Development of a Health Monitoring Vest for the Elderly

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***Abstract* — A health monitoring system is proposed with the aim to provide health monitoring with minimal location and time constraint for the elderly. The challenges in continuously monitoring health faced by conventional medical practice is expected to be solved using this vest-based system, as it is capable to obtain health parameter from its wearer and channel it to a remote web and database server anytime regardless of its location. Results can be monitored through a user interface in the form of a website. The system uses a microcomputer with both UART interface and 3G/4G mobile internet capability. Future improvements mainly focuses on reducing the size and power consumption of the device as well as relooking into data management.**

***Index Terms* — Internet of Things, medical information systems, wearable sensors, wearable computers.**

I. Introduction

As the elderly are most vulnerable to sickness, the capacity of health care centers to timely detect the symptoms of diseases and monitor the health condition of patients will be tested[1]. The conventional medical practice is limited by several weaknesses. Firstly, the health parameters taken from the elderly is only at the time of the health check, thus many factors such as food intake and recent activities may influence the readings[2]. Second, the symptoms of sickness may come to surface at any time, but conventional methods are unable to detect these symptoms instantaneously[3]. Finally, the required scalability to adapt to an ageing world population cannot be handled by traditional methods in healthcare.

Thus, a proposed solution is to create a wearable device that is able to obtain the wearer's health parameters and channel it wirelessly onto a database server at any time regardless of the location of the wearer. A system is developed where the patient's health parameter can be viewed and evaluated by stakeholders (family, patients, doctors, etc.) through a graphical user interface (GUI) to determine the patient's health state.

II. Full System Overview

The system operation is shown in Fig. 1 and explained as follows. The sensor circuitries detect health parameters of the wearer and send the data to the microcomputer via radio frequency (RF) UART protocol communication transceiver. The microcomputer processes the data and forwards them to the server through 3G/4G internet connection. Besides saving the data, the server also provides a GUI in the form of a website. The website is password protected and shows patients' health state in the form of charts and pictures. Based on this operation, the system can be broken down into four parts, which are sensor circuitries, microcomputer configuration, server configuration and GUI creation. Details on each part will be discussed in the following sections.

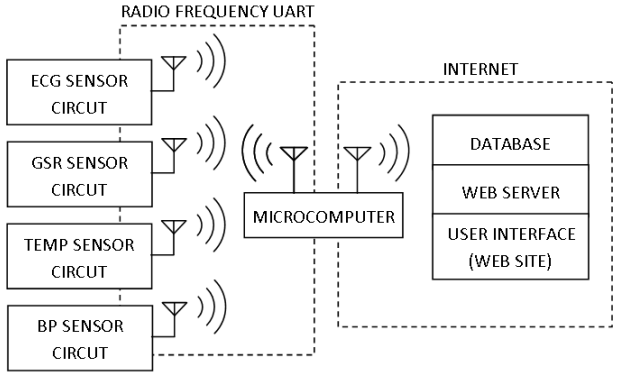

Fig. 1 Block diagram of the full system

III. Sensor Circuitry

There are four sensors on the prototype, Electrocardiogram (ECG), Galvanic Skin Response (GSR), Temperature (TEMP) and Body Position (BP). Each sensor requires different excitation circuit with different signal conditioning circuit. RF transceivers is chosen in this work to ensure flexibility of movement for vest wearers. A transceiver is used at each sensor and the microcomputer.

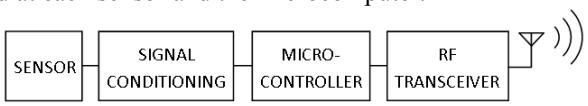

Fig. 2 Sensor circuitry block diagram

The transceiver operates using UART serial protocol, implying the need of a controller in between the sensor and transceiver. A microcontroller (ATMEGA328P) is used for such purpose. When data is requested by the microcomputer, the microcontroller reads the sensor's value and sends the data to the microcomputer. Fig. 2 shows the sensor circuitry. Note that the same circuit is repeated for each sensor and the system is powered by a 5 V rechargeable battery.

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IV. Microcomputer Programming

Microcomputer is the brain of the vest system. It administers the operation of the sensors and the overall communication process. An ARM microcomputer, the Beagle Bone Black with Ubuntu Linux OS is used. The mobile internet modem used is Sierra MC7304.

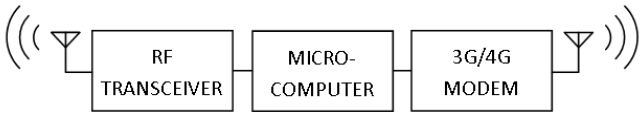


Fig. 3 Microcomputer block diagram

Fig. 3 shows the block diagram of the microcomputer. The system's program is written in C++ language to perform the following operation. Data is requested from each sensor, compiled into a string of HTTP POST, and sent to the server.

V. Database and Web Server

(a) (b)

(c) (d)

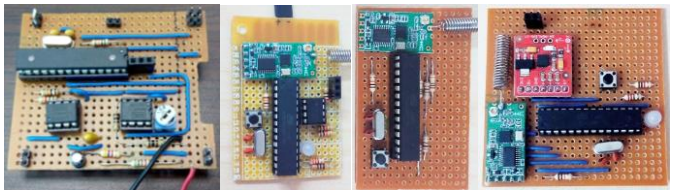
Fig. 4 Website prototype, (a) Login page, (b) Administrator page, (c) System management page and (d) Health monitoring page

The server differentiates data collected from different users using an identification number. Each sensor reading from each user occupies one table consisting of time and data columns. A website is developed using HTML, PHP and MySQL. Fig. 4 shows several screenshots of the website.

VI. Results

Fig. 5 (a) is the microcomputer with RF transceiver and 3G/4G modem Fig. 5 (b),(c),(d), and (e) are the four sensor circuitries. The website prototypes are shown in Fig. 4.

(a)



(b) (c) (d) (e)

Fig. 5 Circuit prototype, (a) Microcomputer, (b)ECG sensor, (c)Temperature sensor, (d)GSR sensor, and (e)Body position sensor

VII. Conclusion

The prototypes are able to perform the basic functionalities of the system. Several suggestions for improvements are as follows. The size of the sensor circuit, currently fabricated on a strip board, can be reduced by making it surface mounted on a printed circuit board. The microcomputer can also be improved by selecting or fabricating an optimum board with specific interface needed by the system. By doing so, not only it becomes more comfortable for the wearer, but also consume less power and increases processing speed.

VIII. MTT-S Undergraduate Scholarship

The Scholarship program drew my interest towards researching in microwave at greater depth. It leads me to a decision of wanting to continue study in the same field while working in the industry. Having attended an MTT-S sponsored conference shows me various fields of researches and application in microwave that inspires me to create and innovate under the same disciple.

References

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