ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 3, March 2017

A New Modeling of Contactless Cardiac and Respiratory Signal Wave Monitoring Device Using Wearable Sensor

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ABSTRACT: This proposed system focuses on design of a health monitoring system for monitoring respiration and pulse meets all the requirements of an ideal on-body sensor. A mobile device is used for monitoring the parameters like respiration and pulse. The device is developed as a flexible material that can be placed in a shirt pocket. It combines two sensors, which work in a noncontact way allowing uninterrupted monitoring. The device includes a microcontroller for data processing and a Bluetooth module for data transmission. The whole device is realized on a small Printed Circuit Board (PCB) which can easily be kept in a shirt pocket or the inside pocket of a jacket. Since the carrier material of the circuit board is flexible, the device adapts its form to the thoracic surface. The use of the sensor method is intended for pulse measurement. The MQ-6 can be used to sense the CO_2 level of the breathing air and converted into electrical signal. One sensor, based on CO_2 (MQ-6), is intended for respiratory monitoring, LM 35 transistor is used to sensing the body temperature and the other is a reflective IR (Infra Red) sensor intended for pulse detection. Because all the sensor signal has some dependence on both physiological parameters, combining the sensor signals allows improved signal coverage.

KEYWORDS: Sensor, IR heart pulse rate probe, MQ6 sensor (CO_2), LM35 Transistor(Temperature), Bluetooth module, PIC 16F877A Microcontroller, IC MAX232.

I. INTRODUCTION

HOME or telemonitoring systems need frequent records of vital signs on a regular basis to assess the health status of a patient. To maintain the patients' quality of life, monitoring of vital signs should take place as uninterrupted as possible. For this purpose, on-body sensors can be considered to be a beneficial one. An ideal on-body sensor for home application should be mobile and convenient, so that it will not restrict the mobility of the patient. Also, it should be easy to use without the need for skilled personal and/or complex electrode application on multiple locations of measurement. Because the device should be compatible for long-term monitoring, direct contact with the skin should be avoided to prevent skin irritation. Finally, for better acceptance by the patients, the sensor should be intangible, i.e., light weight, flat, and adaptable to body motion.

The device used here for monitoring respiration and pulse meets all the requirements of an ideal on-body sensor. It has two sensors that are combined, which work in an isolated way allowing uninterrupted monitoring. The device includes a microcontroller for processing the data and a Bluetooth module for transmitting the processed data. Since the carrier material of the PCB is flexible, the device adapts itself to the surface of the thorax. The use of the sensor method is intended for pulse measurement. The sensors emit light of a specific wavelength into the tissue region under investigation, measure the amount of light that passes through the tissue, and arrive at a measurement unit. Since the intensity of the light at the measurement unit is dependent on content of blood in the tissue, this sensor technique is well suited for cardiac pulse detection. The MQ-6 can be used to sense the CO_2 level of the breathing air and converted into electrical signal.

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II. EXISTING METHOD

In the previous work the healthcare monitoring systems have drawn considerable attentions of the researchers. The key goal was to develop a definitive patient monitoring system so that the healthcare professionals can monitor their patients easily, who are sick or executing their normal daily life activities. In this work a mobile device based wireless healthcare monitoring system is presented which provides real time online information regarding physiological conditions of a patient. By using the information in the text or e-mail message the healthcare professional can provide necessary medical advisory to the patients. The system mainly consists of sensors, the data acquisition unit, Arduino as a controller, and LabVIEW software. The parameters of the patient such as temperature, heart beat rate, muscles, blood pressure, blood glucose level, and ECG data are monitored, displayed, and stored by the system. To ensure reliability and accuracy the proposed system has been field tested. The test results show that the proposed system is able to measure the physiological data of the patient accurately.

III. PROPORSED SYSTEM

The proposed system is designed to measure and monitor important physiological parameters of a patient in order to accurately describe the status of the patient's health and fitness. In addition the proposed system is capable of sending alarming message regarding the patient's critical health condition by text messages or through email reports. A mobile device is presented for monitoring both pulse and respiration. The device is developed as a bendable inlay that can be carried anywhere by the patient. To achieve optimum monitoring performance, the device combines three sensor principles, which work in a safe noncontact way through several layers of cotton or other textiles

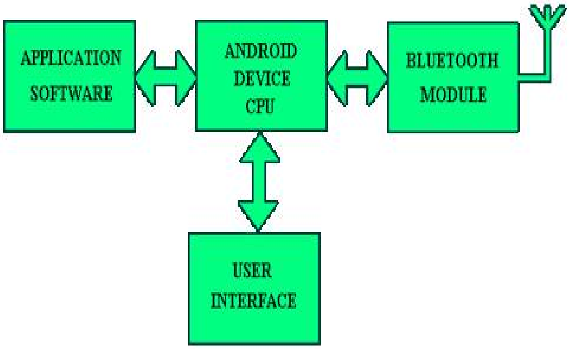

***Fig 1:** Functional block diagram of android app mobile*

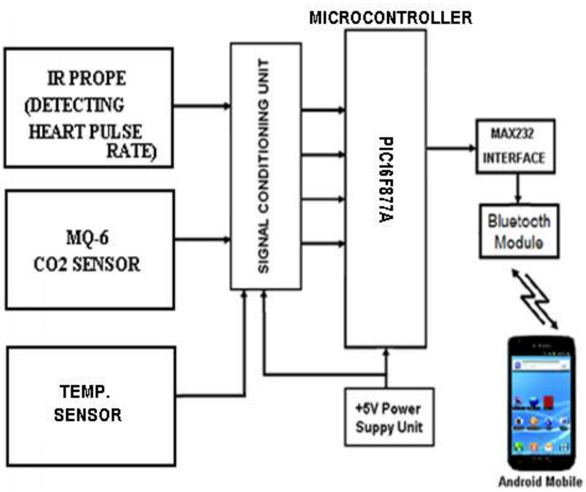

***Fig 1.1:**Functional block diagram of the system*

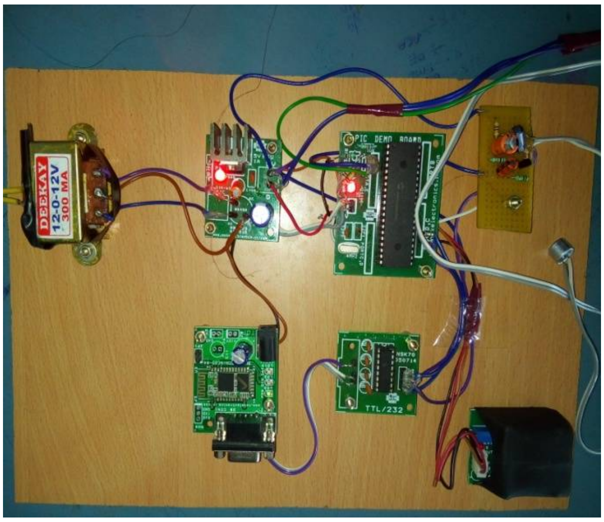

Fig1.2:*Functional overview of hardware Implementation*

One sensor, based on CO_2 (MQ-6), is intended for respiratory monitoring, LM 35 transistor[1] is used to sensing the body temperature and the other is a reflective IR (Infra Red) sensor intended for pulse detection. Because each sensor signal has some dependence on both physiological parameters, fusing the sensor signals allows enhanced signal coverage.

IV. PIN DIAGRAM

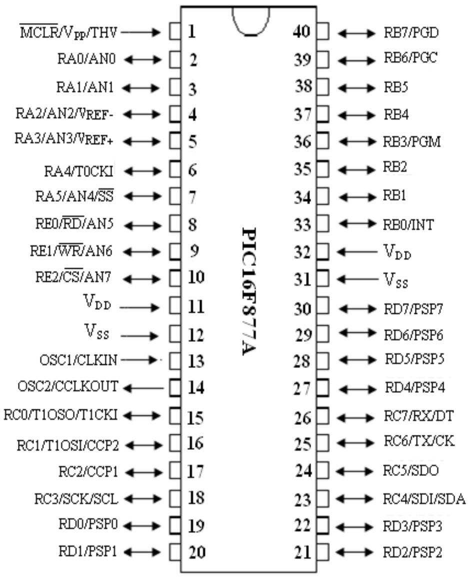

Fig1.3*: Pin Diagram of PIC16F877A*

In the proposed work a powerful (200 nanosecond instruction execution) and easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller is used. The PIC16F877A has the features of 256 bytes of EEPROM data m emory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D)

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converter, 2 capture/compare/PWM functions, the synchronous serial port is configured with either 3-wire Serial Peripheral Interface (SPI) or the 2-wire Inter-Integrated Circuit (I²C) bus and a Universal Asynchronous Receiver Transmitter (UART). All of these features make it ideal for more advanced level of analog to digital applications in automotive, industrial appliances control and consumer applications.

Fig 1.4: Schematic diagram of Bluetooth

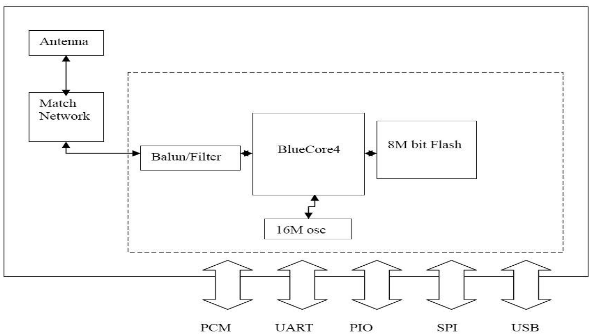

Fig 1.5: Internal block diagram of Bluetooth

AUBTM-20 is Bluetooth Core V2.0 compliant module with SPP. The module is designed to be integrated in a host system which requires cable replacement function. Typically the module will interface with a host through the UART port.

The module could be used in many different applications, e.g.:

- Hand held terminals
- Industrial devices
- Point-of-Sale systems
- Personal Computer
- Personal Digital Assistants (PDAs)
- Computer Accessories
- Access Points
- Automotive Diagnosis Units

This module will act as both SPP master and a SPP slave. In master mode, the module could search around for all the working SPP slave devices and the host could select the device to be connected. In slave mode, it will be looking for connection request from another SPP master devices.

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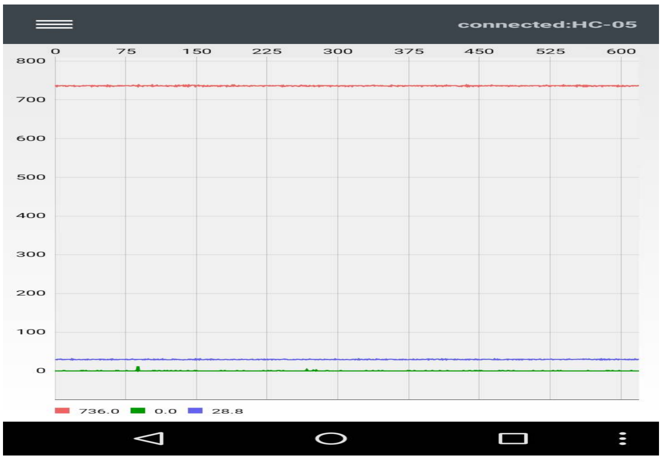
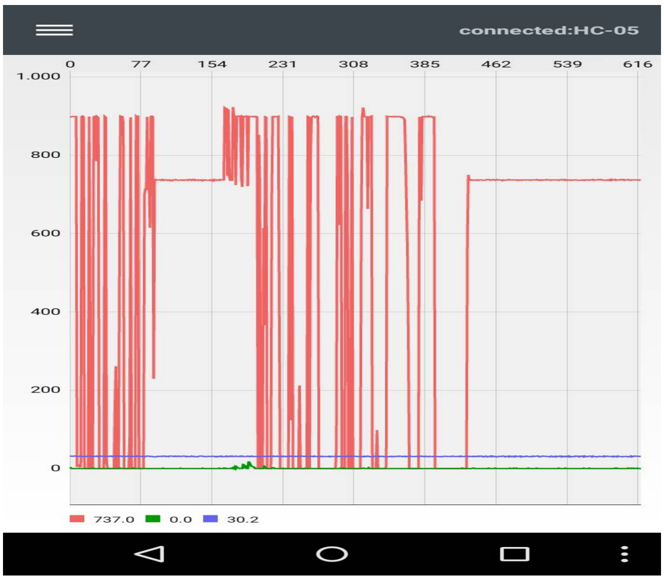
OUTPUT:



A) OUTPUT IN INITIAL CONDITION

This graph represents the initial condition of the sensors,and it is simply connected in bluetooth



(x-axis =time **, y-axis** =ppm**)**

B) OUTPUT BY HEART PULSE SENSOR

This graph represents the output by a heart pulse sensor and it is denoted by red in colour

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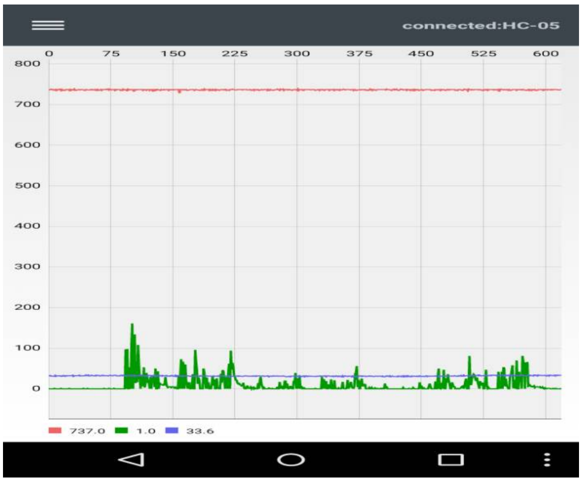
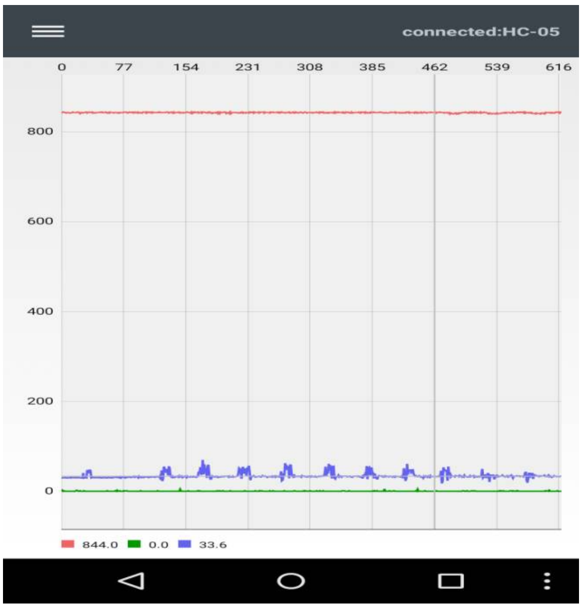


(x- axis=time , **y-axis**=kg/s**)**

C) OUTPUT BY RESPIRATORY SENSOR

This graph represents the amount of flow of oxygen by placing the respiratory sensor in our body it is denotes green in colour.



(x- axis=time , **y-axis**=degree celsius**)**

D) OUTPUT BY TEMPERATURE SENSOR

This graph represents the amount of temperature in our body by placing the temperature sensor (LM 35) and it is denotes as blue in colour.

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V. CONCLUSION

The device presented here shows excellent ability to monitor cardiorespiratory activity. Despite several layers of cotton textile between the sensor and skin, it is still possible to obtain signals suitable for the extraction of respiratory and pulse rate (CO_2 sensor: SNRresp = 98.5 dB, SNRpulse = 42.2 dB;). Combining two noncontact sensor principles and placing them at the same measurement location allows improvement in both physiological information and quality of signal. It has been shown that it is likely to happen that the amount of cardiac or respiratory related signal content of the CO_2 and IR sensor changes in dependence on body posture. Therefore, by fusing both sensor signals, the coverage rate of the parameter extraction could be enhanced. Furthermore, physiological measures derived by combinations of both signals could be monitored. The spatial sensor fusion enables the use of adaptive motion artifact cancellation techniques because both signals will be affected by the same motion artifact. Since the device is mobile, wearable, easy to apply, easy to operate, noncontact, unobtrusive, motion adaptive, and multimodal, it seems to be well suited for on-body sensor networks in telemonitoring applications.

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