Establishing a Just-in-Time and Ubiquitous Output System

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ABSTRACT

Just-in-time (JIT) is an important topic of lean manufacturing and services, focusing on the reduction of the waiting time. In this study, a JIT ubiquitous output system is established based on the application of a hand-held intelligent device. The system can be regarded as a location aware service (LAS). The JIT ubiquitous output system starts from the detection of the user’s location and speed using the global positioning system (GPS) on the hand-held intelligent device. The detection results and the document to be printed are sent to the server with a reasoning module that searches for the nearby service locations to determine the output location, so that the document can be printed out just before the user reaches the output location, i.e. just in time. To this end, the fuzzy Dijkstra’s algorithm is proposed.

Keywords: Ambient Intelligence, Just-in-Time (JIT), Lean, Location Aware Service (LAS), System, Ubiquitous

1. INTRODUCTION

Just in time (JIT) is traditionally a production strategy that strives to improve the performance of a factory by reducing in-process inventory and associated carrying costs (Shingo, 1989). JIT philosophy is to reduce waste, including the waste of time, money, resources, and user interaction. The philosophy of JIT can be applied to various fields. For example, Mille (1993) believed that lean production is the first step to achieve JIT. Deif (2010) used computer simulation to explore the JIT lean strategy for a traditional inventory-based production system. The results showed that if the system has not been completely transferred to lean, lean principles are not always beneficial. In James’s view (2007), enterprise resource planning (ERP) is of great significance to JIT lean production processes to assess work in progress (WIP), timescale implications, and the availability of process information. Bae and Kim (2009) verified the concept that implementing lean contributes to the achievement of green. However, the results showed that prefabrication with JIT delivery consumes less energy but emits more CO2. Kim and Bae (2009) also explored the lean supply chain, and advocated

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that prefabrication and JIT delivery are important components of a lean supply system. Behrouzi et al. (2011) believed that there are four performance measures to assess the lean supply chain performance: waste elimination, continuous improvement, JIT, and flexibility.

This study investigates the application of the JIT philosophy to ambient intelligence (AmI), location aware service (LAS), ubiquitous computing (UC), and mobile commerce (MC). To the best of our knowledge, the concepts of JIT and lean have not yet been applied to these fields. The possible causes include:

1. Lack of the JIT concept;
2. The inaccuracy in positioning the user;
3. Because the needs of the user are subjective, it is difficult to accurately grasp the needs of the user (Kaasinen, 2003; Ren, Meng, Yuan, & Zhang, 2011). In addition, the needs of the users will repeatedly change (Kaasinen, 2003).
4. Network transfer speeds are not stable enough.

AmI is a vision of the future, in which environment supports the people living in (Hagras, Callaghan, Colley, Clarke, Pounds-Cornish, & Duman, 2004; Mokhtar, Liu, Georgantas, & Issarny, 2005; Cook, Youngblood, & Das, 2006; Sadri, 2011). The procedure of developing AmI technologies and systems is shown in Figure 1. From the AmI viewpoint, the present study is based on the following scenario:

On the way to the customer's company, a sales representative needs to print out a document that has just been updated. The sales representative cannot print on the car; let alone after reaching the customer's company, which will be impolite and unacceptable. A viable practice is to go to a convenience store along the road to print out the document. However, it takes time to wait in the convenient store, which is a waste. Instead, the sales representative uses a cell phone to upload the file to the system server, which determines the location of the JIT convenient store and sends the file to the printing system of the JIT convenient store. The sales representative is then informed of the location of the JIT convenient store with a cell phone message. The sales representative arrives at the JIT convenient store just before the document has been printed out, so that he/she just picks up the document and goes without waiting.

This process is illustrated in Figure 2. A context-aware system (CAS) uses context to provide relevant information and/or services to the user (Dey, 2001). LAS is a special CAS that utilizes the location of the user to adapt the service accordingly. Kaasinen (2003) believed that LAS is the most basic and most important part of CASs. As can be seen from Figure 2, the system to be constructed is indeed one kind of LAS.

If, from the perspective of MC, the whole process of the just-in-time printing can be viewed as a combination of convenience stores, system service provider, and cell phone service providers. This creates a special three-tier MC service architecture (see Figure 3). The system service provider provides a referral service, so it can get a commission from the convenience store. In addition to uploading the file, the user can also pay the printing fee online through the system service provider to the convenience store.

The JIT ubiquitous output system is also an application of UC. UC, a combination of MC and CAS, refers to the ubiquitous computing environment that integrates wireless network, information, platform, and content. On the basis of this integrated framework, the user can use any device to access the Internet from any location at any time, without the feeling of operational difficulties, allowing users easier access to real-time, accurate information (Poslad, 2009).

The remaining of this article is organized as follows. In Section 2, how the system determines the user’s position and speed is described. After the user uploads the file to print to the server,
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