Extension and Implementation of Iconic Stereotype for GNSS Application in the UML Class Diagram

Wang Bo° Hye-Min No Cheol-Jung Yoo Ok-Bae Chang
wanglucky°@empal.com hmino@cs.chonbuk.ac.kr {cjyoo, okjang}@moak.chonbuk.ac.kr
Dept. of Computer Science, Chonbuk National University

Abstract

UML cannot meet all the requirements offered in different software system for diverse application domain. GNSS (Global Navigation Satellite System) application domain is an especial environment that requires precise measurement and precision calculation of real-world geographical entities with the help of GPS (Global Position System) in both temporal and spatial factor. Therefore in the paper new extended iconic stereotypes for better modeling GNSS application in the UML Diagram are proposed, and the implementation of a program called StereotypeCreator, which is able to create iconic stereotypes used in one of the most popular visual modeling tools for software development, Rational Rose, will be also proposed.

Keywords: Unified Modeling Language (UML), UML extension, GNSS, Iconic stereotype.

1. Introduction

GNSS application domain is an especial environment that requires precise measurement and precision calculation of real-world geographical entities with the help of GPS (Global Position System) in both temporal and spatial factor. The conventional modeling element of class in UML is not powerful enough to present the spatial feature and temporal feature that GNSS objects embody. Therefore, new modeling elements of class for GNSS application with UML are needed. This paper will propose several new iconic stereotypes formulating modeling elements for GNSS application. Also in this paper the implementation of a program called StereotypeCreator, which is able to create iconic stereotypes used in Rational Rose, will be proposed.

The paper consists of five sections. The following section discusses issues for related works. Several iconic stereotypes presenting class meta-model element in the UML class diagram will be proposed in the third section. Section 4 briefly describes the implementation of a tool called StereotypeCreator for Rational Rose Section 5 presents our conclusion.

2. Issues for related work

Currently a project of GNSS component extraction and development process is being developed by our research team, 4S (GIS, ITS, SIIS, GNSS) research team of software engineering laboratory. In the modeling process we find it is not good enough to present the object features in GNSS application domain by the conventional class model elements in UML. Because the conventional class model element cannot describe the geometry property of the class whose objects can be displayed in a monitoring system, and the conventional class model elements cannot embody the issue that the location of the object can be recorded in a time range and can be gotten in any time later[1][2]. Therefore, the conventional stereotype for the modeling element of class is inappropriate for the modeling in GNSS application with UML. In order to meet these specific requirements of GNSS application domain, new extended iconic stereotypes for class modeling elements need to be brought forward and will be presented in the next section.

3. Iconic Stereotypes for Class Meta-model Element

In Figure 1, the visual notations are used to represent georeferenced classes which are distinguished from conventional classes. Main elements of georeferenced classes are:

- a graphical representation with a symbolistic icon,
- an iconic notation for geographic types (points, lines and polygons),
- the class name,
- attributes,
- operations.

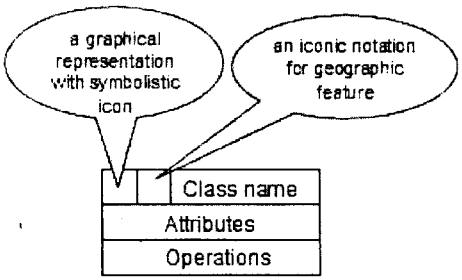

Fig.1. Graphical representation of class meta-model element

For example, the Figure 2(a) depicts the visual representation of a class named "Building" with a symbolistic icon and an iconic notation for geographic types (corresponding to a polygon) on the left side of the class name, Building. The polygon symbol means that each object "Building" is associated to a polygon. Attributes are "address" and "inhabiting_area". The only operation associated to the class is "build".

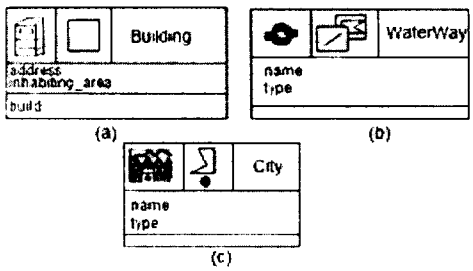

Fig.2. Examples of georeferenced class

The georeferenced classes allow the representation of complex objects and composed objects. Each complex object is related to several points, lines or polygons. For example, a waterway may be considered as a lake (a polygon) connected to a river (a line). Graphically speaking, overlapped iconic figures express complex objects. An example of a complex object class is given in Figure 2(b). Composed objects have several representations in function of scale's point of view. Figure 2(c) presents the graphical notation of a composed class "City"[3][4]. We do not consider composed-complex objects in this paper.

In many cases the value of an attribute of an object varies during all the life cycle of the object [5]. It is possible to associate a temporality to an attribute *x* of an object *a*. In that case, during all the life cycle of *a*, the object is able to "know" all previous values of *x*. Graphically, an icon representing a clock is placed on the right side of the attribute in the class(Figure 3(a)). In the same way, a temporality may be associated to the geometry of an object. In that case, an icon representing a clock is placed on the right side of the iconic notation for geographic types (Figure 3(b)). The Figure 4 depicts the implementation of Class MobileStation presented in Figure 3(a).

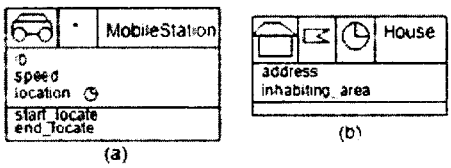

Fig.3. Examples of georeferenced class with temporality

```
using System;
using System.Data;
Class MobileStation
{//geographic features of object
public Point the_point=null;
public int ID;
public int speed;
public Point location;
public MobileStation (){/* code of the constructor */}
public void start_locate()
{ the_point=new Point();
 /*...code of the operation,
 Coordinates are associated to the_point*/
}
public void end_locate()
{if (the_point !=NULL)
 { /* code of the operation */
  the_point=NULL;}
}
public Point get_location(double time)
{//return the value of location at a t time
  return search_value(set_of_location_values,time));
}
public void set_location(Point value)
{//get the current time of the system
 double current_time=getCurrentTime();
 //map the current value of location with
 // the current time of the system
 set_of_location_values.put(current_time,value)
 }
}
```

Fig.4. Example of Class MobileStation Implementation in C#

4. Implementation of StereotypeCreator for Rational Rose

According to the specification of extended iconic stereotype of class meta-modeling element for a georeferenced class in UML class diagram, many kinds of the iconic stereotypes of class can be designed. Stereotype Creator is a software tool used to automatically create all kinds of user-defined iconic stereotypes that can be used in Rational Rose. It can be considered as an extended tool for Rational Rose. The tool can create stereotypes for different modeling elements in Rational Rose that include class, attribute, association, dependency, use case etc [6,7].

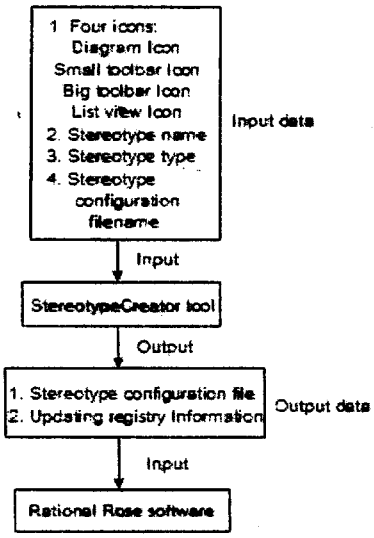

Fig.5.The whole process of StereotypeCreator for Rational Rose

The whole process of StereotypeCreator execution is that users input some simple information required to create stereotype, such as diagram icon, small/big toolbar icon, stereotype name and so on, into StereotypeCreator program, and that StereotypeCreator program processes and converts the data information into output as stereotype configuration file and updates registry information which can be recognized and loaded when Rational Rose software initiates (see Figure 5).

The involved implementation details of StereotypeCreator including program analysis and design are considered unnecessary and are not presented here. The images about execution effect of Stereotype Creator tool are presented in Figure 6.

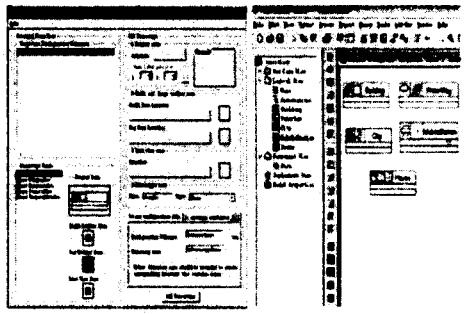

Fig.6. Execution effect of StereotypeCreator for Rational Rose

5. Conclusion

This paper proposes extended iconic stereotypes of class meta-model element for GNSS application in the UML Diagram and its implementation as a tool of StereotypeCreator for Rational Rose. Future research can be positioned in extending other modeling elements for GNSS application such as association, generalization, attribute and so on. Now the tool of StereotypeCreator just can create iconic stereotypes for the modeling elements of the class in a diagram, but in the future StereotypeCreator for Rational Rose will support more kinds of iconic stereotypes for different modeling elements.

References

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