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Design and Development of Health Monitoring System

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Abstract— **It is expected that the Internet of Things (IOT) applications for medical services can be one of the most remarkable solution for taking care of aging population which is in the rapid growth. IOT consists of communications and sensors to accomplish purpose. In the diverse kinds of networks, wireless body area network (WBAN) is a highly suitable communication tool for the medical IOT devices. There are many researches about WBAN and sensor network, which are mainly focused on energy efficiency. However, in this paper, we discuss more practical issues for implementation of WBAN to healthcare service. Therefore, we propose a multi-hop WBAN construction scheme that is consists of operations such as the clustered topology setup and mobility support. As an auxiliary benefit, the proposed scheme achieves an energy efficient feature by reducing the number of total control messages. Extensive simulation shows that the proposed scheme remarkably improves the performance of WBAN [i].**

Keywords— **WBAN, Sensor Network, Clustered topology, Mobility support.**

I. Introduction

Modern society is facing deep worry about how to care of an aging population in the rapid growth. Hence, it is expected that the Internet of Things (IOT) applications for healthcare service can be one of the most remarkable solution for this problem. In IOT, devices collect and share information with each other and even the cloud, making it feasible to record and analyze new data stream. In this regard, healthcare IOT systems check patient's health state in a real-time with wearable or implanted sensing devices. Then, the systems transmit gathered data to healthcare centre such as hospital.

Fig.1 is a basic structure of WBAN. GW is supposed to be Tier '0' and gathers data from sensors. It plays a similar role with sink node of WSN and transmits gathered data through inter-WBAN communication. All the circles except the GW in Fig.1 denote sensor nodes, which monitor body health status. In the figure, we denote the node without alphabet subscript as a Tier '1' and the nodes with alphabet subscript as a Tier '2', respectively. Tier '1' nodes can communicate directly with a GW and have a role to relay data from Tier '2' devices to a GW (Tier '0'). Tier '2' nodes are determined by distance values, which is longer than those between Tier '1' nodes and a GW. The red boxes denote virtual clusters that consist of one Tier '1' node and multiple Tier '2' nodes. We adopt multi-channel TDMA approach for data transmission between parent and child node within each cluster [i].

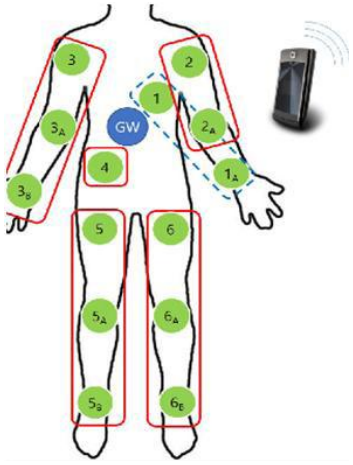

Figure.1 WBAN Topology Setup

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A. Clustered Network Setting:
As WBAN devices turn on, they first start neighbour discovery to make routing table. At first, a gateway (GW) creates routing table entry and sets 1-hop distance parameter according to the user's system configuration. The 1-hop distance parameter is determined by RSSI threshold level set by system user. If dB value of the received signal strength is over the predefined RSSI threshold, the node is marked as a 1-hop neighbouring node.
B. Mobility Support Scheme:
To support mobility, we consider the following two aspects: The first is a normal human activity and the second is a recovery of network failure. For these purpose, we develop a control message. After start-up phase, Tier '1' nodes broadcast a control message in each super frame using common channel band. The control message includes the following information about number of child nodes, remaining battery and used frequency band.

The various sensors used are:
i. Temperature sensor
The LM35IC is used to sense the temperature. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.
ii. Heart beat sensor
The IC LM358N is used as the heart beat sensor. Its dual low power operational amplifier consists of a super bright red LED and light detector. It works on the principle of light modulation by blood flow through finger at each pulse. With each heart pulse detector signal varies and this variation is converted to electrical pulse.
iii. ECG sensor
ECG is primarily a tool for examination of cardiac diseases. An ECG sensing device commonly consists of a group of electrodes to detect electrical events of a heart. The rhythm of the heart is measured in terms of beats per minute (bpm).

II. Implementation

Temperature, ECG, heartbeat sensors are interfaced to the LPC2148 IC of ARM7 family. The room temperature, electrical variations of cardiovascular system sensed by respective sensors are converted into digital values by ADC and are displayed on the LCD. The pulse rate detected by heart beat sensor is monitored by timers and interrupts and the sensed values are displayed on LCD. The values sensed by respective sensors are stored in the cloud via GPRS through UART0 port of LPC2148.

SENDER SIDE

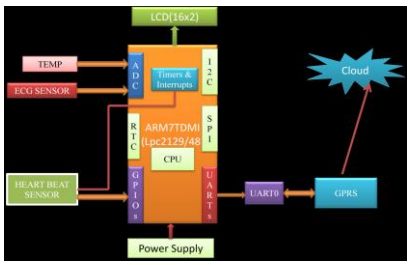


Figure.2 Block diagram of the sender side.

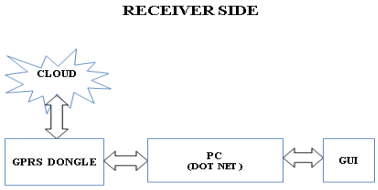
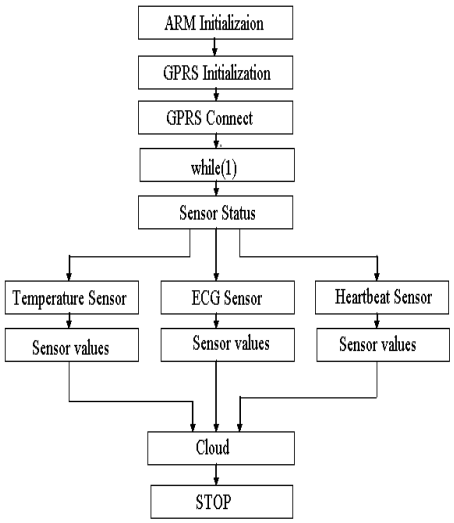


Figure.3 Block diagram of the receiver side

At receiver side, the other person access the sensed data from the cloud database using GPRS dongle that can be viewed on PC and GUI allows user to interact with electronic devices through graphical icons and visual indicators.

Flow of the Main program:

Initialize the ARM controller (LPC2148) and the peripheral devices such as temperature sensor, heart beat sensor and ECG sensor. Check for the GPRS initialization and connection. Monitor the patient's condition i.e., pulse rate and electrical variations of heart via the respective sensors. Load the sensor values and display it on LCD. Also store the sensed values in cloud , to retrieve the information when required.



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III. Results and Tables

Figure indicates the temperature, ECG and heartbeat values sensed by the respective sensors and the graph is being plotted .

Figure.4 Simulation results

IV. Conclusion

The project aims at Wireless Body Area Networks (WBANs) supporting healthcare applications that are in early development stage but offer valuable contributions at monitoring, diagnostic, or therapeutic levels. They cover real-time medical information gathered from different sensors with secure data communication and low power consumption. With the current technological evolution, sensors and radios will soon be applied as skin patches. Doing so, the sensors will seamlessly be integrated in a WBAN. The project has been completed and the simulation module shows the data sensed by the temperature sensor, ECG sensor and heartbeat sensors is represented graphically

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