International Journal of Engineering Research and General Science Volume 3, Issue 2, Part 2, March-April, 2015
ISSN 2091-2730

Design of a Healthcare Monitoring System Using Wearable and Environmental Sensor

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Abstract— As the healthcare industry has evolved, technology provides readily accessible health data that may facilitate people to deal with health concerns. Wearable sensors are commonly used for this purpose. Wearable systems are used for exercise regimes for health and rehabilitation are notably helpful. The benefits wearable kind sensors have include quick response times, minimum sample pre-treatment and high turnout. Wearable sensory devices connected to smart phone apps are already a part of sports personnel. Sportspersons use wearable systems like a pulse oximetry (a non-invasive way to monitor O2 saturation), that helps them to optimize their performance. Normally wearable sensors and portable computing devices present the prospect to produce timely health information of the patient to doctors as well as customers.
By supplying real time health information, a sensor primarily based health care information infrastructure that's based on relatively static based sparsely collected information can be used to maintain the patient medical records effectively. The solution projected for this method combines environmental and wearable sensors so as to monitor both the surrounding space of the patient and the patient's health status at the same time. This would allow a comprehensive understanding of the patient's condition by both the specialist caring for the subject and the patient themselves.

Keywords—: Healthcare, Wearable sensors, Environmental sensors, healthcare monitoring system, health status, and health concerns

INTRODUCTION

The purpose of this paper is to design a health care system that integrates both wearable sensors and environmental sensors, that offers a comprehensive diagnosis of the patient's condition in remote healthcare monitoring.

Common healthcare monitoring systems thus far involved the use of electronic sensors for the sensing and monitoring of the various physiological parameters of the human body. Even though these systems do offer the necessary data for the medical practitioner to help the patient, it still might not be enough for the most effective treatment. Thus a more thorough information of the patient is needed, to the extent that even the environmental factors play a significant role.

Different methods with similar goals have been researched and implemented.[1] Shibu J and Ramkumar.R proposed a technique that provides a non-invasive approach to health care monitoring that allows the individual to keep record of their own health records, by use of smart card.This methodology effectively reduces the time of the patients to be spent within the hospitals additionally it permits us to access the health parameters from anyplace by swiping the smart card in the smart card reader.

Marco Messina, Yen yang Lim, Elaine, Lawrence, Don Martin and Frank Kargl's paper [8] describes the implementation and validation of a prototype of an environmental and health monitoring system based on a Wireless sensor Network (WSN).The solution projected by their system combines environmental and medical sensors so as to observe both the surrounding space of the patient and also the patient's health status at the same time. A series of experimental situations were developed and enforced in a very laboratory setting. The conclusion considers the implementation of future enhancements to the health observance network by introducing new sensors and placement pursuit capabilities, and by group action alarm triggering algorithms and advanced security techniques.

Ming-ZherPoh, Kyunghee Kim, AndrewGoessling, Nicholas Swenson and Rosalind Picard's paper [7] showed the development of wearable sensors suitable for comfortable and continuous cardiovascular assessment. Heartphones, a snug, even fashionable system for measuring the bilateral blood volume pulse (BVP) that fits within normal earbuds by adopting a smart phone as a part of the platform. Heartphones solely think about rely on earphones and a cellular phone, common pocket things, to supply measurements like pulse and beat-to-beat changes in heart rate variability (HRV).

Jayalakshmi R, Mahalingam D and Rajeswari's [2] talked about a healthcare solution that combines android mobile and IPv6 techniques in a wireless sensor network to monitor the health condition of patients and provide a good range of effective healthcare services by using global network. With the help of GSM human body level can be accessed from anyplace. A low-power embedded wearable device measures the health parameters dynamically and is connected according to the concept of IPv6 over low-power wireless personal space network to the M2M node for wireless transmission through the internet or external IP-enabled networks via the M2M gateway.

VeyselAslantas, RifatKurban and tuba Caglikantar [9] created a Pocket pc based, low-cost, portable, wireless health monitoring and alarm system. Human's electrocardiogram (ECG), temperature and pulse data are acquired and sent to a personal digital assistant (PDA) using IEEE 802.15.1 Bluetooth. Although this approach appeared well rounded and convenient as it serves a portable way to monitor electrocardiogram (ECG), temperature and pulse data, in the present day and age, there are several devices that don\'t need any extra device that needs carrying around.

RESEARH GAP

Several healthcare monitoring systems only look at the prospect of limited sensing capabilities and have also not taken into consideration the necessity of including the environmental factors. The many systems involved in healthcare monitoring mainly pertain to using a closed space approach with uncomfortable sensors that many do not like to wear continuously. Or they involve carrying an extra communicating PDA in order to make it portable. Proper alerting mechanism has not been thoroughly implemented.

BLOCK DIAGRAM

Transmitter:

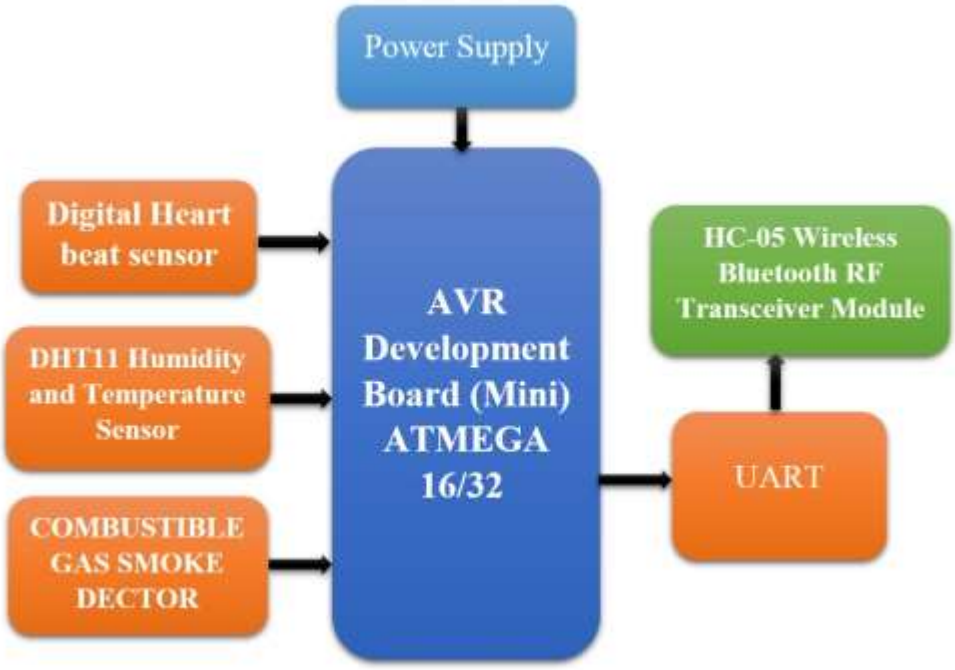

Figure 1: Block Diagram and Transmitter end of M2M (Machine to Machine) System

Receiver:

Figure 2: Receiver end of M2M (Machine to Machine) System

METHODOLOGY

To implement a remote healthcare monitoring system. In these sensors to monitor the medical parameters such as Blood Pressure, Heart Rate and Temperature are designed and interfaced to the microcontroller ATmega16. This microcontroller having inbuilt ADC which converts the sensors input analog signals to digital signals.

These days, wearable sensors such as heart rate monitors and pedometers are in common use. Several products are already on the market, such as the Lifeshirt, developed by Vivometrics, the body monitoring system developed by BodyMedia and the Nike-Apple iPod Sports kit which facilitates individualized feedback control of performance during exercise periods.

The Heart Beat Sensor provides a simple way to study the heart's function. This sensor monitors the flow of blood through Finger. As the heart forces blood through the blood vessels in the, the amount of blood in the Finger changes with time. Heart beat sensor is designed to give digital output of heart beat when a finger is placed on it. It consists of a super bright red LED and light detector. The LED needs to be super bright as the maximum light must pass spread in finger and detected by detector. When the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate. This signal is amplified and triggered through an amplifier which outputs +5V logic level signal. The output signal is also indicated by a LED which blinks on each heartbeat.

The proposed design has a significant advantage: introducing environmental sensors that collect context information will help in analysis of the medical data. When, e.g., a patient is doing sports, medical parameters like heart rate or O2 saturation have to be interpreted differently compared to the same person sleeping in bed. It is estimated that 70% of all illnesses are preventable, and if suitable screening measurements were introduced, this could produce dramatic reductions in costs for treatments and medication.

The environmental sensors mainly include temperature sensors, humidity sensors, and in case of emergency, an alarm signal from smoke detectors. It happens to be very important that the inclusion of special circumstances sensors such as smoke detectors be included so that the attending physician may communicate the appropriate course preventive diagnosis even when the patient is remotely stranded.

The processed signals from the respective medical sensors and the environmental sensors are now sent to ATmega16 Microcontroller that process the received signal and displays on the development kit, but more importantly now proceeds to the next phase of the monitoring system, that is to communicate the received results to the patient and physician. The received data is communicated by simple means of Bluetooth via UART serial communication. In the proposed system we use two RF Bluetooth that are Transceivers and may act as either a transmitter or a receiver. We should note that communication is possible only when one Bluetooth acts as a transistor and the other as a receiver. Communication is not possible for a pair of transmitters or a pair of receivers. The received information is sent to the respective Smart Phones via UART. The Smart Phone is capable of displaying, monitoring, recording and sharing the received information, thus saving cost on display, and recording devices. This solution not only gives patient more freedom, but also provides early diagnosis of cardiac diseases with its alarming properties.

CONCLUSION

A lot of research and effort has gone into the making of a better and well improved healthcare monitoring system, even for remotely located patients. Only a few of these researches have taken into consideration of the environmental factors that affect the human health state. Thus, this paper puts forth the necessity, method and various trends in using both medical and environmental sensors. Further, taking advantage of the advanced technology available to the general public, a remote healthcare monitoring system that is capable of providing health parameters by wireless means to Smart Phones of both patient and physician, it is possible to provide immediate diagnosis simply through the click of a button.

FUTURE SCOPE

In order to implement future improvements to the health monitoring network we can introduce new sensors such as cameras, ECG sensors as well as location tracking capabilities. We can also plan to integrate alarm triggering algorithms and advanced security techniques in Wireless Sensor Networks which would be essential in a health monitoring environment. Another aspect to consider is involving wearable sensors or wearable sensors that may well be cheaper and more diverse in utility which can lend a hand in improving the already existing systems.

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