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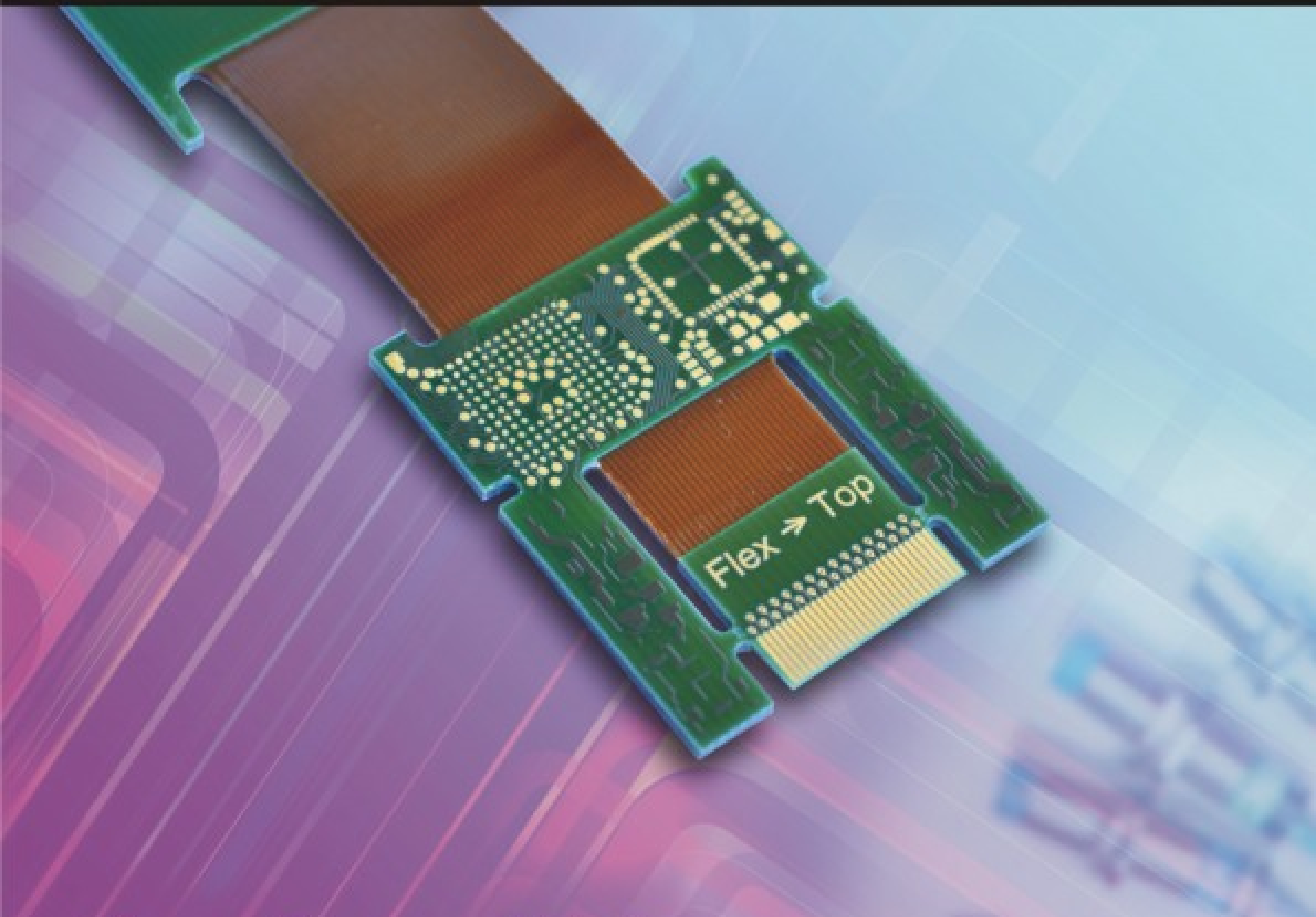

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The Research Abort Concept Restructuring of the Sensor Semantic Networks

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Abstract: A Semantic Sensor Network (SSN) is a sensor network including semantics of sensory data and context information, and relationships between the semantics by using Semantic Web technologies. Even though much research has been activated on SSN, there is little activity on how to restructure concepts in SSN. Research and developments in sensor semantic computing has gained much attention in areas of sensor data mining, sensor semantic, among others. Dealing with large domain concept in this computing environment and its difficulty becomes a difficult task. The idea of concept restructuring is to deal with and reduce the difficulty in dealing with large domain concept and to provide semantics for concept integration, expansion, and update. In this paper, we tackle the task in developing the mechanism to provide the above-mentioned semantics and the framework for processing mechanism integration in concept restructuring using UML-based design. Processing mechanism confirming was conducted to verify towards realizing a workable concept restructuring method.

Keywords: Sensor, Semantic Network, Concept Restructuring, Processing Mechanism, Web Technology

1. Introduction

A Semantic Sensor Network (SSN) is a sensor network including semantics of sensory data and context information, and relationships between the semantics by using Semantic Web technologies. Even though much research has been activated on SSN, there is little activity on how to restructure concepts in SSN.

The evolution of the Semantic Web and the adaptation of its technology in sensor computing environment have created the so-called sensor semantic [1]. In sensor semantic organization, the host computer is enabled to understand the content of "metadata" (defines the meaning of data) and its relation with other metadata hosted by other computer host(s), and this information is processed automatically. Using concept technology, the information on the Web can be retrieved with improved accuracy and effectiveness. However, as sensor (concept) databases and computational resources are geographically distributed, processing the required concept will become more complex and will relatively exhibit low performance [2].

Scientific processing mechanisms, in particular, have emerged as a means to formalize the structure integration of processing mechanisms on the grid environment [3]. In our continuing effort and study in sensor semantic computing, this paper describes the processing mechanism of sub-concept extraction using UML-based design based on some optimization method, towards the development of a framework for processing mechanism integration in concept restructuring. Some procedures were applied to validate the processing mechanism and the results are described.

Article number P_1193

In the field of sensor networks, the term "association confirming" is used for denoting a variety of techniques aimed at semantic prediction, which is, computing and tracking the association of a node. Mobility prediction can be exploited both at network and service level. At network level, semantic prediction and relationship support several crucial tasks, such as handoff management, efficient code division in 3G network, verticality factor prevision for W-CDMA network, wireless routing management [4], system for QoS support [5] and resource relationship [7]. At service level, semantic prediction and relationship are tightly coupled with number of relationship-based applications, such as, navigation, instant messaging [8], friend finder and point of interest services [9], emergency rescue, and many other safety and security services. Although some of the above applications need only rough association estimation, many of them need precise tracking of node association within cells to provide an adaptable quality of service.

A first branch of research on sensor association confirming focuses on satellite-based association, i.e., GPS, which is an interesting option for high-end applications, where relationship precision represents a critical requirement. However, standard GPS association confirming is not well suited for all contexts, as for instance in dense urban areas or inside buildings, where satellites are not visible from the nodes. For these reasons, we claim that even leaving costs and impact on battery consumption aside, GPS techniques are not likely to be the key technologies for a number of interesting Relationship Based Services (RBSs), such as sensor node tracking and path certification. Also, GPS systems are not suitable within urban areas, due to the high costs of their adaptation to urban settings. By contrast, our solution is based on traditional GSM/3G networks and does not involve any change to existing sensor network infrastructure being based on data collected by the sensor network. Our general purpose, low cost Node Service Tracking System (NSTS) for sensor networks provides semantic prediction both at network and service level.

In this paper, we discuss the importance of SAS information in Induced Sensor Network (ISN) prediction for NSTS and propose a novel technique for high reliable nodes relationship and tracking. Our proposal relies on additional information extracted from a SAS database covering the area of interest, used in conjunction with new predictive Detecting. In general SAS maps can include information about the roadways (Type 1), to improve tracking and trajectory prevision, and about the environment (Type 2), used especially for ISN or time delay prediction (for a complete overview of relationship techniques see Section 2). Regarding Type 1, we classify the information extracted from SAS maps in three layers with increasing level of detail: i) layer 1 provides a coarse-grained subdivision of the mapped area into regions (e.g., pedestrian-only areas), ii) layer 2 provides information such as streets width and precise street conformation, iii) layer 3 provides highly detailed information (e.g., distance from crossroads, one-way street) and, when available, information on traffic and speed limits. Concerning environment-related information (Type 2), we consider two possible levels of detail: the absence of information (really diffuse in many SAS map), and the presence of terrain or buildings information.

Our approach takes advantages of both from type 1 and type 2 information of SAS maps, the more information is available, the more accurate the relationship will be. The level of relationship accuracy, in fact, depends on maps information and time constraints.

Our novel contributions can be summarized as follows.

- Improved database technique for multiple Options' association confirming. Our technique is based on an Enquiry Table (ET) signal strength approach where the Enquiry Table is filled with path loss previsions of each detector. These previsions take advantage from environmental information extracted by SAS map (Type 2), and consider the detector's shape to better fit real environments. The Enquiry Table is then used to perform a multi-Options selection. A local minimum management strategy is included to improve the precision in multi-Options selection process.
- Time Series Tracking (TST). Our technique exploits SAS map (Type 1) information and predicts motion model to select one among all Options' relationships. Each Option is previously projected on the road to check whether the semantic model1 is compatible with the actual movement. TST is also able to deal with ISN fluctuation building a time Series graph.
- Restricted New Detecting. We perform a new Detecting for better enforcing other map constraints, such as, one-way streets. Finally, we validate our algorithm providing real experiments carried out in a complex urban environment, that is, the city center of ShangHai, China.

2. Experiment Environments

Fig. 1 shows the system organization of the Distributed Concept Framework (DOF) on a sensor semantic.

The system composed of a Resource Broker, CRPR (Concept Restructuring Processing Resource), Algorithm Server, Concept Server, and Processing Plant. The Resource Broker [6] takes care of handling the users' means, security problem, and other policies to access heterogeneous resources in a widely distributed environment. It has the role to make the connections to destination according to the network traffic situation, number of users, and other related conditions. Likewise, it has the role to distribute the job for the best semantic and performance sought by the user. The Concept Server contains the database of concept, and provides the needed concept for sub-concept processing which it can send to CRPR or directly to the Processing Plant. The Algorithm Server contains the needed algorithm(s) which may be sent to the CRPR or to the selected Processing Plant, which can be a high-end processing computer, a cluster computer, or a supercomputer.

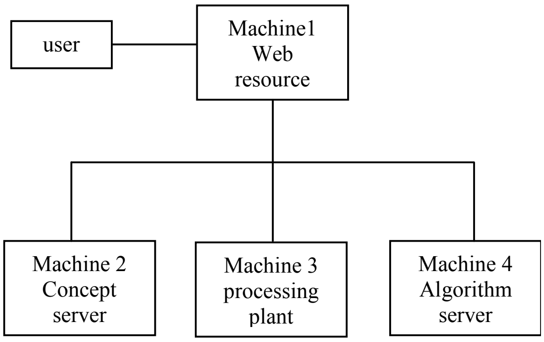

Fig. 1. System of Distributed Concept Framework.

The CRPR has the role of executing the sub-concept processing given the concept data from the Concept Server and the required algorithm from the Algorithm Server. Depending on the CRPR's processing capacity, the CRPR may relegate the sub-concept processing execution to some Processing Plant. To facilitate processing and reduce network traffic, the CRPR may instruct the Concept Server to send directly the concept data, and the Algorithm Server for the required algorithm to the selected Processing Plant. Either way, the CRPR sends the sub-concept processing results back to the user.

3. Related Work

The transactional grid processing mechanism semantic (sensor TW) of the Shanghai sensor deals with guaranteeing reliability and automation of e-business application(s) [7]. They have presented the coordination algorithm for the management of the transactional grid processing mechanism, and the confirming of the algorithm is examined by using Semantic Net. The SNMVT proposed a Semantic Net Processing Mechanism Verification and Optimization Toolkit (SNMVT) to help users explain a processing mechanism [6]. The authors presented some examples on the verification and the optimization analysis.

The paper in [11] describes a tool that supports verification of processing mechanism specified in UML activity graphs. Whereas [9], define formal execution semantics for UML activity diagrams that is appropriate for processing mechanism.

While our paper deals with processing mechanism integration and verification and uses UML, we focus our subject on the sub-concept extraction processing mechanisms integration and confirming on a sensor semantic environment.

Sensor semantic relationship techniques are the topic of several studies in the area of sensor network applications. Among the solutions used by GSM/3G technologies for relationship purposes, the most important and already standardized are restructuring time and concept strength techniques.

Restructuring time-based methods rely on time measurement.

However, they have the main disadvantage of producing acceptable data only when the Line-Of-Semantic (LOS) between terminal and based stations is guaranteed. Generally speaking, the main limiting factor of this class of techniques is that the accuracy of the estimated association depends mainly on the number of measurements done and on the geometric configuration. This problem is even worse in urban environments, where multipath restructurings lead to very complicated scenarios without LOS between the node and the base stations.

Concept strength-based techniques instead are based on Received Concept Strength Indication (RCSI), which measures concept attenuation, assuming free space restructuring and all-directional restructurings, i.e., concept level contours around a base station are concentric circles, where smaller circles enjoy more powerful concepts. Although the same principle works well also for directional restructurings, concept level contours are not concentric circles, but more complex geometrical shapes.

Exploiting this assumption sensor network restructuring relationship problem is reduced to the well-known triangulation association problem which is similar to time-based and angular approaches. As a consequence, RCSI metric is also not well-suited for urban areas and the concept strength calculated with this approach is not more reliable than the one obtained by time-based approaches. The lack of precision in urban environments is then due to the fact that free space restructuring assumption does not hold because of multipath restructuring and shadowing, leading to complex concept shapes. Physical phenomena influencing radio restructuring are mainly four: reflection, diffraction, penetration, and scattering. To solve these problems, deterministic (ray-tracing), empirical (Keli-Stone, Mike-Sevens), and hybrid techniques (Dominant Path) for ISN prediction have been developed, for various environments. ISN prediction methods using concept strength can be profitable for relationship purposes. Even if path loss prediction techniques seem to achieve the best results, many problems still remain unsolved, including the intrinsic error of ISN prediction algorithms and fluctuations due to environmental changes. In this context, recently, an interesting approach has been proposed to deal with ISN fluctuations, by using support vector regression [10]. In a nutshell, regression techniques model the relationship problem as a checkpoint relationship, which can be solved as a machine learning problem. Our approach, however, does not rely on a training phase, since real data sampling are not available everywhere.

Furthermore, we focus on tracking and on dense association confirming, where checkpoint and neural network based strategies are not suitable. Specially, we rely on the basic techniques outlined below.

Database Correlation. This technique relies on a database built on RCSI predictions or measurements. Nodes associations are determined by evaluating RCSI measurements, which are performed by individual terminals or even by the BSs. The measurements are compared with the entries in the database. The corresponding correlation calculations find out the database entry that better matches the measurements lead to the relationship estimation. Our approach basically relies on the principle of database correlation. Much in line with the RADAR system developed by Microsoft research [4] for wireless networks, our method uses an ET for multiple Options' selection. Differently from RADAR, however, we select the number of Options depending on the sensibility of the region and on SAS information.

Restructuring. Using triangulation and database correlation, the intrinsic relationship error of RCSI is never taken into account. Many recent works are aimed at overcoming this problem using Double-Restructuring techniques with sensor network motion model and RCSI triangulation. One interesting work treats the problem of semantic in ATM network.

It develops a hierarchical user semantic model that closely represents the movement behavior of a sensor network user, and uses pattern matching and Double-Restructuring, yielding to an accurate relationship prediction algorithm. Another work proposes two algorithms for real-time tracking, relationship, and dynamic motion of a node station in a sensor network. This method is based on Restructuring and two Rapid restructuring (one to estimate the discrete command process and the other to estimate the semantic state). The semantic model is built on a dynamic linear system driven by a discrete command process that was originally developed for tracking maneuvering targets in tactical weapons system. The command process is modeled as a Gaussian process over a finite set of acceleration levels, as in [7]. The Detecting technique, presented in our work does not Detector the relationship of sensor network using RCSI, but it takes the most probable association Detected by our Time Series Tracking (TST) technique and tries to enforce the map and motion model constraints. Therefore, our Restructuring technique is well distinct from the ones introduced above, even if it exploits a similar motion model.

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.

3.1. Time Series Tracking (TST)

For validating Options selected using the techniques introduced in the previous section, we developed a tracking method based on a time-series algorithm. This algorithm uses m time association estimates and n nodes Options at each time to define a directed acyclic graph, called Time Series Graph (TSG). Every node p in the graph represents one of the possible associations of the node, while edges, defined by the bounded nodes (source and destination nodes), represent motion between them. Each edge has associated a weight that is computed based on reach-ability and map constraints. In our previous work [11], this weight was defined by taking into account the estimated velocity and acceleration at the source node, and by evaluating the reachable velocity and acceleration considering the association of the destination node. The obtained values were then compared with information inferred from the map. Of course, this type of new function works well when a reasonable upper bound to the association error can be assumed. Since in this paper we deal with real (as opposed to lab) environments, an acceptable error for every association cannot be guaranteed. Therefore the aforesaid weighting techniques cannot be applied. We then adopt a simpler weighting technique postponing the refinement to the Detecting stage.

4. Concept Optimization Method in Brief

In narrowing down the target concept/sub-concept, we developed some optimization method, namely: the Entirety Confirming Checking (EnV), and the Correctness Confirming Scheme (CrS) [6]. EnV is a combination of four subschema that check whether there is various form of consistency, and CrS consists of three subschema that check whether there is various form of meaning completeness. The following describes these in detail.

4.1. Entirety Confirming Checking (EnV)

As the name implies, EnV checks for the consistency of the user-specified requirements of the target concept in the form of labeling. Currently, EnV itself is a combination of four sub-method that check for various forms of consistency, the simpler phases within the entire extraction process, and illustrate our distribution scheme pertaining to the ontological workload associated with it. EnV ensures that the requirements as expressed by the user (or any other optimization scheme) are consistent, i.e. there are no contradictory statements in the labeling, as set up by the user. By ensuring requirements consistency, we eliminate the possibility that no sub-concept (based on user preferences) is derivable in the first place. EnV is currently the very first rule to be applied during the extraction process. Moreover, it is also one of the rather simpler rules within the overall extraction process; both from a conceptual level as well as from an implementation viewpoint. EnV is a suite of four optimization method, which without any implicit ordering or execution priority, we denote as EnV(1)–EnV(4).

EnV(1)

If a binary relationship between concepts is selected by the user to be present in the target concept, the two concepts that the relationship associates cannot be disqualified/ deselected from the target concept.

EnV(2)

The EnV(2) rule is similar to EnV(1) with the difference that instead of a binary relationship over the set of concepts, it is applied on a special relationship, called an attribute mapping that exists between concepts and their attributes. This rule enforces the condition that if an attribute mapping has a selected labeling, the associated attribute as well as the concept it is mapped onto must be "selected" to be present in the target concept.

EnV(3)

This rule imposes a requirement on a more specific characteristic of an attribute mapping. It stipulates that if an attribute mapping has a deselected labeling, its associated attribute must also be disqualified from the target concept. Basically, no contradicting preferences are allowed between an attribute mapping and the associated attribute. EnV(3) together with EnV(2) imposes this condition.

EnV(4)

EnV4 is relatively more complex than that of EnV(1)–EnV(3).We utilizes the notion of a Path, again informally, for illustrating EnV(4). Paths are very important in the specification of concept views. They provide seemingly new relationships (new information) that are semantically correct, albeit only implicitly present in the concept definition. A path is defined as the chain of relationships that connect concepts, where the end concept of one relationship is the start concept of the following relationship in the chain. Note that the same relationship can appear only once in the entire path. From an EnV(4) viewpoint, the emphasis of a path lies on the first and last concept it visits, as these two are connected by the path. However, alternative formulations of the "path concept" have been utilized by imposing certain qualification criteria on the concepts that are a part of the connection and/or the relationships that form the chain for other optimization method. Based on the above formulation of a path, we can now introduce the fourth required consistency rule. If an attribute is selected, but the concept it "belongs" (mapped) to is deselected, EnV(4) stipulates that there must be a path from the attribute to another concept that is not deselected. Moreover, the path can only contain relationships with a label other than "deselected".

4.2. Correctness Confirming Scheme (CrS)

The idea of semantic completeness of concept can be interpreted in a number of ways. However, for the purposes of sub-concept extraction, it amounts to the inclusion of the defining elements for the elements selected by the user by way of requirements specification. A defining element is a concept, relationship or attribute that is essential to the semantics of another element of the concept. For example, a concept selected to be present in the sub-concept would be semantically incomplete if its super-concept (the defining element in this case) is deselected at the same time. This could be further generalized into a situation where a set of elements are connected by an IS-A relationship unto any arbitrary depth. The scenario can only get more complex in the presence of more complex relationships such as multiple-inheritance, aggregation, etc. The Correctness Confirming Scheme (CrS) exists to guard against such inconsistencies. The CrS sub-method is briefly described as follows:

CrS(1)

If a concept is selected, all its super-concepts, and the inheritance relationships between the concepts and its super-concepts, must be selected.

CrS(2)

If a concept is selected, all the aggregate part-of concepts of this concept, together with the aggregation relationship, must also be selected.

CrS(3)

If a concept is selected, then all of the attributes it possesses, with a minimum cardinality other than zero, and their attribute mappings should be selected.

5. Processing mechanism Design by UML Activity Diagram

The flow chart is origin to the activity diagram of UML, and is almost similarly interpreted on semantics. The activity diagram of UML is used to show the behavior. The behavior like the flow chart for automatic and the chain is shown below. If one activity ends, the following activity automatically begins. The processing mechanisms of the above two schemas, i.e., EnV and CrS are designed using UML. Here, we use activity diagram constructs action node, wait state node, sub-activity state node, decision/merge, fork/join, initial and final.

5.1. Entirety Confirming Checking (EnV)

This activity diagram can be divided into four steps (step1-step4).

Steps in EnV(1)

1. At the beginning, one in the pair concept is determined whether it is qualified/selected or disqualified/deselected.
2. If the concept is qualified/selected, it proceeds to 3; otherwise, it jumps to 6.
3. The other concept in the pair is then determined whether it is qualified/selected or disqualified/ deselected.
4. If the concept is qualified/selected, it proceeds to 5; otherwise, it jumps to 6.
5. The binary relationship and/or consistency of the pair concept is validated.
6. End.

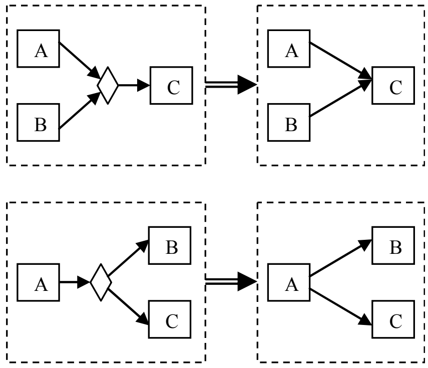

Fig. 2. Example of eliminations of fake state nodes.

Steps in EnV(2)

1. At the beginning, one concept in the set is determined whether it is qualified/selected or disqualified/deselected.
2. If the concept is qualified/selected, it proceeds to 3; otherwise, it jumps to 6.
3. The other concepts are also determined whether they are qualified/selected or disqualified/deselected.
4. If the concepts are qualified/selected, it proceeds to 5; otherwise, it jumps to 6.
5. The attribute mapping of the set of concepts is validated.
6. End.

Steps in EnV(3)

1. At the beginning, one concept in the set is determined whether it is qualified/ selected or disqualified/deselected.
2. If the concept is disqualified/deselected, it proceeds to 3; otherwise, it jumps to 4.
3. The associated attributes of this attribute mapping is also disqualified/deselected.
4. End.

Steps in EnV(4)

1. At the beginning, an attribute is determined whether it is qualified/selected or disqualified/deselected.
2. If the attribute is qualified/selected, it proceeds to 3; otherwise, it jumps to 5.
3. If the concept in the attribute is deselected, it proceeds to 4; otherwise to 5.
4. A path from the attribute to another concept which is not deselected is determined.
5. End.

5.2. Design of CrS

This CrS activity diagram can be divided into four (step1-step3).

Steps in CrS(1)

1. At the beginning, a concept is determined whether it is qualified/selected or disqualified/deselected.
2. If the concept is qualified/selected, it proceeds to 3; otherwise, it jumps to 4.
3. The concept's super-concepts and its inheritance relationship with its super-concepts are selected.
4. End.

Steps in CrS(2)

1. At the beginning, a concept is determined whether it is qualified/selected or disqualified/deselected.
2. If the concept is qualified/selected, it proceeds to 3; otherwise, it jumps to 4.
3. The concept's aggregate part-of concepts and relationships are selected.
4. End.

Steps in CrS(3)

1. At the beginning, a concept is determined whether it is qualified/selected or disqualified/deselected.
2. If the concept is qualified/selected, it proceeds to 3; otherwise, it jumps to 4.
3. The concept's attributes' with minimum cardinality other than zero and attributes' mapping are selected.
4. End.

6. Design and Confirming by Activity Diagram

In mathematics, a hyper-graph is a generalization of a graph, where edges can connect any number of vertices. An activity hyper-graph is connected directly with hyper-graph. An activity hyper-graph is a quintuple (Nodes, Edges, Events, Guards, LVar).

N nodes are partitioned into a set of AN activity nodes, a set of FN final nodes, and one initial node, Initial. Events are sets of event expressions, and Guards are sets of guard expressions. Actions are sets of action expressions. An activity hyper-graph consists of a set of labeled state nodes that are connected by labeled directed hyper-edges. State nodes of an activity hyper-graph are action state nodes and final state nodes. An activity hyper-graph can have variables. A hyper-edge can be labeled with an optional event expression and an optional guard expression, where the latter can refer to variables of the activity hyper-graph. For every XOR-node, all its entering and exiting edges maps into one compound transition. And for every AND-node, all its entering and exiting edges map into the same compound transition. If AND-nodes are connected to OR-nodes, the mapping becomes slightly more complicated. Syntactic constraints on activity diagrams are as follows:

1. Every edge that leaves an action state node is labeled with empty event NULL.

$$a \in AS \Rightarrow \vee\{guard(e) \mid \exists e \in Edges \cdot a2 \in source(e)\}$$

2. For every edge e that has action state node a as source, a is the only source of e.

This implies that for every edge with multiple sources, none of its sources is an action state node.

3. The disjunction of guards on the edges leaving an action state node must be a tautology.

$$initial \in source(e) \bigcup target(e) \Rightarrow$$

$$initial \notin target(e) \wedge source(e) = \{initial\}$$

4. The initial state node may only occur in the source of an edge. Moreover, if it is a source of an edge, it is the only source of that edge.

$$final \in source(e) \bigcup target(e) \Rightarrow$$

$$final \notin source(e) \wedge target(e) = \{final\}$$

The final state node may only occur in the target of an edge. Moreover, if it is target of an edge, it is the only target of that edge.

5. The edges leaving the initial state node must have no events and the disjunction of their guard expressions must be a tautology.

$$\vee\{guard(e) \mid e \in Edges \wedge source(e) = \{initial\}\}$$

$$e \in 2Edges \wedge source(e) \bigcap AS \neq \emptyset \Rightarrow event(e) = NULL$$

We convert the activity diagram into an activity hyper-graph, and verify the validity of EnV and CrS. The integration of nodes will be easy and its validity will be simple if the activity diagram is converted into an activity hyper-graph. We verify the confirming with regards to the relationship between element and transition of state, flow of control and non-execution element. The method is described as follows:

• Relation between element and transition of state Initial, final, activity, decision, and merge are called state elements. The state element connects the former element and the next element of the number decided respectively. The transitional element connects the initial and final state elements. Table 1 shows the number of the former and the next elements.

• Transition of state

1) Specification at the initial position - The initial position of the control is examined. If the number of initial elements is one, the initial position of the control can be specified.

2) Divergence control - The control after the element moves to one transition without failure. It depends on the guard condition from which transition the element moves after divergence. The guard condition number (g1, g2, g3, . . ., gn) in a certain divergence is a factor of ($1 \leq i \leq j \leq n$), in which gi and gj are different at a certain time, except when n=1.

• Non-execution element: It determines whether a non-execution element exists.

Table 1. Number of former and next elements.

State element	Former element	Next element
Initial	--	1
Final	1	--
Activity	1	1
Decision	1	2-
Merge	2-	1
Transition	1	1

6.1. Confirming of EnV

• Transition of state

1) Specification at the initial position - Because the number of initial elements is one, it satisfies the requirement.

2) Divergence control – In step1 of EnV(1), the number of decision elements is one. Because the guard condition is two, gi and gj becomes (1≤i≤j≤2). Therefore, the control decision in step1 of EnV(1) works. Likewise, from step 2 in EnV(2) to step 4 EnV(4) satisfies the requirements.

• Non-execution element. Because non-executable element doesn't exist, it satisfies the requirement.

6.2. Confirming of CrS

• Transition of state

1) Specification at the initial position - Since the number of initial elements satisfy the requirement.

2) Divergence control - The number of step1 (CrS(1)) of decision elements is one. There are two guard conditions, and so gi and gj becomes (1≤i≤j≤2). Therefore, the control decision in Step1 of CrS(1) works, and satisfy the requirement.

• Non-execution element

Because non-executable element doesn't exist, it satisfies the requirement.

7. Conclusions

We described the EnV and CrS optimization method and corresponding sub-method for sub-concept extraction. We design and described the processing mechanism of each scheme using UML activity diagram, and converted it into activity hyper graph. We used relation between element and transition of state, transition of state, and non-execution element confirming criteria.

The processing mechanism of our proposed Distributed Concept Framework in a sensor semantic was designed using UML activity diagram. The relations between the element and transition of state, the transition of state, and non-execution element criteria were also used to validate the processing mechanism design. Preliminary results confirm the validity of the design which can be a reference in designing a VO (Virtual Organization), as part of a larger sensor semantic environment. Future work includes a more detailed design with more resources and thorough analysis and confirming of the processing mechanism integration, and its implementation on a prototype system.

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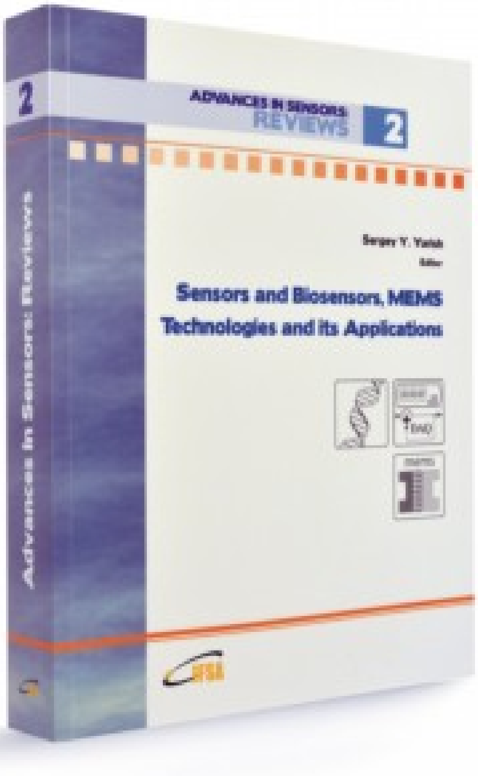

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