Hierarchical Petri Net Model of a Location Based VOD Client System

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Abstract. Petri net is a well known graphical and mathematical modeling tool and has been widely used in analysis of various computer systems. We introduce a Petri net model of the client system of a location based contents providing system such as a mobile video on demand system. The system is so complex that the Petri net model contains so many transitions and places. In order to address this problem, we used hierarchical Petri net to model the system.

Keywords: Petri net, Hierarchical Petri net, System Model, System Analysis.

1 Introduction

The authors of [1-3] have shown how the Petri net minimum cycle time can be used to verify that the design of the system satisfies the user's requirements and maximize the performance of the system all the while saving as many resources as possible.

IPTV stands for Internet Protocol Television and it is known to be the next killer internet application. Among the IPTV service types, video on demand (VOD) is most popular one. If a mathematical method with which we can find optimal VOD system design is available, we can save a lot of resources. As the first step of developing such a method, this paper introduces a Petri net model of VOD client system.

A hierarchical Petri net is one way to represent a large Petri net as a group of many small Petri nets. Using a hierarchical Petri net we can easily handle complex systems. The Petri net model we introduce in this paper is hierarchical.

2 Related Works

Petri net and mobile IPTV are related topics. There are so many related works but we omit discussing them because of the space limit. The readers of this paper must be familiar with the basic concepts regarding Petri nets that appear in [4].

3 A Petri Net Model of a Mobile VOD Client

A location based VOD client displays the layout of the domain area, determines the current location of the mobile device, determines which point of interest is around the mobile device, fetch the video that is closely related to the point of interest, and plays the video. A hierarchical Petri net model of this scenario is shown in Fig. 1. In the figure, we can find abstract transitions, Get Map, Location, Booth, Content Fetch, and Media Play.

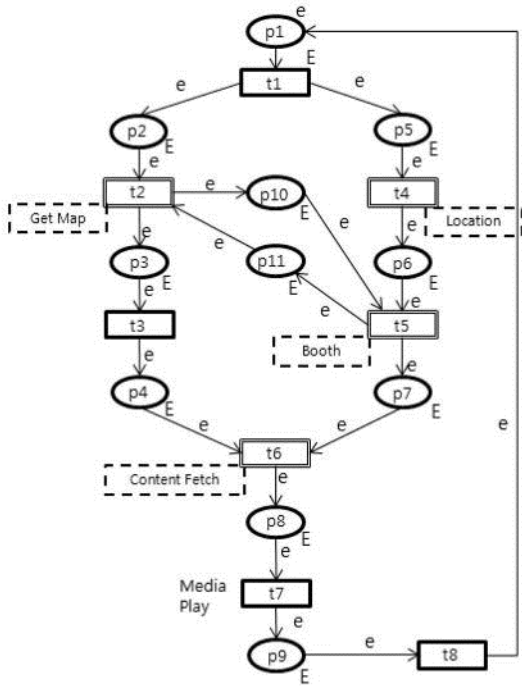

Fig. 1. A hierarchical Petri net model of a location based VOD client system

If a mobile device requests map information by sending the name of the area, the "Get Map" web service retrieves the file of the requested map from the database and extracts the geometrical information, such as lines, polylines, circles, etc, from the file and returns the geometrical information to the mobile device. The detail process of "Get Map" is described in Fig. 2. In Figure 2, t_{205} represents the retrieval operation and p_{206} represents the DB server processors handling the map database. Transitions t_{202} and t_{207} represent the wireless communication between the DB server and the mobile device and places p_{211} and p_{212} represent the wireless agents. If there are many wireless agents then this web service can communicate with many mobile devices at the same time. Similarly, if there are many processors in the DB server, then it can serve many retrieval requests at the same time. In this figure t_{210} is the feedback transition added to make the consistent refinement.

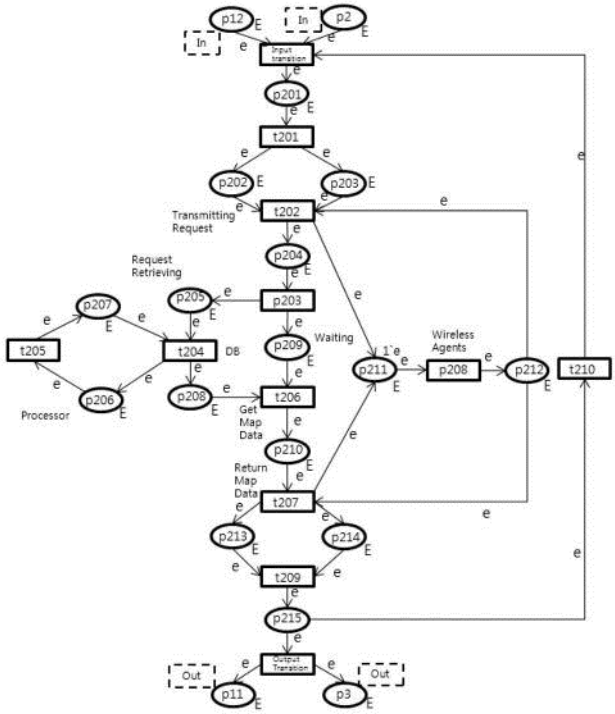

Fig. 2. A refinement of "Get Map", t_2

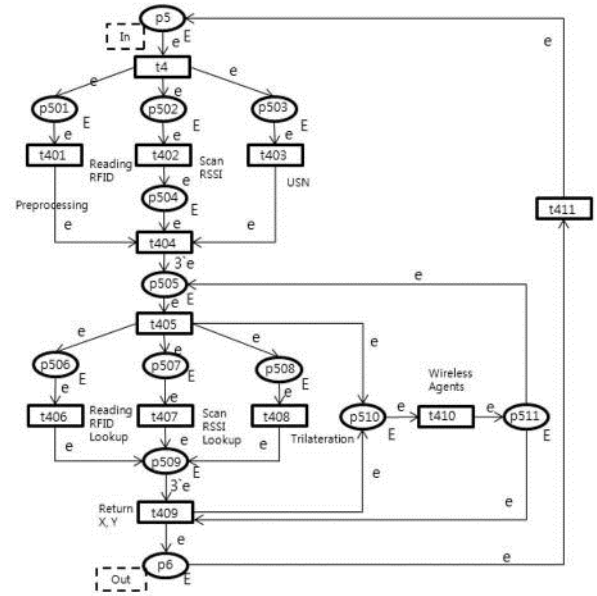

Fig. 3. A refinement of "Location", t_4

If a mobile device collects and sends RFID, RSSI and/or USN data to an indoor positioning web service then the web service returns the estimated location of the

mobile device. Considering the description of Fig. 2, the meaning of this model should be clear so a detailed description is omitted.

The refined Petri net for the "Booth" abstract transition describes the process of determining the points of interest around the mobile terminal. The process takes the map (from the "Get Map" web service) and the location (from the "Location" web service) as its input and for each of the areas where a point of interest is positioned checks to see if the location lies within the area. If it finds any area where the location is included then it returns the point of interest associated with the area, otherwise it returns NIL. We omit the refined Petri net model because of the space limit. Matter of fact, we have to omit further discussion of the refinements of the other abstract transitions and analysis of the Petri nets because of the space limit.

4 Conclusion

Location based mobile VOD application is expected to get much more popularity in the near future. This paper introduced a hierarchical Petri net model of a location based mobile VOD application. The Petri net model is built in CPNTools. We are now working on analysis of the Petri net model by running simulation on CPNTools and on analysis of the structural properties of the Petri net model. We are also working on efficient method of minimum cycle time analysis for the hierarchical Petri net.

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