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An RTOS based Architecture for Patient Monitoring System with Sensor Networks

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Abstract

Objective: The main scope of this project is to provide a better treatment and to supervise the patient round the clock until the patient in the hospital**.** By using this prototype, we can reduce the human interaction in the hospitals. **Methods:** To reduce the problems we developed a prototype by using Raspberry-Pi 2 processor, Raspbain os, 8051 microcontroller ECG sensor, Heartbeat sensor, Temperature Sensor (LM35), USB Camera and IoT. **Findings:** This system helps to direct interact between patient and doctor when the patient is in hospital, doctor can treat the patient while sitting in his chamber and he can give the suggestions to the patient. By using this prototype, the can check the status of the patient when the doctor is not there in the hospital. We provide a web page which consists of all the details of the patient in that web page only we get the reading of the patient heartbeat, ECG and temperature. We will get the live video steaming of the patient, this video streaming is used for multiple purposes like one is to know the status of the patient condition and the other one as security purpose. **Applications/Improvements:** This prototype is developed to supervise the patient condition round the clock and to give better treatment to the patient. This can be used in industries, irrigation systems and in medical fields.

Keywords: 8051 microcontrollers, Raspberry pi 2 processor, Sensors, Usb camera, Wi-Fi

1. Introduction

Patient supervisor system has a better possible way to take responsibility and to make down the medical costs[1,2,3]. This paper helps in supervising the health conditions of the patient and will give the report about a long time changes in health condition. There is a possible way to know the actual reason to go to illness. To know the accurate conditions and to give the live updates, reading of the patient to caretakers and healthcare providers. Various patient supervisor system has a capable of generating alerts in real time with various actual conditions like falls, they may have a problem with driver's alertness and heart strokes are investigated[4,5].

The Figure 1 explains the basic architecture of patient supervisor system. It has three different types of sensors which are used to supervise the patient. There are three different nodes, in this one is patient node, second one is central node and the third one is doctor's node. The patient node consists of three sensors like temperature sensor, Heart beat sensor and ECG sensor. These three sensors will take the readings and then forwarded to central node by using x-bee modules. For central node we are connecting x-bee, usb camera and internet module the central node is a temporally storage system. Central node will place the data into webserver. The doctor node is the permanently storage system.

The central node will collect the information from the patient node and process and stores temporally, the data generated by the sensors are forwarded to the doctor node to keep the data for long time. Patient supervisory system has an option of live streaming to monitor the patient condition and the moments are stored in the web server. The central node is implemented by using raspberry pi processor and a monitor. When the signal is sending from central node to doctor node. In this patient supervisory system, we are also doing live streaming of the patient moments and that are also stored in the webserver.

The patient supervisory system consists of an operating system which is basically divided into two different

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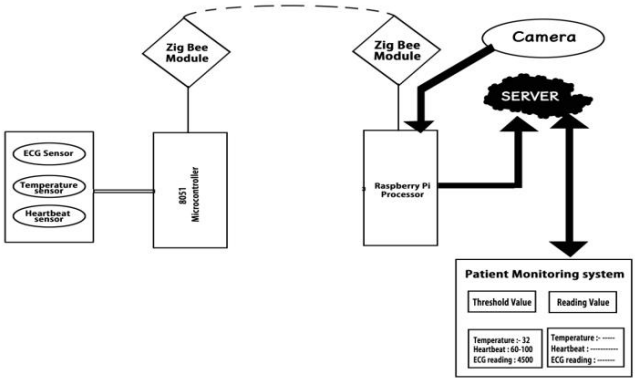

Figure 1. General block diagram of real time patient monitoring system.

systems in that one is General purpose operating system (GPOS) and second one is Real time operating system (RTOS). General purpose operating system uses a 'FAIR Scheduling' to assure all jobs gains a perfect execution time. These GPOS does not take any priority to execute. For example, two are more sensors are sending data at a time then this operating system will not assign any priority and executes in FIFO (First in First Out) manner. At that time if any patient condition is critical then that person can't get proper treatment. So to reduce this type of problems we are using RTOS (Real time operating system) which will give the high priority to important tasks to execute.

The patient supervisory system may prescribe to observe number of signals sent by different types of sensors in this some of sensors are commonly used for observing the patient condition. The used sensors are like ECG, heartbeat and temperature.

Finally in this paper we are proposing an Operating system in real time based patient supervisory system that meets the hard-real time requirement for multi sensor and video streaming of the patient. The central node will make possible of using a commercial hardware and runs with operating system to receive the data from patient node and process to doctor's node. The working of the system is verified in multitasking condition and in no load conditions. Here we determine, whenever all the processing tasks has the same priority, in General propose operating system, then the system will fail to resolve the high-priority data with in time frames are required.

2. Literature Survey

Gives a calculated outline of a wearable physiological checking framework in view of remote sensor system to screen physiological parameters like ECG, EMG, EEG, SaO2, body temperature, circulatory strain, respiratory rate GSR and development of the wearer[6]. The gained signs are pre-prepared at every hub at the sensor level and transmitted to the wearable information obtaining equipment (sink hub) for further handling. It is then transmitted remote to the remote checking station.

Depicts the improvement of a wearable sensor stage to screen various physiological relates of mental anxiety[7]. The alterations in both framework configuration and sensor choice to adjust data substance and wear capacity is nitty gritty. Utilizing test signals gathered from the wearable sensor, a chose number of physiological components that show great relationship with mental anxiety is portrayed.

Conjointly describes the design of a wearable graphical record monitor that's patient location freelance and provides continuous observation[8]. The signals from the sensors square measure transmitted mistreatment Bluetooth to the good phone in its space, which may successively be send to the destination via net.

Proposes an influence and space economical ECG (ECG) and signal process application device node for wireless body space networks (WBAN)[9]. This device node will accurately record and observe the QRS peaks of graphical record wave with high-frequency noise suppression. The planned system is enforced in zero.18-mm complementary metal oxide–semiconductor technology with 2 chips: analog forepart computer circuit (IC) and digital application specific computer circuit (ASIC).

In their paper portray a model framework for constant wellbeing perception gathering[10]. The framework comprises of an unassuming remote body space system (WBAN) and a home wellbeing server. The sensors of the WBAN screen client's heartbeat rate, portable and train action and exchange the information with time-stamp to the house server at normal interims of your time. The house server might integrate this data into the native information for the user's examination or it should forward the data more to a medical-server.

Describes the thought of low-power wireless device nodes for medical specialty applications that square measure capable of operative autonomously or on terribly tiny batteries[11]. Component-level power improvement for the radio and digital signal process is delineated within the paper beside a brief comparison between radio power consumption and on-node process.

Provides many solutions for rising the dependableness and therefore the power management of real-time of

period of time multi-patient observation systems[12]. A reliable wireless Personal space Network supported digital signal process has been developed mistreatment sleep strategy and alternative techniques like dynamic voltage and frequency scaling to attain low power management and motor-assisted power management[13,14]. Results show that this approach has been made in Outperforming the one WPANs in terms of potency and dependableness.

Provides a novel wireless knowledge assortment system for health observation of patients supported PIC controller and wireless sensors[15,16]. The exclusive characteristics of this method like low power, low cost, and high flexibility build them ideal for this application.

3. Hardware Implementation

The block diagram shows the prototype of the implementing system. In this system we are using two micro controllers and one controller works with a Raspbian-Os and other one is 8051 microcontrollers. For 8051 microcontrollers we interfaced three sensors like temperature, heartbeat and ECG sensor's. The two controllers will communicate with x-bee modules. We use an Ethernet network connection for upload in data of sensor into webserver, which is getting from patient node.

3.1 Sensors

There are three sensors used in this system. Some of this will send the data rates in between 1Hz to 1 KHz. The main aim of this project is to send data which has high priority of 3leads signals and other two leads signals will be from remaining sensors. ZigBee transceiver is used to send the data of patient node to central node. ZigBee receiver is used to receive the data and upload in the server.

3.2 Central Node

To upload the data into server raspberry pi2 processor is used. This raspberry pi2 processor consists of GPOS and RTOS, we used Raspbian operating system which has the capacity to perform multi stack support.

Raspbain operating system is used for live streaming the patient condition. The prototype hardware is used for central node is raspberry pi2 B+ processor which is manufactured by raspberry pi. This processor is chosen because it is low cost than compared to another device which need to perform Raspbain operating system.

The utilities of this processor are raspberry pi2 B+ model name is Broadcom BCM 2835 system-on chip. Its architecture is arm11. The CPU configuration is 700MHz power low ARM1176JZFS processor, memory is 512MBS-DRAM. It has inbuilt Ethernet, HDMI, 4 Usb ports with Usb2.0 connector, the GPIO connector is 40 pin and the power consumption is +3.3V, +5V and Ground.

3.3 Doctor Node

Doctor node is connected to an ethernet, when doctor check the results of the patient and in this we are making live streaming of the patient by using Usb camera, when the doctor compare's both values like sensor and patient condition then doctor prescribes the medicine to the patient in the webpage.

4. Experimental Results

The Figure 2 shows the implementation of patient monitoring system consists of 8051 microcontrollers, temperature sensor, ECG sensor, heartbeat sensor and Zig-bee modules which is used to take the continuous reading of patient of his/her conditions. Patient node consists of threshold values of human beings like heartbeat ranges between 60-100 times per second, ECG ranges from 4000-5000and the body temperature ranges between 96F-103F. when the patient reading excess the reference values automatically buzzer will be in ON state. And these values are transmitted to doctor node via central node. To transmit the data from patient node to central node zigbee module is used.

The Figure 3 shows the implementation of central node system consists of Raspberry pi2 processor, usb

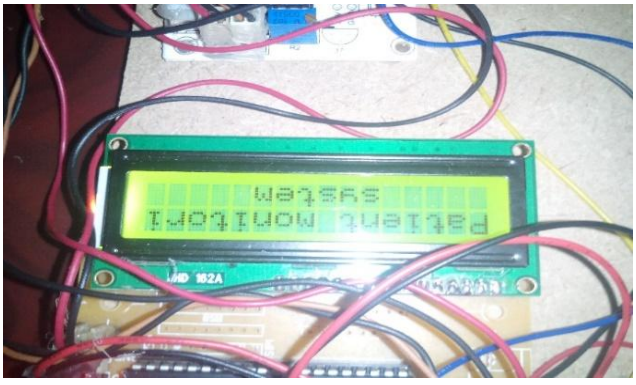

Figure 2. The Implementation of patient monitoring system.

camera, Wi-Fi router and Zig-bee module. Whenever the data is received from the patient node through Zig-bee module that data is directly uploaded to the webserver which is used by the doctor. For this central node we are interfacing the usb camera which is used to give the live video of the patient in the room. If the sudden changes occur in the patient condition, then the doctor will check his condition on his pc and suggests for treatment and a medicine if necessary.

Finally Figure 4 shows the implementation of doctor node which consists of 1GB RAM, monitor, Intel processor and an internet connection. In the doctor node, for every one minute the data is uploaded from the central node. Whenever patient values excess the reference value then automatically buzzer will ON, then the doctor will suggest some medicines to the patient to come to normal state.

The Figure 5 shows the live streaming of the patient condition who is the ICU Unit.In this the patient condition will be monitored by the doctor by siting in his cabian and he can treat the patieent directly.If doctor want to suggest any medicine he can suggest the from his cabin.

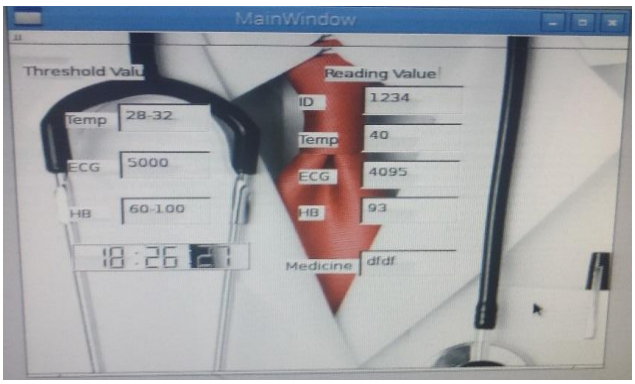

Figure 3. Implementation of central node.

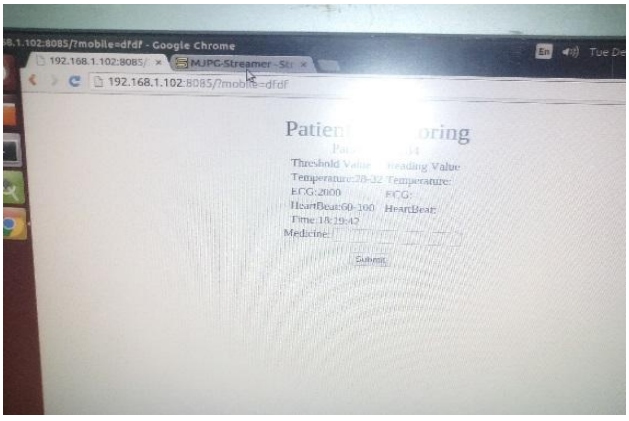

Figure 4. Implementation of doctor node.

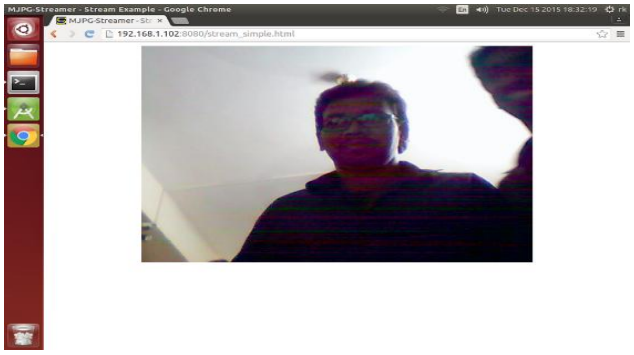

Figure 5. Video streaming of the patient monitoring.

5. Conclusion

Patient supervisory system is more popular because it is low cost and easily available. This permits to use the multiple sensors for patient supervisory system. The patient may be having a chronic and acute conditions. Here we are using high bit sampling rate sensors like video, ECG, along with typical signal processing techniques which will absolute increases the processors to go under more work, and it may go to starvation of tasks in real time jobs. A patient supervisory system based on Operating System in Real time can optimize the time criticality jobs to known that alarms are generated in an exact manner.

6. References

1. Sinha N, Ravi. Implementation of Health Monitoring system using mixed Environment. Indian journal of science and technology. 2015 Aug; 8(20):1–5.
2. Roy R, Venkatasubramanian. EKG/ECG based Driver Alert System for long Haul Drive. Indian journal of science and Technology. 2015 Aug; 8(19):1–6.
3. Sucharitha M, Parimala GK. Wavelet based ECG steganography for protecting patient Confidential Information. Indian journal of science and Technology. 2015 Sep; 8(24):1–5.
4. Radhimeenakshi S, Nasira GM. Remote Heart Risk Monitoring System Based on Efficient Neural Network and Evolutionary Algorithm. Indian journal of science and Technology. 2015 Jul; 8(14):1–6.
5. Chu R, Gu L, Liu Y, Li M, Lu X. Sen Smart: Adaptive Stack Management for Multitasking Sensor Networks. IEEE Trans. Comp. 2013 Jan; 62(1):137–50.

6. Pandian PS, Safeer KP, Gupta P, Shakunthala DT, Sundersheshu BS, Padaki VC. Wireless Sensor Network for Wearable Physiological Monitoring. Journal of Networks. 2008 May; 3(5): 1–9.
7. Choi J, Ahmed B, Gutierrez-Osuna R. Development and valuation of an Ambulatory Stress Monitor Based on Wearable Sensors. IEEE transactions on information technology in biomedicine. 2012 Mar; 16(2):279–86.
8. Jun D, Jia-wei Z, Hong-hai Z, Li-ping W, Xia L, Zhen-jiang L. Wearable ECG Monitors and Its Remote Diagnosis Service Platform. IEEE Intelligent Systems. 2011.
9. Xin Liu,Yuanjin Zheng, Myint wai Phyu,F.N.Endru, V.Navaneethan, Bin Zhao. An Ultra-Low power ECG Acquisition and Monitoring ASIC system for WBAN Applications. IEEE Journal on Emerging and Selected Topics in Circuits and Systems. 2012 Mar; 2(1):60–70.
10. Otto CA, Jovanov E, Milenkovic A. A WBAN-based System for Health Monitoring at Home. 3rd IEEE/EMBS International Summer School On Medical Devices and BioSensors – ISSMDBS. 2006 Sep; 20–3.
11. Bachmann C, Ashouei M, Pop V, Vidojkovic M, De Groot H, Gyselinckx B. Low-Power Wireless Sensor Nodes for Ubiquitous Long-Term Biomedical Signal Monitoring. IEEE Communications Magazine. 2012 Jan; 50(1):20–7.
12. Abdalla AN, Nubli M, Siong TC, Khairi F, Noraziah A. Enhancement of realtime multi-patient monitoring system based on wireless sensor networks. International Journal of Physical Sciences. 2011 Feb; 6(4):664–70.
13. Raut CD, Giripunje VG. The Real-Time Monitoring System for In-Patient Based on Biomedical Data Acquisition System. 2011 International Conference on Information and Network Technology; IACSIT Press, Singapore; 2011.
14. Czaja S, Beach S, Charness N, Schulz R. Older Adults and the Adoption of Healthcare Technology: Opportunities and Challenges. Technologies for Active Aging, Sixsmith and G. Gutman, Eds., ed: Springer US. 2013 Mar 9. pp. 27–46.
15. McLaughlin BL, Mariano LJ, Prakash SR, Schachter SC. An Electroencephalographic Recording Platform for Real-Time Seizure Detection. Proc IEEE Int Conf Eng in Med and Bio Soc. (EMBS); 2012 Aug; San Diego, USA. pp. 874–8.
16. Kurylyak Y, Lamonaca F, Mirabelli F. Detection of the Eye Blinks for Human's Fatigue Monitoring. proc IEEE Int symp Med Meas And Applicant. (Me MeA). 2012 May; Budapest, Hungary. pp. 1–4.