Advanced Science and Technology Letters
Vol.30 (ICCA 2013), pp.179-182
http://dx.doi.org/10.14257/astl.2013.30.38

Variability Modeling Technique for sensor network based monitoring product line

JeongAh Kim

[2]Department of Computer Education, KwanDong University,
Kangwon-Province, South Korea,
clara@kd.ac.kr

Abstract. This paper propose variability modeling technique for sensor network based monitoring product line. There are so many variety sensor network based monitoring systems and many development projects have constructed these systems in various application domain. It means that sensor-based monitoring system is very good candidate for product line engineering. For product line engineering, variability modeling is critical and starting activity. In this paper, very simple but clear modeling notation is suggested for sensor-based modeling techniques.

Keywords: Product line Engineering, Variability Modeling, sensor network

1 Introduction

If there are many similar systems or products in specific domain, it mean we can construct product line or product family. Software product lines, or software product line development, refers to software engineering methods, tools and techniques for creating a collection of similar software systems from a shared set of software assets using a common means of production [1,2].

Sensor network based monitoring is used in many applications, there are many development projects. There are so many commonality in sensor type, sensing technology, protocols, so on. If we established sensor network based monitoring system, it can help to reduce the complexity. [3] introduces the software product line development approach in agriculture system but not mentions how to variability modeling.

For establishing the product line, variability analysis and variability modeling are very critical success factor since they lead the stable and reusable asset repository. In this paper, we suggested very simple but clear variability modeling notation to add variability information to various models constructed in sensor network based monitoring product line.

ISSN: 2287-1233 ASTL

2 Backgrounds

2.1 Software Product Line Engineering

Software product line engineering is relevant to products in a domain, and not to a single application. By analyzing commonality and variability between products on the basis of relevant features, it establishes reusable core assets and architecture. Variability analysis is the most critical step in developing a product line and result in feature modeling. With feature model, we identified the commonality and variability of requirement. Also, feature model help to identify the commonality and variability of other elements which are components, modules and code segmentation.

2.2 Sensor network-based Monitoring System

The wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network. At the early time of WSN was developed for military applications such as battlefield surveillance. But these days, this technology is used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

3 Variability Modeling for Sensor Network Model

In general, in order to express variability, a stereotype is used among the many extended mechanisms of UML. A stereotype-based method is a way of extending the vocabulary of UML through a number of stereotypes. This is the most common approach for expressing variability. As conventional stereotypes to model variability, complex stereotypes have been proposed to provide the detailed meaning of variability. It is important to balance simplicity with the provision of multiple entities while implementing a model. A model with various elements may be able to provide various types of information; yet, an arbitrary interpretation is possible, and the consistency of abstraction can decrease. Therefore, a model with a wide variety of elements is not necessary.

This study attempts to maintain as simple a model as it can while defining the minimum elements necessary to provide meaningful information. The part that is variable includes a variant. A Variant itself can include a variable part and a common part. Interpreting this in perspective of reuse, we can classify variants into two categories: a black box variant that can be reused as it is and a white box variant that can be reused after some internal adjustments.

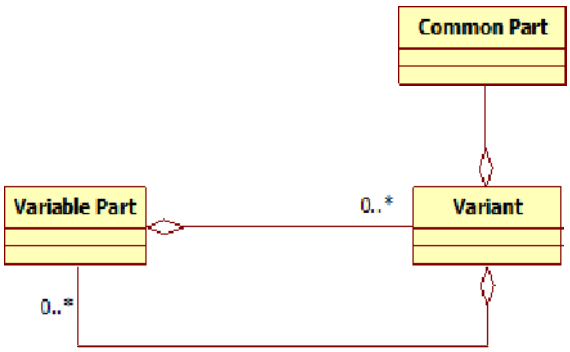

Fig. 1. Meta Model for Variability Modeling

The variant part of the black box variance is the variation point itself; hence, it can be reused as it is. As for white box variance, the variant part includes the Variant, so redefining the Variant is needed. Figure 1 explains the meta model for variability modeling.

The variance classification viewpoints can be distinguished into mandatory, optional, and alternative ones. The viewpoint "mandatory" refers to an element that must be included and that could decide whether the element could be included or not; "alternative" refers to an element that can be chosen from a certain set of elements; and "optional" refers to an element that can be selected after finding whether this element is required or not. So, we propose very simple but clear notations, <<M>> for mandatory and black box reuse, <<VP>> for mandatory and white box reuse, <<VO>> for optional feature type and black box reuse, <<VA>> for alternative type and black box reuse. For white box reuse, we just add <<P>> meaning for partial reuse.

4 Conclusions

This paper propose variability modeling notations for establishing sensor network based monitoring product line. These notations are simple but clear and include the meaning of the variability in perspective of reuse so that it is easy to understand the model. As a future work, we are planning to apply this approach to establish the real sensor network based monitoring product line.

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