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## WPAN기반 시멘틱 웹 헬스 모니터링

### WPAN Based Semantic-Web Health Monitoring

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**요 약** WPAN은 근거리 무선 개인 통신망으로 센서간의 연동과 센서와 네트워크간의 요소기술을 포함하고 있다. 유비쿼터스 센서 네트워크의 핵심 기술로 WLAN이나 CDMA망과 연계하여 더 큰 유비쿼터스 네트워크를 형성할 수 있다. 본 논문에서는 WPAN과 헬스케어의 융합의 관점으로 정기진료를 필요로 하는 환자들 중 임신부를 대상으로, 임신중의 활동사항을 스마트폰을 이용하여 체계적으로 관리할 수 있는 스마트폰 애플리케이션을 제안한다. 진단결과 데이터를 스마트폰에 WPAN 방식을 사용하여 전송하며, 스케줄링과 함께 애플리케이션의 다양한 서비스를 제공할 수 있도록 한다.

**Abstract** In recent years, mobile healthcare systems that transfer patient data wirelessly have been used in the medical field. However, the current messages supported to patients are difficult to satisfy the specific patients, and there is a lack of healthcare systems to help manage patients with diabetes or pregnant women on a regular basis. In this regard, this paper demonstrates that the semantic-web service to which data transfer method, application framework and networking of WPAN are applied can be implemented. In addition, it suggests common data types to integrate data from a variety of sources and provides a common framework in which information on the Web can be shared and reused in applications, businesses and communities, etc. As an example, the healthcare monitoring that can manage healthcare for pregnant women, which includes confirmation of pregnancy, periodic health management, fetal movement, prenatal care and health-related knowledge, is proposed.

**Key Words** : Healthcare system, WPAN, Semantic-web, Diagnostic system

#### 1. Introduction

The recent advances in information and telecommunication technologies have contributed to the acceleration of the ubiquitous era in modern society. In particular, telecommunication s industry is being engaged in building a ubiquitous environment thar

requires efficient establishment of the network to take full advantages of wireless communications<sup>[1]</sup>. Wireless Personal Area Network, which is abbreviated as WPAN, includes linkage between sensors and element technologies between sensors and networks. A larger ubiquitous network can be formed through connection to WLAN or CDMA network using the core technology

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of ubiquitous sensor networks<sup>[2]</sup>. In the medical field, the smartphone healthcare system that can transfer diagnosis data to patient's smartphone using healthcare systems has been applied.

In this paper, related research is described in Chapter 2, and system design is suggested in Chapter 3, and system implementation in Chapter 4. Chapter 5 shows a comparative evaluation, and a conclusion is presented in Chapter 6.

## II. Related Research

### 1. WPAN

As a networking element technology in order to realize the ubiquitous era where the benefits of the information and communication can be enjoyed by anyone at anytime and anywhere, WPAN is a technology related to a variety of application framework, networking, and data transfer method to guarantee the features of low power/small size/low price, including the element technologies such as 60GHz mmW WPAN, Low-Rate WPAN, WiMedia UWB, and mobile communication Bluetooth.

### 2. Personalization

The meaning of personalization is to make products or services fit for the needs of the individual consumer or the purpose of the use, and recently it has been applied to the environment of World Wide Web mainly. In other words, the services or the contents provided by the web environment are not commonly supplied to all the users but instead supplied by selecting only what individuals want. Therefore, this reduces the cost put into the organization and the employees to the business, and to the customers, this gives an impression that a cyber personal assistant exists for them by providing the service just right to them<sup>[3][4]</sup>.

Currently, the areas where personalization is actively progressed are Personalized Homepage and Personalized Search<sup>[5]</sup>.

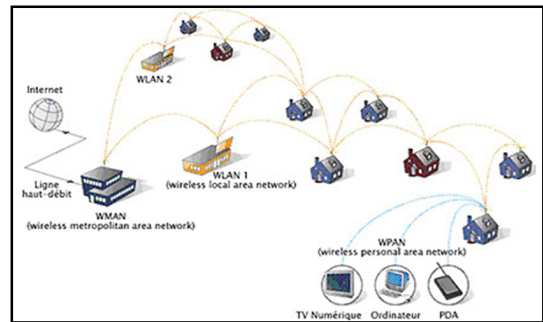


Fig. 1. Concept of WPAN

그림 1. WPAN 개념도

### 3. Semantic-Web

Tim Berners-Lee suggested a next generation web technology called Semantic Web which allows people and machines (computers) to understand and handle the meaning of the information that exists in the web based on W3C. It has a common form for combining data from a variety of sources, and through this, it provides a common framework where web's information can be shared and reused in applications, businesses, and communities<sup>[6][7]</sup>.

## III. System Design

### 1. Flow Chart of the System

As seen in the Fig.2, the system loads the data on a pregnant woman which is saved in the DB in the hospital server and sends it to a doctor, which can give help with diagnosing. The system allows the pregnant woman to receive the information and announcements according to the relevant period via text messages on a smartphone; the data here is received through WPAN. The pregnant woman who receives the relevant data is supplied with 4 functions from the smartphone application: Scheduling, Entertainments, Meals, and Knowledges.

The flow chart of the system is shown in the Fig.3. Firstly, the system searches the subjects diagnosed by the doctor in the database in order to bring the history

of the pregnant woman from the hospital server.

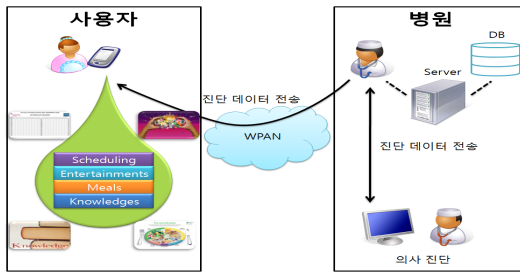


Fig. 2. Transfer structure of diagnosis data  
그림 2. 진단 자료의 전환구조

It allows the doctor in charge to see the data found in the server after the preprocessing process, and it also sends the data externally and delivers it to the smartphone of the pregnant woman.

Through the Scheduling, previous checkup histories and checkups coming up can be checked, and entertainments such as exercise management for the current period or menus managing the daily amount of intake and information for pregnant women which is the basic knowledge that they need to know about can be used as part of the smartphone services.

## 2. System Configuration Model

Fig. 4 presents the process of viewing the delivered data to the pregnant woman through a smartphone in a system configuration model. The lower layer is made up of Wireless Communication System to send data wirelessly and Mobile Platform in order to support the interface of a smartphone. Application, which is the upper layer, means the function and roles supported by a smartphone; Data Receiver for receiving data from the hospital server is included and it processes Pre-Processing for processing the data, and can Display to show Pre-Processed data.

The pregnant woman can check the displayed data of her current pregnancy cycle through the Scheduling, and can check the previous checkup histories and checkups which need to be done in the future, and can check if there are any problems with the embryo by

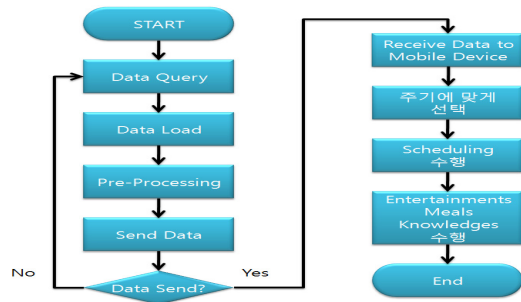


Fig. 3. Diagnostic data processing  
그림 3. 진단 자료 처리과정

carrying out ‘view the status of the embryo’, and additionally record the mentality section where the status can be written in the form of a diary. In the Entertainments, according to own relevant schedule, she can gain weight normally, manage the weight and fitness for keeping physical strength, carry out the obesity measurement in order to know whether or not there needs to be a regulation of meals, manage the exercise hours so she can systematically do fitness for the period, listen to music for the embryo’s prenatal care or read books, and can be supplied contents where she can check the videos.

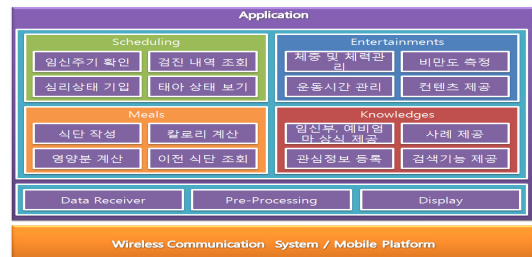


Fig. 4. Application system architecture  
그림 4. 어플리케이션 시스템 구조

In the Knowledges, the system provides the knowledge about the common sense of the pregnant woman or infant care after birth for pregnant women and mothers-to-be, and it also provides examples to prevent them from miscarriage through unexpected accidents or giving birth to a premature baby due to an illness. And search function and scrap function of the relevant information are granted because it is difficult

to search the vast amount of knowledges one by one.

#### IV. Implementation of the System

A smartphone was used to realize the system as a smartphone device, and the OS is Android. Before loading it to the smartphone directly, Android 2.1 which is an Android simulator was worked with a computer. The specifications of the computer were AMD Turion(tm) X2 Ultra Dual-Core Mobile ZM-85 2.30GHz, and 2GB RAM, and Windows XP SP3 was used for the operating system.

Fig.5 shows the algorithm of main screen where the application receives the pregnant woman's data from the hospital server and carries out it through a smartphone. The p(period) and data[] is received in the device for general users and the information of the application is formed. The data [] occurred by the p is filtered as the application can be carried out according to the period. From the data received from a hospital, the photo of the fetus in the data [] is input to the pic along with the p in order to output the state information of the fetus. It is inadequate for general pregnant women to distinguish if there are any problems by looking at the photo of the fetus, so the status is output on the bottom along with the photo. For the output of the status, it explains the general state of the fetus and this is placed in the sta. Finally, in order to output these 3 functions on the screen, the p, pic, and sta are output. Maintain the Wait status so it can be on standby on the screen until the user views the status and carries out the next function. In order to allow the user to use the 4 functions of Scheduling, Entertainments, Meals, and Knowledges, the system uses the switch(menu) so the functions can be performed.

Fig.6 is the algorithm of recommended model learning which enables users to use customized recommendation function in the application. M is the initial model learned in order for ordinary people to use

the semantic web in advance. In other words, it is the standard model learnt by ordinary people in advance. LearningModel(), the function of the study model, distinguishes whether a new data exists or not in if.

```

Receive p, data[] for current user U;
Filtering data[] by p;
pic ← unborn baby's picture in data[] with p;
sta ← explanation for unborn baby's current state;
Display p, pic, sta;
Wait for U's input menu;
switch(menu) {
    //Execute selected function
    case SCHEDULING:
        ...
    case ENTERTAINMENTS:
        ...
    case MEALS:
        ...
    case KNOWLEDGES:
        ...
};

```

Fig. 5. The Main Screen Algorithm

그림 5. 화면 알고리즘

If there is a new value, and if there are more cases with a lot of conditions, it can suggest closer recommendations to users. Therefore, it takes into account the sensitivity of pregnant women and brings the current weather data to gain weather information of W, so that users can directly describe. Following this, it gets the sequence function which is the analysis model D[], and it Loads all the types of the contents and number of uses to insert them in the Data[] arrangement. Also, the data[] analyses the information used in each content, and puts it in the C[] repeatedly. Next, the Feedback is conducted because this influences the performance of M. It gives recommendation by regulating the Threshold from items in M according to the functions of W, D[], and C[].

In the main screen, the upper screen has an fetus emoticon which shows the fetus's growth according to the pregnancy period, and the current period and history of the fetus's condition are presented. At the bottom of the screen, it is composed with the button icons of the 4 functions provided by the application: Scheduling, Entertainments, Meals, and Knowledges.

```

// Assume  $M$  is initial model that was learned for the
// public beforehand using semantic web
learningModel(){
  if(new data is existed) {
     $W \leftarrow$  Get data of weather at this time;
     $D[] \leftarrow$  Load and analysis written diary data;
     $CData[] \leftarrow$  Load all contents' type and counter;
    for each  $CData[]$ 
       $C[] \leftarrow$  Analysis used history for  $CData[]$ ;

    //Feedback because it affect  $M$ 's performance
    Adjust threshold for  $M$ 's items by  $W, D[], C[]$ ;
  }
  //Recursive loop
  learningModel();
}

```

Fig. 6. Recommended model learning algorithm  
 그림 6. 추천모델 학습 알고리즘

## V. Comparative Evaluation

We explain the comparative evaluation carried out between the web service based on Web1.0 which is widely used, RISS using the Semantic Web method, and the scheduling service modeling suggested in this paper. The general web provides data from the server and can save small amount of address in link type. But, even if users passively search directly and edit the data, if it is not renewed in the server, it is hard to edit. In addition, it is hard to approach specific searches so when searching the data, other candidate data appears, which makes unnecessary data. However, the execution of operation is done quickly due to comprehensive search, which means that it has a short waiting time.

The Scheduling service suggested in this paper stores the specific categories of date, weather, diary, and contents, so that real time recommendation is available from the combined results of each category, and it is able to do a more definite search due to limited categories. It filters the searched data, and can present the detailed data for a specific keyword. It approaches through filtering of specific categories so the waiting time is long, but a higher effectiveness is provided to users with the search results.

## VI. Conclusion

In recent years, smartphone healthcare systems have been used in hospitals or public health centers, and a variety of healthcare systems are currently being developed. However, the reality is that there is a lack of healthcare systems to support patients that require regular medical examinations and treatments.

Accordingly, this paper proposed a healthcare scheduling application using smartphones that manages healthcare especially for pregnant women, which includes confirmation of pregnancy, periodic health management, fetal movement, prenatal care and health-related knowledge by applying data transfer method, application framework and networking of WPAN. Through this, user-based personalized information can be collected, managed and applied, and the optimal healthcare scheduling through learning is expected to be achieved.

For future work, there is a need to promote the modeling that can output the fetal heartbeat sound and transfer its vibrations to increase the intimacy between the fetus and a pregnant woman.

## References

- [1] Hyung-Kyu Yang, "Security Analysis of a secure dynamic ID based remote user authentication scheme for multi-server environment," Journal of the Institute of Internet, Broadcasting and Communication (JIIBC), Vol. 13, No. 1, pp. 273-278, 2013.
- [2] P. Koutsakis, M. Vafiadis, and A. Lazaris, "A New Bandwidth Allocation Mechanism for Next Generation Wireless Cellular Networks," Wireless Network 16, pp. 331-353, 2010.
- [3] Hyeon-Seok Na, Sung-Yeol Yun, Seok-Cheon Park, "Design and Implementation of Mapping System for Effective Health Information Data Exchange in Multi-Platform Environment"

Korean Institute Of Information Technology, Journal of Korean Institute of Information Technology, Vol.10 No.12, pp 143-150, 2012.

[4] Eui-Jun Jeong, Frank A. Biocca, Min-Kyu Kim, "Realism Cues and Memory in Computer system : Effects of Violence Cues on Arousal, Engagement, and Memory", Journal of Korea game society.Vol.11, No. 4, pp127-142, 2011

[5] Jeong-Do Kim, Sung-Dae Park, Yun-Hyung Jang, Jun-Seok Park, Woo-Hyuk jung and Sang-Goog Lee, "Real-time analytical method for predicting stress and dangerous heart condition using ECG

signal in computer game", Journal of institute of information technology, Vol. 9, No.2 , 2011

[6] Hea-Jin Kim, " Context-Awareness Technology for Location Based-Service for Ubiquitous Learning", Journal of the Korea Academia-Industrial cooperation Society v.12, n.11, 4869-4874, 2011

[7] Han-joon Kim, Joonho Noh, Jaeyoung Chang."Multihop Transmission in Cognitive Underlay Network Over Rayleigh Fading Channels"The Journal of IWIT (The Institute of Webcasting, Internet and Telecommunication),VOL. 12 No.2, pp.69-76, 2012

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