

A Study on Ubiquitous Healthcare System based on LBS

Jinsoo Ahn, Jungil Heo, Suyoung Lim, Wooshik Kim

Abstract—Ubiquitous refers to the circumstance which allows users to be able to have service at anytime in anywhere. According to the quality of life increased, people also have increased concern regarding health. Moreover, as Ubiquitous era is coming, people want to have treatment at anytime in anywhere. Therefore, an interest of remote treatment is gradually increasing. As a result, Healthcare methods which make immediate responds to emergency situations by applying location-based-service to existing remote treatment systems are studied. Location-based service is a service for seeking people or things location through mobile devices based on wireless communication network and uses the information. Through this service, bionics data such as ECG data and pulse data with location information can be transferred to remote places like hospitals and emergency rooms and maintained by such institutions.

Index Terms— LBS, Healthcare, GPS, Ubiquitous, ECG

I. INTRODUCTION

There is no limit to human being's desire to their health. The interest of the health has been increasing with the development of the wireless communication in the Ubiquitous environment.

Therefore, people want to secure their health at anytime in anywhere, as well as hospitals. As a result, various systems are developed to check patient conditions and give them proper treatment from a remote place in real-time. In addition to this, currently, services to find patients' location and use the information are needed.

Location-based service is a service for seeking people or things location through mobile devices based on wireless communication network and uses the information. In this service environment, patients can freely move from insides such as home and office to outsides like roads. However, the movement data are automatically transmitted to the remote places through sensors and devices in the garage.

Purpose of this service is that patients who meet emergency situation have proper first-aid treatments from emergency institutions by checking the patient location and current conditions.

In this paper, we suggest management methods for

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location information, not just transmission of ECG data, body temperature and pulse.

II. REVIEW OF THE EXISING STUDY

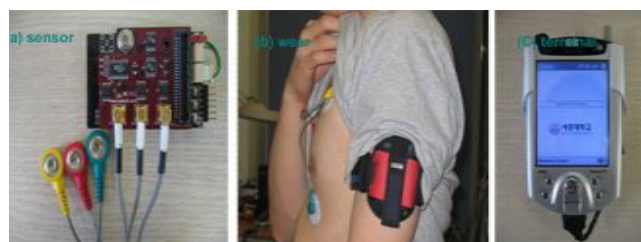


Figure 1. The Picture of Implementation.
(a)sensor, (b)wear, (c)terminal

In the conventional circumstance, a patient lives with a sensor such as (a) in the picture 1 on his/her arm attaching it like (b). PDA like (C) collects the information. Then, the information is transmitted to a local place through wireless LAN, CDMA and cellular modems.

Existing platform consists of a pulse checking sensor, the non-contact temperature sensor (ZTP-115 from GE) for checking body temperature, the CC2420 chip from Chipcon Co., for supporting IEEE 802.15.4 and ATMege128L chip of AMTEL for controlling nodes. In addition, PDA used is iPAQ5450 which use PocketPC2003 as operating system. Although this conventional system may identify users' condition, patient may not have proper treatment on time because it can not provide information regarding the patient location in emergency. Therefore, a system which allows rescuing patient more quickly is needed.

III. LBS

A. The definition of LBS

In TS 22.071 of 3GPP, LBS is a standard network service which can supply location based applications. Also, in OGC (Open GIS Consortium, 2001) LBS is defined as every application software service which connect, supply and adopt location information. FCC (Federal Communications Commission) defines LBS as a service which allows user being able to receive their physical location and position and existence.

In sum up, LBS is defined as application services and systems for providing and using additional information combined users' location information in moving and much different information in real-time with consideration of two important sides which are location movement and accessibility to information in the movement. LBS can be

divided into Location Determination Technology, LBS server technology for management of location data and LBS application technology for providing service. Among these, the Location Determination Technology ensuring location accuracy and reliability must be prepared for LBS activation.

B. Types of Determination Technology

Location Determination Technology for detecting terminals is inevitable in the LBS realization. Location Determination Technology can be divided into the Determination Technology based on satellite communication and Determination Technology based on mobile communication.

1) Determination Technology based on satellite communication.

The Determination Technology based on satellite communication includes GPS in U.S. and GALILEO in E.U. While this technology is most widely used in the world because it provides wider signal area and stable service through a satellite, it has lower accuracy, depends on weather and service is not available in the inside of buildings or other places where hardly receive the GPS signal from a satellite.

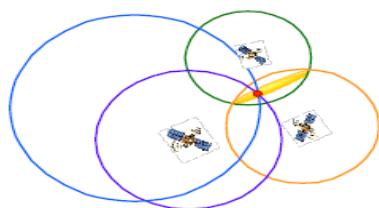


Figure 2. GPS

GPS consists of 24 satellites on the earth orbit, a control tower for controlling the satellites and a GPS terminal. Every 4 satellites are located on 6 orbits by every 60 degree. GPS terminal in earth can receive at least 5 different satellite signals to 8 signals. GPS can recognize every location in earth. However, exact location determination can be difficult in inside of buildings, downtown and some place because of signal diminution. In addition, the accuracy also decreases because the location is roughly assumed through a base station which receives a signal from certain mobile phone by defining signal reaching area of base station as a cell. Especially, if the area the base station covers is wider such as rural, the accuracy is significantly low.

However, it can be applied to existing mobile phones without attaching additional device or upgrading software. E.U, China and Israel joined in Galileo project. Approx. 30 satellites including 3 Spare satellites moves 3 orbits on 23,616 km from surface with 56 degree as an inclined plane in every 14 hours and 4 minutes. The design and development were completed in 2005. In 2007 the satellites are launched. Commercial service starts in 2008. Target accuracy is 1m.

2) Determination Technology based on mobile communication.

Determination Technology based on mobile communication can be divided into the network based type

which uses reception signals from a base station of network and handset based type which uses a GPS receiver on handsets. The followings are handset based type technology.

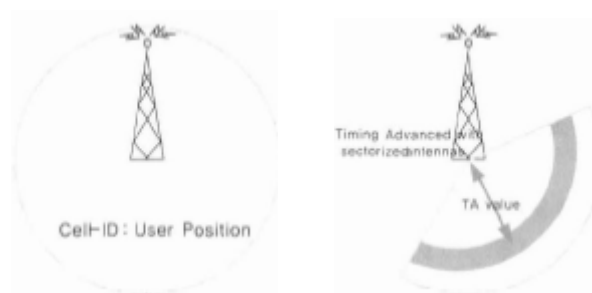


Figure 3. Cell-ID

Cell-ID Type is an algorithm which makes a base station location with cell id including a handset be a handset location. It decides a location by a base station itself or sector ranges of the base station.

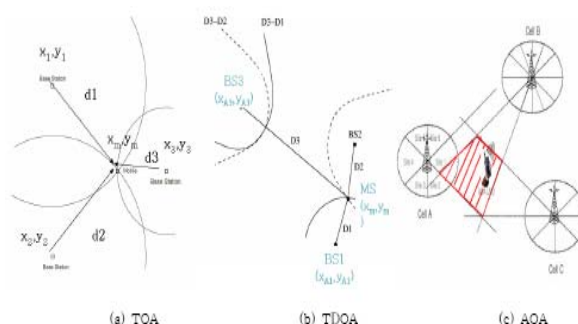


Figure 4. TOA, TDOA, AOA

TOA(Time of Arrival) Type calculates distance between a handset and a base station by estimating time to reach at the handset from the base station. The distance can be calculated based on the estimated values coming from measuring different signals from different base stations.

AOA(Angle of Arrival) is a determination technology to decide a location through finding signals from receivers based on signal sources, by estimating angle of signals transmitted from receivers. In other words, there are 4-12 antennas installed on one base station for each direction. The location is an overlapped place with a cell site which is an antenna direction of each base station receiving antenna number sending signals and a signal source.

TDOA(Time Difference of Arrival) technique is an algorithm that measures the position of the mobile unit at the same distance away from the base-station by measuring the time difference of the received signal that is transmitted from more than two base-stations.

A-GPS(Assisted Global Positioning System) technique is based on a mobile unit. The positioning method using GPS satellite seems superior in the aspect of accuracy. However, it has a drawback that the quality of a transmitted electromagnetic wave is degraded inside the building or at the downtown, where reflection, deflection, and attenuation occurs by the building wall.

Therefore, A-GPS is a good complement for the conventional GPS based position method or network based technique through the combination of the advantages of those

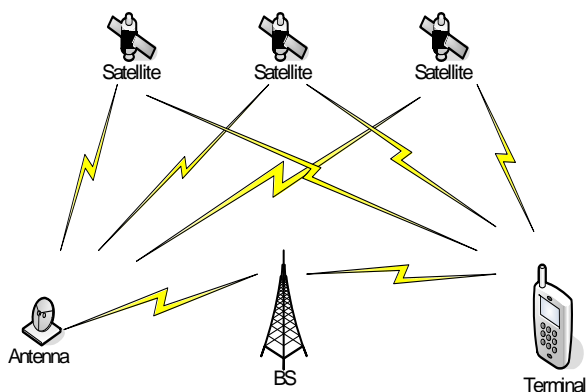


Figure 5. A-GPS

two positioning mechanism. gpsOne chip of Qualcomm is based on an A-GPS.

Mobile unit receives signal not only from GPS satellite but also from base-station at the same time, which works as an A-GPS base-station, resulting in the improvement of signal reliability by reducing the error component due to the reflection by the buildings at downtown. The error range is up to 10~30m. This technique, however, has two disadvantages: we need an additional mobile with built-in GPS chip, and a new device with which GPS signal can be received should be added to the base-station.

To make use of the conventional positioning method to the LBS, accuracy is the most important parameter. Also, indoor positioning should be accurate, since most patients usually live in the room.

For the present, the application of the conventional positioning method has many difficulties. Nevertheless, the better healthcare system can be build through the development of the improved positioning technique and location based service.

IV. MAIN SUBJECT

Free movement is allowed to the patient with mobile sensor attached. The measured data are transmitted to the remote server through the CDMA and WLAN network by the mobile unit such as PDA. To obtain the position data, position information is periodically transmitted with the biometric data by adding the GPS module. Position is determined with sensor network constituted using Zigbee inside the building, because the GPS positioning has a limitation in the indoor positioning.

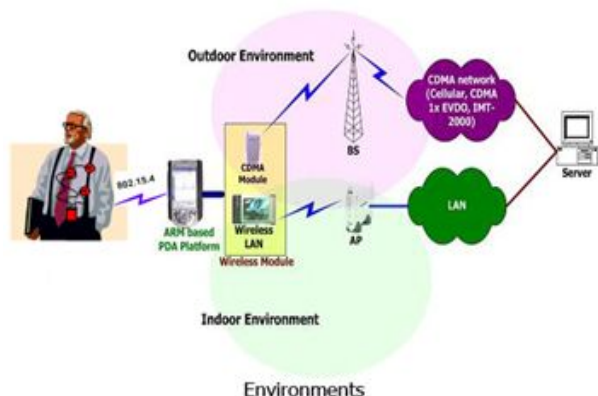


Figure 6. Communication environment of implemented system.

To achieve this, GPS module is added to the ZigbeX of Hanback Electronics. Outdoor position data is transmitted using GPS, and indoor position is determined using Ad-Hoc network.

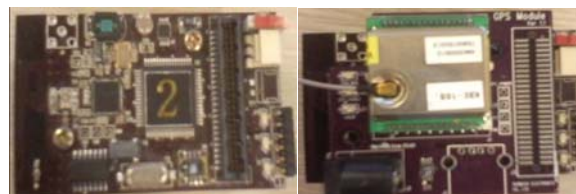


Figure 7. The Picture of ZigbeX and GPS Module.

Received data at the server are transmitted to the hospital, and the doctor can always check the status and take care of his patient from the distant place. Also, emergency call will be made to the emergicenter when the biometric data are outside the predetermined critical value. Then the positioning of the patient will be started at the same time. Since the position data as well as the biometric data have already been sent to the hospital, we should transfer the patient as soon as possible.

Identification of an anonymous, unconscious or unidentifiable patient with abrupt accident is possible, when he or she put on this equipment.

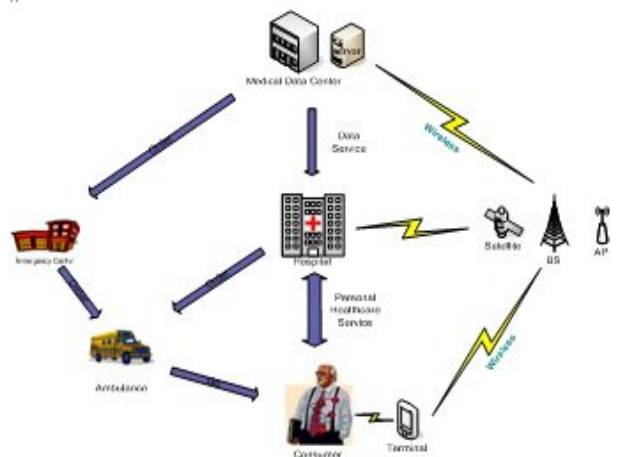


Figure 8. Overall Model of Healthcare System

In the hospital, a doctor can take care of a patient easily with the previously received information about the patient.

Also, information on the time of arrival of an ambulance reduces the preparation time loss, resulting in the fast medical treatment.

Above all things, custom healthcare service becomes available for the patient. Custom emergency medical treatment system is essential for the patient in the era of Ubiquitous.

V. CONCLUSION

In this paper, we proposed the methodology of remote patient management system based on the location information service with the biometric data of a patient.

With this system, we can transfer the patient who is in the state of heart disease or a stroke to the hospital fast and safe, with the help of location data from the positioning system.

In the near future, a custom emergency medical treatment

system will be available to the patient in the era of Ubiquitous.

Although the accuracy of outdoor and indoor location data is somewhat limited, the better service can be provided through the development and importation of the precise positioning method, which overcome the error limitation of the conventional positioning algorithm.

TABLE 1.
COMPARATIVE ANALYSIS OF LBS METHOD

	Space	Time	Emergency Treatment Response
Previous Method	· Difficulty of location cognition due to dependency on report of an observer.	· Takes too much time to find out a patient.	·Emergency treatment without knowing its reason.
LBS Method	· Accurate range of location determination error(less than 1M)	· Immediate response for a patient's abnormality.	· Possible to apply emergency treatment by knowing a patient's identity and a cause of a disease.

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