

# WIRELESS SENSOR NETWORK BASED SMART HOME FOR ELDER CARE

<sup>1\*</sup>N.Srinivas,<sup>2</sup>K.Srinivasa Reddy,<sup>3</sup>Geetha Reddy.Evuri

\*nenavathsrinivas6@gmail.com, reddy.sinu2003@gmail.com, gre.413@gmail.com

<sup>1,2</sup>Dept. of ECE,NITS,Hyderabad,Telangana,India. <sup>3</sup>Dept.of EEE,VITAE,Hyderabad.

**Abstract**— The proportion of elderly people in any population is growing rapidly creating the need to increase geriatric care and this trend isn't going to change in the near future. This will put tremendous strain on national resources and the cost of elder care is only going to escalate. More and more elderly people are choosing to stay alone, independently, rather than in a retirement village or old people's home. Such people, often frail and infirm, do however require constant monitoring so that medical help can be provided immediately in times of dire needs. Considerable research efforts have been focused towards in-home monitoring of elderly people, often using wireless personal area networks. As wireless sensing technology continues to evolve, it is playing an important role in improving the quality of life for elderly people and their families. Wireless sensors based smart home monitoring system provides a safe, sound and secure living environment for the elderly people. A wireless sensors based smart home consists of number of wireless sensors that provide information. The information from the sensors can be used for monitoring elderly people by detecting their abnormal patterns in their daily activities and picking up any unforeseen abnormal condition when occurs. The project is focused on research and developmental issues of an intelligent wireless sensors based smart home and determination of person's daily activities based on the usage of different appliances. The daily pattern can then be compared to determine the early signs of behavioral pattern change of elderly, which can potentially allow for early medical intervention. While several sensors are readily available off the shelf, making them "intelligent" in the context of a specific application (such as monitoring of the elderly) is always a challenging task. We have developed a framework, dealing with the design intricacies and implementation issues of novel sensors, targeted to achieve a Digital Home specifically for the elderly. The developed monitoring system is used to recognize activities of daily living and life style of elderly person living alone. Even though the monitoring system uses a limited number of sensors, it determines the daily behavior of the person. The system was installed in residential environments with ease. Moreover, the proposed sensing system presents an alternative to sensors that are perceived by most people as invasive such as cameras and microphones, making the sensors are almost invisible to the user thereby increasing the acceptance level to use the system in a household environment.

**Keywords:** wsn, zigbee, sensor, heartbeat sensor.

## I OVERVIEW OF THE SYSTEM

In this paper, we presented the wireless sensor networks (WSN) to observe the human physiological signals by ZigBee, which is provided

with lower power consumption, small volume, high expansion, stylization and two-way transmission, etc. ZigBee is generally used for home care, digital home control, industrial and security control. This paper developed a suite of home care sensor network system by ZigBee's characteristic, which is embedded sensors, such as the biosensor for observe heart rate and blood pressure. The biosensor transmits measured signals via ZigBee, and then sends to the remote wireless monitor for acquiring the observed human physiological signals. The remote wireless monitor is constructed of ZigBee and personal computer (PC). The measured signals send to the PC, which can be data collection. When the measured signals over the standard value, the personal computer sends Global System for Mobile Communication (GSM) short message to the manager. The manager can use the PC or personal digital assistant (PDA) to observe the observed human physiological signals in the remote place.

**Block Diagram:**

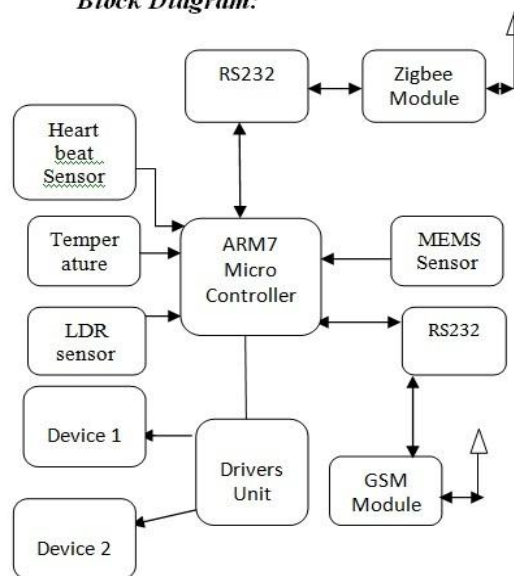


Fig 1: Block diagram

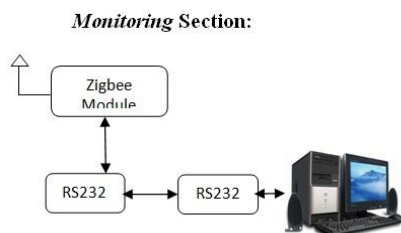


Fig 2: Monitoring section

#### A. Temperature sensor:



Fig 3: Temperature sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of  $\pm 1/4^{\circ}\text{C}$  at room temperature and  $\pm 3/4^{\circ}\text{C}$  over a full  $-55$  to  $+150^{\circ}\text{C}$  temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only  $60\ \mu\text{A}$  from its supply, it has very low self-heating, less than  $0.1^{\circ}\text{C}$  in still air. The LM35 is rated to operate over a  $-55^{\circ}$  to  $+150^{\circ}\text{C}$  temperature range, while the LM35C is rated for a  $-40^{\circ}$  to  $+110^{\circ}\text{C}$  range ( $-10^{\circ}$  with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface

mount small outline package and a plastic TO-220 package.

#### B. Heart beat sensor:



Fig 4: Heart beat sensors

The sensor consists of a light source and photo detector; light is shone through the tissues and variation in blood volume alters the amount of light falling on the detector. The source and detector can be mounted side by side to look at changes in reflected light or on either side of a finger or earlobe to detect changes in transmitted light. The particular arrangement here uses a wooden clothes peg to hold an infra red light emitting diode and a matched phototransistor. The infra red filter of the phototransistor reduces interference from fluorescent lights, which have a large AC component in their output.

The skin may be illuminated with visible (red) or infrared LEDs using transmitted or reflected light for detection. The very small changes in reflectivity or in transmittance caused by the varying blood content of human tissue are almost invisible. Various noise sources may produce disturbance signals with amplitudes equal or even higher than the amplitude of the pulse signal. Valid pulse measurement therefore requires extensive preprocessing of the raw signal.

The setup described here uses a red LED for transmitted light illumination and a pin Photodiode as detector. With only slight changes in the preamplifier circuit the same hard- and software could be used with other illumination and detection concepts.

The detectors photo current (AC Part) is converted to voltage and amplified by an

inexpensive operational amplifier (LM358). A PIC16F877 microcontroller converts the analog signal with 10 bits resolution to a digital signal. An average is calculated from 250 readings taken over a 20 milliseconds period (This equals one period of the European power line frequency of 50 Hz).

### C. LDR Sensor:

Although the M1 has a Sunrise / Sunset clock built in that will determine when the sunrises and sets, hence if it is dark or Light outside, often inside light is a totally different subject. The system needs to know what the light level is in a particular room so when automating internal lighting it needs to know if the lights should be activated or not. Otherwise it defeats the purpose of energy saving by automating the lights for cost savings.

One way of doing this is with a \$5.00 item from Ness with our Ness-LDR. This LDR wires directly into a M1 Zone Input (Any Zone). The Zone need to be programmed as a Analog Zone. The more light the LDR sensor has on it the lower the voltage the zone will read and the lower the light level, the higher the zone voltage. The following table will provide a summary of the type of voltages v's light (Lux) you could expect to read.



Fig 5:LDR Sensor

As the Ness LDR is very small (approx 5 mm x 4mm x 2 mm) it can be installed anywhere. Although it can be installed on a PIR detector consideration must be given as to the amount of light near the ceiling in a corner compared to lower near the floor. As a suggestion you could mount it on a blank electrical plate attached to the wall near the floor / power point level where the light is more even. This would change from site to site, room by room The LDR Sensor is wired directly to any Zone input. (Even the Keypad Zone input, (where a good location for the LDR could be on the keypad)) It does not need power.

### D. MEMS Sensor:

MEMS accelerometers are one of the simplest but also applicable micro-electromechanical systems. They became indispensable in automobile industry, computer and audio-video technology. This seminar presents MEMS technology as a highly developing industry.



Fig 6: MEMS Sensor

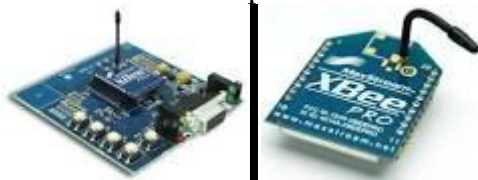
An accelerometer is an electromechanical device that measures acceleration forces. These forces may be static, like the constant force of gravity pulling at our feet, or they could be dynamic - caused by moving or vibrating the accelerometer. There are many types of accelerometers developed and reported in the literature. The vast majority is based on piezoelectric crystals, but they are too big and to clumsy. People tried to develop something smaller, that could increase applicability and started searching in the field of microelectronics. They developed MEMS accelerometers. The first micro machined accelerometer was designed in 1979 at Stanford University, but it took over 15 years before such devices became accepted mainstream products for large volume application. In the 1990s MEMS accelerometers revolutionised the automotive-airbagsystem industry. Since then they have enabled unique features and applications ranging from hard-disk protection on laptops to game controllers. More recently, the same sensor-core technology has become available in fully integrated, full-featured devices suitable for industrial applications. Micro machined accelerometers are a highly enabling technology with a huge commercial potential. They provide lower power, compact and robust sensing. Multiple sensors are often combined to provide multi-axis sensing and more accurate data.

### E. Zigbee module:

The XBee/XBee-PRO RF Modules are designed to operate within the ZigBee protocol and support

the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band and are compatible with the following:

- XBee RS-232 Adapter
- XBee RS-232 PH (Power Harvester) Adapter
- XBee RS-485 Adapter



The XBee/XBee-PRO ZB firmware release can be installed on XBee modules. This firmware is compatible with the ZigBee 2007 specification, while the ZNet 2.5 firmware is based on Ember's proprietary "designed for ZigBee" mesh stack (EmberZNet 2.5). ZB and ZNet 2.5 firmware are similar in nature, but not over-the-air compatible. Devices running ZNet 2.5 firmware cannot talk to devices running the ZB firmware.

#### F. GSM Modem:

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

As mentioned in earlier sections of this SMS tutorial, computers use AT commands to control modems. Both GSM modems and dial-up modems

support a common set of standard AT commands. You can use a GSM modem just like a dial-up modem



In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, you can do things like:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

The number of SMS messages that can be processed by a GSM modem per minute is very low, only about six to ten SMS messages per minute.

## II .OPERATION AND RESULTS

Wireless sensor network for wellness determination of elderly is working with sensors includes heart beat sensor, temperature sensor, LDR sensor, MEMS sensor, and Driver unit which is connected to two external devices such as fan and light. Sensors sense the respected values and send it to the ARM7 processor, that will be processed and send it to the Zigbee module and GSM module, while coding we will set particular value to the temperature sensor, heart beat sensor, LDR sensor, MEMS sensor, when it exceeds that particular value then we will be getting message to our mobile through GSM module.





Fig 7: Integration of all sensors with ARM7

### III .CONCLUSION

In this system, the required number of sensors for monitoring the daily activities of the elderly has been used. A smart sensor coordinator collects data from the sensing units and forward to the computer system for data processing. Collected sensor data are of low level information containing only status of the sensor as active or inactive and identity of the sensor. To sense the activity behavior of elderly in real time, the next level software module will analyze the collected data by following an intelligent mechanism at various level of data abstraction based on time and sequence behavior of sensor usage.

#### *Acknowledgment*

The author would like to thank Mr.K.Srinivasa Reddy, Associate Professor, for providing necessary facilities to carry out this work. A special gratitude to my parents for their constant encouragement without which this assignment would not be possible.

### References

- [1] A. H. Nasution and S. Emmanuel, "Intelligent video surveillance for monitoring elderly in home environments," in *Proc. IEEE 9th Workshop Multimedia Signal Process.*, Oct. 2007, pp. 203–206.
- [2] Z. Zhongna, D. Wenqing, J. Eggert, J. T. Giger, J. Keller, M. Rantz, and H. Zhihai, "A real-time system for in-home activity

monitoring of elders," in *Proc. Annu. Int. Conf. IEEE Eng. Med. Biol. Soc.*, Sep. 2009, pp. 6115–6118.

- [3] S. J. Hyuk, L. Boreom, and S. P. Kwang, "Detection of abnormal living patterns for elderly living alone using support vector data description," *IEEE Trans. Inf. Technol. Biomed.*, vol. 15, no. 3, pp. 438–448, May 2011.
- [4] A. Wood, J. Stankovic, G. Virone, L. Selavo, H. Zhimin, C. Qiuhua, D. Thao, W. Yafeng, F. Lei, and R. Stoleru, "Context-aware wireless sensor networks for assisted living and residential monitoring," *IEEE Netw.*, vol. 22, no. 4, pp. 26–33, Jul.–Aug. 2008.
- [5] J. K. Wu, L. Dong, and W. Xiao, "Real-time physical activity classification and tracking using wearable sensors," in *Proc. 6th Int. Conf. Inf., Commun. Signal Process.*, Dec. 2007, pp. 1–6.
- [6] Z. Bing, "Health care applications based on ZigBee standard," in *Proc. Int. Conf. Comput. Design Appl.*, vol. 1. Jun. 2010, pp. V1-605–V1-608.
- [7] K. P. Hung, G. Tao, X. Wenwei, P. P. Palmes, Z. Jian, W. L. Ng, W. T. Chee, and H. C. Nguyen, "Context-aware middleware for pervasive elderly homecare," *IEEE J. Sel. Areas Commun.*, vol. 27, no. 4, pp. 510–524, May 2009.
- [8] H. Yu-Jin, K. Ig-Jae, C. A. Sang, and K. Hyoung-Gon, "Activity recognition using wearable sensors for elder care," in *Proc. 2nd Int. Conf. Future Generat. Commun. Netw.*, vol. 2. Dec. 2008, pp. 302–305.
- [9] A. A. Moshaddique and K. Kyung-Sup, "Social issues in wireless sensor networks with healthcare perspective," *Int. Arab J. Inf. Technol.*, vol. 8, no. 1, pp. 34–39, Jan. 2011.
- [10] K. Hara, T. Omori, and R. Ueno, "Detection of unusual human behaviour in intelligent house," in *Proc. 12th IEEE Workshop Neural Netw. Signal Process.*, Nov. 2002, pp. 697–706.
- [11] S.-W. Lee, Y.-J. Kim, G.-S. Lee, B.-O. Cho, and N.-H. Lee, "A remote behavioral monitoring system for elders living alone," in *Proc. Int. Conf. Control, Autom. Syst.*, Oct. 2007, pp. 2725–2730.

#### Authors:

**Mr.NENAVATH SRINIVS I** pursuing M.Tech in VLSI & ES from Nagole Institute of Tech.Sci.,Hyderabad. He completed B.Tech ECE from JNTUH affiliated Nova engineering college .



**Mr.K. Srinivasa Reddy** is Associate Professor of the Electronics and Communication Engineering, Nagole Institute of Technology and Science, Hyderabad .He received his B.Tech degree in Electronics and Communication Engineering from JNT University, Hyderabad, and M.Tech degree in Embedded Systems from JNT University, Hyderabad. He is a member of The International Association of Engineers (IAENG). He had Fifteen publications in National and International Journals. He has written three text books in the field of wireless communications.



**Mrs.Evuri.Geetha Reddy** is Assistant Professor of the EEE, VITAE, Hyderabad .She received his B.Tech degree in EEE from JNT University, Hyderabad, and M.Tech degree PED from Vignana University, Guntur.. She is a member of The International Association of Engineers.