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Real Time ECG and Saline Level Monitoring System Using Arduino UNO Processor

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ABSTRACT

The epidemic growth of wireless technology and mobile services in this epoch is creating a great impact on our life style. Some early efforts have been taken to utilize these technologies in medical industry. In this field, ECG sensor based advanced wireless patient monitoring system concept is a new innovative idea. This system aims to provide health care to the patient. We have sensed the patient's ECG through 3 lead electrode system via AD8232 which amplifies minor and small bio-signals to the arduino which processes them, along with saline level. Saline level is detected through IR sensors. The output of the electrical pulse is shown with the serial monitor. The saline level is indicated by LCD. The major output ECG analog signal is displayed on serial plotter. The outputs are displayed through mobile application.

Keywords: Arduino UNO, 3lead ECG clamp, AD8232, LCD display, IR sensor, Saline bottle, Bluetooth module and mobile phone.

1. INTRODUCTION

In many cases, Patient requires continuous monitoring and essentially needs lengthy stay in hospitals which is again becoming costly now days. Traditional monitoring system allows continuous monitoring of vital parameters which require the sensors to be connected to bedside machines or PCs, and patient is essentially confined to bed.

However, today's busy world and increase in sudden death events motivates for a monitoring system that continuously monitors remotely located patient. Depending on this factor many researchers have developed patient monitoring system. ECG Holter monitoring is the most widely used technique for providing ambulatory cardiac monitoring for capturing rhythm disturbances. A traditional Holter monitor can record up to 24 hours of ECG signals and the recorded data is subsequently retrieved and analyzed by a clinician.

Due to the short duration involved and the unknown context within which ECG signal is captured; reliable interpretation of the recorded data is always a challenge. Telemetry is another way of monitoring remotely located patient. However, current biomedical devices lack in the ability to provide large-scale analysis, simulations and computations at the patient's location. Wireless Sensor Network is becoming a promising technology for various applications. One of its potential deployments is in the form of Wireless Biomedical Sensor Network (WBSN) for measuring physiological signals. Many ECG monitoring system are developed based on WSN technology.

2. EXSITING WORKS

2.1.1 Application using mobile devices

In the last decade the healthcare monitoring systems have drawn considerable attentions of the researchers. The prime goal was to develop a reliable patient monitoring system so that the healthcare professionals can monitor their patients, who are either hospitalized or executing their normal daily life activities. In this work we present a mobile device based wireless healthcare monitoring system that can provide real time online information about physiological conditions of a patient. Our proposed system is designed to measure and monitor important physiological data of a patient in order to accurately describe the status of her/his health and fitness. In addition the proposed system is able to send alarming message about the patient's critical health data by text messages or by email reports. By using the information contained in the text or e-mail message the healthcare professional can provide necessary medical advising. The system mainly consists of sensors, the data acquisition unit, microcontroller (i.e., Arduino), and software (i.e., LabVIEW). The patient's temperature, heart beat rate, muscles, blood pressure, blood glucose level, and ECG data are monitored, displayed, and stored by our system. To ensure reliability and accuracy the proposed system has been field tested. The test results show that our system is able to measure the patient's physiological data with a very high accuracy. A Smartphone based health monitoring system has been presented in this work. By using the system the healthcare professionals can monitor, diagnose, and advice their patients all the time. The physiological data are stored and published online. Hence, the healthcare professional can monitor their patients from a remote location at any time. Our system is simple. It is just few wires connected to a small kit with a Smartphone. The system is very power efficient. Only the smartphone or the tablet needs to be charged enough to do the test. It is easy to use, fast, accurate, high efficiency, and safe (without any danger of electric shocks). In contrast to other conventional medical equipment the system has the ability to save data for future reference. Finally, the reliability and validity of our system have been ensured via field tests. The field tests show that our system can produce medical data that

are similar to those produced by the existing medical equipment.

2.1.2 Wearable ECG Monitor

In this paper, a wearable medical device for Electrocardiogram (ECG) and blood pressure monitoring is presented. Its basis is a validated and certified existent medical device. This device was evolved in order to allow new physiological signal monitoring and real time assessment of blood pressure levels by adding a photoplethismography (PPG) probe and the incorporation of new algorithms in an online interface. The device presents accuracies of 94.6% for systolic blood pressure and 92.3% for systolic blood pressure when compared with reference values obtained from a commercial electronic Sphygmomanometer.

2.1.3 Saline Level Monitoring System

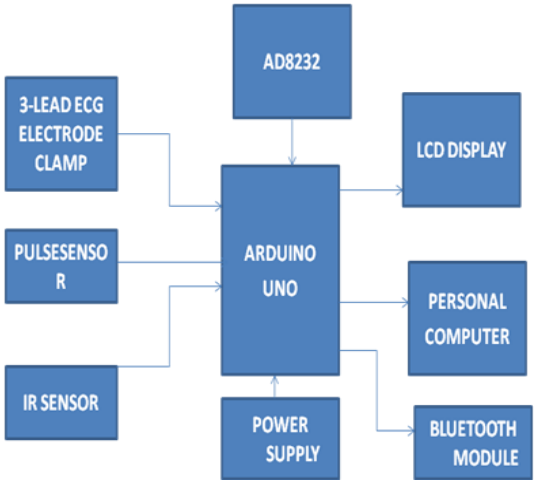
This paper proposes an automatic, low cost saline level measurement system using microcontroller ATMEGA 328.The main building blocks of the proposed system are microcontroller ATMEGA 328, Bluetooth module and IR sensors. The system contains two LEDs. The status of the saline can be given in two forms that are normal status and warning status. When the saline level is normal, then green LED blinks and when the saline level is below the critical value then red LED will blink. When red LED blinks then buzzer starts ringing and nurse will get notification through mobile with the help of Bluetooth module. At present, there is no such valid system for saline level monitoring.

Proposed system reduces efforts of nurses and it is very cost effective as the same circuit which is used for the saline bottle can be reused for another bottle. It can also be easily implemented in rural hospitals. This paper proposes the system which can automatically monitor the saline flow by using microcontroller. The system is reliable, cost effective and convenient for nurses. It can be reused for the next saline bottle. It is beneficial for nurses as well as doctors at rural hospitals. The system helps nurses to monitor the saline flow from a distance. It is mainly advantageous at night timing as there is no need for nurses to go to patient's bed to check the level of saline in the bottle.

3. PROPOSED WORK

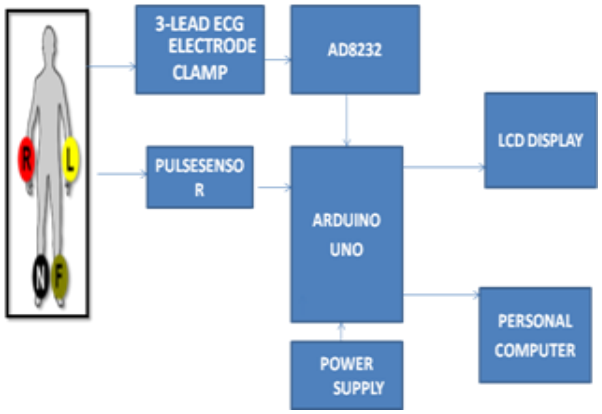
In this proposed system, we have constrained the cost, working space and simplified the gadgets to show the ECG output. Serial plotter is used in displaying the analog signal structure .The Arduino serial plotter function allows to natively graph serial data from Arduino to PC in real time. Serial plotter is an offline tool allowing to visualize data and troubleshoot code offline without having to use third party services like PLOTY. In our system there is a simplified interface for two other parameters, saline level and pulse detection. We use sensors for secondary parameter detection and are directly interfaced with the Arduino processor. The processor processes input data from the sensors and concludes the final information using program code. It is finally displayed on LCD. We have sensed the patient's ECG through 3 lead electrode system via AD8232 which amplifies minor and small bio-signals to the Arduino which processes them, along with saline level. Saline level is detected through IR sensors. The output of the electrical pulse is shown with the serial monitor. The saline level is indicated by LCD. The major output ECG analog signal is displayed on serial plotter. We also connect some external parameters (i.e.) pulses calculated in beats per minutes.

3.1 Block Diagram



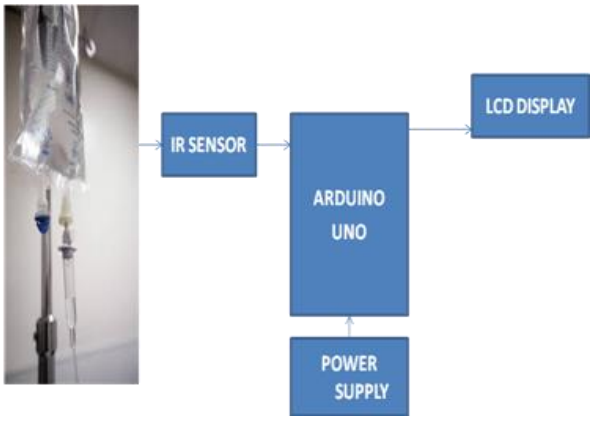
Block diagram of transmitter

3.1.1 Block 1 ECG Detection



Block 1 of transmitter

3.1.2 Block 2 Saline Detection



Block 2 of transmitter

3.2 Hardware

3.2.1 ECG Electrode

ECG electrode clamp

The heart has four chambers. The upper two chambers (left/right atria) are entry-points into the heart, while the lower two chambers (left/right ventricles) are contraction chambers sending blood through the circulation. The circulation is split into a "loop" through the lungs (pulmonary) and another "loop" through the body (systemic).The cardiac cycle refers to a complete heartbeat from its generation to the beginning of the next beat, comprising several stages of filling and emptying of the chambers. The frequency of the cardiac cycle is reflected as heart rate (beats per minute, bpm).

3.2.2 Power Supply

Power supply adaptor

In the alternating current model, shown on the right side of the figure, the line with the indications concerning the output says: AC 12 V 500mA 6VA, that respectively represent: alternating current, maximum output load and power, expressed in VA. In some cases, in the place of the AC abbreviation, the symbol "~" may be found, and it still means "alternating current". On the left, on the contrary, the direct current model, in the line with the output values shows in an equally clear way +5 V 2A.finally, in these power supplies, the voltage polarity is always indicated on the output JACK; in this case the graphics represented on the tag indicates that the positive pole (+) is connected to the central part of the jack while the negative pole (-) is connected to the external part.

We may still notice the presence of the "~" symbol on the tag, but it is clearly referred to the power supply input that, obviously, must be connected to the alternating current network.

3.2.3 Arduino UNO R3

Arduino R3

Arduino/Genuine Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; in the 14 digital pin we connect pin 0 and 1 are used for transmitter and receiver pin of Bluetooth. Pin 2-5 are used for LCD data configuration. Pin 6-8 are the high for parameter component this is acted as Vcc of 5v.pin 10 and 11 are used for AD8232 lead off (LO^-) and lead on (LO^+). Analog pin A_0 is used for input from the AD8232 output pin. Vcc and ground pin are connected correspondingly. Every analog pin are get the input from the sensors output.

3.2.4 AD8232

AD8232

The AD8232 may be an incorporated sign molding square to ECG and other bio-potential estimation requisitions. It may be planned will extract, amplify, Furthermore channel little bio-potential.

This table measures electrical action of heart through set on the skin. Interfacing this table for Arduino we get ECG chart through preparing IDE window. We might utilize the cathode jack or disaster will be imminent pin gaps for electrodes. Associate relating cathode pads over skin et cetera give acceptable 3. 3V.

What's more GND force supply from the Arduino board, the SDN (shutdown) pin will be not associated with any apiece. Yield from those breakout table will be made on Arduino's A0 (Analog enter 0) pin. Will identify those heads off circumstances LO– and LO+ are associated with Arduino advanced pin D11 and D10 separately.

3.2.5 Pulse Sensor

Pulse sensor

The Pulse Sensor Amped is a plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast and easy to get reliable pulse readings. Also, it sips power with just 4mA current draw at 5V so it's great for mobile applications.

Pulse Sensor Amped is a plug-and-play heart-rate sensor for Arduino and Arduino compatibles. It has 3 wires. provide 3.3V or 5V and GND for red and black pins. Purple color.

3.2.6 IR Sensor

An infrared sensor will be an electronic device that emits in place will feeling exactly viewpoints of the surroundings. An IR sensor might measure the high temperature from claiming an article and also detects the movement. These sorts of sensors measures only infrared radiation, as opposed emitting it that is known as an indifferent IR sensor. Here sensor out pin may be associated with the Arduino analog pin A_1.

3.2.7 Bluetooth Module

It is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). Range is approximately 10 Meters (30 feet). BC417 2.4 GHz Bluetooth Radio chip. KEY: If brought HIGH before power is applied, forces AT Command Setup Mode. LED blinks slowly (2 seconds) VCC: +5 Power GND: System / Arduino Ground TXD: Transmit Serial Data from HC-05 to Arduino Serial Receive. NOTE: 3.3V HIGH level: OK for Arduino RXD: Receive Serial Data from Arduino Serial Transmit .STATE: Tells if connected or not.

4. SOFTWARE

4.1 ARDUINO-1.8.1-R3-WINDOWS

An IDE for the Arduino microcontroller. Arduino is a free software electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. This IDE allows for program writing, code verification, compiling, and uploading to the Arduino development board. Libraries and example code will also be installed. The Arduino Software (IDE) on computer, according to its operating system.

Windows, Mac OS x10.1, Linux 32 bits, Linux 64 bits, Linux ARM. The Arduino Serial Plotter function has been added to the Arduino IDE, allowing you to natively graph serial data from your Arduino to your computer in real time. If you're tired of seeing your Arduino's analog sensor input data pour onto your screen like The Matrix, this looks like a prettier way to visualize what's going on. The Serial plotter is an offline tool allowing you to visualize data and troubleshoot your code offline without having to use third parts services like Processing or Plotly. Since there is no official documentation on the Arduino website regarding the use & functionality of the Serial Plotter, I decided to documents its uses and features.

4.2 Blue Terminal

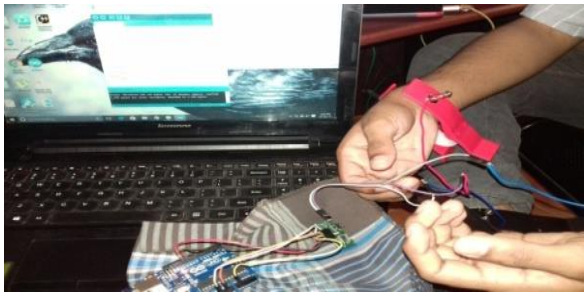
Blue Terminal is a serial emulator program for Windows only, and is customized to work with the Bluegiga range of bluetooth modules. Blue Terminal is a serial emulator program for Windows only, and is customized to work with the Bluegiga range of bluetooth modules. Blue Terminal is designed to build on previous terminal emulators, such as Telix, Windows3 Terminal, Hyper terminal and Putty.

5. RESULTS AND DISCUSSION

5.1 Result

The electrical pulses and saline levels are the minor parameters indicated through LCD and the major ECG is shown through serial plotter, all the three parameters which are vitally important in screening a cardio patient are compactly displayed in one place making the doctor's work hazel free.

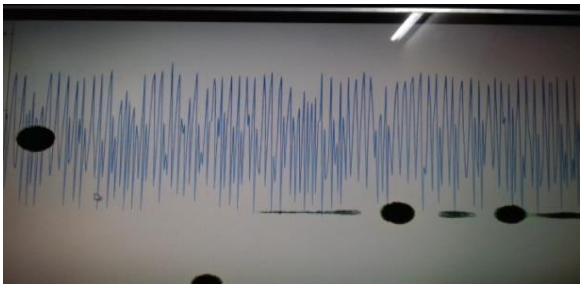
5.2 Output



Internal circuitry

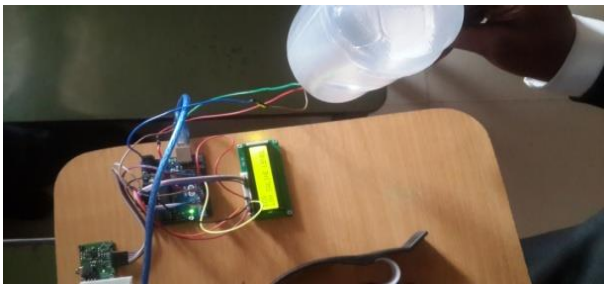
Electrodes are fixed on the patient's right wrist, left wrist and right ankle. Then the sensors start to detect the patient's pulses continuously. Now we have sensed the patient's ECG through 3 lead electrode system, sending them directly to AD8232 which amplifies minor and small bio-signals to the Arduino which processes them and sends the processed data to the Arduino program.

In this picture, the displayed serial monitor continuously lists the number of signal sensed from real time pulse sensing.



Program interface

The sensed continuous ECG signal from the sensor is sent through the AD8232 for amplification and the amplified real time signals are plotted through the feature of the Arduino processor called serial plotter. The Arduino serial plotter function allows to natively graph serial data from Arduino to PC in real time. Serial plotter is an offline tool allowing to visualize data and troubleshoot code offline without having to use third party services. Electrocardiography is the process of recording the electrical activity of the heart over a period of time using electrodes placed on the skin. These electrodes detect the tiny electrical changes on the skin that arise from the heart muscle's electro physiologic pattern of depolarizing and repolarizing during each heartbeat. It is a very commonly performed cardiology test.



Saline level interface

A separate structure consisting of saline bottle, elastic band, IR sensor makes up the secondary parameter device that detects and displays the saline level. The output is displayed on the LCD.

The IR sensor sensing the level of the saline liquid is directly connected to the Arduino UNO processor. Based upon the processed real time data, software is written for the Arduino to indicate low and high levels of saline as output.

In the above picture the result displayed is the level of saline in the bottle indicated by detection as low.

6. CONCLUSION

With this proposed method, the monitoring of ECG signals can be done easily with the further locating the doctor. By means of compressing the real-time signal the rate of compressing will be increased with high accuracy and more data storage.

7. FUTURE WORK

Compressive sensing technique to be further proceed. Along with ECG other signals can be transmitter for early diagnosis.

REFERENCES

[1] Allada Tirupathi Rao, M.Gopi, M.V.S.S.Prasad, "Real Time ECG Signal Transmission for Remote Monitoring", *ISSN: 2321-9939.*

[2] Prerana N Gawale, A.N.Cheeran, Nidhi G Sharma, "Android Application for Ambulant ECG Monitoring", *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. 3, Issue 5, May 2014.

[3] Onder Yakut, Serdar Solak, Emine Dogru Bolat, "Implementation of a Web-Based Wireless ECG Measuring and Recording System", *International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering*, Vo.9, No.10, 2015.

[4] Kalaivani, P., G. Sathya Nikitha S Paulin, Boselin Prabhu.S.R., Sophia.S, "Performance Improvement of Distributed Island Multicasting with Overlay Data Distribution", *Australian Journal of Basic and Applied Sciences*, 9(36) December 2015, Pages 221-228.

[5] Kalaivani, P., G. Sathya and N. Senthilnathan, 2014. "Dynamic Data Routing in MANET using position based opportunistic Routing Protocol", *International Journal of research in computer Applications & Robotics (IJRCAR)*, 2: 12.

[6] Kalaivani, P., G. Sathya, N. Senthilnathan, "QoS Parameters Estimation in MANET Using Position Based Opportunistic Routing Protocol", *American Journal of Computer Science and Engineering Survey*, ISSN 2349-7238.

[7] Sathya, G., P. Kalaivani, N. Senthilnathan, 2015. "Balancing the Energy Consumption and Data Integrity in MANET", *International Journal of Chemical Sciences and Research*, 3(2).

[8] Addison PS (2005), "Wavelet transforms and the ECG: a review", *PhysiolMeas* 26(5):R155.

[9] Alemdar H, Ersoy C (2010), "Wireless sensor networks for healthcare: a survey", *Comput Netw.*, 54(15):2688–2710.

[10] R.Vasuki et al., "An portable monitoring device of measuring drips rate by using an Intravenous (IV) set*",* *International Journal of Biotechnology Trends and Technology*, Vol. 1, Issue 3, No.4 2011.

[11] C.C.Gavimath et al., "Design and Development of versatile saline flow rate measuring system and GSM based remote monitoring device", *International Journal of Pharmaceutical Applications*, ISSN 0976-2639.

[12] R.Aravind, Syed Mustak Ahmed, "Design of family health monitoring system using wireless communication", *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. 2, Issue 9, September 2013.