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A SMART HOME MONITORING SYSTEM FOR ELDERLY PEOPLE

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Abstract: Wireless sensor network based home monitoring system for elderly activity behaviour involves functional assessment of daily activities. In this paper, a mechanism for estimation of elderly well-being condition based on usage of house-hold appliances connected through various sensing units is reported. Two new wellness functions are defined to determine the status of the elderly on performing essential daily activities. Wireless sensor network with ZigBee components are connected in the form of mesh topology and a central coordinator of the sensing units collect data from the sensors connected to various appliances. The developed software system continuously reads the data from the coordinator and efficiently stores on the system for further data processing in real time.

Keywords: Activities of daily living, elder care, home monitoring, smart home, wellness, wireless sensor network.

I. INTRODUCTION

A Normal person performs daily activities at regular interval of time. This implies that the person is mentally and physically fit and leading a regular life. This tells us that the overall well-being of the person is at a certain standard. If there is decline or change in the regular activity, then the wellness of the person is not in the normal state. Elderly people desire to lead an independent lifestyle, but at old age, people become prone to different accidents, so living alone has high risks and is recurrent. A growing amount of research is reported in recent times on development of a system to monitor the activities of an elderly person living alone so that help can be provided before any unforeseen situation happened. An intelligent home monitoring system based on ZigBee wireless sensors network has been designed and developed to monitor and evaluate the well-being of the elderly living alone in a home environment.

The developed system is intelligent, robust and does not use any camera or vision sensors as it intrudes privacy. The intelligent software, along with the electronic system, can monitor the usage of household appliances and recognize the activities to determine the well-being of the elderly. A variety of systems for monitoring and functional assessment for elderly care have been proposed and developed in recent times. Monitoring activities of the person based on camera based sensors are reported in [1, 2] where the images of the person are taken and analyzed. In real practice applications such as surveillance and security make full use of camera based system but for home monitoring activities it lacks a huge acceptability among the elderly. Other than camera, infrared based Small Motion Detectors (SMDs), passing sensors, operation detectors and IR motion sensors have been incorporated in the house for monitoring the human activity behaviour [3] and the interpretation of human activity is limited to only to a few human activities.

There are a number of projects available on wearable health devices [4, 5] personal wellness monitoring and safety [6] integrated with sensors to provide continuous monitoring of person's health related issues and activity monitoring. Also, systems using RFID communication technology in elderly center were introduced [7, 8]. Though these devices are for specific purposes, they have severe concerns related to security, privacy and legal aspects [9]. Usually people are reluctant to wear a system continuously on their body. So it may not be a viable option for a healthy elderly people. This situation may be acceptable for a patient under rehabilitation.

If many sensors can be installed for the monitor of all appliances used by the elderly in a newly constructed house, it provides necessary data for elderly monitoring [10]. Systems like remote human monitoring using wireless sensor networks [11, 12] were introduced in recent times. Software systems with different machine learning techniques are incorporated into the wireless systems like [13]. Also, monitoring and modelling of elderly activities of daily living were incorporated [14, 15]. Though technology is effectively implemented but, these systems are limited to a few activities. There is a huge demand for an electronic system with intelligent mechanism, low cost, flexible, easy to install, robust and accurate for monitoring basic Activities of Daily Living (ADLs) of elderly living alone so that help can be provided at the right time. Real-time processing of data is a must for recognizing activity behaviour and predicting abnormal situations of the elderly.

II. SYSTEM DESCRIPTION

The uses of electrical appliances are monitored by the electrical appliance monitoring sensing units as shown in Fig.2. These operate based on the detection of light and air connected to appliances such as, lamp and fan. Fig.3 illustrates the care unit. The wellness information is provided to the care unit through Zigbee. The message is

triggered to the care provider when there is any change in their regular activities.

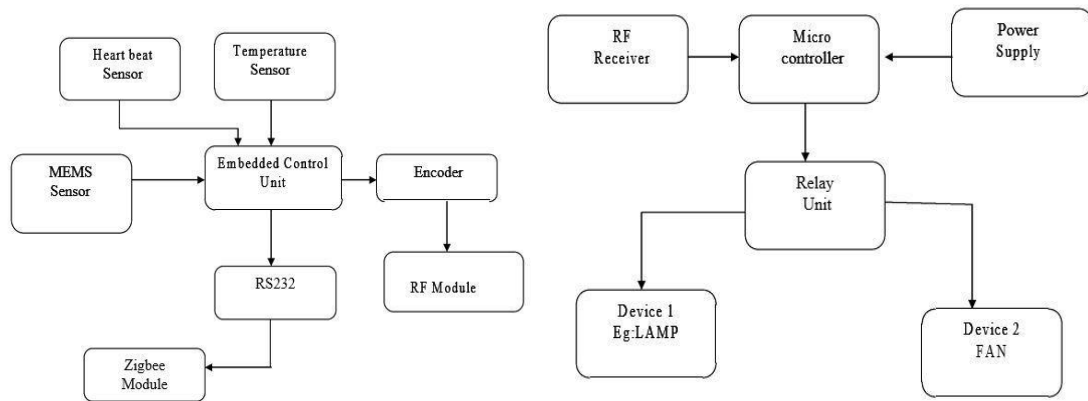


Fig.1: System Block Diagram

Fig.2: Appliance Unit

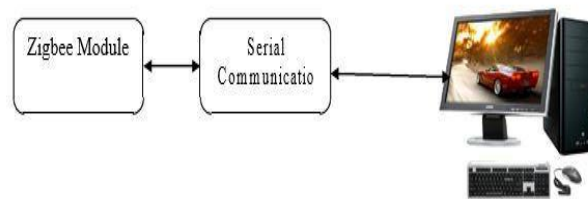


Fig. 3: Care Unit

The system consists of two basic modules as developed in [17, 18]. At the low level module, Wireless sensor network integrated with Zigbee modules of mesh structure exists capturing the sensor data based on the usage of house-hold appliances and stores data in the computer system for further 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 behaviour 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 behaviour of sensor usage. A smart sensor coordinator collects data from the sensing units and forward to the computer system for data processing. For this WSN consisting of different types of sensors like MEMS sensor, temperature sensor and heart beat sensor with zigbee module sensing units are illustrated in Fig.1.

A. Data acquisition

Captured data are dynamically changing and demanding fast, real-time response time for forecasting the irregular behaviour of the elderly. To analyze the data properly, an efficient process of storage mechanism of sensor data onto the computer system is executed. Issues like storage requirements for continuous flow of data streams and processing of data to generate patterns/abnormal events in real time were effectively dealt in the current system. Since there is a continuous in flow of sensor streams we have stored the sensor data in the processing system only when there is a change in the sensor events -Event based storage (i.e.) when status (active or inactive) of the sensor is changed then the sensor fusion data is recorded. This is most efficient technique, as it reduces the size of storage to a large extent and more flexible for processing of data in real time. Event monitoring collection of data has enormous benefit over continuous flow collection of data in terms of the amount of data storage and processing of data in real-time applications like home monitoring.

B. Wellnes determination of elderly

If the elderly person needs assistance with some of their Activities of Daily Living (ADLs) - An index or scale which measures a patient's degree of independence in bathing, dressing, using the toilet, eating and transferring (moving from a bed to a chair, for example) [17] as these are used to determine the need for long-term care or Instrumental Activities of Daily Living (IADLs), professional caregivers accessing the elderly activity reports will have an objective assessment of their actual needs and appropriate care services based on the daily functional assessments of the person. There are numerous wellness concepts suggested by experts from various domains, each of which is defined from their specialist perspective and contain several dimensions of wellness [18,19,20].

III. EXPERIMENTAL RESULT AND DISCUSSION

The experimental setup is as follows: WSN consisting of Heart beat sensor, temperature sensor, mems sensor and LDR sensor re-installed in the home to monitor elderly behaviour and assist the elderly living alone if there is any irregular behaviour at a particular time. Along with the wireless sensor network a laptop installed with the developed intelligent software connected with zigbee module acting as coordinator is associated with WSN to collect and monitor the elderly behaviour. Program for data acquisition activity recognition and wellness determination are written using Network simulator-2.

IV. SIMULATION RESULTS

NS is an object oriented discrete event simulator. Back end is C++ event scheduler. Front end is OTCL (Object Tool Command Language). In the care unit, the wellness information is transmitted to the appropriate care provider through GPRS. Once the value of the sensor exceeds, it turns to Red colour and it will pass message to the mobile as illustrated in Fig.4. In the appliance unit, the RF signals are transmitted to the control appliances through the antenna as illustrated in Fig.5.

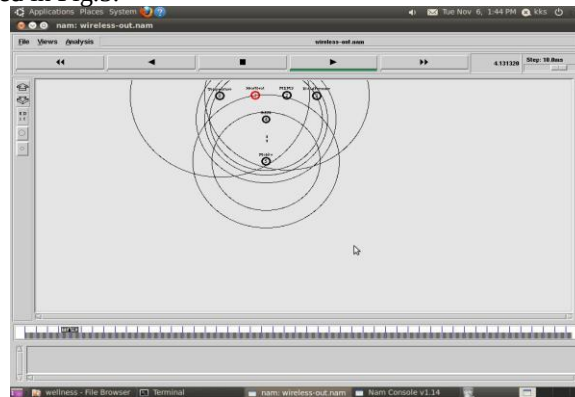


Fig. 4: Care unit

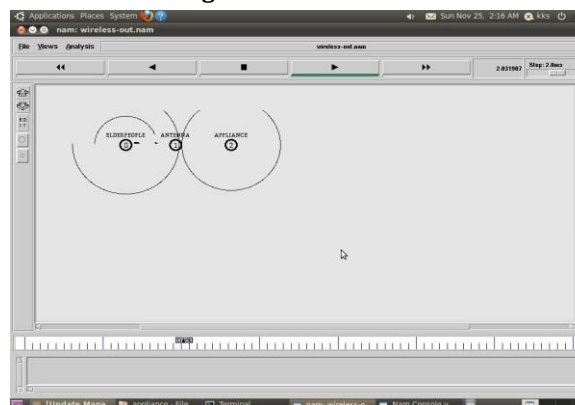


Fig. 5: Appliance unit

V. CONCLUSION

Wellness is a wide and multifaceted phrase. In this research Wellness is about well-being of elderly in performing their daily activities effectively at their home. This will facilitate the care providers in assessing the performance of the elderly people. In the near future, the system will be augmented with the physiological parameter monitoring sub-system.

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. V1-605–608.

- [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. Hyoun-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 behavior 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.
- [12] D. Lymberopoulos, A. Bamis, T. Eixeira, and A. Savvides, "BehaviorScope: Real-time remote human monitoring using sensor networks," in *Proc. Int. Conf. Inf. Process. Sensor Netw.*, Apr. 2008, pp. 533–534.
- [13] E. Nazerfard, P. Rashidi, and D. J. Cook, "Discovering temporal features and relations of activity patterns" in *Proc. IEEE Int. Conf. Data Min. Workshops*, Dec. 2010, pp. 1069–1075.
- [14] P. George, X. George, and P. George, "Monitoring and modeling simple everyday activities of the elderly at home," in *Proc. 7th IEEE Consumer Commun. Netw. Conf.*, vol. 7, Jan. 2010, pp. 1–5.
- [15] H. Medjahed, D. Istrate, J. Boudy, and B. Dorizzi "Human activities of daily living recognition using fuzzy logic for elderly home monitoring," in *Proc. IEEE Int. Conf. Fuzzy Syst.*, Aug. 2009, pp. 2001–2006.
- [16] E. Dishman, "Inventing wellness systems for aging in place," *IEEE Comput.*, vol. 37, no. 5, pp. 34–41, May 2004.
- [17] *Covering Health Issues*, 6th ed., Alliance Health Reform, Washington D.C., 2005.
- [18] C. Soomlek and L. Benedicenti, "Operational wellness model: A wellness model designed for an agent-based wellness visualization system," in *Proc. 2nd Int. Conf. eHealth, Telemed. Social Med.*, 2010, pp. 45–50.
- [19] A. Kailas, "A generic conceptual model linking wellness, health lifestyles, and user assistance," in *Proc. 13th IEEE Int. Conf. eHealth Netw. Appl. Serv.*, Jun. 2011, pp. 266–269.
- [20] A. Kailas, C.-C. Chong, and F. Watanabe, "A simple iterative algorithm for wellness applications," in *Proc. IEEE Wireless Commun. Netw. Conf.*, Apr. 2010, pp. 1–6.