Expert Systems with Applications 37 (2010) 6651–6662

Contents lists available at ScienceDirect

Expert Systems with Applications

journal homepage: www.elsevier.com/locate/eswa

Intelligent location-based mobile news service system with automatic news summarization

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ARTICLE INFO

Keywords:
News summarization
Information retrieval
Mobile device
Location-awareness service
Fuzzy synthetic evaluation

ABSTRACT

The accelerated rapid development of wireless network and mobile computing technologies has increased the convenience of mobile information services for obtaining useful information in our daily lives. The technology has thus become an essential research issue. In particular, location-based services (LBSs) on mobile devices can convey location related information to individual users, thus helping users to obtain helpful and adaptive information. Accordingly, this study presents an intelligent location-based service system to provide local news with summaries to personal handheld PDA (Personal Digital Assistant) device based on the user's location. First, this study proposes a novel multi-document news summarization scheme based on fuzzy synthetic evaluation. This scheme identifies a key paragraph in a news story as a summary based on three evaluation scores, in order to dispatch news information to mobile devices with small screens. Furthermore, to sense a user's location precisely, the study also develops a practicable location-awareness scheme based on GPS (Global Positioning System) signals to identify the position of a user in the Taiwan area. Finally, an intelligent location-based mobile news service system with automatic news summarization for location-based news services was implemented by combining the proposed multi-document news summarization and user location schemes. The proportion of satisfactory news summaries is up to 86%, and the accuracy of the user location-awareness scheme is up to 90%, according to experimental results in multi-document summarization and user location identification. These experimental results show that the proposed system can be successfully applied in real-world applications for personalized location-based news services.

1. Introduction

Numerous paper-based newspapers have been transformed into digital format and published on the Internet, so that digital newspapers are gradually becoming popular electronic media for conveying information immediately. News documents frequently contain rich information that is useful and valuable in decision-making (Cheung, Huang, & Lam, 2004; Fung, Yu, & Lam, 2003). However, immediately obtaining key news information required by an individual user is a fundamental issue. Although many commercial portals provide immediate on-line news using a basic search mechanism and categorize news articles for users, few news web sites provide intelligent schemes for news services. Moreover, mobile phones and Personal Digital Assistant (PDA) increasingly enable people to access the Internet at any time and place, making location-based services increasingly important in our everyday lives. Thus, providing immediate news information associated with user's location significantly benefits individuals in making decisions. For instance, local security news can enhance personal safety while traveling; local traffic news can help a person to plan appropriate travel routes, and local accident news can avoid suffering from accident damage. Hence, an intelligent system providing location-based news services is valuable for many people.

A location-based service (LBS) is an information service that can be accessed by mobile devices through a mobile network, and which exploit the location of the mobile device (Virrantaus, Markkula, Garmash, & Terziyan, 2001). Location-based services for mobile devices include a location-aware collaboration system named NAMBA for shopping and meeting (Yoshino, Muta, & Munemori, 2002); a location-aware medical information system for determining a hospital worker's current location from a hospital information system (Rodriguez, Favela, Martinez, & Munoz, 2004), and a ubiquitous GPS and web enabled mobile search mechanism for retrieving personalized and locally targeted search results (Choi, 2007). Other location-based services for mobile devices, such as location-based games on cellular phones, and context-aware ubiquitous learning system based on learner location for supporting effectively English vocabulary learning, are also already operational LBS applications in the entertainment and education fields (Chen, Li, & Chen, 2007; Rashid, Mullins, Coulton, & Edwards, 2006). Although no intelligent location-based news ser-

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doi:10.1016/j.eswa.2010.03.055

vice has been developed for mobile devices based on our best knowledge and literature survey, access to information through mobile phones and other handheld devices is growing significantly, supporting decision-making away from a computer (Otterbacher, Radev, & Kareem, 2008; Yang & Wang, 2007). Large documents are impossible to load and visualize on handheld mobile devices due to the limited screen size, low network bandwidth and low memory capacity of these devices (Yang & Wang, 2007). Therefore, summarization techniques have been adopted to deliver information on handheld devices (Otterbacher et al., 2008; Yang & Wang, 2007).

News summarization is a document summarization method that extracts significant news information for readers (Chen, Kuo, Huang, Lin, & Wung, 2003). The main purpose of a summary is to present the main ideas in a document in less space. The current state of the art of summarization includes single-document summarization through extraction, the beginnings of abstractive approaches to single-document summarization, and a variety of approaches to multi-document summarization (Radev, Hovy, & McKeown, 2002). Identifying the informative paragraphs from single or multiple documents is the main challenge in summarization (Radev et al., 2002). The three major problems on multi-document summarization are recognizing and coping with redundancy, identifying important differences among documents, and ensuring summary coherence even in material from different source documents (Radev et al., 2002). Measuring the quality of a summary has certainly proven to be a difficult problem, principally because no obvious "ideal" summary exists, even for relatively straightforward news articles (Radev et al., 2002).

Therefore, this study aims at developing an intelligent location-based mobile news service system with automatic news summarization for mobile device users. Providing location-based news service to a mobile device involves considering two key issues: identifying the most representative paragraph as news summarization for mobile devices from categorized Google news corpora (Google news, 2009), and developing an accurate user location detection scheme with a low computational load to support the proposed location-based news services on mobile devices. To reach these goals, this study presents a novel fuzzy synthetic evaluation based multi-document news summarization scheme based on categorized Google news corpora, which is suitable for information delivery based on user location to small, mobile devices. Additionally, this study proposes an effective user location detection scheme with low computational load, in which the user is located through GPS signals, to support the proposed locations-based news services. Meanwhile, the proposed schemes have been successfully implemented as an intelligent location-based news service system for delivering news information to handheld mobile devices. Experimental results reveal that the proposed multi-document news summarization scheme can obtain a satisfied news summarization quality for users to read, while the proposed user location-awareness scheme can accurately identify user location to support the proposed location-based news service.

The remainder of this paper is organized as follows. Section 2 presents the system architecture of the proposed intelligent location-based mobile news service system with automatic news summarization. Section 3 describes the proposed multi-document news summarization scheme based on categorized Google news corpora. Section 4 presents a user location-awareness scheme based on GPS signals to support the proposed location-based news services. Section 5 presents our experimental results. Finally, conclusions are stated in Section 6.

2. System design

This section describes in detail the system architecture of the proposed intelligent location-based news service system, and the system components.

2.1. System architecture

This study presents an intelligent location-based mobile news service system containing both the server and client-side subsystems to provide location-based news service. Figs. 1 and 2 show the system architectures of the server and client subsystems, respectively. In the server side subsystem, the news crawler agent extracts news documents from the Google news site, and identifies news metadata, including news title, published medium, reporter, location, date, news body and hyperlink to the original published medium, to the e-news and information database based on regular expression matching. Chinese word segmentation is performed on news titles and news bodies using ECScanner (2009) to perform multi-document news summarization. The Chinese word segmentation process filters out all 1-gram words, because these are non-meaningful in judging informative paragraphs for news summarization. Moreover, the multi-document news summarization agent primarily identifies a single most representative paragraph

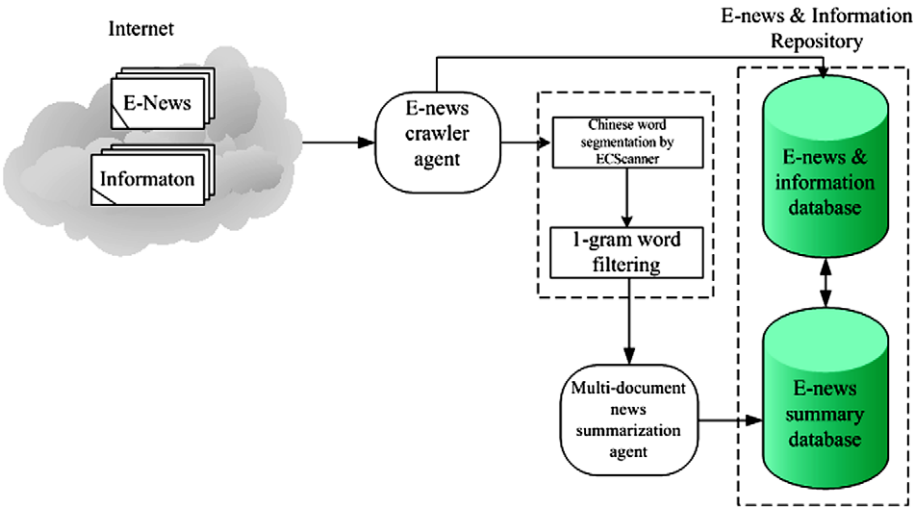

Fig. 1. The system architecture of the server side of the proposed intelligent location-based news service system.