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Remote Health Monitoring using Wireless Body Area Network

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Abstract*—A body area network is a wireless network of biomedical sensors that are attached to a human body. The aim of wireless body area network (WBAN) is to facilitate continuously recording and monitoring of a person's health condition and transfer it over a long-distance communication network. A sensing system is to be worn by the individuals for a long duration. This limits the size of the battery. These factors have made energy the most critical resource in WBAN. The parameters sensed by the individual devices are to be transferred onto a mobile phone or a tablet via wireless network. This data is then gathered, stored and then sent to the doctor for continuous monitoring of the patient's health condition. The doctor can thus access the patient's health status on the go and this will help the patient to get immediate attention in life-threatening situations.

***Keywords*— Healthcare, Medical Server, Body Area Network (BAN), Remote Monitoring.**

I. INTRODUCTION

The predicament currently persisting upon the health industry across the globe is that of a rapidly increasing aged population or the "Baby Boomer" generation. The dilemma mainly concerns the delivery of effective and efficient services to a population where chronic and acute diseases are most prevalent. Healthcare Deliveries have gradually shifted from acute hospital care to outpatient care to home care. Home care, typically involves periodic visits by a nurse or other caregivers, and may require patients to maintain detailed records about their diet, and health. This situation is a concern since it might result in a drastic change in the availability, accessibility and affordability of healthcare.

Having said this, it needs to be noted that the care providers are in an advantageous position of being in the web 2.0 era where they can use the best of technology to deliver what is required. It would be absolutely unrealistic though to think that technology alone can fulfil such a pervasive need.Critical amendments need to be made in the processes within the healthcare organizations to swiftly accommodate the current needs. The patient monitoring market is an expanding and profitable sector in the global healthcare industry which needs to be addressed and captured.

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The main cause of death in the world is Cardio-Vascular Disease (CVD), representing 30% of all global deaths. According to the World Health Organization, worldwide about 17.5 million people die of heart attacks or strokes each year; in 2015, almost 20 million people will die from CVD [6].

These deaths can often be prevented with proper health care. Worldwide, more than 246 million people suffer from diabetes, a number that is expected to rise to 380 million by 2025 [7]. In healthcare, WBAN monitors patients suffering from chronic diseases such as diabetes to have more precise treatment in terms of medication. Healthcare expenditure is expected to reach 20% of the Gross Domestic product (GDP) in less than 10 years, threatening the well-being of the entire economy in the US. The number of people suffering from diabetics or CVD and the percentage of people in the population age 60 years and older will grow in the future. Even without any further increase in world population by 2025 this would mean a very large number of potential customers. These statistics suggest that healthcare needs a major shift toward more scalable and affordable solutions. WBAN technology could provide the connectivity to support the elderly in managing their daily life and medical conditions. Wearable systems for continuous health monitoring are a key technology to helping in transition to more proactive and affordable healthcare. According to American Heart Association, treatment within first 12 minutes of cardiac arrest brings a survival rate of 48-75%, and this rate drops to 2-4% after 12 minutes. Numerous other examples of diseases would benefit from continuous or prolonged monitoring, such as hypertension, asthma, Alzheimer's disease, Parkinson's disease, renal failure, post-operative monitoring, stress-monitoring, prevention of sudden infant death syndrome etc.

WBAN is well positioned to benefit the physiological sensing applications, and bio-kinetic sensing applications are increasing, as athletes and fitness enthusiasts seek to improve human performance. WBAN can deliver the bio-feedback and interactivity necessary for the next-generation fitness and entertainment applications..

II. CURRENT SCENARIO PROBLEMS

At this point of time the health of each patient has to be monitored individually. The nurse/doctor has to keep a constant tab on the health condition of each and every patient in the ward. The problem is that the doctor or nurse cannot be present by the patient's side 24*7. Also, the doctor has no access to the exact condition of his patients from any remote place. In case of emergency, the doctors cannot be contacted directly in some cases and hence valuable time is wasted.

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Generally a patient's data is stored manually and only the overview of his illness is stored at the time of his admission and discharge. All the data stored manually is interpreted virtually and accordingly medication is advised. Also, a person taking rest at home cannot be properly and continuously monitored.

III. REMOTE SENSING

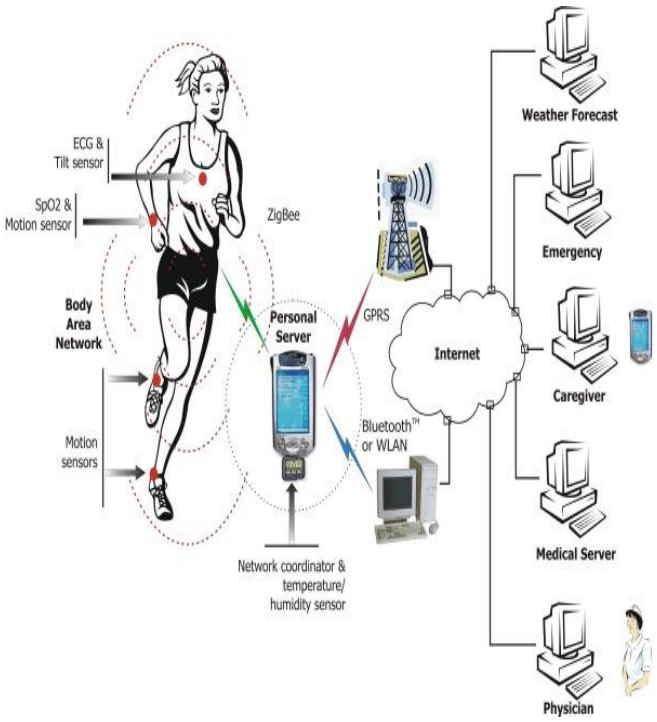

Fig1. Remote Sensing

Remote Patient Monitoring is a concept that has evolved to address the issues rooting from the current healthcare dynamics. The aim to decongest ER, to reduce costs, for both insurance companies and patient, and making healthcare available to all who need it is met. The Remote patient monitoring infrastructure is an all-inclusive term that encompasses a number of high-tech applications that involve providing remote care for people.

The applications can range from monitoring a person's heart rate while working out on a treadmill in a fitness club to transmitting a patient's telemetry readings to a nurse over the Internet. There is a wide variation in terms of clinical conditions that can be monitored, how often they should be monitored, and whether they should be monitored real-time or periodically.

The patient requiring care is placed in a remote location, typically at home, from where he/she can connect to the wide range of home care applications which send relevant data to a central server. This central server is in turn accessible to the referring physician who can monitor and diagnose the patient without physical presence near the patient.

The action expected from the physician as a result of such monitoring is to make a clinical decision on whether the patient requires:

- Immediate hospitalization
- Urgent doctor visit
- Continued monitoring

The judgment on which patients can be put into a continuous remote monitoring mode instead of hospitalization is also the prerogative of the physician.

IV. PROPOSED SYSTEM

The main motive here is easy accessibility of patient's health condition to the doctor from any remote location so that he would be able to take the required actions. This will help to save the valuable seconds in case of emergency.

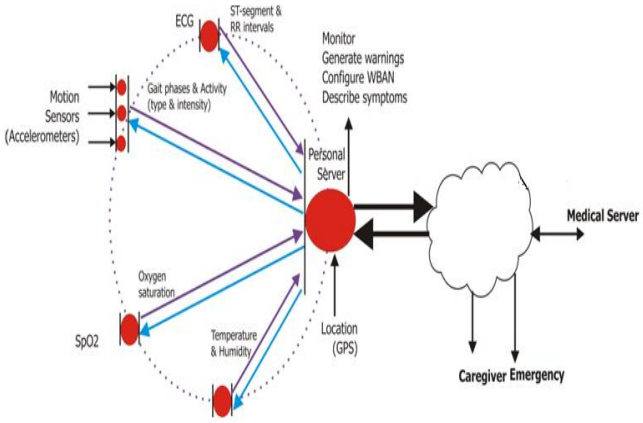

Fig 2. Proposed System Architecture

Medical WBAN used for patient monitoring is shown in Figure 1. 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, SpO_2levels etc. [1].

The data gathered from these sensors is sent to a data accumulator. The data accumulator then forwards it to the medical server. The personal server sends out message to the doctor's mobile phone in occurrence of life-threating circumstances through GSM network.

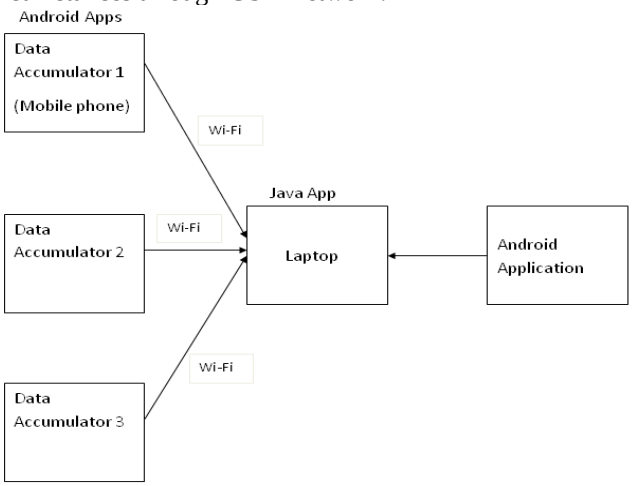

Fig 3. Overview of the System.

User Classes and Characteristics There are three Main users of the system:

1. Care seeker (Patient):The care seeker is the patient itself who is suffering from diseases.He will have body sensors attached to his body which indeed transfer vital parameter to mobile phones(android phones) over Wireless network.
2. Care taker (Doctor):He is a person who is capable of his day to day activities and assisting the care seeker. He may be a friend, family member, relative, doctor or a nurse.

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3. Administrator:He is the one who will add new patients to the system and also add doctors to it. Also capable of updating patient and doctor's information.

V. CASE STUDY

In this section we present a hypothetical case study to illustrate the usefulness of our proposed system. The patient presented is fictitious, but representative of common issues a recovering heart attack patient would face. We discuss the issues and describe how our system can be used to both address the problem and provide advantages over typical present day solutions. Juan Lopez is recovering from a heart attack. He has been under supervision at the hospital. He requires continuous monitoring as his condition is far from better.

Our health monitoring system offers a solution for Juan. Equipped with a WBAN, tiny sensors provide constant observation of vital statistics, estimate induced energy expenditure, and assist Juan's exercise. Tiny electronic inertial sensors measure movement while electrodes on the chest can measure Juan's heart activity. All Juan's parameters are taken onto the personal server/data accumulator. These are then sent to the intermediate server over a local Wi-Fi Network. In case the parameters are found to be critical, a message is sent onto the doctor's phone over GSM network with the help of a GSM module. Also, a local alarm is set off to notify the nurse or any attendant present inside the ward. At the same time the parameter values are also stored in the intermediate server. The doctor can access the patient's health condition at any given moment just by connecting to the server. This will enable him to watch Juan's progress at any given time with the help of graphs and accordingly he can take decisions regarding medication that needs to be adopted.

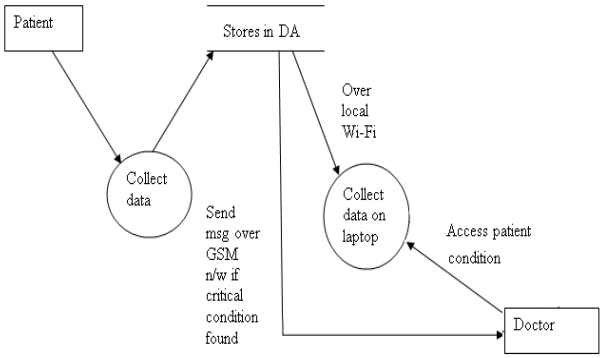

Fig 4. Data flow for the system

The same can be extended to home monitoring system. Let us assume that Juan is now being monitored from his home. Here, however, the personal server can directly contact Emergency Medical Services (EMS) if the user subscribes to this service. This cuts healthcare costs and makes better use of the physician's time. Figure 2 illustrates this example of home monitoring

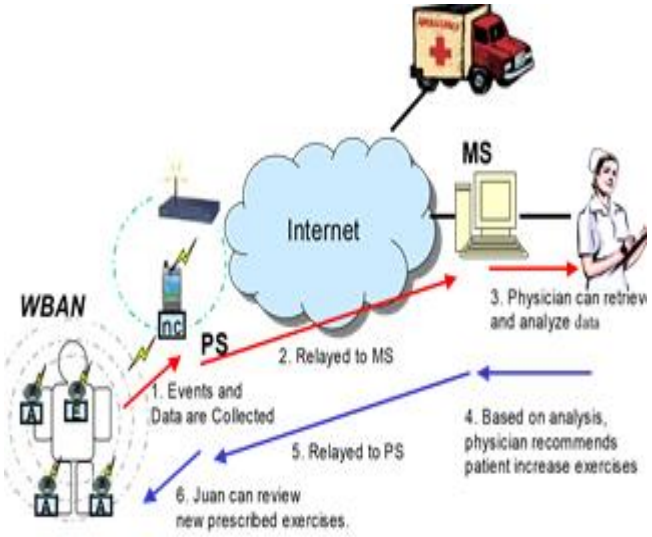

Fig 5.System flow for home monitoring

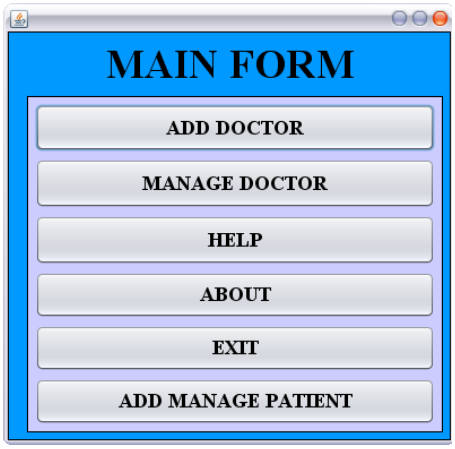

Fig 6. Main Form

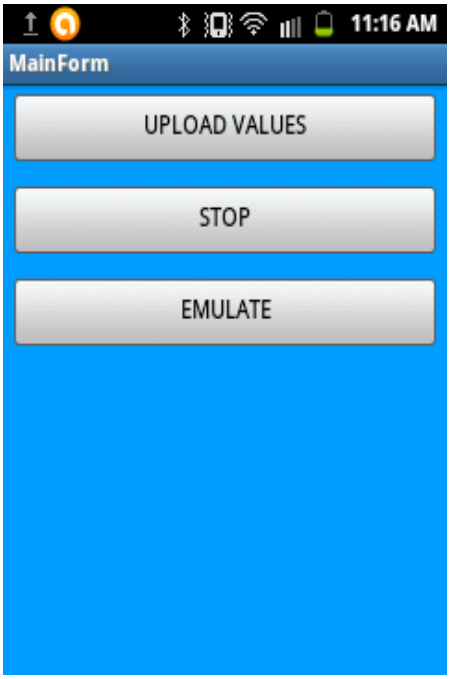

Fig 7. Application View

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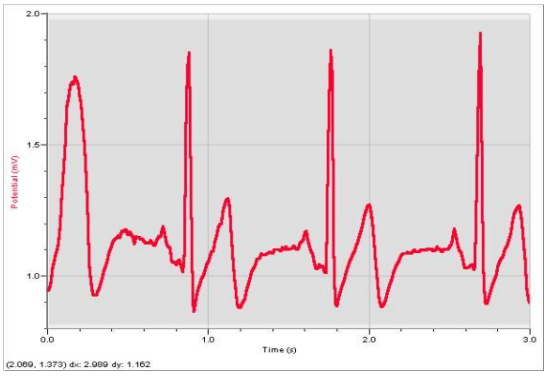

Fig 8. Graph view

VII. FUTURE SCOPE

Another area of application can be found in the domain of public safety where the WBAN can be used by firefighters, policemen or in a military environment. QR Code (QUICK RESPONSE CODE) can be generated for profile of each patient so that the doctor can directly view the patient's profile.NFC (Near Field Communication) tags can be used so that the doctor can check all the parameters when he is on a round without contacting the server.

VIII. CONCLUSION

Continuous monitoring with early detection has the potential to provide patients with an increased level of confidence, which, in turn, may improve quality of life. Continuous monitoring data into medical databases will allow integrated analysis of all data to optimize individualized care and provide knowledge discovery through integrated data mining. Combining mobile high bandwidth with miniaturized sensor devices and computers will give rise to new services and applications that will affect the change in the daily life of citizens. Patients provided with some form of home-based monitoring have to be hospitalized less, and when they are hospitalized, they are discharged earlier than unmonitored patients. WBAN will be able to deliver healthcare to patients in hospitals, improving the quality of life of patients. Whether the patient is in the hospital, at home or on the move, the patient will no longer need to stay in bed, but will be able to move around freely. Furthermore, the data obtained during a large time interval in the patient's natural environment offers a clearer view to the doctors than data obtained during short stays at the hospital.

In healthcare, patients and non-patients will be able to get medical advice from a distance (telemedicine) as if they had been taken in a medical center called 'ubiquitous medical care', which means continuous monitoring anywhere and anytime.

REFERENCES

[1] A. Juric & A. Weaver, "Remote Medical Monitoring", IEEE Computer, PP96-99 April 2008
[2] R. Ashok and D. Agrawal, "Next Generation Wearable Networks", IEEE Computer, Vol. 36, PP31-9, Nov. 2003
[3] I.F.Akyildiz, W.Su, Y.Sankarsubramaniyam and E.Cargici, "Wireless Sensor Networks: A Survey", Computer Networks, Vol. 38, No. 4, PP393-422, 2002.
[4] K. Bilstrmp, "A Preliminary Study of Wireless Body Area Network", Tech. Report, IDE0854, University of Halmstad, Sweden, PP1-36, Aug. 2008
[5] D. Lewis, "Application in Body Area Network", Doc: IEEE P802.15-08-0407-00-0006-TG6, Nov. 2008
[6] World-Health-Organization [online] http://www.who.int/mediacentre/factsheets/fs317/en/index.html.
[7] International Diabetes Federation (IDF) [Online] http://www.idf.org/.

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