

An Embedded Health Care Supervisory Systems

Pooja Gupta

*Department of Computer Science Engineering
Shri Govindram Seksaria Institute of Technology and Science, Indore, M.P., India*

Aniket Kulkarni

*Department of Biomedical Engineering
Shri Govindram Seksaria Institute of Technology and Science, Indore, M.P., India*

Akshay Sarda

*Department of Biomedical Engineering
Shri Govindram Seksaria Institute of Technology and Science, Indore, M.P., India*

Abstract- Most of the systems used in medical healthcare are based on embedded electronics systems. These medical systems are primarily made from embedded electronics becoming mostly installed in health care systems nowadays. Utilization of these systems are more and also to home care applications and effective in monitoring from medical and economical view. The upcoming trends of distance monitoring embedded systems for supervisory applications require complexity of architecture and infrastructure for cost reduction and effectiveness. There are new modern technologies for sensing, transferring a micro chip data processing technologies. They can advance the better health supervision with first-aid treatment.

Keywords –Embedded System, Supervisory, Sensor, Soft computing.

1. INTRODUCTION

Now a days there are a lot of electronic products which include embedded systems. Many of them can be found in everyday use electronic instruments like MP3 players, cameras, multimedia, mobile phones, home electronics systems and toys, but this systems are at the same time in car parts, in medical devices and household appliances. These are mostly equipped by embedded system's necessary intelligence. Likelihood of these being used are so wide that the emergence of embedded systems and their importance has entered the field of cybernetics and information technology. Document Management Committee Embedded System Technology Platform, the strategic initiative defines Embedded Systems (ES) as a combination of hardware and software embedded into a single unit for a dedicated task to drive an external process device or system. In it, the electronic module with the micro processor and other programmed electronics control device in which the system is installed. Embedded systems are realized for functioning even without man machine interaction and are able to reply to occurrence of events in real time. Not only personal computers which interacts with the ambient mouse, keyboard, I/O and graphical user interface, but the sensors, activator and specialized communication channel amongst the wire and wireless communications together control the devices.

As nowadays numbers of elderly and single senior people are increasing, and thus the medical or hospital centres will probably need very soon more technological contributions. There will be important health supervisory policy displaced to ambient systems equipped with security and reliability wireless communication between embedded systems and supervisory headquarters.

The health care services are divided to several types, like for patients - sporadic stress on management of chronically states, implantable medical devices, and distance standalone embedded rehabilitation systems, get ahead of the gravely man, first-aid treatment and exquisite care.

Thanks to new medical progress in diagnostics and therapy like fine diagnoses set up, preventive medical examination, robot assistive treatment and drug efficiency, the commitment time in the hospital are shorter and shorter. In other way more and more people are being taken care in these medical centres. Rest of the time instead of spending in hospitals, they spend in their home environments. This scheme from the psychological point of view is better for convincing and also gives reasonable cost and ability to patients to be fit and

settled with home care. Most of these people live as singles and these are the target group for supervisory health systems for remote form checking and watching health situations in one time.

In recent days the boom of telemedicine systems has started. Many of them have different monitoring strategy and watching mechanism. Health supervisory systems has to incorporate n important feature of unidentified intelligent health care embedded system which can afford anamnesis about health check status for patients and medical centers in one time. All of those involved person can easily check their health condition and vitality status in any time they want and share to doctor certainly.

The interface between the diagnostic person and man are sensors measuring the object's biological signals of body. This type of measurement is rather different than on hospital biochemist laboratory. The measurement signal can easily inform us about actual and long time bio signal trends in time. The re convalescent time in home care can produce twenty four hours mapping of heart rate variability, circadian rhythms and so on. Combination of information from on-body and stationed sensors power up the signal entropy about the health status. As provisioned, the bio signals will be feed to our unique modular embedded medical sensors parameters detectors, relevant parameters will be extracted out by using proficient signal processing mechanism.

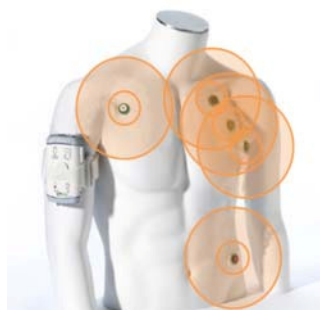


Figure 1: Body Area Network Protocol

The proficient signal processing mechanism is treated by experimental expert system with learning knowledge base for diagnosis of the health status. The man has actual reception about their health status and can make the plan to visit to doctor only if their problem gets inescapable.

II. DESIGN OF HEALTHCARE SUPERVISORY SYSTEM

Design of embedded health care supervisory systems should be mobile and communicate with surrounding sensors by wire or wireless way. Characteristics of the supervisory systems are mobility with light weight, long life battery profile, first aid emergency pushbutton and user interface for self check information. The sensors and health embedded systems also should be under undisturbed in prevailing life style with the simple operation. This system has to give high authenticity, security and diagnosis validity with respect of the hardware and software parts. There is necessity also to have native interaction and ambient intelligence in medical between healthcare processes and the home-care supervisory systems and the deep embedding of wireless sensor and actuator technologies into the neighborhood. These are the most responsible feature of embedded systems application in look of systems provides technological infrastructure for ambient intelligence realization.

2.1 DATA READING

The most important part of health systems are high quality and statements biological data. The data are measured by sensors from on body and patient's surrounding. The data are disturbed by artefact from human body as biological artefacts and technical artefacts biasing the measurement from circumambience. The on body sensors are mostly wirelessly connected and powered to mobile embedded system. The wide range of bio signal types are measured like ECG, PPG, ACC for position and energy expenditure measurement, temperature, and so on.

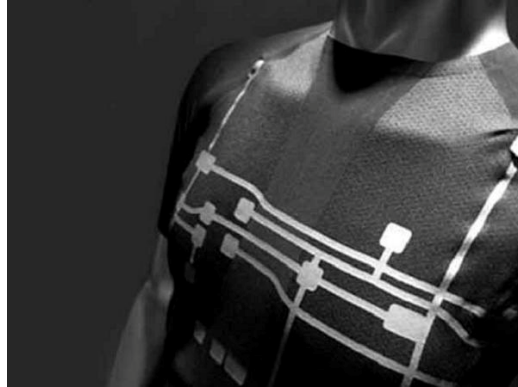


Figure 2: Sensing Shirt

There are also sensors for wirelessly communication with embedded systems where the wire connection is not convenient as vibration sensors.

Commonly used glue electrodes for electrical heart activity slicked on skin are time limited due contact gel dewatering, skin shifting etc. Nowadays trend is to use the innovative type of measurement by conducting polymer based electrode covered on any type of flexible t-shirt. Polymer based electrodes are deployed for any number of leads ECG or other type of bio signal measurement and the wirelessly are connected outright on the t-shirt pin terminal. The preference of that solution is long term stability of electrical signal conduction and scanning. Fig.2.

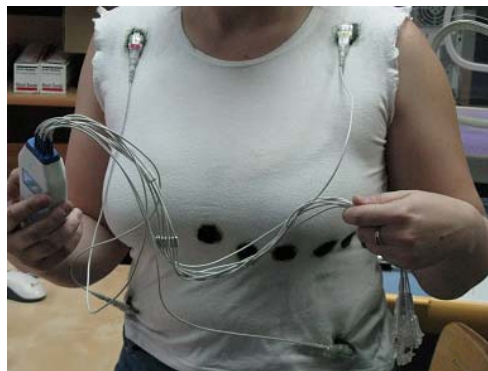


Figure 3: Alternative Conducting Polymer T-Shirt with Wire Connection into Personal Embedded System

The embedded health supervisory systems are able to measure falls and positions of human body. A lot of number of elderly people has problem with stability and subsequent falling which is vicariously risky. The next problem based on physics and late age osteoporosis are in context very hazardous not for living, but if they are living alone the exhaustion, starvation and pain stress and immobility. Together it causes fatal situation with less possibility of distress call.

The competence to men's standing and movement monitoring may help either to identify man at risk of falls or to planning time monitoring of user movement on the flat and their anomaly in circadian rhythms. Collective information about the fall and other bio signals gives necessary information to establish right reason of fall and set up the right diagnose and consecutive response. Blood pressure and glucose, weight and temperature trends, motion in apartment, blood oxygenation characteristics can be manipulated similarly to the ECG signal as long as the sensors are well-implemented. One of the really important characteristic is modular implementation of each supervisory embedded sensor according to user's requirement.

2.2 INFRASTRUCTURE OF DATA TRANSFER

Next important part of ambient supervisory system is fine data communication from sensors to processing system. Data communication can be done by wireless communication in most of medical applications raising practicability and comfort in long-run user monitoring. There are some short-range wireless transmission standards on the market that allow appropriate data transfer rates suitable for continuous transmission of necessary values of user vital state inquest.

Previous works on the available wireless communication standards focuses on the most common technologies with available specifications which are namely Bluetooth (IEEE 802.15.1.), WIFI (IEEE 802.11), WPAN (IEEE 802.15.4 / ZigBee), WiMax (IEEE 802.15.4). Fig. 4.

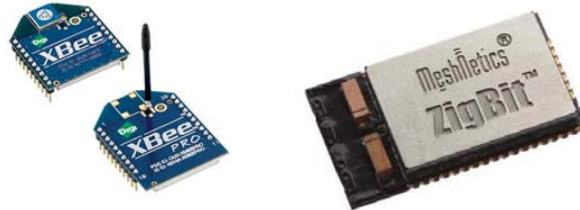


Figure 4: Xbee is a ZigBee transceiver

Decision on what wireless data transmission system to use is driven by data capacity and transmission range from sensors to sensors and Embedded system. Nowadays the ZigBee technology due bandwidth, communication range, energy consumption, and reliability benefits gives reasonable utilization in home care applications. There were communication test for validating the usability in home-care applications. We used the OEM-modules for vital parameter monitoring from Microchip, and Maxstream inc. We were also tested the WiMax technology for data middle distance range transmission with the weak results actually.

2.3 MOBILE EMBEDDED SYSTEM

The heart of electronics system and also coordinator in communication is embedded system managing biometric data from numerous stationary and on body sensors, (Fig. 5). Next the investigation information about the inquisition parameters is transferred into outer part of flat. The outer part represents the LAN or long distance wireless communication within health services, first aid or family relatives.

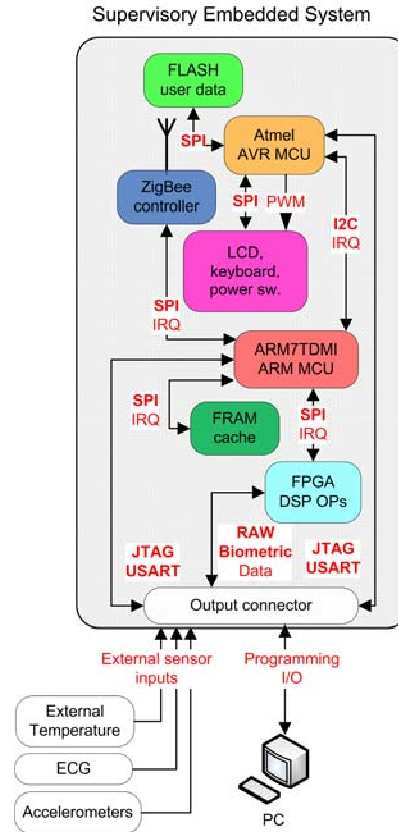


Figure 5: Block Diagram of Portable Embedded System

The bio signals related to the decision-making process are able to be transformed remotely. When the users go out, the mobile embedded system is possible to take with. Coming back the mobile embedded system should be plugged in docking station as LAN gate and also battery-charging. Cell practical installation of the system was tested success in our biotelemetry flat.

III. SOFTWARE ROLE

Every system is as good as the software implemented in. Also in the embedded systems the possibility of embedded software makes it powerful. From the beginning the sensing by sensors is driven by software for frequency of reading, filtering, and data packet construction. Next step is data communication between transceiver and it amounts transferred packet management to store and ensure reliability and security. Embedded systems process the data and aggregates information for preliminary diagnosis, set or assign them to health expert as medical doctor or first-aid treatment.

The complexity of the software part is area of implementation if infrastructure of that system is big. Realization of that part of measuring is much more complicated than hardware realization. The cooperation between the hardware and software realization groups has to be narrow.

IV. SUPERVISORY HEALTH SYSTEM

4.1 INFORMATION EXPLICATION

In the home care application data measurement is problem of objective information delivery. Many beneficial information about the health condition is given by ECG signal from twelve leads measurement. It generally causes 82 % of all health problems. Thus, the ECG analysis is important part of our signal interpretation.

We used modern mathematical methods and experimental expert system decision trees for evaluation of signals

measured by embedded system.

The detailed signal processing of this signal will be described in other paper due to huge number of information. Home monitoring is assuming more and more importance to perform patient diagnosis and therapy and reduces hospitalization costs. Telemedicine technologies allow unifying different clinical objectives: prevention, diagnosis, therapy, admission and home assistance. [7] This out-of-hospital system makes closer patient-Physician relationship because of patient active participation in patient's own treatment process. In this way it is possible not only to check patient's health condition but also to study care efficiency as to eventually modify pharmacological treatments. [7]

4.2 DISTANCE ANAMNESIS ASSESSMENT

The goal of all supervisory systems especially health supervisory systems is conveys critical situation and first-aid treatment safeguard. Incorporation of software and hardware parts affair the software agents on each levels to process the adaptable remote diagnostic system.

The critical and a life threatening situations are advice by text message service into supervisory centre, first aid and other like family relations or neighbour. Simultaneously there should be chance to transfer measured data from user by LAN, Wi-Fi, 4G communication into the supervisor centre.

The supervisory centre with physician is able to check the risk factor of each user remotely. From this point of view, the representative data set from the user gives clinical information's about the real plunge risk to set up the sensing parameters in case of a spurious warning. After obtaining at supervisory centre a demand from the medical sight there is possibility to update information in decision software in mobile embedded system at user by different way like GSM. There is also possibility for distance monitoring and up-dating the embedded system by internet web based interface. Thanks to that the broad range of users and physician can enter the real conditions of each monitored user and also by this way the personal verification with the trend data are displayed.

This point of view of the representative data set from the user gives clinical information's about the real plunge risk to set up the sensing parameters in case of a spurious warning. After obtaining at supervisory centre a demand from the medical sight there is possibility to update information in decision software in mobile embedded system at user by different way like GSM.

Every user can have a specific set in the seat up for the embedded system diagnosis software for their specific diesis. It concern number of sensors, and list of tests making without user interaction.

The diagnosis is saved at central terminal server. The central terminal server contains the software agents that start various diagnostic tests on the personal embedded system.

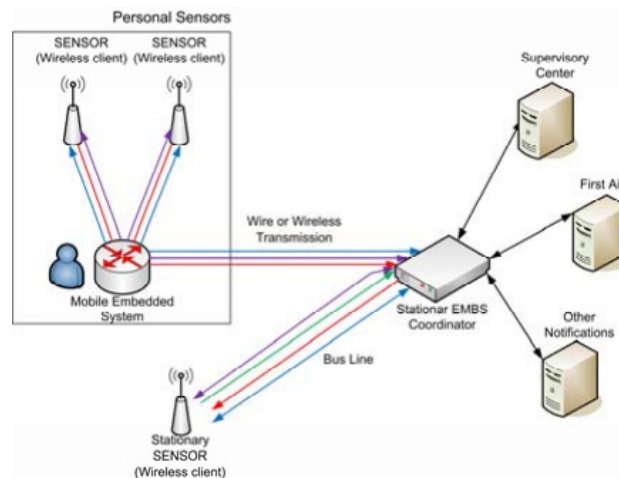


Figure 6: General Configuration of Remote Diagnose

4.3 PREDICTIVE EVENTS

The future of the supervisory maintenance system will cooperate with artificial movement systems and implantable devices of nanostructures to prevent the fall, cardiac incidents and glycaemia shock. This prediction can be realized for several cases of diesis, but with great impact to ser health. Using fast multi

health supervising services especially for singles a elderly people in home background. From the economical point of view and quality of medical care the home-made sequential therapy is perspective. This is a very important role taken by more and more complex supervisory embedded systems. Perspective of this kind of systems is in modern sensors and communication technologies and also roofed-in high quality implemented software. Those kind if medical supervision gives to this personal system role of health bodyguard.

REFERENCES

- [1] Krejcar, O., Janckulik, D., Motalova, L., (2009) Complex Biomedical System with Mobile Clients. In The World Congress on Medical Physics and Biomedical Engineering 2009, WC 2009, September 07-12, 2009 Munich, Germany. IFMBE Proceedings, Vol.25/5. O. Dössel, W. C. Schlegel, (Eds.). Springer, Heidelberg.
- [2] V. Kasik, (2002) "FPGA based security system with remote control functions." 5th IFAC Workshop on Programmable Devices and Systems, NOV 22-23, 2001 GLIWICE, POLAND, IFAC WORKSHOP SERIES. Pages: 277-280, 2002, ISBN: 0-08-044081-9.
- [3] Penhaker M., Cerny M., Martinak L., et al. HomeCare - Smart embedded biotelemetry systém In Book Series IFMBE proceedings World Congress on Medical Physics and Biomedical Engineering, AUG 27-SEP 01, 2006 Seoul, SOUTH KOREA, Volume: 14, Pages: 711-714, 2007, ISSN: 1680-0737, ISBN: 978-3-540-36839-7
- [4] Srovnal, V., Penhaker, M.: Health Maintenance Embedded Systems in Home Care Applications In sborník 2nd International Conference on Systems ICONS 2007, NJ 08855-1131, USA:Institute of Electrical and Electronics Engineers -IEEE, 2007, 6 s., ISBN 0-7695-2807
- [5] Machacek, Z., Srovnal V. : Automated system for data measuring and analyses from embedded systems, Proceeding of the 7th WSEAS International Conference on Automatic control, Modeling and Simulation. Prague, Czech Republic 2005, ISBN 960-8457-12-2, 6p.
- [6] Srovnal, V. Jr., Machacek, Z., Srovnal, V.: Wireless Communication for Mobile Robotics and Industrial Embedded Devices, 2009 Eighth International Conference on Networks ICN, Gosier, France. 2009. IEEE CFP0987F-CDR. ISBN 978-1-4244-3470-1, 6p.
- [7] Kotzian, J., Machacek, Z., Srovnal, V. Jr., Srovnal, V.: Embedded control system for the mobile robot, WSEAS Transactions on Systems, ISSN 11092777, Issue 12, Volume 4, p.2261-2268.
- [8] Cerny M., Penhaker M. The Circadian Cycle Monitoring In Conference proceedings
- [9] Penhaker M., Cerny M., Rosulek M. Sensitivity Analysis and Application of Transducers In konference proceedings 5th International Summer School and Symposium on Medical Devices and Biosensors, JUN 01-03, 2008 Hong Kong, PEOPLES R CHINA, Pages: 85-88 Published: 2008, ISBN: 978-1-4244-2252-4