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Tutut Herawan
Rozaida Ghazali
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Mustafa Mat Deris *Editors*

Recent Advances on Soft Computing and Data Mining

The Second International Conference on Soft Computing and Data Mining (SCDM-2016), Bandung, Indonesia, August 18–20, 2016, Proceedings

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Preface

Soft computing became a formal computer science area of study in the early 1990s. Earlier computational approaches could model and precisely analyze only relatively simple systems. More complex systems arising often remained intractable to conventional mathematical and analytical methods. Soft computing refers to a consortium of computational techniques in computer science (like fuzzy systems, neural networks, etc.) that deals with imprecision, uncertainty, partial truth, and approximation to achieve tractability, robustness and low solution cost. Soft computing tools, individually or in integrated manner, are turning out to be strong candidates for performing tasks in the area of data mining, decision support systems, supply chain management, medicine, business, financial systems, automotive systems and manufacturing, image processing and data compression, etc.

Data mining is a process that involves using a database along with any required selection, preprocessing, subsampling and transformations of it; applying data mining methods to enumerate patterns from it; and evaluating the products of data mining to identify the subset of the enumerated patterns deemed knowledge.

The SCDM 2016 is very significant in a sense that it starts a host of activity in which Faculty of Computer Science & Information Technology, Universiti Tun Hussein Onn Malaysia, Soft Computing & Data Mining research group, and Faculty of Industrial Engineering at Telkom University Indonesia collaborated. After the success of our four previous workshop events in 2010 until 2013 and our first SCDM edition in 2014, we hope to continuously move in this journey of success through this Second International Conference. Indeed, we are honored to host this event and the fact that we are getting more papers, commitments, contributions and partnerships indicate a continuous support from researchers throughout the globe. We are much honored to be an integral part of this conference with the theme "Navigating the Future with Precise Knowledge".

The SCDM-2016 was held in Bandung, Indonesia during August 18–20, 2016. We received 122 regular papers submissions from 11 countries around the world. The conference also approved two special sessions—Ensemble Methods and Their Applications (EMTA) which accepted 12 manuscripts and Web Mining, Services and Security (WMSS) which accepted 10 manuscripts. Each paper in regular submission was screened by the proceedings' chairs and carefully peer reviewed by two experts from the Program Committee. Meanwhile for workshop submissions, the paper has been peer reviewed by two experts from the Program Committee. Finally, only 42 papers (for regular-giving an acceptance rate of 34%) and 22 papers (for workshops) with the highest quality and merit were accepted for oral presentation and publication in this proceedings volume.

The papers in these proceedings are grouped into two sections and two in conjunction workshops:

- Soft Computing
- Data Mining
- Workshop on Ensemble Methods and Their Applications
- Workshop on Web Mining, Services and Security

On behalf of SCDM-2016, we would like to express our highest gratitude to Soft Computing & Data Mining research group, Universiti Tun Hussein Onn Malaysia, Telkom University, Steering Committee, General Chairs, Program Committee Chairs, Organizing Chairs, Workshop Chairs, all Program and Reviewer Committee members for their valuable efforts in the review process that helped us to guarantee the highest quality of the selected papers for the conference.

We also would like to express our thanks to the three keynote speakers, Prof. Dr Jemal H. Abawajy from Deakin University, Australia; Prof. Mochamad Ashari, from Telkom University, Bandung, Indonesia; and Dr. Aida Mustapha from Universiti Tun Hussein Onn Malaysia.

Our special thanks are due also to Mr. Suresh Rettagunta and Dr. Thomas Ditzinger for publishing the proceedings in Advances in Intelligent Systems and Computing of Springer. We wish to thank the members of the Organizing and Student Committees for their substantial work, especially those who played essential roles.

We cordially thank all the authors for their valuable contributions and other participants of this conference. The conference would not have been possible without them.

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Contents

Web Mining, Services and Security

Integration of Self-adaptation Approach on Requirements Modeling

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Abstract. Self-adaptation approaches appear to respond to environmental complexity and uncertainty of today's software systems. However, in order to prepare the system with the capability of self-adaptation requires a specific strategy, including when conducting stage requirements modeling. Activity of requirements modeling to be very decisive, when selecting and entering new elements to be added. Here we adopt a feedback loop as a strategy of self-adaptation, which is integrated into a goal-based approach as an approach to requirements. This paper discusses the integration of the two approaches, with the aim of obtaining a new model, which has the advantages of both.

Keywords: Self-adaptive systems · Requirements modeling · Goal-based · Feedback loop · Rule-based systems · ECA rules

1 Introduction

Standish Group International [1], in the report shows that the challenge of software development continues to increase, reaching 43%, while employment requirements in capturing, selecting, and implementing a custom development applications is the most difficult activity. This is partly due to the requirements modeling for adaptation needs very different from the requirements for conventional requirements, which only aims to understand the problem domain, and is done only at design time [2]. Besides the cost of system maintenance continue developing States from 60% to 80% [3]. Thus, the issue of maintenance-related system configuration and reconfiguration of the system repeated has been a challenge that requires settlement.

These facts indicate that the software system must have the ability to adapt to a dynamic environment. In order to meet these needs, it is important to establish a perspective that can guide us in understanding the domain and identify possible changes [4], which need to be predicted from the beginning. Therefore, modeling changes to the system must be controlled completely, including the evaluation of needs, especially related to the design of the control system [5], it can be met, one of

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them during the activity of requirements modeling in order to realize an adaptability of the system independently, or known as self-adaptive systems (SAS). Activity of requirements modeling can be directed to arrest and formulate the needs of the system at design time, but is able to accommodate the needs at run-time. The second section of this paper discusses the related work, then on the third section we describe the proposed model, followed by a discussion of related work in section four, and we conclude this paper in section five.

2 Related Work

The focus of the research discussed in this section relate to the goal oriented requirements engineering (GORE) approach, based on a literature review and paper survey, this approach has had many successes as a basis for forming autonomous behavior adaptation needs. However, this approach to get its own challenges when it comes to meeting the needs of the nature of SAS. Table 1 shows the comparison of related research, in general model of GORE expanded by integrating elements that can bring the ability of self-adaptation. Among them, GORE collaborated with the principles of fuzzy logic as used in the model FLAGS and ADS-i*, this work focuses on addressing the uncertainty of the system, similar to LoREM, but the elements are adopted is model-driven approaches. Additionally, GORE approaches through an agent concept has been widely adopted, such as Tropos4AS, CARE, SOTA, GASD, STSs including Lorem, FLAGS, and ADS-i*, these works exploit the advantages of the concept of an agent to capture variability context and develop the behavior of self-configure. While the work GOCC and ZANSHIN, enter the control theory to bring a generic function feedback loops.

Table 1. Comparison of related work.

Model	Specification of design-time	Specification of run-time
LoREM [6] (Goal-based, Model-driven) Goldsby, 2008	i* model	Application-driven process
	Forth concept of requirements: goal, requirements, mechanism selection, infrastructure adaptation	Technology-driven process
GOCC [7] (Goal-based, Control theory) Naka, 2008, 2011	KAOS model	Control loop pattern (stimulus-respond)
	Modelling of configuration architecture generator (compiler): goal relation	Parser machine detector (new pattern and conflict)
	Three-layer (collect, analyze, act)	
FLAGS [8] (Goal-based, Fuzzy goal)	KAOS model and LTL	ECA rules
	Adaptive goal, run-time trigger	Supervision manager: mapping goal to BPEL

(*continued*)

Table 1. (*continued*)

Model	Specification of design-time	Specification of run-time
Baresi, 2010	Fuzzy goal, goal operator temporal	
ADS-i* [9] (Goal-based, Fuzzy goal) Serrano, 2011	i* model	Implementation BDI abstraction to JADEX
	Strategic dependency and rationale	
	Heuristic of i* abstraction into BDI	Reasoning machine: qualitative reasoning
	Fuzzy logic: task analysis and softgoal	
ARML [10] (Goal-based, Ontology) Qureshi, 2012	Techne model	ECA rules
	Integration of goal and shared ontology	Integration of PDDL3 and Hierarchical task network
	Context, resources, domain assumption	
GASD [11] (Goal-based, Model-driven) Wang, 2012	Prometheus model	OWL ontology
	Goal tree concept (selection algorithm): goal, plan, restriction model	Mechanism of knowledge based
	Designing of BDI architecture	JADE run-time
STS [12] (Goal-based, Ontology) Dalpiaz, 2013	Tropos/i* model	BDI agent
	Goal model, context model, plan specification, domain assumptions	Monitor-diagnose-reconcile-compensate
Zanshin [13] (Goal-based, Control theory) Souza, 2013	Techne model	PID controller
	Awarness requirements	Qualitative adaptation. Evolution requirements: ECA rules
	Variaton point (VP), control variable (CV), diferensial relation	
SOTA [14] (Goal-based, Natural language) Dhaminda, 2014	i* model and context-free grammar	Checking: labeled transition system analyzer.
	Goal pattern: achieve, maintain avoid	Mapping goal to event
	Precondition and postcondition goal, actor utility, entity and dependency	
Tropos4AS [15] (Goal-based, Model-driven) Morandini, 2015	Tropos/i* model	BDI agent
	Goal type, environment, failure	Transitions rules: goal state-intuition
	Environment and goal condition	
	Variability design	Inference rules

A variety of approaches are integrated self-adaptation to approach these goals, in addition to having the advantages of each still has some shortcomings, such as the principle of fuzzy logic and natural language constructions require approaches are quite complex and highly dependent on the specification requirements are very complete. In addition, the agency approach and model-driven substantially less can be directly mapped at run-time concepts related needs evolution cycle. While the application of control theory is very focused on the control feedback loop, in which the needs of the entity of the problem domain that is represented in the domain of models has not been included, as well as the need to determine variability and system independent, requires a special architectural design, so the need for further research to analyze the relationship. Inspired from the above description, arises an idea of how to formulate the mechanism of the process of adaptation of generic (providing a formal framework that can give rise generic function feedback loop for adaptation needs at run-time), but can accommodate variability context and behavior of real-world systems (through the ability of an agent in forming a knowledge of design time).

Here, we see loop feedback implementation has a promising chance if be equipped with data mining approach. A data mining algorithm can be functioned to face uncertain condition at run-time. these views become one of our future research concern to formulate a model that we are developing.

3 Integration of Self-adaptation Approach and Requirements

One approach GORE adopted in concept of requirements modeling are Tropos [16]. Stages requirements in Tropos consists of phases, (a) early requirements, a view to identifying the needs of stakeholders and how it relates to each other, (b) late requirements, capturing changes in a domain that is caused by the need for the system to-be and the true nature of the system. While abstraction of the model feedback loop which is used as the concept of self-adaptation, consists of monitors, analyzers, planners, executors, and knowledge (MAPE-K) [17]. Taking into account the context-aware scenario, MAPE-K implements architectural patterns ECA (event-condition-action), consists of three main components [18], which is a component context processor, the component controller, and component action performers, wherein (a) events, modeled and observed by one or more context processor, this component depends on the definition and modeling of context information, (b) condition, described the behavior of the application and observe the event, by empowering component of the controller is represented by the behavior description component, (c) action, triggered by action performers through a rule that has been specified.

3.1 The Concept of Integration

In order to realize the adaptability of the system, we steer stages in Tropos requirements may have the capability to monitor the variables of each goal decomposition of changes occurring, and can manage the changes at run-time (Fig. 1). This is done to supplement the capability requirements Tropos models, in capturing and representing variability of context and behavior of the system.

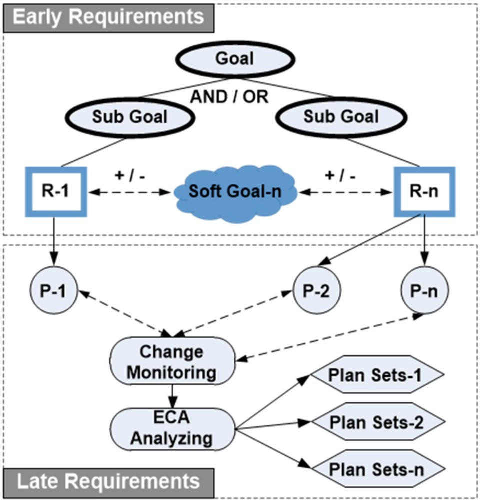

Fig. 1. Integration of self-adaptation approach on requirements modeling activity.

According to Zhuo-qun [19] in the modeling of i* model, variables can be derived from the actor's inner task set, the task is an entity that can be detected and the source of the parameter type, if a task has uncertainty, then all tasks that have a relationship dependencies with the task of the need to be monitored, and when determining what is monitored, the values of the parameters can be used to represent them. Based on these opinions, if the theory is applied to the model Tropos then this task equivalent to the plan, in which each plan may have a dependency relationship with the goals, resources, or other notation. While monitoring the variable and handling needs of adaptation, the model was developed as a criterion of feedback loop mechanism guarantees that the process will be established.

Early requirements other than the function to identify the needs of stakeholders, this phase also aimed to capture the monitoring requirements of any entity that allows the change. Thus modeling the goal at this stage is expected to represent the needs of early to determine the mechanism of adaptation. Begins with decomposition AND/OR towards goal into sub-goals, identify requirements (R−1, R−2, R−n) of each goal that may change and affect the parameters, and has contributed a positive or negative (+/−) to one or more soft goals (non-functional) requirements, topped off by defining variables and parameters of each of these goals (P−1, P−2, P−n). In the late phase requirements, delegates goal in addition to capturing the needs of system-to-be, directed also to analyze the needs of adaptation. Starting with the restructure dependency goals, monitor changes that affect the parameters of each goal (P−1, P−2, P−n), analysis by ECA methods to analyze behavioral changes, and to determine the variation of adaptation is based on the establishment of the rule which is defined as a plan (Plan Sets-1, Plan Sets-2, Plan Sets-n).

3.2 Case Illustration

Cases discussed is related to the adaptation needs of the system of lectures at universities. Where there is a class system actors who represent the needs of lecturer, students, and the program (prodi). The problem that occurs is the system must be able to ensure that teaching and learning activities can be held as scheduled. In addition, the number of face-to-face classroom sessions must achieve a minimum 14 and a maximum of 16 sessions, if it does not satisfy the range, it must be done through the establishment of additional tuition replacement schedule.

In the illustrative model of Fig. 2, hard goal or goal "to monitor the course" decomposed into two sub-goal of "organizing the lecture" and "cancellation of lecture" through OR-decomposition, meaning that if the lecture was held in accordance with the criteria, then the goal "cancellation lecture" does not need to be achieved but if otherwise, then the solutions developed is to determine the replacement schedule. Modeling for the replacement schedule need not be discussed in this paper, in the illustration Fig. 2 needs replacement schedule delegated to other actors through the goal "choose schedule". Goal "organizing the lecture" decomposed with AND-decomposition, the three sub-goals of the (start on schedule, completed on schedule, filling of attendance and the minutes) must all be achieved through the plan "monitoring" and an additional plan "check the number of lectures" for the goal "fill the attendance and the minutes", which contribute positively/full satisfaction (++) against soft goal "availability of classroom" and "lecture targets". While the plan for

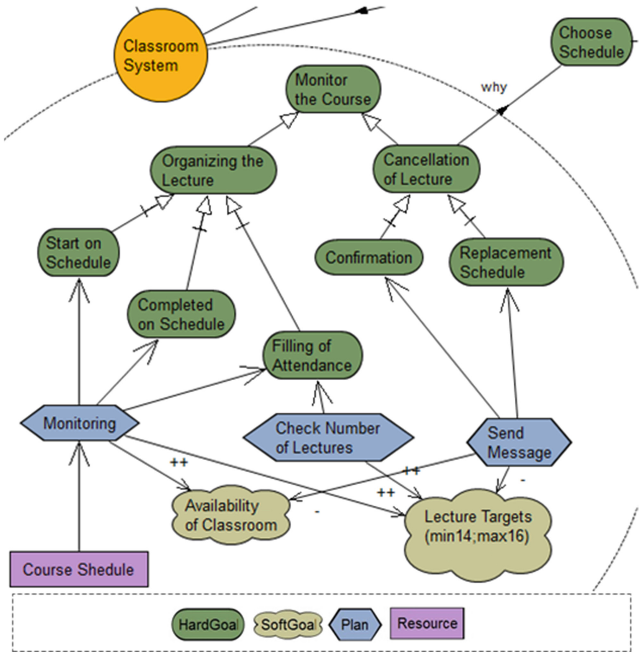

Fig. 2. Modeling of lecture monitoring system.

achieving the goal “lecture cancellation” has contributed partial negative (−) against both soft goal, considering the cancellation of the lecture could adversely affect the achievement of the lecture and meeting room availability, but will not impact negatively if the determination of the replacement schedule can be achieved.

Based on the modeling, we can capture the issue of adaptation to be resolved, namely the third sub-goal of “organizing the lecture” is a goal that must be monitored, because the decomposition made an AND-decomposition, meaning that variable in every goal that is linked dependencies to each other. This can be represented by defining each parameter value in the plan that will be developed, namely by setting a rule to analyze aspects of dynamic behavior. For example the study program will be given a notification message when lectures in class was held or not held. Assumptions for the lecture was held, when the course of time according to the schedule. Based on the concept in the pattern of the ECA, we consider the situation “lecturer and students enter the classroom” as an event (e) that triggers an evaluation by the ECA rules:

```
If <lecturer and students enter the classroom (e1) AND
start as scheduled (c1) AND completed on schedule (c2)
AND filling attendance (c3)>, then <send notification
{prodi} (a1),”course achieved”>
```

Elements of c1, c2 and c3 is a condition (c) to ensure that the lecture was held based on the criteria or not, as an example is late more than 10 min of schedule, was considered not fit the criteria. This condition represents a situation where the rules of action (a) will be activated, based on the condition (c) specified when the event occurs (when the “lecturer and students enter the classroom”), and a1 is “send notification (in the program)” is an action that is executed when a condition that occurs in accordance with the criteria or is true. Figure 3 illustrates the flow of information among the components in the pattern of ECA.

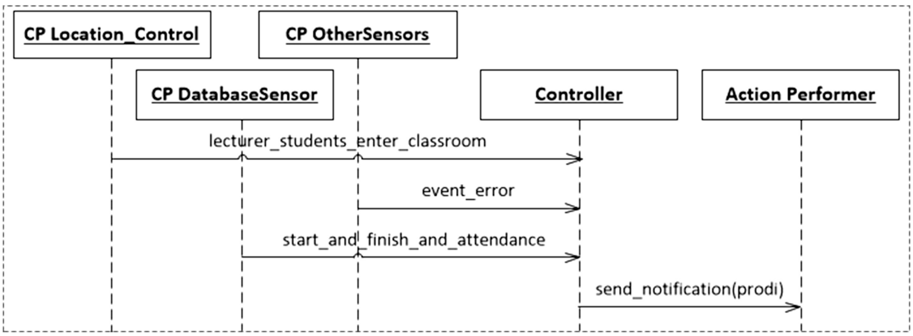

Fig. 3. The dynamic behaviour of ECA pattern.

The controller observed the occurrence of an event when lecturer and students enter the classroom, this event was captured by the location controller component, which is an instance of context processor (CP). With the use of sensors in the classroom, location controller can sense when lecturer and students entering the class. When this happens, the event "lecturer_students_enter_classroom" generated. Then, the controller evaluates "start_and_finish_and_attendance" and "event_error". Finally, if the third condition is true, the controller will trigger action "send_notification" which has been specified in the ECA, this action is the executed by the performers.

In the requirements activity, evaluation controller begins by defining variables that must be monitored, which is derived from the resource "course schedule". Based on the path dependencies, all the variables associated with "time" holding "course", i.e. start, finish, filling attendance and event news, as well as delay time tolerance. Tolerance delay time is context variables are added. In addition, to maximize the system's behavior, also added requirements to detect "errors" associated with "event" unexpected, e.g. sending error messages (msg_error) or lost connections (conn_error). Thus obtained variables are represented as: course_time and error_event = (course_time, event_error).

As for the needs analysis process, we should set the value of each parameter and the rules for the lecture can be considered established criteria or not. The action was carried out for both of these criteria is, if the lecture is held it will be sent a notification to the course that lectures held, and if the college is not established then the notifications are delivered is not the implementation of tuition based on a schedule, and the goal "choose the schedule" will be delegated to actors program a study to establish a replacement schedule. The criteria that the college is considered established, if the college began as scheduled, completed on schedule, charging absent and the minutes of a maximum of 15 min before the lecture is finished, and the delay tolerance for all these parameters is 10 min. Thus, the rule can be specified as in Table 2.

Table 2. Rule of course monitoring.

Rule	Statement
Rule-1:	*If (course_time = time.start and time.finish and time.attendance) and (event_error = null), then send notification {prodi}"course achieved"*
Rule-2:	*If (course_time = time.start and time.finish and time.attendance > 10 minutes) and (event_error = null), then send notification {lecturer} "check your teaching schedule"*
Rule-3:	*If (course_time = not time.start and time.finish and time.attendance) and (event_error = null), then send notification "course not conducted" and delegate goal to actor {prodi}*
Rule-4:	*If (course_time = time.start and time.finish and time.attendance) and (event_error = not null), then send notify user*
Rule-5:	*If not [event], then send notification "course not conducted" and delegate goal to actor {prodi}*
Rule-6:	*If not [criteria], then send notify user*

Based on these rules, it can be mapped into the ECA table (Table 3), so that there are four action as an alternative solution for the needs of adaptation. In order to define a comprehensive planning, determination of other parameters that can affect the system, as well as the formulation of reasoning mechanisms can be developed further.

Table 3. ECA of course monitoring.

Event	Condition	Action
"lecturer_students_enter_classroom"	*course_time = time.start and time.finish and time.attendance; event_error = null;*	*send notification {prodi} "course achieved"*
"lecturer_students_enter_classroom"	*course_time > 10 min; event_error = null;*	*send notification {lecturer} "check your teaching schedule"*
"lecturer_students_enter_classroom"	*course_time = not time.start and time.finish and time.attendance; event_error = null; not [event];*	*send notification "course not conducted" and delegate goal to actor {prodi}*
"lecturer_students_enter_classroom"	*event_error = not null; not [criteria] {msg_error};*	*send notify user*

4 Discussion and Future Work

The proposed framework when compared to the Tropos framework adopted, basically can be a complement to enhance the ability of adaptation requirements. When evaluated in general, the framework of this proposal can be developed as a generic framework that can be applied to various types of systems, in addition to the feedback loop automation through reconfiguration and evolution mechanism can improve the adaptability. So that this concept can reduce maintenance costs and increase flexibility in dealing with change factors for requirements engineering activities.

Comparison adaptation framework through two phases of requirements can be seen in Table 4. The work that has been done, is an initial foundation for the work ahead more specific, namely (a) identifies the need for an extension of the modeling language is adopted, taking into account the initial concept that has composed, (b) the alignment of the model which has been developed into a model that is adopted, to define the operational semantics that can accommodate the abilities of adaptation mechanisms, mainly dealing with strategy reconfiguration and evolution of software devices. Data mining approach become one of our future study, to determine appropriate time in adaptation, (c) evaluating the model in more detail to determine the level of success of approaches that have been proposed.

Table 4. Comparison of requirements modeling framework.

Phase	Tropos framework	Proposed framework
Early requirements	Stakeholder requirements • Description: actors, goals, plans, resources • Strategic dependency • Decompositions, means-ends, contributions	Adaptation requirements • Identify stakeholder requirements • Defining goals that could potentially change, as the requirements (R−n) • Determine the variable and parameters goals (P−n)
Late requirements	Delegating goal as a representation system-to-be • Introducing the actors • Specification of dependencies • Decompositions, means-ends, contributions to the actors	Delegating goal as adaptation requirements • Identify the cause of the goal parameters change (change monitoring) • Analyzing the behavior change • Determine the variation changes (ECA) • Determine the plan (plan sets-n)

5 Conclusion

Activity of requirements modeling at design time for the adaptation needs of the system, in essence proposes concepts and analytical techniques for designing monitoring needs and adaptation at run-time. Uncertainty at design time managed to combine design with specifications variability monitoring, through achievement criteria satisfaction goals. Here we propose an extension of an existing model. We see the feedback loop approach through ECA rules have the advantage to realize a generic function in reasoning at run-time. While Tropos models with the agent's concept has advantages in terms of capturing the variability of context and system behaviour, particularly related to the needs of the entity of the problem domain that is represented in the domain models.

We assume the integration of the two approaches can be complementary disadvantages and advantages of each. Therefore, we propose a framework as our preliminary study, and this approach still requires more in-depth study. Mainly deal with how to integrate a feedback loop with a centralized approach to the design needs of independent software-based agents. Currently, we are evaluating and formulating the system in more detail, including committing study toward alignment from both approach with formulating analysis technique using data mining at sensor data through data history, and context inference in determining context needs as run-time at the knowledge base.

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