A Context-Aware Traveler Healthcare Service (THS) System

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Abstract—In the paper, we introduce a new context-aware Traveler Healthcare Service (THS) system and compared it with ordinary emergency healthcare system. Until now, any disease or injury during a trip was regarded as an emergency and the patient is usually sent back to the closest hospital having an emergency room. With the ordinary emergency healthcare service, the traveler may suffer from high cost due to unnecessary additional emergency treatment or improper treatment because of insufficient personal health information. However, a traveler may receive a more convenient (and efficient) healthcare service if pertinent context information for the traveler is provided, for example location of the patient, sex, age or important medical history. We propose the architecture of a context-aware THS system which can be used in a tourist region and explain its operations.

I. INTRODUCTION

Recently, combining future healthcare services and information technology (IT) such as location-based service, mobile device centric applications or ubiquitous context-aware technologies have attracted much attention from medical personnel, hospitals, government and patients [1].

Most of IT based healthcare services have been focused on resident patients [2-4]. The resident healthcare service makes use of the personal health information such as medical history and drug usages from his/her hospitals. The personal health information is given in a paper or electrical format, e.g., EMR (Electronic Medical Records).

Emergency service however is usually performed without sufficient personal health information because of the urgent situation. Therefore in emergency, medical service is usually done in a “best-effort” service with the offhand patient information. Recently, IT based (e.g., location based) emergency healthcare services include finding near hospital, tracing shortest route, paging a doctor or preparing an operation room etc.

With the ordinary emergency service, the patient is usually sent back to the closest hospital having emergency rooms. A traveler may receive a more convenient healthcare service if pertinent context information for the traveler is provided, for example location of the patient, sex, age, important medical history. With the context-aware healthcare service, the traveler may be sent to a proper convenient hospital or get a prescription through telephone or fax. A context-aware Traveler Healthcare Service (THS) system is introduced for this purpose.

In the paper, we introduce a context-aware THS for Kangwon Province in Korea. Kangwon is one of the most popular tourist place in Korea. We propose the architecture of the THS system and compared it with the conventional ordinary emergency healthcare system.

II. THE CONTEXT-AWARE TRAVELER HEALTHCARE SERVICE (THS)

A. Definition of the THS

Healthcare services during a trip have attracted much attention because travelers want safe trip in the first place. Travelers are usually more sensitive to emergency healthcare services than residents. These days tsunami, flood or forest fire occurs more frequently than before, so travelers want a new framework to provide convenient and safe healthcare services during their trips.

The rationale of the THS is that all the medical services for travelers need not to be treated as ordinary emergency cases. With the ordinary emergency healthcare service, the traveler may suffer from the following troubles:

- high cost due to unnecessary additional emergency treatment
- improper treatment because of insufficient personal health information
- hard to link the healthcare service result with the family doctor of the patient

In order to improve the quality of healthcare service of a traveler the followings are considered in the THS.

- analyzing general condition of the patient to find out proper and efficient treatment
- instant access of the patient’s health information (detailed or simple)
- organizing and utilizing pertinent context information of the patient
For context-aware THS service the following information can be used as useful contexts:
- individual characteristics (sex, age, important health history etc)
- environmental information(location, traffic etc)
- disease condition (symptom, types of disease etc)

B. Operation of the THS

The architecture of the THS is shown in Fig. 1. At the top of the figure an ordinary emergency healthcare system is shown, where a patient who is in need of emergency service calls the 119 (911 in the US) for help. Every decision in delivering the patient to a healthcare institution is determined at the 119 rescue service system.

In the context-aware THS (shown at the bottom of Fig. 1) the THS Engine works tightly together with the 119 rescue system. The THS Engine gathers traveler’s individual characteristics under the “THS Agreement” which is set between traveler and the THS system. A traveler may not agree to providing hid/her personal information to the THS.

Under the THS Agreement the THS Engine gathers context information continuously for instant use in case of emergency.

At the incidence of emergency, the THS Engine first analyzes the situation based on the contexts. The analysis considers disease patterns of the traveler, the geographical information or individual contexts. For each level of disease and severity, a proper medical institutional information is matched to each condition.

C. Algorithm

a) Context Classification

Common and plausible disease-condition of the traveler is listed through the advice of medical specialist and experts in emergency department. Highly incident infectious disease in specific area, injuries, aggravated conditions of patient with chronic should also be considered in advance.

Diseases are classified based on the ICD-10 [5] and expressed in the shape of three type condition. 1) aggravated chronic disease such as hypertension, DM, and heart problem, 2) infectious disease and parasitic disease such as malaria, diarrheal disease, and skin eruption, 3) Injuries such as traffic accident, fire and falls.

Typical Emergency diseases for travelers are as follows.

1) Aggravated chronic disease
   - hypertension
   - diabetes mellitus
   - COPD (Chronic Obstructive Pulmonary Disease)
   - Heart problem (MI, ischemia, heart failure)

2) Infectious disease and parasitic disease
   - malaria
   - Diarrheal disease
   - skin disease

3) Injuries
   - Road traffic accidents
   - poisonings
   - Falls
   - Fires, sun burn
   - Drowning
   - Other unintentional injuries

b) Classification of medical institution

In order to find a proper medical institution for a patient we used the following classification rules.

- Facility condition: medical vs. surgical facility, availability for operation.
- Equipment condition: availability of equipment for diagnosis and treatment
- Medical personnel condition: specialist, nursing personnel

Figure 2 shows the process of the THS services.
III. DISCUSSIONS

For the THS to be practical, a reasonable policy to access the personal health information is required. For this purpose, the THS needs an agreement to be signed before his/her trip. In order to encourage to signature the THS Agreement we need a technical solution to satisfy the followings:

- Temporal access to the personal health information only during the trip
- Guaranteeing that all travel related personal context will be cleared up after the trip

We are considering practical provisioning of the proposed THS system to Kangwon Province in Korea. Kangwon has more than a hundred beaches, tens of ski resorts and many beautiful mountains for leisure. Kangwon is one of the three official places now competing to host the 2014 Winter Olympic Games.

Population of Kangwon is about 1,500,000, while the annual number of travelers to Kangwon is about 80,000,000, and more than 11,000,000 cars are visiting Kangwon each year. However Kangwon is very thinly populated and also cities in kangwon are located sparsely, therefore the hospital or clinics cannot be easily accessed by the residents or visitors.

We hope that the THS would help the travelers receive more intelligent and convenient healthcare services during the trip. Along with the growth of experience-based tourism, such as rafting, hang-gliding and cycling, travelers are more exposed to an accident and prone to making worse of his/her illness. In the future, advanced THS may provide travelers with familiar guidelines for the safe recreation and more interesting tours.

IV. CONCLUSION

In the paper, we introduce a context-aware Traveler Healthcare Service (THS) system in order to provide a convenient healthcare service especially for travelers. Important contexts for the THS may include individual characteristics (sex, age, important health history etc), environmental information (location, hospital information, traffic etc), and disease condition (symptom, types of disease etc). The THS works tightly together with the conventional 119 rescue system by gathering traveler’s personal context within the scope of the “THS Agreement” A traveler can choose the level of information to be released to the THS during his/her trip. Under the THS Agreement the THS Engine gathers context information continuously for instant access in case of emergency. For each level of disease and severity, a proper medical institution information is delivered to the patient through the rescue service agent.

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