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ACQUISITION OF CARDIAC SIGNALS USING SENSORS IN SMART PHONES

D.Vijendra Babu, L.Nagarjuna Reddy, Y.Dheeraj Kumar Reddy, V. Gautham , K.S.Gopichand
ECE Department, Aarupadai Veedu Institute of Technology, Vinayaka Missions University,Paiyanoor-603 104.Chennai.Tamil Nadu.

ABSTRACT

Several projects based on Smart-phone systems have been proposed in different fields and many more application scenarios are being explored. A critical aspect still unresolved is the possibility of acquiring external information, such as data from other Sensors. Sensor interface is therefore possible if a suitable front-end able to digitize Sensor data and to handle the communication with the Smartphone is employed. In order to lower the complexity and the cost of the front-end as well as to reduce its power consumption, an effective method for the acquisition of external sensor signals through the Smartphone audio input is proposed in this paper. A sensor system composed by a photoplethysmographic sensor for Cardiac signal monitoring and a pair of electrodes for tissue impedance estimation has been used. Specific software routines for Android operating system have been developed to process the acquired Sensor signals providing Visualization, Data storage and simple Data analysis, and thus demonstrating the feasibility of the proposed approach.

Key Words: Cardiac signal, ECG, Micrcontroller, Sensor, Smartphone, Android

INTRODUCTION

Today, the broad proliferation of Smart phones and Tablets has determined a wide availability of software applications for numerous purposes. Smart phones are now essential devices for many aspects of everyday life. The presence of powerful processing units, Embedded sensors as well as the availability of many standard communication interfaces has recently attracted the interest of the Scientific community. Several works based on Smart phone systems have been proposed in different fields and many more application scenarios are being explored. A critical aspect still unresolved is the possibility of acquiring external information, such as Data from other sensors. Due to their nature of consumer devices, Smart phones provide Digital and high level communication interfaces, such as USB and Bluetooth. Sensor interface is therefore possible if a suitable front-end able to digitize sensor data and to handle the communication with the Smart phone is employed. In order to lower the complexity and the cost of the front-end as well as to reduce its power consumption, an effective method for the acquisition of external sensor signals through the Smart phone audio input is proposed in this paper.

In the proposed system, the Patient health is to be monitored through smart phones. A Heart beat Sensor is used to sense the Patient's heart rate. Respiratory Sensor is used to sense the Patient's respiration. Pulse Sensor is used to check for the patients pulse. Pulse-oxy sensor is used to monitor the Patients oxygen saturation. All the parameters of the Patient will be monitored using Smart phones .Any change in their Health, the intimation will be sent to care taker through Bluetooth.

AT89S52 MICROCONTROLLER

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the Indus-try-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry.

In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning.

BLUETOOTH

Bluetooth is a proprietary open Wireless Technology standard for exchanging data over short distances from fixed and mobile devices, creating personal area networks (PANs) with high levels of security It can connect several devices, overcoming problems of synchronization. A master Bluetooth device can communicate with a maximum of seven devices in a PICONET, though not all devices reach this maximum. The devices can switch roles, by agreement and the slave can become the Master. Real Time location systems (RTLS), are used to track and identify the location of objects in real-time using Nodes/tags attached to, or embedded in the objects tracked, and Readers that receive and process the wireless signals from these tags to determine their locations

ECG SENSOR

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ECG works mostly by detecting and amplifying the tiny electrical changes on the skin that are caused when the heart muscle depolarizes during each heart beat. At rest, each heart muscle cell has a charge across its outer wall or cell membrane.Reducing this charge towards zero is called de-polarization, which activates the mechanisms in the cell that cause it to contract. During each heartbeat a healthy heart will have an orderly progression of a wave of depolarisation that is triggered by the cells in the sinoatrial node, spreads out through the atrium, passes through intrinsic conduction pathways and then spreads all over the ventricles. This is detected as tiny rises and falls in the voltage between two electrodes placed either side of the heart which is displayed as a wavy line either on a screen or on paper. This display indicates the overall rhythm of the heart and weaknesses in different parts of the heart muscle.Biomedical devices, Bioengineering & Communication Technologies are converging to revolutionize Home- and self-care Health systems, making it possible for people to play a greater role in maintaining their own Health. The recent introduction wireless body sensor network has made a great impact on Healthcare.

PULSE OXIMETERS

Pulse Oximeters measure the absorption of red and infrared light by Pulsatile blood. They are inexpensive, continuous and portable. Oxygenated blood absorbs light at 660nm (red light), whereas deoxygenated blood absorbs light preferentially at 940nm (infra-red). Pulse Oximeters consist of two light emitting diodes, at 600nm and 940nm, and two light collecting sensors, which measure the amount of red and infra-red light emerging from tissues traversed by the light rays. The relative absorption of light by Oxyhemoglobin (HbO) and Deoxyhemoglobin is processed by the device and an oxygen saturation level is reported. The result is a continuous qualitative measurement of the Patients Oxyhemoglobin status. Oximeters deliver data about pulse rate, oxygen saturation (SpO_2) and even cardiac output. They are, however, far from perfect monitors.

PRESSURE SENSORS

A Pressure Sensor measures Pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. Pressure sensors can be classified in terms of pressure ranges they measure, temperature ranges of operation, and most importantly the type of pressure they measure.

RESULTS & DISCUSSIONS

The Cardiac Signals are obtained using various Sensors such as Respiratory Sensor, Pulse Oxymeter Sensor, ECG Sensor & Pressure Sensor. The obtained signals are viewed in Smartphone. Figure 1 shows the Transmitter section .Figure 2 shows the Respiratory Sensor, Figure 3 shows the of Pulse Oximeter Sensors. Figure 4 shows the ECG Sensor. Figure 5 shows ECG Sensor..Figure 6 shows the Graph in Receiving Station (Smartphone)

Figure 1.Transmitter Section

Figure 2.Respiratory Sensor

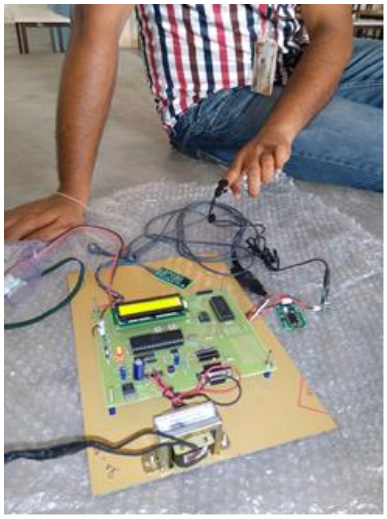

Figure 3.Pulse Oximeter Sensor

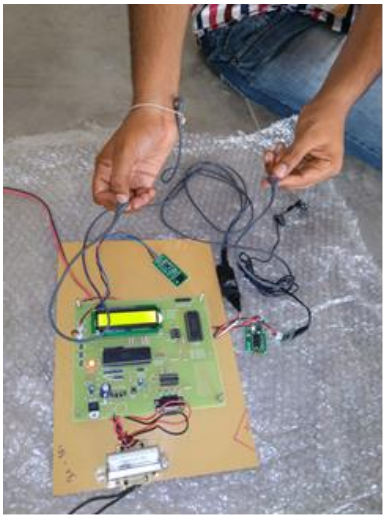

Figure 4.ECG Sensor

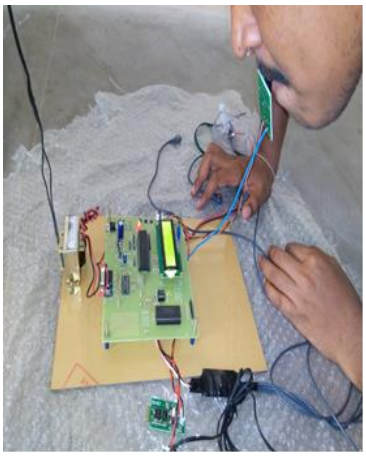

Figure 5.Pressure Sensor

Figure 6.Receiver Section

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