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Ubiquitous Computing (UC) for Discovery Service Technologies used in Location Detection and Self Therapeutic Services for Healthcare Systems in u-Health

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***Abstract*– Ubiquitous computing introduces inimitable requirements for the discovery technique prototype, which lets services and devices become aware of each other without explicit human administration. The vision of ubiquitous computing has been described in terms of the disappearing computer. In this vision, we are free to focus on the interactions of daily life in various domain, rather than attending to the technology assisting us in those interactions, for example in UC discovery service technologies used in location detection and self therapeutic services in healthcare systems. The machine (while perhaps not literally invisible) becomes a tool much like a hammer or pen, easily appropriated and used as second nature. Discovery lets services and devices spontaneously become aware of the availability and capability of peers on the network without explicit administration. In practice, this means that a client can discover and potentially use a device without prior knowledge of it. Although discovery is a necessary component of ubiquitous computing, the wide range of discovery systems in use today reflects the varied needs of the communities from which they originated.**

***Index Terms*– Ubiquitous Computing, Service Technologies, u-Health Care and Health BAN**

I. INTRODUCTION

DISCOVERY is the process by which an entity on a network (a client) is spontaneously notified of the availability of desirable services or devices on the network (resources) [1]. More precisely, discovery is a mechanism for dynamically referencing a resource on the network. These references are handles or other information that the client can subsequently use to contact the resource. Resources entering the network make themselves available by registering with the discovery system. This can involve finding a directory service and registering with it or simply making periodic announcements on the network. During this process, resources provide descriptive information (such as their resource type and trait) as well as information the client will need to use them (such as an IP address and port number). Clients Provide criteria describing the resources they're Interested in, and the system uses these criteria to Identify appropriate resources for the client.

This Process might involve querying a directory or simply Filtering resource announcements. In all discovery systems, registration and deregistration are highly dynamic—as resources come and go, the discovery system can asynchronously notify clients of resources' availability.

II. DISCOVERY IN PRACTICE

The choice of discovery technology depends on the intended application. Many discovery systems were designed with the enterprise in mind and embody design decisions reflecting that intent: managed directories intended to run on centralized servers, IP-based transports compatible with enterprise services, flexible scoping, and powerful search mechanisms that execute in the directory service, and security to prevent unwanted access to enterprise resources. While many ubiquitous computing systems [3] will fit into these design choices, others won't. In particular, mobile systems or systems that don't support constant connectivity, that prioritize low power consumption, or that have limited computational capacity might require technology with a different set of trade-offs.

III. UBIQUITOUS SERVICE IN u-HEALTH

Today's paradigm of "one size fits all" healthcare is mainly applied in hospital, clinics and healthcare centers, limited by the medical cost and resources. The emergence of ubiquitous computing and continuous progress in medical devices [9] and diagnosis methodology, however, is enabling personalized healthcare services [6] to be delivered to individuals at any place and any time. Personalized healthcare provides medical services which are truly effective "for me". This ensures that healthcare services provisioned to an individual are customized to his/her prevailing healthcare needs. With personalized healthcare, we can further achieve "early health" system where disease is addressed and prevented at the earliest possible moment, rather than a "late disease" model where the emphasis is mainly on diagnosis and treatment.

To achieve healthcare personalization [7], other than phenotypic and genotypic patient data, factors such as individual's lifestyle, surrounding situations, device capabilities, event of happenings, etc, should be taken into account. Such personalization factors are known as context, which is referred to any information that can be used to characterize the situation of an entity (can be person, place or computational objects) and the interaction between them [1].

As a result, personalized healthcare system is context-aware – provisioning healthcare information based on user's changing context so that the right information can be delivered to the right person, at the right time, at the right place, using the right way.

In ubiquitous computing environment, computing entities ranging from sensors, actuators, devices to web services and applications, are supposed to scatter in different spaces and serve people even without their awareness. For example, a wearable health monitoring device can constantly examine one's blood pressure, body temperature, pulse, etc.; the availability of large display screen, surveillance camera and embedded microphone array at home may support remote medical consultation; web services can tell the consultation hours of a certain doctor. To fully exploit the power of various hardware and software components, an infrastructure which enables device self-integration and service interoperability among heterogeneous functional components is required.

IV. TECHNOLOGIES FOR PERSONALIZED HEALTHCARE INFRASTRUCTURE

With the development of mobile and high capacity personal computing devices, miniature wearable sensors and ever improving wireless communication infrastructures, ubiquitous healthcare (u-health) [2] is becoming a realistic prospect from the technical point of view [1] - [4]. The potential now exists for healthcare professionals and patients to transfer health related data anywhere anytime. Furthermore, the healthcare systems of different healthcare providers are increasingly interconnected. Consequently, ubiquitous access to and availability of healthcare information is becoming technically feasible. However current mobile devices and wireless communications still suffer from certain limitations which restrict the ability to store, process and transmit large volumes of multimedia clinical data in real time. Mobile devices still have limited memory and processing power, and are especially restricted by of battery life.

State of the art wireless communications technologies now handle high bandwidth applications, however transmission of some kinds of (multimedia) clinical data strains or exceeds the capacity available today. Furthermore applications need to adapt to the dynamically changing communications environment and to the changing needs and situation of the user. In this paper we describe the AWARENESS approach to context awareness for BAN-based u-health applications [12]. Which powers the sensors and performs some signal processing and filtering? At the remote location a health professional can view biosignals and other BAN data and send control commands to the BAN. IntraBAN communication may be wireless (e.g., via Blue Tooth) or wired.

V. u-HEALTH BANS

Fig. 1 shows the general configuration of the BAN service platform. The patient wears a set of devices which

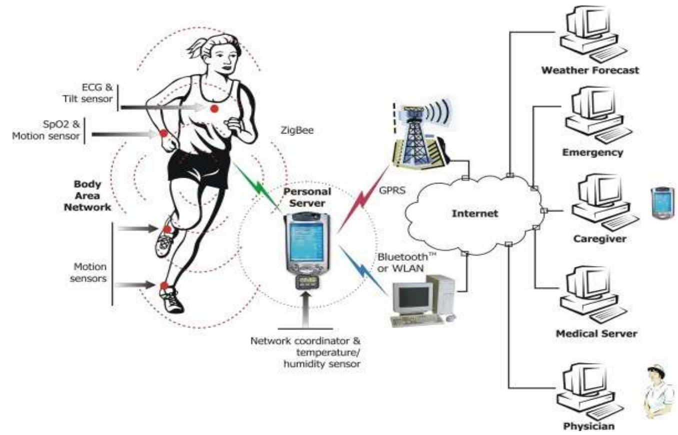

Fig. 1. A Health BAN Network for Telemedicine

communicate via the MBU with a user (or with a software application) at a remote location via the BAN Backend server.

Some sensors are standalone, others are front-end supported. In the latter case the sensors are connected to a sensor front end or 'sensor-box'.

The Fig. 2 shows one variant of the BAN. In this case the MBU is implemented on a Qtek PDA [8]. The sensors are electrodes and a respiration sensor, examples of front end supported sensor systems. In the centre is the sensor box (the Mobi from TMSI).

Fig. 2. BAN with electrodes and respiration sensor

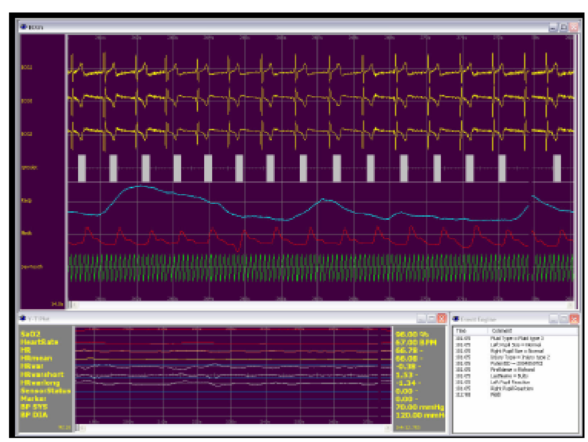

Fig. 3. Display of BAN data from multiple biosignal sources

The Fig. 3 shows a visualization of output from the patient trauma BAN. The upper part shows ECG output from three Outputs (a button used for alarms or notifications). Blood pressure (systolic) and blood pressure (diastolic) are measured externally and values are input manually.

To the right of the graphical representation, current values of the parameters are presented textually (e.g. 96% for oxygen saturation). Bottom right there is a panel of text showing further information relevant in trauma cares, including: fluids administered left and right pupil size and reaction, and injury type, by timestamp.

VI. CONCLUSION AND FUTURE ENHANCEMENTS

We have described the u-health BAN and service platform and three variants of the Health BAN aimed at applications in neurology. Following this we discussed the importance of context awareness and outlined the approach taken in the awareness Project. Another challenge relates to usability of the BAN itself. The development team have made enormous progress in BAN and BAN service platform development, however current generation BANs have not yet reached desirable levels of unobtrusiveness and user friendliness, due to various limitations of current technologies. It is not convenient for patients to wear current generation BANs for long periods, for one because they have to wear or carry and manage a collection of different devices including a PDA or smart phone [11]. We envisage several directions in which BANs may evolve in the long term to overcome some of these shortcomings. We envision increasing miniaturization eventually enabling the “disappearing BAN”, incorporating micro- and nano-scale devices, processes and materials, possibly implanted, communicating with the Ambient Intelligent Environment to provide cost-effective, unobtrusive, pervasive, context aware services in u-Health.

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