

A Study on Wireless Body Area Network of Intelligent Motion Sensors for Computer Assisted Physical Rehabilitation

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Abstract: In the recent generation aged/young people are suffering from various health issues like respiratory problem, blood sugar, blood pressure, heart related diseases, the current medical techniques fails to overcome these situations. Recent technological advances in integrated circuits, wireless communications, and physiological sensing allow miniature, lightweight, ultra-low power, intelligent monitoring devices. A number of these devices can be integrated into a Wireless Body Area Network (WBAN). This is a study on the applications of Wireless Body Area Network in physical rehabilitation and to study the existence of Wireless Body Area Network in and around the city.

Keywords: Wireless Body Area Network (WBAN), Physical Rehabilitation, Intelligent Motion Sensors.

I. INTRODUCTION

Since the aged population are suffering from various health issues like blood pressure, diabetics, asthma, breathing problem or heart related disease, the existing medical resources cannot satisfy future healthcare demands. Resources are limited and it is impossible for most patients to afford long-term hospital stays due to economic restrictions work, and other reasons, even though their health status must be monitored in a real-time or short periodic time mode. The advancement of wireless communications and semiconductor technologies has grown significantly supporting a range of applications including medical and health care systems, it is better to have a device which detects the variations in health and alert the patient in advance. The healthcare sector is always looking for advanced Information and communication Technology (ICT) systems to efficiently administer the health of a person. The advanced ICT systems will be able to deliver healthcare not only to patients in hospital and medical centres, but also in their homes and work places, thus offering cost savings, and improving the quality of life of patients. Wireless Body Area network (WBAN) is the one such invention which is helpful for any patient who's suffering from different health problems.

Wireless Body Area Network (WBAN) is a Wearable health monitoring systems integrated into a telemedicine system, it is the technology that will be able to support early detection of abnormal conditions and prevention of its serious consequences. A WBAN consists of number of tiny sensor nodes and a Gateway node used to connect to an external database server. The Gateway node could connect the sensor node to a range of telecommunication networks. These communication network could be either a

standard telephone network, mobile phone network, a dedicated hospital/medical centre network or using public WLAN hotspots (WiFi). WBAN can also works with mobile data networks such as 3G/4G networks to transmit patients' data. WBAN could allow storing their personal data in any portable devices (PDA / iPod etc) and then transferring that information to suitable computers.

The ICT systems are already in use in medical areas but their applications are limited. The main drawback of current systems is the location specific nature of the system due to the use of fixed/wired systems. WBAN are location independent monitoring systems.

WBAN are classified into 2 categories

1. Wearable WBAN
2. Implantable WBAN



Fig1 [wearable wireless sensor devices: wrist watch]

Wearable WBAN comes in different types either a kind of wrist watch (Fig1) or can be kept in the pocket and implantable WBAN may be embedded inside the body or surface mounted on the body in fixed position.

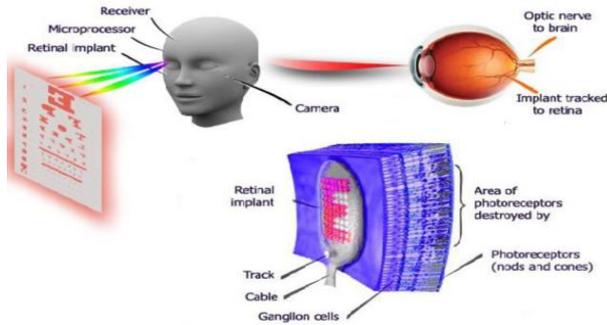


Fig2 [Implantable wireless sensor devices: Retina implant in blind people]

A good example for implantable WBAN is retinal implant in blind people (Fig2). Many patients can benefit from continuous monitoring as a part of a diagnostic procedure, optimal maintenance of a chronic condition or during supervised recovery from an acute event or surgical procedure. This device alarms the person who wears it and Auto medication is also possible in case of emergency.

These devices provide continuous health monitoring and real-time feedback to the user or medical personnel. The wire-less nature of the network and the wide variety of sensors offer numerous new, practical and innovative applications to improve healthcare and the quality of life. The sensor measures certain parameters of human body, either externally or internally. Examples include measuring the heartbeat, body temperature or recording a prolonged electrocardiogram (ECG).

Several sensors are placed in clothes, directly on the body or under the skin of a person and measure the temperature, blood pressure, heart rate, ECG, EEG, respiration rate, SpO2 levels etc. Next to sensing devices, the patient has actuators which act as drug delivery systems. The medicine can be delivered on predetermined moments, triggered by an external source or immediately when a sensor notices a problem. The sensor monitors a sudden drop of glucose, a signal can be sent to the actuator in order to start the injection of insulin. Consequently, the patients will experience fewer nuisances from his disease.

II. APPLICATION

Some of the Applications of Wireless Sensors in Healthcare are Stated Below.

Heart Diseases

Cardiovascular disease refers to various medical conditions that affect the heart and blood vessels. The conditions include heart attack, heart failure, stroke, coronary artery disease. This disease is the leading cause of mortality in the developed world .

World Heart Organization stated that heart disease accounts for about 17 million (about 30%) deaths annually throughout the world and 80 percent of all deaths in China are caused by chronic disease About one-half of those who

die do so within 1 hour of the start of symptoms and before reaching the hospital.

A WBAN is a key technology that provides real-time monitoring of cardiovascular patients by continuously sense, process, and transmit physiological data from central control unit to the medical server through personal server, which the physician can make use of the information to treat the patients. Also promoting timely intervention of health care structure as and when required.

Asthma

Millions of patients are suffering from asthma in the world, a WBAN can help these patients by monitoring allergic agents in the air and providing real-time feed-back to the physician and/or to the patient himself. A portable Global Positioning System (GPS) device was developed that continuously consults a remote server by sensing user's reports to decide whether current ambient air quality will threaten user's health. The server also collects real-time data from the network of national air quality monitoring stations. If it finds anything allergic to the patient, an alarm to the patient and/or physician will be triggered.

Cancer Detection

National Centre for Health Statistics in their annual report stated that about 9 million cancer patients were diagnosed in 1999 and the number is increasing every year. Cancer is now one of the biggest threats to the human life. A WBAN with a set of miniaturized sensors can be used to differentiate between different types of cells and identifying cancerous cells, enabling physicians to diagnose tumours without biopsy.

Diabetes

World Health Organization (WHO) reported that more than 220 million people worldwide have diabetes and 1.1 million people died from diabetes in 2005. Following are some of the complications that occurs as a result of diabetes: amputations, blindness, kidney disease, stroke, high blood pressure, heart disease Treatment includes blood pressure control, exercise, insulin injections. A WBAN can be used in a more effective way to treat diabetes, by providing a more consistent, less invasive and accurate method for monitoring glucose levels in the body

Artificial Retina

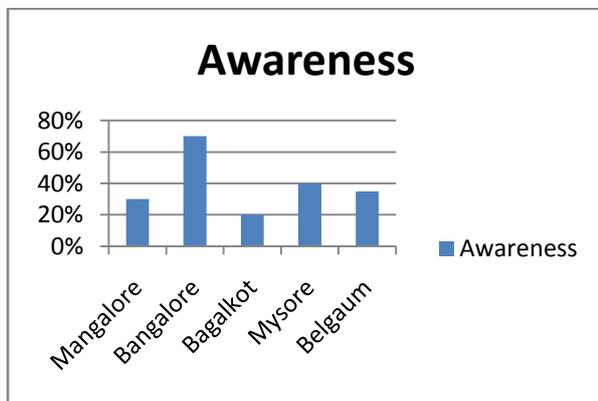
Optoelectronic Retina Prosthesis (ORP) chips can be implanted into the back of human eye, which assist blinds and/or patients with low vision to see normally.

In addition, WBAN systems can be used for gait phase detection during programmable, functional electrical stimulation , analysis of balance and monitoring of Parkinson's disease patients in the ambulatory setting , computer supervision of health and activity status of elderly, weight loss therapy, obesity prevention, or in general promotion of a healthy, physically active, lifestyle.

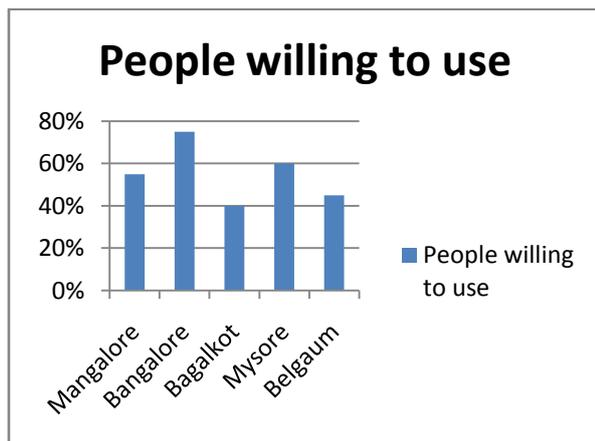
III. WIRELESS SENSOR DEVICES FORECAST AND AWARENESS IN PEOPLE

As the study on WBAN is done we found several applications and advantages of the WBAN on human health monitoring. But most of the old generation or young generation are not getting its benefits, the reason may be several, either people are not aware of it or do not have sufficient knowledge about it. As the study is done based on the usage of the device and awareness in people, we selected certain areas of Karnataka where the wireless wearable and implantable devices are available. The following chart represents some sample approximate data of usage of WBAN.

| SL.NO | District | Awareness |
|-------|-----------|-----------|
| 1 | Mangalore | 30% |
| 2 | Bangalore | 70% |
| 3 | Bagalkot | 20% |
| 4 | Mysore | 40% |
| 5 | Belgaum | 35% |



| SL. No | District | People willing to use |
|--------|-----------|-----------------------|
| 1 | Mangalore | 55% |
| 2 | Bangalore | 75% |
| 3 | Bagalkot | 40% |
| 4 | Mysore | 60% |
| 5 | Belgaum | 45% |



IV. CONCLUSION

From the study conducted on the wireless body area network technique its working and advantages and discussions presented above, the following conclusions can be drawn:

- Study identified and selected existing technologies and protocols that satisfy the main requisites of WBANs for medical purposes such as patient mobility, secured and reliable data, economy of power consumption, and the need for a large number of sensor nodes to coexist in a relatively small space.
- By using the system the healthcare professionals can monitor, diagnose, and advice their patients all the time. The physiological data are stored and published online. Hence, the healthcare professional can monitor their patients from a remote location at any time.
- Due to the some of the challenges or security issues or lack of knowledge of people about the technology, WBAN cannot be exploited completely.
- Continuous monitoring with early detection likely has the potential to provide patients with an increased level of confidence, which in turn may improve quality of life. In addition, ambulatory monitoring will allow patients to engage in normal activities of daily life, rather than staying at home or close to specialized medical services.

REFERENCES

- [1] Ricciardi L, Mostashari F, Murphy J, Daniel JG, Siminerio EP: A national action plan to support consumer engagement via e-health. *Health Aff (Millwood)*. 2013.
- [2] Say R, Murtagh M, Thomson R: Patients' preference for involvement in medical decision making: a narrative review.
- [3] Hayakawa M, Uchimura Y, Omae K, Waki K, Fujita H, Ohe K: A smartphone-based medication self-management system with realtime medication monitoring. *ApplClin Inform*. 2013.
- [4] Swan M: Emerging patient-driven health care models: an examination of health social networks, consumer personalized medicine and quantified self-tracking. *Int J Environ Res Public Health*. 2009..
- [5] Chen KY, Bassett DR: The technology of accelerometry-based activity monitors: current and future. *Med Sci SportsExerc*. 2005.
- [6] [http://www.who.int/chp/chronic_disease_report/full_report.pdf]
- [7] Weber S, Scharfshwerdt P, Seel T, Kertzsch U, Affeld K: Continuous wrist blood pressure measurement with ultrasound.
- [8] Paul G, David A, Dwight Reynolds A: Accuracy and novelty of an inexpensive iPhone-based event recorder [abstract].
- [9] Wearable Technology Special Issue of the IEEE Engineering in Medicine and Biology Magazine 2003.
- [10] Park S, Jayaraman S: Enhancing the Quality of Life through Wearable Technology.
- [11] Martin T, Jovanov E, Raskovic D: Issues in Wearable Computing for Medical Monitoring Applications: A Case Study of a Wearable ECG Monitoring Device.