameters such as the context information, and through a hierarchy of markup language to accurately describe the context information types and data structures. If use RDF/S and the XML serialization, based on the Composite "Capabilities/PreferencesProfile (CC/PP) and User AgentProfile (UAProf) to extend the process, in turn, support high dynamic context information. But it should be pointed out that the model for the relationship between the context information is hard to define.

(2) The key values of the model

This model is mainly used for distributed service framework, typical performance in the operating system environment variables, above and below the value of the information submitted as environment variables for the application. Therefore, this model is relatively simple to operate, with a series of attributes can be key to way to describe and support the service discovery process (SLP), but does not apply to design efficient complex context algorithm.

(3) The object-oriented model

The model using the encapsulation of the object-oriented technology, the details of the encapsulated in the object and require specific interface to achieve access to the context information, thus improve the reusability of context, but it makes it hard for operation interface and has the uniformity, and limited to specific modeling object. Such as physical and logical sensors provide Cues of abstraction and object-oriented modeling CUIDE project.

(4) Graph model

Has the general structure and powerful graphical component of UML is also very suitable for context modeling, this module can use diagram to achieve visual, but at the same time is unable to describe the dynamic characteristics between context and difficult to verified and calculated. In practice, there are related to air traffic management and on the basis of the object is a role model of context information modeling.

(5) The formal graphical model based on Petri net

This model is mainly based on both mathematical and graphical expression of Petri net and set up, and suitable to describe the computer system of asynchronous concurrent model. And trend of today's research shows that by Karl a. Petri invented in the last century 60 s Petri net increasingly is considered to be the mother of all process definition language. That is used to express the relationship between context and dependencies.

So far, but even so, Petri net to design more tend to use context situation modeling method. In addition, it is necessary to point out is the method of Petri net for more than formal verification and analysis, and the application of specific application system deployment and execution is not applicable.

(6) Model based on ontology

This model is mainly based on the concept of Shared conceptual model of concept and the relationship between the specification and description, using the W3C Web Ontology Language (OWL) was used to model the context. From this we can see, the model of knowledge sharing, support logic, is advantageous for the use of existing mature ontology library advantages of knowledge reuse.

(7) Model based on logic

The model is defined as the facts, formulas, and within the context of the rule, has the high formalization, said new facts can be derived from a collection of facts of conditions, and the context as the condition of complete individual to target specific subset reasoning.

The context modeling design principles

Standardized principles: first, the principle requires the operation of the context data must be based on a unified semantic without ambiguity of the interface. In order to achieve a standard interface for use of context. Principles of can be identified: context data needs to be global in its sensing application identity, through a unique identification is needed in the global access, this way can be fixed by identifying the implementation model of proper function. Third, regularization principle: the change of the context data should have, under the condition of specific rules shall be the trigger of a specific event occurs at the same time and change the state of another context, these are all based on rule engine. Sixth, the granular principle: context can be abstracted as services, and the context of fine-grained data can be aggregated into the context of a coarse-grained service. Seventh, networking principles: context modeling can exists in the form of network topology, the network topology contains vertices and edges, which vertex context data, says side said the relationship between the context^[3].

THE RESOURCE ORIENTED DYNAMIC SITUATION BASED ON PETRI NET MODELING METHOD

The principles of resource-oriented and key terms definition

For context modeling is not exceptional also, need to abide by the principle of resource oriented: first, the principle of unified resource representation formats, resource supply and demand both sides can be negotiated interaction, also can be XML. Multiple expressed in the form of JSON, etc. Second, unique identification principle, only in the URL as a symbol of resources. Third, the standard interface principle, general with HTTP PUT/GET/POSTDELETE as operating resource standard interface. Fourth, the principle of hypermedia link, need to rely on resources to realize the interactive link URL resource description and good design. The following key terms are defined to describe:

Definition 1: resource oriented context (ROC) refers to the context of resources, in line with the REST style WoT resources is generally recognized as the ROC of minimum size.

Definition 2: the context of events (CE) refers to the rules of a particular constraints, context values change the behavior of the trigger an event action process.

Definition 3: Dynamic Situation (DS) refers to the ROC and CE constitute a resource collection. The collection respectively by the context events and hyperlinks to establish and reflect dynamic relationship^[4].

3.2 The context of resource oriented Petri net model

PN is defined by the collection and operating, and contains a library, change and directed arcs and token by four elements, the libraries and change nodes with circular or square said. Thus, ROC can be modeled as PN form, namely COPN. Defining

4: the Resource - oriented Context Petri Net is a group of five yuan COPN = (P, T, F, I, o), the P and T, respectively called COPN library (Place) (Transition), and the change F Flow relationship (Flow base), I for initial import library (Input Place), 0 to terminate the Output library (the Output Place).

$$P \cap T = \Phi \quad (1)$$

$$P \cup T \neq \Phi \quad (2)$$

$$F \subseteq P \times T \cup T \times P \quad (3)$$

$$i = \{x \in P \cup T \mid (x, i) \in F\} = \phi \quad (4)$$

$$0 = \{x \in P \cup T \mid (0, X) \in F\} = \phi \quad (5)$$

As input and output and the CE rules exist in the initial input library and terminate the output of the distribution determines the dynamic characteristic of COPN of Token, and characterization of the state of the ROC, and consumed by the initial input library and termination of the generated output library. COPN Peri web graphical representation is shown in Figure 1:

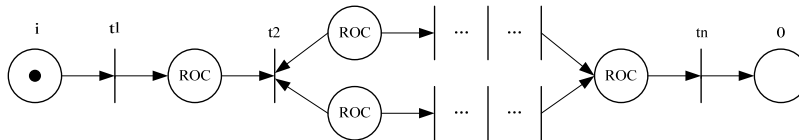


Figure 1 : COPN Peri net graphical representation

BASED ON ECA MODEL OF DYNAMIC CONTEXT MODELING LANGUAGE AND EXECUTION ENVIRONMENT

The context of resource oriented Petri net mapping and ECA rules

ECA rules by the Event - Condition - the Action (Event Condition one Action) consisting of a triple execution method. Its semantic is: when the composite event expression describes composite event occurs, check whether compound conditional expression is true, if it is true then send out. The TABLE below will be sent to you by ROC. COPN and ECA Rule comparison and mapping. the ROC, COPN and ECA Rule mapping is shown as TABLE 1.

TABLE 1: The ROC, COPN and ECA Rule mapping

ROC (Style)	COPN (Modeling)	ECA Rule (Execution)
Context (resources), the URL as a resource identifier	Place (Library)	ECA in the Event: the Event - Vanaged Object Event management objects
HTTPPUT、GET、POST、 DELETE operation interface for resources	Transition (Changes) ; When input Place have Token, the Transition is activated, the output Place state changes to generate a new Token	ECA execution; When the Event occurs, and the Condition to satisfy conditions, the Action is triggered
Hypermedia (resources, the correlation between application state jump), the relationships between the resources	Flos (Directed arc)	ECA decision-making process: the Event management object through the if...Then...The relationship between the rules and operation with the Action object
Resources, according to encapsulate the resource state, such as the value of the temperature of air conditioning switch state, the position of the people, it's hot air conditioning switch state	Token (Token) , After Place the Token is in Place, Transi was ignition tion allowed, thus be ignition	Condition in ECA
Identification, granular, standardization, networking	Formal, routing, network	Rules, executable

Based on Petri net resource oriented context of ECA markup language

Resource-oriented COPN Markup Language design named ECA - -based Context Petri Net Markup Language one CPNML (ECA). The following TABLE is the ECA - CPNML Situation used for characterization of DS and status. CPNML Situation file label style which evaluate the status of the DS is shown as TABLE 2.

Dynamic situation based on rules lead climb Execution environment (DS Execution Environment)

Based on ECA - CPNML modeling for dynamic situation, ECA - CPNML can be transferred to the ECA rules engine identification by language, then based on Ponder2 policy engine execution environment, dynamic situation of architecture as shown in the Figure 2 below.

Event Bus: Mainly responsible for monitoring function, through the Managed Object to define this situation events, and give the Policy context event transmission Service module decisions; ECA - CPNML Parser: mainly responsible for parsing and extracting the ECA - CPNML file and Rule. Rule the DB: be responsible for structured storage input rules details. Policy Decision: is mainly responsible for parsing the Event Bus incoming events and matching with the deposit to the strategy in the DB Rule, and through the Communication Inteface RESTIuI API provided complete matching Policy, if the match is successful activate the rules. The Policy Action, is mainly responsible for calling after execution rule matching the corresponding Action to change the target state. The Communication Interface: provide a REST API, access to a target resource support REST way, defines the four standard Interface: http_put(). http-get(), http_post(), http_ delete(). By ECA - CPNML modeling after DS will be deployed in the DS Execution Environment. And parse and execute according to the

following steps: the first step to load the target file. The second step is to check token state fields. If its value "unready" and "ready", respectively, enforce respectively the third and sixth step. The third step to check field specifies Rules file, if respectively display "None" and not "None", you will need to read the Linked respectively Rules and the Rule of Component field points to the file and each step 5 and step 4. Step 4: if the rules file traversal, token stat fields can be set to "ready", read the rules file and skip to step 6. If there is no traverse the rules file, Situation file can be set as the target file to return to the first step. Step 5: using the rules to determine whether a Token field to satisfy the judgment of the conditions specified in the Object, if will token state field is set to "ready" and skip to step 6, if not, repeat step 5; Step 6: according to the operation mode and parameters will Action Situation, pointing to the file is set as the target file and returns the first step^[5].

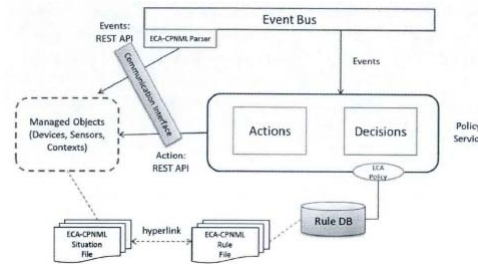


Figure 2 : DS Execution Environment architecture based on Ponder2 engine Extension

TABLE 2 : ECA - CPNML Situation file label style which evaluate the status of the DS

Element	Attribute	Meaning
Situation	url: Situational global identity	DS dynamic situation, corresponding Petri net in Place
	id: Clean inside the slope	
Component-Rules	name: situation	The regulation of the situation
	operation: The situation of resources permissions to operate, four kind of permissions PUT/GET/POST/DELETE	
Linked-Rules	tokenstate: The situation of library token state. If token Ready for the "Ready" or as "unready", Consumed by the token state set Tokens	The rules of aggregation scenarios associated with the DS
	-	
Consumed-Tokens	-	Token state collection, which is made up of Token
	-	
Token	id: Token id	Context is a token, its value or the state of the dynamic scene
	Name : Token Name	

CONCLUSION

Resource oriented modeling method of dynamic situation to follow the REST architectural style, using Petri model of dynamic context resources relations, shall be introduced at the same time have the ECA rules characteristics model to do the business logic. But not to calculate and validate the correctness of the model dynamic situation, still need further research and discussion later.

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