An Outdoor Intelligent Health Care Patient Monitoring System

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Abstract –The main aim of the paper is to monitor the patients suffering from chronic diseases, blood pressure and the elderly people at their home itself with an android application.By doing this, unnecessary visit to the health centercan be avoided. The system wasdeveloped to monitor the vital signs such as temperature, blood pressure,heartrate, gassensor and fall detection. The system design consists of an Arduinocontroller andGSM900A. The monitored values can be sent through the mobile phones and if it detects abnormal state then it enables the buzzer and the information is passed to the concerned members through the mobile application. In case of monthly check up there is no need for the patient to go and meet the doctor with the proposed system. The patient can send an SMS as CHECK to test the body condition to detect the health condition of the patient from the ECGsignal. The system will also transmit the healthcare information to the concerned doctor's mobile phone through app.

Keywords:Healthcare Monitoring,Global Positioning System, ECG signal andFall detection.

I. INTRODUCTION

Nowadays, the requirement for healthcare system development is rigorously increasing. In the past, consumer used to see doctor whenever they found problems of their health status. However, prevention is much more efficient than curing. Advanced technology can help to check their health Status as well as providing location services wherever instant health problems happened. In recent years, there has been a tremendous change in the healthcare system considering the both convenience and efficiency which allows consumer to instantly locate the position of patient who has instant problem health problem.

It is important for patients that healthcare practitioners cooperate closely and efficiently in the chain. This is especially critical when caring for and treating the chronically ill [1]. The complexity of healthcare lies in making the correct diagnosis and avoiding duplicate analysis. The right tests and examinations should be carried out, and information should be shared among all the relevant healthcare practitioners. This means both professional information and information about the patient, his or her illness, past and future treatment and medication. It has often been said that we need coordinators in healthcare to link all the parties to one another and organize things from the patient's perspective. The candidate mentioned most frequently for this task is the general practitioner , who already bears overall final responsibility in many healthcare systems; otherwise, there is a risk of duplication, which only makes matters more complicated rather than simpler. Of course, general practitioners do not monitor patients every single day.

2. PROPOSED METHODOLOGY

This paper proposed a methodology based on health monitoring that overcomes the above mention disadvantages. This project is designed to reduce the work of visiting the hospital for usual checkup for the patients. To protect the ill patients & aged persons by embedded system based real time patient distance monitoring system using GSM/GPS technologies. Sensors such as temperature, gas, fall detection, heart rate and blood pressure rate adopted in this work to effectively maintain the proposed health monitoring system. A monitoring system, specifically designed for cardiac care with electrocardiogram (ECG) signal analysis as the core diagnostic technique, could play a vital role in early detection of a wide range of relating to the heart, from a simple arrhythmia to life threatening conditions such as myocardial infarction. The system that have developed consists of three major components, namely, (a) mobile gateway, deployed doctor-patient's relationship mobile device, that

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receives 12-lead ECG signals from any ECG sensor, (b) remote server component that hosts algorithms for accurate annotation and analysis of the ECG signal and (c) point of care device of the doctor to receive a medical diagnosis report from the server hardware on the analysis of ECG signals. The focus has been toward developing a system capable of detecting critical heart disorder events well in advance using an advanced remote monitoring system. A system of this kind is expected to have applications ranging from tracking wellness/fitness to detection of symptoms leading to fatal related to critical events

Vital signs are measurements of the body's most basic functions. The main vital signs routinely measured by health care unit and doctors are:

- Body temperature
- Pulse rate
- Respiration rate (rate of breathing)
- Blood pressure

(The Blood pressure is not considered a vital sign, but is often measured along with the vital signs.)

Vital signs are used to detect and monitor medical problems. In this system temperature, pulse rate, ECG is considered.The body temperature of a person normally varies depending on gender, recent activity, food and fluid consumption, time of day, and, in women, the stage of the menses cycle. For a healthy adult the normal body temperature can range from 97.8 degrees Fahrenheit (36.5 degrees Celsius) to 99 degrees Fahrenheit (37.2 degrees Celsius).

The pulse rate is a measure of number of times the heart beats per minute and the heart rate. The arteries expand and contract when heart pushes blood through arteries. The pulse measured only measures the heart rate, but also can represent the Heart rhythm and Pulse strength.

The normal pulse value for the healthy adults ranges from 60 to 100 beats per minute. During exercise, illness, injury, and emotions the pulse rate may fluctuate and increase. Than males, 12 age and older females tend to have faster heart rates. Athletes, such as runners, may have heart rates near 40 beats per minute due to cardiovascular conditioning and experience no problems. According to the National Heart, Lung, and Blood Institute (NHLBI) the high blood pressure for adults is given as

- 140 mm Hg or greater systolic pressure
- 90 mm Hg or greater diastolic pressure

In an update of NHLBI guidelines in 2003 for hypertension, a category of new blood pressure called pre hypertension

- 120 mm Hg – 139 mm Hg systolic pressure
- 80 mm Hg – 89 mm Hg diastolic pressure

The NHLBI guidelines specify normal blood pressure as follows

- Below 120 mm Hg systolic pressure
- Below 80 mm Hg diastolic pressure

2.1 Block Diagram Description

The following diagram shown in Figure 1 is the block diagram of the proposed system.

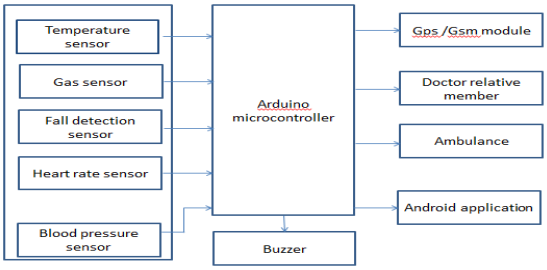

Figure 1. Block Diagram of the Proposed System

Temperature Sensor

The body temperature is measured by using the temperature sensor LM35. It is a three terminal device uses. Pin number one is 5 volt voltage supply and three are for ground. Pin two is analog voltage output with respect to temperature. There is no need of extra circuitry to operate it. Arduino UNO microcontroller is used to read temperature value. The Relation between the temperature and analog output voltage is:

1ogC = 10m volt (1)

Hence for every 1 degree increase in temperature there will be an increment of 10m volt in output voltage of LM35 sensor. The output of sensor is given to analog channel of Arduino UNO. Now after reading ADC value, using voltage and temperature relationship voltage is converted into temperature. These conversions have been done through programming.

The LM35 series devices are directly on integrated circuit temperature sensors, with an output voltage linearly polarised radiation to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to health benefits a large constant voltage from the output to attain convenient Centigrade scaling.

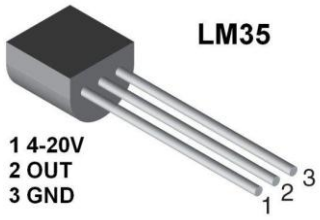

Figure 2. LM35

The LM35 device does not require any external calibration or a beating to provide typical accuracies of ± ¼ °C at room temperature and ± ¾ °C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the small level. The low output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with in single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 μA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to the operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy). The temperature sensing element is comprised of deltaV BE architecture.

Heart Beat Sensor

The new version uses the **TCRT1000** reflective optical sensor for photo plethysmography. The use of TCRT100 simplifies the build process of the sensor part of the project as both the infrared light emitter diode and the radar are arranged side by side in a leaded package, thus blocking the surrounding ambient light, which could otherwise affect the sensor performance. I have also designed a printed circuit board for it, which carries both sensor and signal program unit and its output is a digital pulse which is synchronous with the heartbeat. The output pulse can be fed to either an ADC channel or a digital input pin of a microcontroller for another processing and retrieving the heart rate in beats per minute (BPM).The project is based on the principle of photoplethysmography (PPG) which is a non-invasive method of leveling the variation in blood body in tissues using a light source and a detector. Since the change in blood volume is synchronous to the heart beat, this capacity can be used to calculate the heart rate. Transmittance and reflectance are two basic types of photoplethysmography. For the transfer PPG, a light source is emitted in to the material and a light detector is placed in the opposite side of the tissue to measure the resultant light. Because of the limited penetration depth of the light through organ tissue, the transmittance PPG is applicable to a reduced body part, such as the finger or the ear lobe. However, in the reflectance PPG, the light source and the bright detector are both placed on the same side of a body part. The light is emitted into the tissue and the reflected light is measured by the detector. As the light doesn't have to penetrate the body, the reflectance PPG can be activated to any parts of human body. In either case, the detected light repeated from or transmitted through the body part will fluctuate according to the pulsatile blood flow caused by the beating of the heart.

Figure 3. Heart Beat Sensor

Arduino Uno

An Arduino board historically consists of an Atmel 8-, 16- or 32- bit. AVR microcontroller with complementary components that further programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which let users connect the CPU board to a variety of interchangeable add-on program termed shields. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²C serial busso many shields can be stacked and used in parallel. Before 2015, Official Arduino had used the Atmel mega AVR series of chips, specifically the ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560. In 2015, units by other architect were added. A handful of other processors have also been used by Arduino compatible devices. Most boards consists of a 5 V linear regulator and a 16 MHz crystal oscillator (or ceramic resonator in some variants), despite some designs such as the LilyPad run at 8 MHz and dispense with the onboard voltage regulator due to specific form-board restrictions. An Arduino's microcontroller is also pre-programmed with a boot loader that reduces uploading of programs to the on-chip radiation memory, compared with other devices that typically charge an external programmer. This makes using an Arduino more straightforward by allowing the use of an ordinary computer as the programmer. Currently,

opt bootbootloader is the defect bootloader installed on Arduino UNO.

At a conceptual level, when using the Arduino combined development environment, all boards are programmed over a sequntial connection. Its implementation varies with the hardware translation. Some serial Arduino boards contain a constant shifter circuit to convert between RS 232logic altitude and transistor transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), complete using USB-to-serial adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a isolated AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a portable USB-to-serial adapter board or cable, Bluetooth or other methods, when used with traditional microcontroller tools rather of the Arduino IDE, standard AVR in-system programming (ISP) programming is used.

Blood Pressure Sensor

The BMP180 is the next-generation of sensors from Bosch, and replaces the BMP085. The good news is that it is completely identify to the BMP085 in terms of firmware/software - you can use our BMP085 tutorial and any example code/libraries as a bit-in replacement. The XCLR pin is not physically present on the BMP180 so if you need to know that the data is ready you will need to query the I^2C bus. This board is 5V compliant - a 3.3V regulator and a I2C level shifter circuit S included so you can use this sensor safely with 5V logic and power.

- Vin: 3 to 5VDC
- Logic: 3 to 5V compliant
- load sensing range: 300-1100 hPa (9000m to -500m above sea level)
- Up to 0.03hPa / 0.25m resolution level
- 40 to +85°C operational range, +-2°C temperature accuracy
- This board/chip uses I2C 7-bit address 0x77.

Gas Sensor

Sensitive material of MQ-6 gas sensor is SnO2, which with lower conductivity in clean air. The sensor's conductivity is higher along with the gas concentration rising.MQ-6 gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to identify different combustible gas, especially Methane; it is with low cost and suitable for different application. This sensor composed of micro AL2O3 ceramic tube, TinDioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a layer made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped in the level MQ-4 has 6 pin, 4 of them are used to retrieve signals, and others are used for providing heating current.

ADXL345

The ADXL345 is a small, thin, low power, 3-axis accelerometer with a large amount of resolution (13-bit) measurement at up to + or - 16 *g*. Digital output data is formatted as 16-bit twos complement and is accessible potential either a SPI (3- or 4-wire) or I2C digital interface. The ADXL345 is well suited for mobile material applications. It measures the static acceleration of gravity in maximum speed tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (4 m*g*/LSB) enables measurement of inclination changes less than 1.0°.

concerned person special sensing functions are provided. Activity and inactivity sensing detect the presence or loss of motion and if the acceleration some axis exceeds a user-set level. Tap sensing detects single and double taps. Free-fall detection if the creation is falling. These functions can be mapped to one of two interrupt output pins. An integrated, patent pending 32-level first in, first out (FIFO) defence can be used to store data to minimize host processor intervention. Low power modes enable intelligent motion-based power management with threshold sensing and active acceleration measurement at difficult low power dissipation.

GSM

GSM/GPRS engine SIM900A, works on frequencies 900/ 1800 MHz. The Modem is coming with RS232 interface, which allows you connect PC along with microcontroller among RS232 Chip(MAX232). The baud rate is configurable from 9600-115200 through AT command. The GSM/GPRS Modem include internal TCP/IP the quantity of to connect with Internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface.

The onboard Regulated Power supply allows to connect wide range uncontrolled power supply. This GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem is that its RS232 port can communicate and establish embedded applications. The modem can be connected to PC serial port directly or to any microcontroller through the period of time MAX232. It can be used to send and receive

SMS or make/receive voice calls. It can also be used in the GPRS mode to connect to internet and do many applications for data logging and control. This GSM modem is a deeply flexible plug and play to quad band **SIM900A** GSM modem for direct and easy integration to RS232 applications. Supports features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack.

4. SIMULATION RESULTS

The Arduino Uno is the heart of the whole system that program is loaded and compiled to run. The output is verified using the virtual terminal window. Virtual Terminal is a tool in Proteus, which is used to view data coming from the Serial Port (DB9) and also used to send the data to Serial Port. The following Figure 4 shows the simulated results of the proposed system using Proteus 8.1.

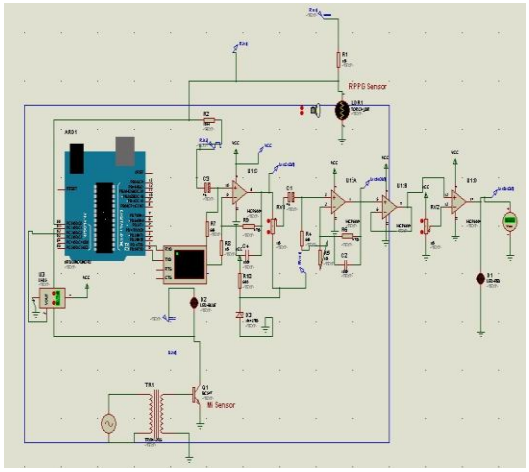

Figure 5. Simulation results

The Figure 6 shows the patient normal values of vital sign.

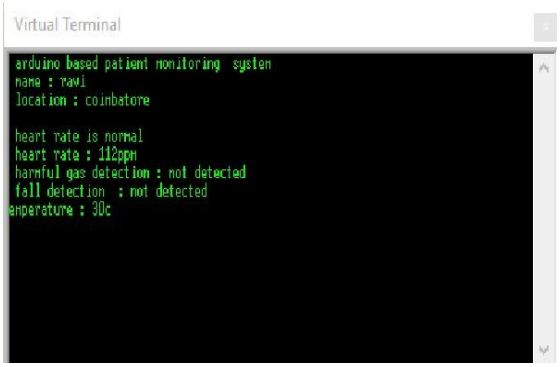

Figure 6. Normal values of vital sign

The patient abnormal values of vital sign is shown in the Figure 7.

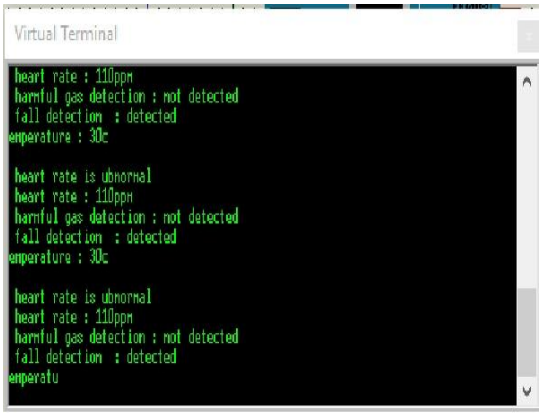

Figure 7. Abnormal values of vital sign

5. CONCLUSION

The outdoor health monitoring system which is effectively used in real time medical applications is developed here. This system monitors the vital signs of the patient in the home and there is no need to visit hospital often. It uses the ARDUNIO UNO controller to receive input and transmit to external devices. It uses the GSM 900A modem which transmits the messages and when it receives the text as check it automatically monitors the respective parameters to transfer. This system is designed to reduce the work and it can be implemented with the low cost and for the daily usage to save life in emergency condition. The simulation for the whole model is designed and tested using Proteus 8.1.

Reference

[1]. Brouwer, Roy, Luke Brander, OnnoKuik, ElissaiosPapyrakis, and Ian Bateman. "A synthesis of approaches to assess and value ecosystem services in the EU in the context of TEEB." VU University Amsterdam (2013).

[2]. S.-C. Lee, and W.-Y. Chung, "A robust wearable u-healthcare platform in wireless sensor network," in Communications and Networks, Journal of , vol.16, pp.465-474, Aug. 2014.

[3] B. S. Lin, B. S. Lin, N. K. Chou, F. C. Chong, and S. J. Chen, "RTWPMS: A real-time wireless physiological health monitoring system," IEEE Trans. Inf. Technol. Biomed., vol. 10, no. 4, pp. 647-656, Oct. 2006.

[4] H. Y. Zhou, and K. M. Hou, "Pervasive Cardiac health Monitoring System for Remote Continuous Heart Care," in Proc. 2010 4th Int. Conference on Bioinformatics and Biomedical Engineering

(iCBBE), pp. 1-4, Jun. 2010. 134 IEEE Transactions on Consumer Electronics, Vol. 62, No. 2, May 2016.
[5] C. H. Wang, M. F. Horng, J. W. Lee, Y. C. Liu, R. S. Tsai, W. T. Wang, L. Chang, Y. H. Kuo, P. C. Chung, and K. F. Ssu, "Development of Intelligent Home Health-Care Box Connecting Medical Equipment and Its Service Platform," in Proc. The 9th Int. Conference on Advanced Communication Technology, pp. 311-315, Feb. 2007.
[6] J. Kang, I. H. Shin, Y. Koo, M. Y. Jung, G. J. Suh, and H. C. Kim, "HSDPA (3.5G)-Based Ubiquitous Integrated Biotelemetry System for Emergency Care," in Proc. 2007 29th Annual Int. Conference of the IEEE Engineering in Medicine and Biology Society, pp. 3665-3668, Aug. 2007.
[7] G. Cheon, I. H. Shin, M. Y. Jung, and H. C. Kim, "Implementation of a Real-time Multi-Channel Gateway Server in Ubiquitous Integrated Biotelemetry System for Emergency Care (UIBSEC)," in Proc. 2009 Int. Conference of the IEEE Engineering in Medicine and Biology Society, pp. 5207-5210, Sep. 2009.
[8] V. Vaidehi., K. Ganapathy, K. Mohan, A. Aldrin, and K. Nirmal, " Video based automatic fall detection in indoor environment," in Proc. 2011 Int. Conference on Recent Trends in Information Technology (ICRTIT), pp. 1016-1020, Jun. 2011.
[9] S. L. Hsieh, C. C. Chen, S. H. Wu, and T. W. Yue, "A wrist -worn fall detection system using accelerometers and gyroscopes," in Proc. 2014 IEEE 11th Int. Conference on Networking, Sensing and Control (ICNSC), pp. 518-523, Apr. 2014.
[10] J. Wang, Z. Zhang, B. Li, S. Lee, and R. Sherratt "An enhanced fall detection system for elderly person monitoring using consumer home networks," IEEE Trans. Consumer Electronics, vol. 60, no. 1, pp. 23-29,Feb. 2014.
[11] Y. W. Bai, S. C. Wu, and C. L. Tsai, "Design and implementation of a fall monitor system by using a 3-axis accelerometer in a smart phone," in Proc. IEEE 16th Int. Symp. Consumer Electronics (ISCE), pp. 1-6, Jun. 2012.
[12]. S.S. Torkestani, S. Sahuguede, A. Julien-Vergonjanne, J.P. Cances, "Indoor optical wireless system dedicated to healthcare application in a hospital," in Communications, IET , vol.6, pp.541-547, March 27 2012.
[13]. Lee, WahChing, FaanHei Hung, Kim Fung Tsang, Chung Kit Wu, and Hao Ran Chi. "RSS-based Localization Algorithm for Indoor Patient Tracking."
[14]. M. Wang, G. Zhang, C. Zhang, J. Zhang, and C. Li, "An IoT-based appliance control system for smart homes," in Intelligent Control and Information Processing (IC ICIP), 2013 Fourth International Conference on, Beijing, 9–11 June 2013, pp. 744–747.
[15]. L. Zhang, G.-J. Ahn, and B.-T. Chu, "A role-based delegation framework for healthcare information systems," in Proceedings of the seventh ACM symposium on Access control models and technologies, Monterey, California, USA, June 3–4, 2002, pp. 125–134.
[16]. Zhen, H.-B. Li, S. Hara, and R. Kohno, "Clear channel assessment in integrated medical environments," EURASIP Journal on Wireless Communications and Networking, vol. 2008, pp. 1–8, 2007.
[17]. L. Tytgat, O. Yaron, S. Pollin, I. Moerman, and P. Demeester, "Avoiding collisions between IEEE 802.11 and IEEE 802.15. 4 through coexistence aware clear channel assessment," EURASIP Journal on Wireless Communications and Networking, vol. 2012, pp. 1–15, 2012.
[18].A. Rodrigues, T. Camilo, J. Sa Silva, F. Boavida, M. Silva, N. Blanco, et al., "Hermes: A versatile platform for wireless embedded systems," in World of Wireless, Mobile and Multimedia Networks (WoWMoM), 2012 IEEE International Symposium on a, San Francisco, CA, 25–28 June, 2012, pp. 1-9.