A Study on Knowledge-based Context Aware Framework using Machine Learning

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Abstract. In a smart environment, users want to be automatically provided with service, appropriate for user’s situation, by using a large number of devices, existing in the IoT enviroment. The use of ontology for expressing context is advantageous to obtain the characteristics expressed in the various kinds of context using the object-based modeling approaches. In order to provide context aware service, context rules must be defined from attributes of context information. Some of these rules are expanded through knowledge base of context rules by being newly added, using the Machine Learning Engine.

Keywords: Context awareness, Machine Learning, knowledge base, Ontology

1 Introduction

Regarding recent information system, IoE services are used in various kinds of environments and IoE service providing environment may change dynamically. The method of recognizing the change in environment and adapting to it is required to react to such service providing environment changes. One of the key technologies that can provide user-centric intelligent environment is the context awareness technology. A context-aware system can improve the user experience, by only showing or doing the relevant thinks for a given context[1].

This paper is about research on context aware engine using machine learning in order to provide context aware service during unpredicted situations in the IoE environment.

2 Context Aware Framework Technology

The IoE sensors used in context aware service, detect changes or state of the user or the environment and the context information service is provided by transferring such detected information.

In order to provide context aware service using ontology, semantic conversion must be performed through collecting IoE environment data. Converted data perform semantic reasoning through context awareness rules, and automatically provide
context awareness service by integrating knowledge base and individual service domain knowledge.

Fig. 1 shows the knowledge-based context aware engine using machine learning. The Context Aware Engine function is gone through mapping based on context layer.

2.1 Context Data layer

Context Data layer is the bottom layer of concept layer structure of context aware framework. It is composed of various sensors and SNS data. Recently, due to provision of various web services, not just the sensor data of hardware, but also the social web service data such as SNS service, is capable of being used as important context data.

2.2 Context Acquisition layer

Context Acquisition layer collects various context data. The information collected in this layer is expressed in various ways according to the type of sensor and web service and the processing of data is required to exclude meaningless values among these data.
2.3 Context Processing layer

Context Processing layer is processed in common file format such as ‘RDF’ for the intellectualization processing of collected context data, and processed context information is used for reasoning and knowledge base of context data.

2.3 Context Management layer

Context Management layer performs context information modeling, context rule creation, and reasoning. Context rule can be formed through machine learning. The information inferred from inference rule, is provided to the service, drawing situation and service information from context/service info capture.

3 Context Aware Rule Creation in Context life 4-cycle

The context information required for the provision of context aware service includes various kinds of information such as user, time, location, and status[2]. Such context information is gone through acquisition, context modeling, and reasoning in order to enable context-aware service that provides service appropriate for user’s situation. Fig. 2 shows the context aware rule creation process using MLE and the relation with context life 4cycle[3].

Fig. 2. Context-aware rule creation in Context life 4-cycle

The context acquisition is the step of collecting only the meaningful data through the preprocessing of ‘raw data’. The ‘raw data’ not only includes sensor information
connected to network but also can include the information of Social web service such as SNS.

The context modeling is the step of converting raw data and making context information. This step includes translation, annotation, ontology modeling, and context-aware rule creation. Raw data is converted to RDF file and performs context modeling by using ontology. The context-aware rule is made by using ‘attribute’ defined in this modeling. IoE context aware rule creator creates rules by receiving necessary context/service/rule creation information from individual context aware service. The context rule creator creates 3 types of Context Aware Rule. The 3 types are the Complete Rule with all the complete rule patterns, the Partial Rule with both complete rule patterns and incomplete rule patterns, and the Incomplete Rule with all the incomplete patterns. RDF/OWL rules are all complete rules because they are created based on standard. The 3 types of rules described above may all exist among the User defined rules. The Complete Rule, which can be known through existing data, is directly reflected to the Inference Rules, but the Partial Rule and the Incomplete Rule are reflected to the reasoning rule after being converted to the Complete Rule through drawing complete patterns by using Machine Learning Engine. For example, when measuring the heart pulse rate of a patient, the average pulse rate can be known through the existing data, but the predictive values without any data such as heart pulse rate predictive value need creation of new rules. In such situation, precise predictive values can be drawn by using the Machine Learning Engine. Moreover, such context aware rules are capable of being expanded on context knowledge base.

The context reasoning is inferred context information by using context rule. In this step, inferred data is made as the result value, and more appropriate service information is created by using such reasoning data.

The service execution enables the provision of appropriate service using reasoning result value.

4 Conclusion

Context modeling in context life 4-cycle includes translation, annotation, ontology modeling, and context-aware rule creation. The context-aware rule is made by using ‘attribute’ defined in this modeling. This paper is related on context aware engine that handles non-deterministic context awareness rules, using machine learning engine in order to provide context aware service during unpredicted situations in the IoE environment.
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References

