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Reuse-based Navigation Application Modeling Methodology

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Abstract

This paper suggests a modeling methodology to build a key business process-oriented system based on extraction of key components that is not limited to a certain domain. From this business-oriented perspective, major key components are extracted and applied to relevant application, which contributes to improved software quality such as development, maintenance, productivity, etc. To extract components, necessary functions for a system are classified functionally and hierarchically and modularized. From the process, the self-execution unit is produced for a meaningful service. It does not use the existing procedure- or object-oriented system, a process-oriented component design method, but business-based modeling methodology, and it suggests a process to extract, define, and analyze components that are commonly used in relevant application domains which is a foundation for building GPS system.

Keywords: *GNSS, GPS, Reuse, Modeling*

1. Introduction

GPS (Global Positioning System) is invented for the military and developed by the Pentagon, but it is available for civilian use after opening the civil codes. GNSS includes US GPS, Russian GLONASS (Global Navigation Satellite System), European Galileo, etc. Currently, GPS satellite such as Block II/IIA, Block IIR, Block IIR-M, and others are being used[1][2].

The basic principle of GNSS is to measure the propagation time that is considered to be the time the signal takes to travel from the satellite to the receive, calculate distance from satellite to receiver, and measure the current location using trigonometry. In these applications, the focus is that they are located on different domain, but it has common and key components. In other word, the existing applications have disadvantages in terms of separate implementation and development for each domain even though they have common components[3][4].

For development of GPS system from a business perspective, this paper aims to extract key components that is not limited to the specific domain and suggest a modeling method that is able to build business process-oriented system.

2. Related works

Recent projects for GNSS component development process extracted components after requirement analysis of business components. Then, business components extracted by an interaction diagram are refined, and the components to be included in the system components that are extracted for defining architecture are found and combined[5][6]. However, the method

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has an advantage in that its extraction clearly separate system and business components because it clearly defines the system component that can be functionally reused in respect of system service. On the other hand, the method has disadvantages in that it is hard to discern whether the word in the type diagram has a meaning or not by a work-site operator who has no systemic concept and it is difficult to draw a relation between those words when the operator draws a type diagram to figure out business requirements[7][8].

In this paper, it does not use the existing procedure or object-oriented system, a process-oriented component design method, but business process-based modeling methodology, and it suggests a process to extract, define, and analyze components that are commonly used in relevant application domains which is a foundation for building GPS system to overcome these disadvantages.

3. GPS system analysis

Analysis of business requirements and extraction of business class models are required prior to developing an application. According to these requirements, mobile and reference stations receive signals from GPS satellite. The satellite continuously transmits information about time, its orbit, rough orbits of entire satellites, their reliability, and error correction factors that are required for other navigation system, and the receivers of mobile and reference stations continuously receive these message signals for navigation.

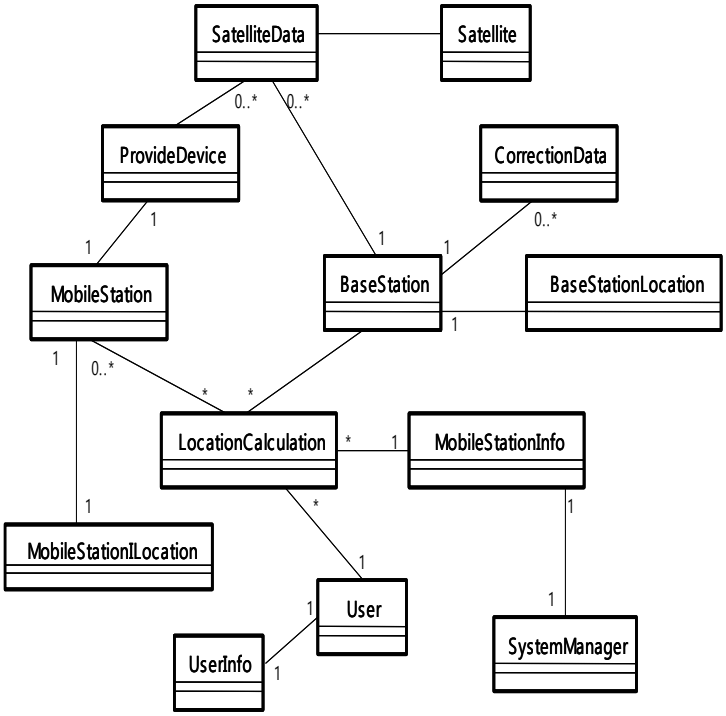

Figure 1. Initial business class model

The receiver of mobile station receives signals from GPS satellite and processes data. And then, using the signal received from the satellite, the location of mobile station is measured, orbital information relating the satellite is extracted, and rough information of orbit such as the number of satellites and the satellite number that is used is extracted. In addition, the receiver extracts the time to receive signals from the GPS satellite. The mobile station transmits

processed data to the control station, including its location, satellite number, the number of satellites, time to receive signal from the satellite, location of other satellites, and speed that is calculated with speedometer in the mobile station. It also transmits its own unique ID, information and its condition to the control station

Furthermore, the reference station calculates error based on the signal from GPS satellite and correction value of each satellite after comparing signal from the GPS satellite with the received signal, by using precisely known value of location of the reference station. And, the reference station transmits the calculated error in RTCM format to the control station.

The major business class extracts candidates from the requirement documents using the noun phrase approach that is an approach to find the corresponding noun in the requirement document, and all nouns are considered as candidates in the approach. The candidate list is classified into three main types: irrelevant class, relevant class, and fuzzy class.

Extracted candidates are divided into relevant class and fuzzy class. The initial business class model is shown in [Figure 1], which is a class diagram of extracted candidates.

4. GPS system modeling based on business

The extraction rule of major use cases is as follows. Major use cases only related to success of a scenario. If an exception occurred while processing the use case scenario and the use cases that do not concerns flows, the use cases are not regarded as a successful use case.

From the relevant business process perspective, scenario are as follows.

▪ The receivers of mobile and reference stations continuously receive the navigation message signals, which is information about time, its own orbit, rough orbits of entire satellites, their reliability, and error correction factors that are required for other navigation system.

Extensions: If the receiver does not get a signal, it will be an error. It prepares to receive signals by back into the situation that can receive the signal.

▪ Using the signal from GPS satellite, the location of mobile station is measured, orbital information relating the satellite is extracted, and rough information of orbit such as the number of satellites and the satellite number that is used is extracted. In addition, the receiver extracts the time to receive signals from the GPS satellite.

Extensions: If the receiver does not process the data, it receives the signal from the satellite again and processes the data.

▪ The mobile station transmits processed data to the control station, including its location, satellite number, the number of satellites, time to receive signal from the satellite, location of other satellites, and speed that is calculated with speedometer in the mobile station. It also transmits its own unique ID, information and its condition to the control station.

Extensions: If transmission is failed, it transmits data again.

▪ The reference station calculates the correction value of each satellite after comparing signal with the received signal, by using precisely known value of location of the reference station, and the results are exported into RTCM (Radio Technical Commission for Maritime Services) standard format.

▪ The reference station calculates the correction value of each satellite after comparing signal with the received signal, by using precisely known value of location of the reference station. It transmits the calculated RTCM error information to the control station. At this time, all error information is transmitted.

Extensions: If transmission is failed, it transmits data again.

▪ The control station calculates the correct location of the mobile station by using the correction value in RTCM format obtained from the reference station and information about location and satellite obtained from the mobile station.

Extensions : If the control station does not measure the location of mobile station, it sends an error message and obtain information again.

At first, the range of the business class model is determined. As shown in Figure 2, delete the class that has no relation and decide the range of the model.

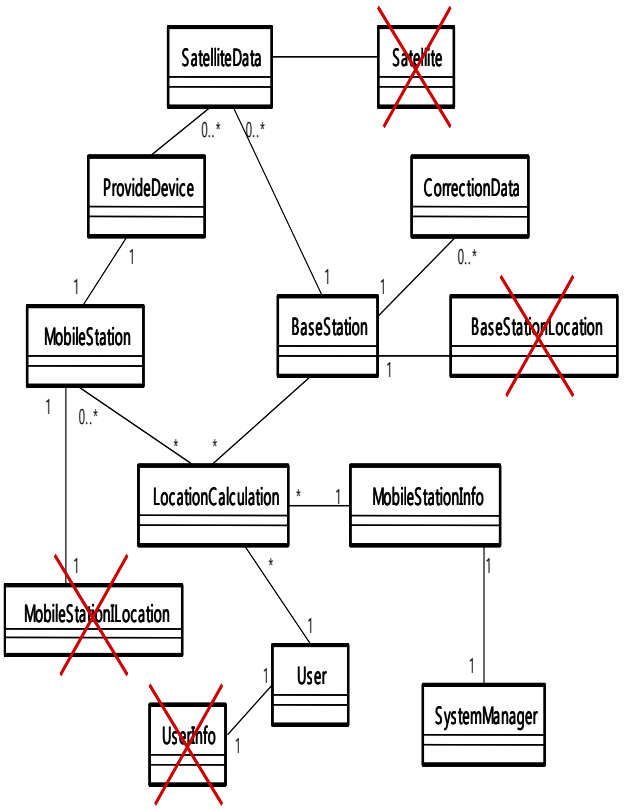

Figure 2. Determine business class model scope

The business class model that refines the initial business class model is shown in [Figure 3].

5. Conclusion

To develop GPS system from the business perspective, this paper suggests a modeling methodology to build a key business process-oriented system based on extraction of key components that is not limited to a certain domain. Although there are disadvantages of the existing development methods of application in that there are common modules between domains, it makes up for in disadvantages, which is implementing and developing functions in the separate domain due to ease of development. From this business-oriented perspective, major key components are extracted and applied to relevant application, which contributes to improved software quality such as development, maintenance, productivity, etc. To extract components, necessary functions for a system are classified functionally and hierarchically and modularized. From the process, the self-execution unit is produced for a meaningful service. This study suggests a modeling method, which is that the component is developed by

distinguishing between reusable and new one by applying the reusable property, which reduces its development time and secures quality component. It does not use the existing procedure- or object-oriented system, a process-oriented component design method, but business-based modeling methodology, and it suggests a process to extract, define, and analyze components that are commonly used in relevant application domains which is a foundation for building GPS system.

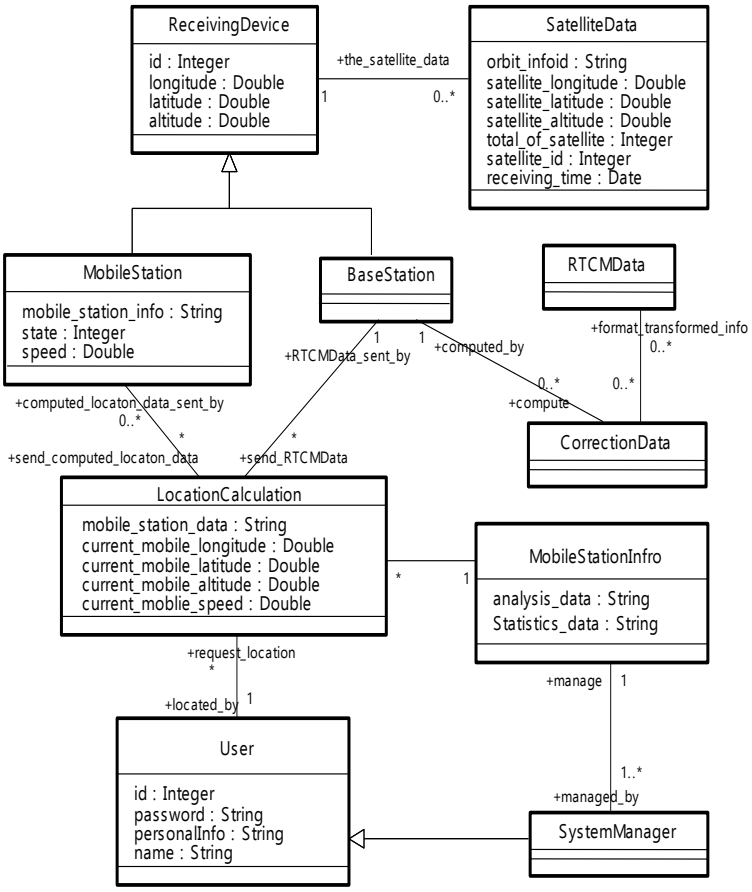

Figure 3. Business class model

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