HOMECARE ANNOUNCEMENT SYSTEM FOR PEOPLE HAVING INJURES

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The idea of applying high technology in homecare is to improve the medical services and facilitate the recovery of the patient. During the recent years, there was a rapid growth in the development of maintenance telemedicine systems and monitoring devices for patients with chronic diseases and those requiring continues telemonitoring treatments. Wireless technologies hold great promise for using in this area, which requires high mobility and where physically wired connections are not a feasible solution. In this paper a system for assistance of elderly and people having injures is presented. The aim was using wireless technologies to develop simple and user-friendly system directed to improve the life style of this group (more than 7%) of people. In addition a proposed collision free protocol for data transfer is discussed in details.

Keywords: Homecare, Bluetooth, Wireless data transfer

1. INTRODUCTION

Homecare, aged care, telemedicine, etc., are some of the emerging areas in healthcare industry where utilization of wireless technologies would enhance health services [1, 2]. Wireless networks technology has been consistently improving with time and increasingly finding its way in all aspects of our daily lives. The medical applications are field where technologies such as Wireless Networking have a promising future [4, 5, 6]. To reduce the charge for patients, keeping the patients in hospitals for a long-term basis would not be suitable for patient. They might be discharged from the hospitals earlier. In order to hold down the cost of medical expenses, at the same time not compromising on the quality of service, home care becomes the best solution.

As the world's population ages, those suffering from diseases of the elderly will increase. In-home pervasive networks may assist residents by providing control of home appliances, medical data lookup and emergency communication. The first product that was marketed in the homecare field was an alarm system, which still exists. They consist of a wearable alarm button that is wirelessly linked to a central system. The alarm signal is dispatched by pagers or by ordinary or portable telephone to a surveillance service. They have two drawbacks: the patient must self-determine that something is going wrong and must manually trigger the alarm, that is, be still awake or conscious. The described bellow system is directed to support the daily activities and give assistance to people have injures – hard of hearing, deaf, elderly, with limited movements ability, etc.

2. SYSTEM DESCRIPTION

The system includes three different modules - named Sensor Module, Intermediate Node and Warning Light Indicator. They are elements of Wireless Personal Area Network (WPAN). WPANs using 802.15.4 or Bluetooth have potential uses in the medical fields [3]. These are short range networks that can be deployed for example, within a patient's room. Other uses of WPANs are in interfacing multiple expensive and large devices within the hospital. Data from one device can be forwarded directly to another without doctors wasting time by transferring this information by hand. In presented solution we proposed a WPAN suitable for application at home of the patient.

- The role of the Sensor Module (SM) is to acquire information from correspond sense detector – fire sensor, gas sensor, door bell ring, in door alarm sensor, telephone, etc. SM is realized by microcontroller PIC16LF877, Bluetooth – ABM-600-2 by AIRLogic and specialize analogue circuit depending on the signal source. The special futures of the used Bluetooth module are:

- Bluetooth V2.0+EDR (Enhanced Data Ratio) Compliant
- Transmit Power +4dBm (Class2)
- 2.7V to 3.6V Operation
- Full Bluetooth data rate over UART and USB
- Four Low Power modes – Park, Sniff, Hold and Deep Sleep
- Support up to seven slaves
- 2Mbps and 3Mbps modulation modes.

A high-capacity Li-ion battery for power supply is used, which guarantees the autonomity more than six mounts. If there isn't a signal to the sensor's input, the SM is in a sleep mode and total consumption is about 50 μA. If the sensor has received a signal, the SM - goes in active mode and transfers data to the closest neighbor Intermediate Node.

- Intermediate Nodes (IN) are modules realized as SM but with small differences: they have not sensing devices and corresponding analogue part and they are permanently connected to the power net at every room. They perform two functions: first as a transceiver of the signal from SM to Warning Light Indicator and second they act as a light indicator after the data from SM has been received. This allows the person immediately see that something happened, independently of his location at home.

- Warning Light Indicator (WLI) is a stationary device placed at the room where the person spends a lot of time. The WLI is a central station of WPAN. The type of activated SM visualizes on a display realized by high brightness LED-s. In addition it is possible to connect to the WLI a vibrating module which can be placed under the pillow or attached to the arm during the sleep. Other future is the possibility to connect by GSM in cases of dangerous with emergency center or with few numbers wrote in advance in its memory.

A diagram of WPAN embedded at home is presented on fig. 1. The arrows show the possible direction of data transfer.

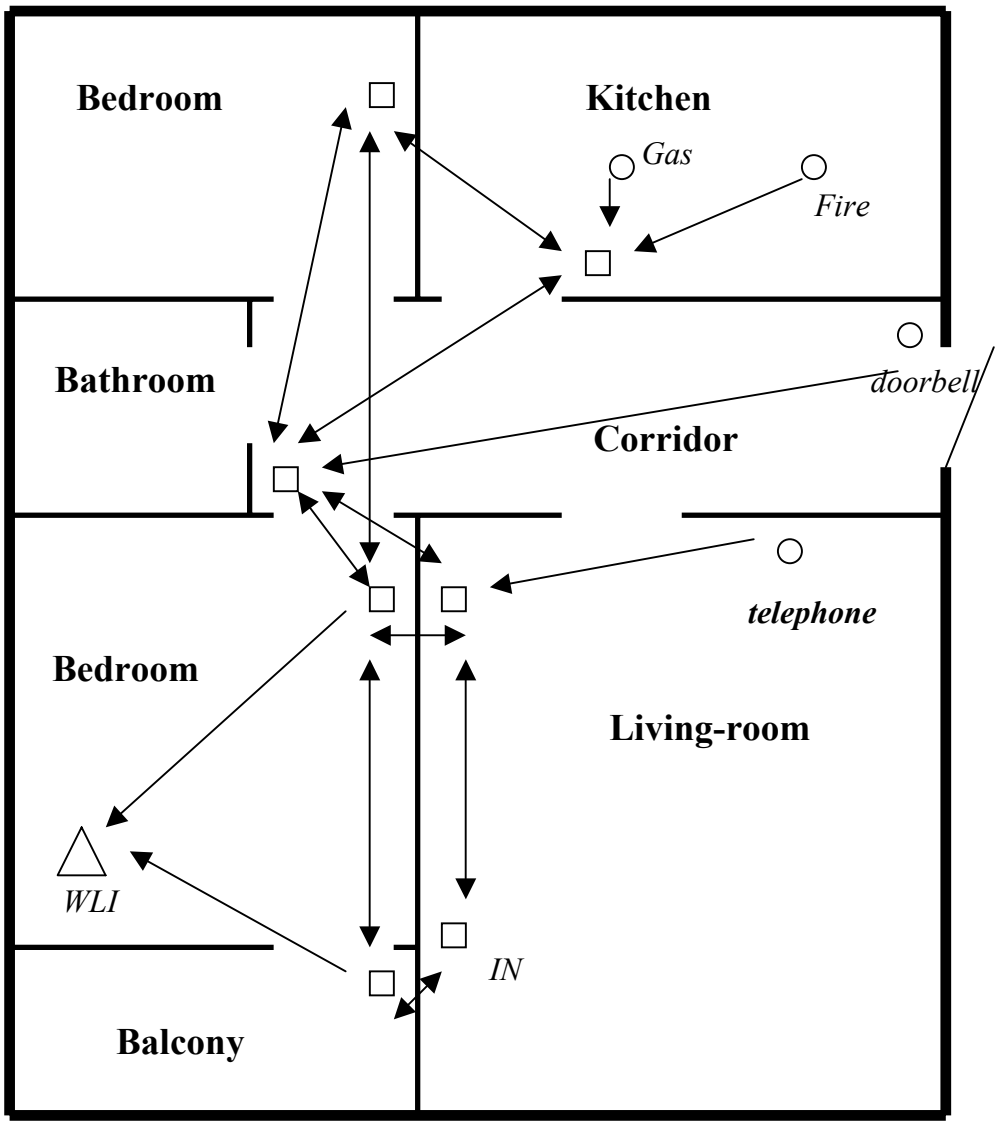

Fig. 1 WPAN – diagram

- Sensor Module ○

- Intermediate Module □

- Warning Light Indicator △

3. PROTOCOL FOR DATA TRANSMISSION

After activation of a separate SM it establishes a connection with the closest IN and sends data contenting the unique code of the event and the sequence number of its appearance. Each IN is in condition to connect with up to 16 neighborhoods IN. In the EEPROM of the IN an identical code in table format is written. This code consists of two parts. The first one (fig. 2) is a symbol sequence of 2 bytes indicating: the sequence number of alarm, type of alarm and the device number in the net. This

byte arrangement allows easy device identification and fast traces the path of data through the net.

AN AT IN1 IN2 IN5…..INx
where:
AN is a sequence number of alarm (byte)
AT is an Alarm type (byte)
IN1…INx are root of alarm in WPAN (bytes)

For example:
Step 1: 02 01 – alarm package – source SM – target IN3
Step 2: 02 01 03 – the same alarm package – source SM – passed through IN3 – target IN5
Step 3a: 02 01 03 05 – the same alarm package – source SM – passed through IN3 and IN5 – target IN7
Step 3b: 02 01 03 05 – – the same alarm package – source SM – passed through IN3 and IN5 – target IN10

Fig. 2 Data package format and rooting

The second part (the target in the example above) is the serial number of the corresponding Bluetooth module with witch the connection will be establish. This is unique number stored during the process of manufacturing of Bluetooth modules that can not be changed.

Such table organization allowing the establishment of connection not only with one device has some advantages. From one side it accelerates a data transfer between SM and WLI and from other, this type of transfer supports the functionality of the net in cases when some IN was unplugged from power net or was damaged.

4. CONCLUSION

The presented WPAN architecture was realized and tested at the Laboratory of Biomedical Engineering at TU-Sofia. Two Sensor Modules (door bell and telephone), two Intermediate Nodes and Warning Light Indicator were distributed in three rooms. The experimental investigations included number of tests directed to determine: time for data transfer between SM and WLI, reliability of the communication, system reaction in cases of data transfer from both SM-s to WLI at same time. The achieved results confirmed workability of the system independently of the modules disposition. The time for data propagation is about 2 sec when one SM sends data and about 5 sec when both devices send data at same time.

The next development step is aimed at novel systems that integrate a coherent set of interacting portable devices, while preserving mobility and independence and bringing optimum assistance to medical support. This integration includes the following features:

- automatic fall detection, considered by professionals as a major risk for elderly and disabled people;
- automatic monitoring of vital medical physiological parameters such as electrocardiogram, body temperature, heart rate;
- transfer of physiological parameters and voice between the user and external intervening parties such as medical doctors, medico-social institutions or monitoring centers.

5. REFERENCES

[1] Bibbi Thome, Anna-Karin Dykes, Ingalill Rahm Hallbert, 'Home care with regard to definition, care recipients, content and outcome: systematic literature review', Journal of Clinical Nursing 2003; 12: 860–872

[2] Jean-Pierre Dan, Jean Luprano, Homecare: A Telemedical Application, Medical Device Technology. Chester: Dec 2003. Vol. 14, Iss. 10; p. 25

[3] N. Timmons and W. Scanlon, "Analysis of the performance of IEEE 802.15.4 for medical sensor body area networking," IEEE Sensor and Ad Hoc Communications and Networks Conference (SECON), 2004.

http://www.ece.mtu.edu/ee/faculty/cchigan/EE5970-Seminar/BSN-802-15-4.pdf

[4] N. Chevrollier and N. Golmie, "On the Use of Wireless Network Technologies in Healthcare Environments," Proceedings of the fifth IEEE workshop on Applications and Services in wireless networks (ASWN 2005), June 2005 Paris, France, pp. 147-152.

http://w3.antd.nist.gov/pubs/aswn05.pdf

[5] Chien-Liang Fok, Gruia-Catalin Roman, Chenyang Lu, "Efficient Network Exploration and Fire Detection using Mobile Agents in a Wireless Sensor Network", MURI ONR 3-Year Review, Baltimore, MD. Nov 19, 2004

http://mobilab.wustl.edu/projects/agilla/pubs/DaniLiangONR_2004-11-12-11.pdf

[6] J. A. Stankovic, Q. Cao, T. Doan, L. Fang, Z. He, R. Kiran, S. Lin, S. Son, R. Stoleru, A. Wood, "Wireless Sensor Networks for In-Home Healthcare: Potential and Challenges", in High Confidence Medical Device Software and Systems (HCMDSS) Workshop, June 2-3 Philadelphia, PA, 2005.

http://www.cs.virginia.edu/~control/medical/pubs/HCMDSS05.pdf