Chapter 39
Ambulance Dispatching System with Integrated Information and Communication Technologies on Cloud Environment

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ABSTRACT

The quality of emergency medical services (EMS) prior to a patient's arrival at a hospital is directly affected by the efficiency to dispatch an ambulance for first aid. In this paper, we created an ambulance dispatching system for first aid, which is integrated with Information and Communication Technology (ICT) and performed on a cloud platform. In virtue of ICT, the system can readily monitor the movements of ambulance with Geographic Information System (GIS) and determine any ambulance dispatching task and saves more time spent in transporting an accident victim to a hospital. Furthermore, the system running on a cloud platform is characteristic of integrated medical resources and terminal equipment with or without powerful hardware that is flexibly added into or removed from the system for supporting dispatch.

INTRODUCTION

The booming Internet and communication techniques have driven development of Information and Communication Technology (ICT) (Huang & Chen, 2010). The more effective achievements and better application services than those in the past should be attributed to ICT appropriately integrated into different fields. Currently, the exponentially growing populations suffering from chronic diseases in each country have been inevitably imposing heavy burdens on the social medical system of a rapid ageing society. Against this background, the effective medical resource management and fast physiological information processing in a medical system supplemented by

ICT for methodical health care of patients has become an important issue (Gupta, M., 2006; Barmentlo, M., 2007; Masson, Y., 2007; Kiefer, S., 2007; Halford, S., & Lotherington, A. T., 2015; Hilty, L. M., & Aebischer, B., 2015). Moreover, the developed countries have made huge investments in manpower and material resources related to researches, for example, EU's "ICT for Better Healthcare" for research of e-health in Framework Programme 6 (FP6) and Framework Programme 7 (FP7) to which hundreds of millions of Euros have been provided (European Commission, 2009).

In the case of ambulance dispatching for emergency medical service which is intended to give an accident victim first aid prior to further treatment in a hospital, a service center should be responsible for supply of urgent medical resources and ambulance dispatching (History of the Emergency Medical Services, 2014; Medic One began with a basic need and focused vision, 2014). In this regard, a service center that depends on radio to communicate with the ambulance staff for current status and dispatching still fails in proactively detecting movement of an ambulance anytime and performing immediate dispatching for any urgent accidental event. Furthermore, a service center not collecting real-time information for dispatching may delays ambulance dispatching when a case reporter who informs the service center of an accident by telephone does not provide a precise location.

For a patient waiting for first aid, time spent in case report by emergency telephone or a dispatched ambulance arriving at the scene and moving to a hospital is very precious. During decision-making of dispatching an ambulance and transportation of a patient, time is critical to the patient's life because the probability of successful rescue is reduced by 7% to 10% for every one-minute delay of first aid (Cummins, R. O., Eisenberg, M. S., Hallstrom, A. P., & Litwin, P. E., 1985). In this regard, a complete and fast ambulance dispatching system and a vehicle-borne patient physiology monitoring system for time-effectiveness of

rescuing a victim who suffers from an accidental event or the onset of a disease will contribute to rescue of more precious lives. In this paper, we integrate several existing ICT such as smart devices built in Global Position System (GPS) and the third generation (3G) mobile communications systems, Geographic Information System (GIS) (Kenneth E. Foote & Margaret Lynch, 2015), 3G/4G networks, and cloud system to accelerate the process of ambulance dispatching and develop an ambulance dispatching system for emergency medical services. The system constructed on a cloud platform comprises subsystems as follows: (1) case management subsystem; (2) ambulance management subsystem; (3) route planning subsystem; (4) ambulance dispatching subsystem; (5) patient physiology monitoring subsystem.

The system running on a cloud platform is characteristic of integrated medical resources and terminal equipment with or without powerful hardware that is flexibly added into or removed from the system for supporting dispatch. In addition, the movements of ambulances are readily controlled by ICT-based system with GIS and cloud computing supporting a service center's decision-making of any dispatching task, saving time for on-board emergency care, and improving quality of emergency medical services prior to treatment of a hospital.

BACKGROUND

As a brand-new concept for Internet service, cloud computing based on the principles of parallel computing and grid computing for organization of a huge cloud platform provides on-line services accessed by users without powerful hardware facilities. Three service models offered by cloud computing are (Sun Microsystem, 2009):

1. **IaaS (Infrastructure as a Service):** IaaS provides virtualized recourses over the Internet, such computing resource, storage,

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