Mobile Phone Based Remote Monitoring and Control System for Individualized Healthcare

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Introduction

THIS paper presents development of a wireless electronic healthcare system for real-time monitoring and control of individuals requiring continuous care. It has been shown that wireless solutions for healthcare can help in achieving improved patient-care and reduced costs [1]. Various internet [2] and mobile phone based [3] systems have been designed for remote patient monitoring.

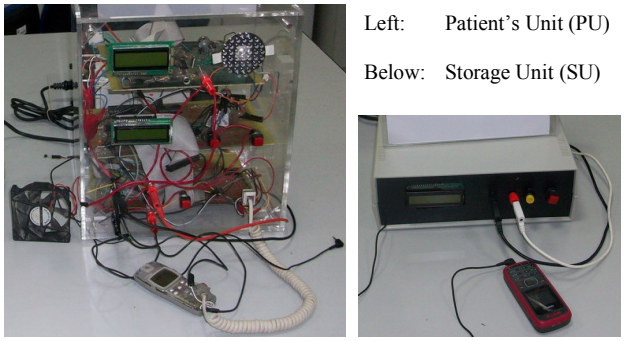
The system presented here allows acquisition of patient related data from various devices in real-time. Mobile phones are used for communication. Separate modules allow the following functions from remote locations: access to the patient's data, system generated warning calls, control of various devices and storage of the data in a central computer. Also, the system features interactive communication with the users utilizing voice which is generated by speech synthesizer. Moreover, for security, each mode of communication is password protected.

Materials and Methods

The system was based on micro-controllers consisting of two main units (as shown in figure 1) – *Patient's Unit* (PU) and *Storage Unit* (SU). The PU comprised of a micro-controller which acquired data from the patient's devices and a dual tune multifrequency decoder (DTMF) in addition to a *patient's mobile phone* (PMP). In the present study, PU acquired simulated patient's body temperature (BT), blood pressure (BP) and heart rate (HR). However, the unit is capable of working with any number of actual devices which are normally associated with patient monitoring. PU analyzed the acquired data and performed three functions:

- interactive communication (e.g., with a physician) of patient's vital signs and remote control of devices.
- Communicating with a pre-set mobile number (*e.g.*, physician's) to report any abnormality as it occurred.
- Transferring patient's data to a remote computer (*e.g.* in a hospital) for storage.

The second unit, SU, is microcontroller based storage system connected to the telephone network. Data is transferred from PU at regular time intervals.



Left: Patient's Unit (PU)

Below: Storage Unit (SU)

Fig. 1. Prototype of the system showing the patient's unit on the left and the storage unit on the right.

Fig. 2. Some of the messages from the system displayed at the patient's unit in addition to voice communication with other mobile phones.

Results

Figure 2 shows some of the messages from the system. All the mentioned functions of the system were tested successfully with password verification. Calls made from unauthorized phones or with wrong password were rejected.

A phone call was made to PMP connected to the patient's unit and values for BT, BP and HR were obtained interactively using voice communication. Also, to test remote control of the devices, a fan connected to the system was switched on and off by giving instructions to the system over phone. An increase in temperature of the temperature sensor above a fixed value (38^0F in this case) immediately resulted in automatic activation of the PMP and a call was made to a pre-set mobile phone. On successful verification for *ID* and *password*, the type of abnormality was reported. SU also worked satisfactorily transferring data to a remote storage unit automatically every 4 hours.

References

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