ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 3, April 2016

Design of android application using ANT+ Protocol based healthcare system

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Abstract—The tremendous and rapid development in sensors technology allowed this applications in various fields requiring monitoring such as transportations, rare species surveillance, agriculture, military activities, medical fields etc. One of the newest proposals is ANT(Advanced and adaptive Network Technology) which is emerging as a widely used MAC protocol for wellness and sports sensor devices. The system use wireless technologies to transmit vital signs for medical evaluation. The use of android application provides mobility and flexibility to this project. Our system is flexible to uses parametric approach to auto starts the sensors with their configuration settings. More sensors can be added so that it is scalable. Person can monitor his body parameters by developing his own profile in his mobile or PC(). For analysis purpose our system shares data and also stores data. Thus this system proposes continuous, real time, remote safe and accurate monitoring of heart beat, patients' position using MEMS and temperature of the patient. It also provides mobility for our system by integrating our kit with android application and provides us to view the report of the monitoring patient by using web page.

Keywords---ANT+ protocol, Android, Healthcare system, WSN (Wireless Sensor Networks).

I. Introduction

To provide better health care services is the greatest challenge in the health care system to an increasing number of people using limited financial and human resources. These Multiple and conflicting requirements has to be supported by the wireless patient monitoring system. It is based on Wireless sensor networks. An emerging technology and has great potential to be employed in critical situations is Wireless Sensor Networks (WSN). Various monitoring applications such as industrial, health, environmental and security have been deployed in Wireless Sensor Networks. Information and communication technology (ICT) is an extended term for information technology which stresses the role of unified communications and the integeration of telecommunication (telephone lines and wireless signals), computers as well as necessary enterprise software, middleware, storage and audiovisual systems which enable users to access, transmit and manipulate information. The WHO(World Health Organization) provides remote healthcare solution in the format of e-health. They stated some problem related to health, the health related problem addressed are 76% of the rural population in India has very poor access to healthcare. 76% of the medical facilities are concentrated in urban areas and there is an overall shortage of medical personnel. Thus rural patients are left to semi- and non- qualified practioners, creating huge disease burden. WHO has also described a solution for above addressed problem. It is that the technology enables rural patients to reach urban doctors through a telemedicine solution. This comprises of modular data analysis unit (MDAU) a USB powered multi parameter diagnostic device which captures ECG, temperature, heart and lung sounds and BP and communicate with the remote doctor through a low bandwidth audio/video/data conferencing. The solution allows for integration of the whole healthcare delivery ecosystem to provide meaningful service. They also captures the workflow of delivery processes and enables resource optimization by capturing and analyzing operational service delivery data. The functionality is also describes by WHO. It is that a rural operator carries out remote consultation for the patient at the village using the internet with a doctor sitting anywhere in the world, doctors remotely control the MDAU device to obtain medical parameters, provide a prescription to the patient, and store medical records. The solution also supports supply-chain management, lab reports and referrals.Wireless Sensor Network can be easily used in the environment where the wired system cannot be used or if used then caution should be taken for example in medical treatment is the advantage. The Wireless Sensor nodes can also be implemented to monitor patients. The wireless sensor network comprises of relative impression sensor nodes capable of collecting, processing storing and transferring information from one node to another. The sensor readings can be propagated through network autonomously. Therefore

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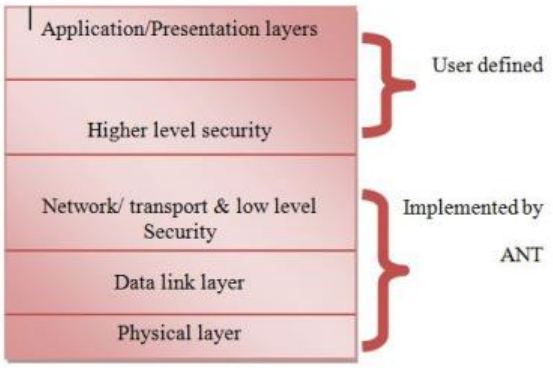
a standard is required that is capable of establishing the network between these nodes as well as provide low cost and less power consumption. We have witnessed a major expansion of ANT (Advanced and adaptive Network Technology) protocol and its extension ANT+ in recent years. These protocols are considered by the industrial community as well suited architecture to the monitoring application in medical field where it is necessary to use WSN. A communication protocol with ultra low power consumption. It provides the use of many channels by maximizing the maximizing the battery life time. It has very good theoretical baud rate which attends 1Mbps, making this protocol more suitable for wireless personal area networks with low bandwidth. The wireless device sensors are applied together in a group in order to provide general services. In this paper we discuss about ANT+ in chapter II, and the methodology of our project is discussed in chapter III, chapter IV deals with experimental results and its discussion, summary of the paper is seen in chapter V.

II. ANT+ protocol

ANT is a 2.4GHz bidirectional wireless sensor network communication technology optimized for transferring low-data rate, low latency data between multiple enabled ANT-enabled devices. The ultra low power consumption of ANT guarantees an extended battery life even from low-capacity supplies such as a coin cell battery, enabling use in heart rate monitors, bicycle computers and wrist watches. ANT's small size and low implementation cost allow effortless integration into the tiny form factor of wrist watches, PDAs and mobile phones.ANT provides carefree handling of the physical, network and transport OSI layers . In addition , it incorporates key low-level security features that form the foundation for user-defined sophisticated network security implementations. ANT ensures adequate user control while considerably lightening computational burden in providing a simple yet effective wireless network solution. The interface between ANT and the Host application has been designed with the utmost simplicity in mind so that ANT can be easily and quickly implemented into new devices and applications. The encapsulation of wireless protocol complexity within the ANT chipset vastly reduces the burden on the application host controller, allowing a low-cost 4-bit or 8-bit microcontroller to establish and maintain complex wireless sensor networks. Data transfers can be scheduled in a deterministic or ah-hoc fashion. a burst mode allows for the efficient transfer of large amount of stored data to and from a PC or other computing device. ANT aggressively balances functionality, cost, size and power consumption within the constraints of a wireless sensor network. Typical applications include sensor integration, tagging systems, remote monitoring etc.



A typical ANT enabled devices consist of an application host MCU interfaced with an ANT module or chipset. The host MCU establishes and maintains a communication session to other remote ANT enabled services by means of a simple bidirectional serial message protocol.

Network topologies:

The ANT protocol has been designed from the ground up to support a large range of scalable network topologies. It can be as simple as a 2-node unidirectional connection between a transmitting peripheral device and a receiver or as complex as a multi-transceiver system with full point –to-multipoint communication capabilities. ANT usage and configuration are channel-based. Each ANT node (represented by a circle) can connect to other ANT nodes via dedicated channels. Each channel generally connects two nodes together; however a single channel can in fact connect multiple nodes. Each channel has as a minimum a single master and slave participant. The master act as the primary transmitter; the slave act as the primary receiver. ANT supports the establishment of numerous unique public and private networks. A particular network may specify a set of operating rules for all participating nodes. In order for two ANT devices to communicate, they must be members of the same network. This provides ability to establish a network that can be purposely shared among multiple vendors with the goal of establishing an 'open' system of interoperable devices. Conversely, a private network could be defined to ensure network privacy and restrict access to intended participating devices. Channels can be

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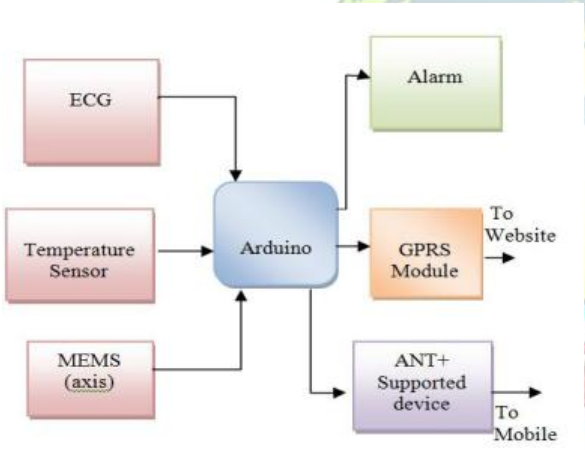
independently assigned to different networks so that it is possible for a single ANT device to be a member of multiple networks. The ANT Network has two components which are described below. The network key is an 8-byte which is configurable by host application. A particular network number will have a corresponding network key. The network number and the network is open to all participating devices and has no set rules governing its use.

III. Methodology

In this chapter let us see about the hardware used in this project and its detail description. The total hardware of this kit can be divided into following modules.



The rps unit in our kit consists of the transformer which converts 230v ac supply ac supply into 12v ac supply6. Thus it performs step down process. This 12ac is again fed into the bridge rectifier which converts the 12v ac into the 12v dc. This is again fed into two IC namely 7805 and 7812, which produces the output voltage of 5v and 12v respectively.The arduino Uno microcontroller board based on t5he ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs) 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC- to – DC adapter or battery to get started. The Uno differs from all proceeding boards in that it does not use the FTDI USB - to - serial driver chip. Instead, it features the Atmega8U2 programmed as a USB - to – serial converter. “Uno” means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno version 1.0 will be the reference version of Arduino, moving forward. The Uno is the latest in a series of USB.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. ANT+ supported Bluetooth device is a HC serial Bluetooth products consist of Bluetooth serial interface module and Bluetooth adapter.ECG means Electro cardio graphy. Electro Cardio graph shows the electrical activity of heart muscles. The recorded ECG wave form is known as electro cardio graph and the instrument is termed as electrocardiogram. ECG gives the valuable information about the cardiac disorders. There are mainly two types of lead systems found in the ECG, they are, bipolar lead system and unipolar lead system. Here we use unipolar lead system. This system is introduced by Wilson. In this system, voltage is taken between single exploratory electrode and the central terminal two equal resistors are connected to a pairs of limb electrodes and the center point act bas one terminal to measure the voltage. In this lead system, small increase in ECG voltage can be realized. 3 augmented lead connections are possible. They are Augmented voltage right arm (a VR), Augmented voltage left arm (a VL), Augmented voltage foot (aVF). Wearable electrocardiograph (ECG) monitoring

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systems today use electrodes that require skin preparation in advance, and require pastes or gels to make electrical contact to the skin. Moreover, they are not suitable for subjects at high levels of activity due to high noise spikes that can appear in the data.

To address these problems, a new class of miniature, ultra low noise, capacitive sensor that does not require direct contact to the skin, and has comparable performance to gold standard ECG electrodes, has been developed. This paper presents a description and evaluation of a wireless version of a system based on these innovative ECG sensors. We use a wearable and ultra low power wireless sensor node called Eco. Experimental results show that the wireless interface will add minimal size and weight to the system while pr4oviding reliable, un tethered operation. Electrocardiograph (ECG) is one of the most widely used biomedical sensing procedures to date. The heartbeat is the definitive indicator for a wide range of physiological conditions. Although ECG instruments were quite bulky, miniaturization in recent years has opened up brand new applications by enabling wearable versions to collect data in scenarios that were not possible before. The next sensor module in our kit is MEMS.MEMS (micro-electro mechanical system) based accelerometers are devices that measure the proper acceleration. Christo Ananth et al. [6] discussed about an eye blinking sensor. Nowadays heart attack patients are increasing day by day."Though it is tough to save the heart attack patients, we can increase the statistics of saving the life of patients & the life of others whom they are responsible for. The main design of this project is to track the heart attack of patients who are suffering from any attacks during driving and send them a medical need & thereby to stop the vehicle to ensure that the persons along them are safe from accident. Here, an eye blinking sensor is used to sense the blinking of the eye. spO2 sensor checks the pulse rate of the patient. Both are connected to micro controller.If eye blinking gets stopped then the signal is sent to the controller to make an alarm through the buffer. If spO2 sensor senses a variation in pulse or low oxygen content in blood, it may results in heart failure and therefore the controller stops the motor of the vehicle. Then Tarang F4 transmitter is used to send the vehicle number & the mobile number of the patient to a nearest medical station within 25 km for medical aid. The pulse rate monitored via LCD .The Tarang F4 receiver receives the signal and passes through controller and the number gets displayed in the LCD screen and an alarm is produced through a buzzer as soon the signal is received. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.the another sensor module used in our kit for data transfer is GPRS Module.This is a GSM/GPRS-compatible Quad-band cell phone, which works on a frequency of 850/900/1800/1900MHz and which can be used not only to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMSs. Externally, it looks like a big package (0.94 inches x 0.94 inches x 0.12 inches) with L-shaped contacts on four sides so that they can be soldered both on the side and at the bottom. Internally, the module is managed by an AMR926EJ-S processor, which controls phone communication, data communication and the communication with the circuit interfaced with the cell phone itself. The processor is also in charge of a SIM card which needs to be attached to the outer wall of the module. In addition, the GSM900 device integrates an analog interface, an A/D converter, an RTC, an SPI bus, an I²C, and a PWM module. The radio section is GSM phase 2/2+ compatible and is either class 4 (2 W) at 850/ 900 MHz or class 1 (1 W) at

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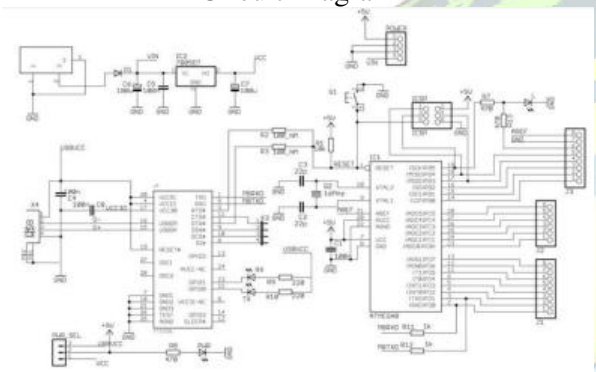
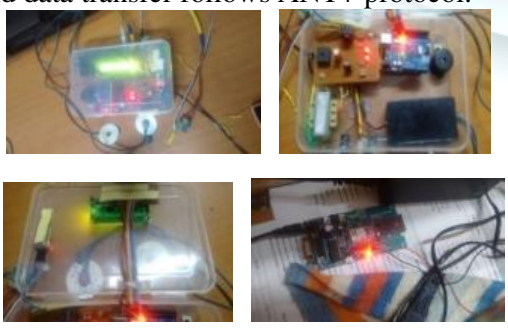
1800/1900MHz.The TTL serial interface is in charge not only of communicating all the data relative to the SMS already received and those that come in during TCP/IP sessions in GPRS (the data-rate is determined by GPRS class 10: max. 85,6 kbps), but also of receiving the circuit commands (in our case, coming from the PIC governing the remote control) that can be either AT standard or AT-enhanced SIMCom type. The module is supplied with continuous energy (between 3.4 and 4.5 V) and absorbs a maximum of 0.8 A during transmission.

IV. Experimental results and discussion

Circuit Diagram



The output of project can be viewed by three ways, they are LCD display in the kit, android application in mobile and also by website. Thw LCD display output is diorectly connected to our kit. The kit is integrated to android mobile application through ANT+ supported Bluetooth device. The integration of our kitr to website is done through GPRS module and data transfer follows ANT+ protocol.



Output in kit: the display in our kit is as such that values of MEMS X,Y,Z axis is displayed as X,Y and Z respectively. Then the temperature value is denoted as T and ECG value os denoted as E. Thus kit directly displays us the values of MEMS axis, temperature sensor and ecg value.

In android application:the mobile android application that we have used is being named "Sensor reader". Then the output displayed in our android application is in the order such that MEMS-X, MEMS-Y, MEMS-Z and then the value of temperature and followed by the ECG value. All these displayed reading are in tabulated format and this readings are again transformed into graphical representation. The x axis of the graph is plotted with time and y-axis is plotted with readings. The different values of MEMS X,Y,Z and temperature and ECG is differentiated by using different colors such that MEMS-X by pink, MEMS-Y by magenta, MEMS-Z by violet and temperature by orange, ECG is denoted by blue color. The connection to our kit is enabled by option provided at the right side corner. Our kit Bluetooth device is named as HC-05.

Website output: the output can also be viewed through website also. The website link: http://sacs2016ece.esy.es. The webpage is titled as healthcare monitoring system. The values of MEMS X,Y,Z. and ECG and temperature are first displayed as tabulation. The tabulation consists of date and trime of the value measued and values of all sensors are displayed accordingly.these values are also represented in the form of graphical representation also. Individual graphical representation is given for each values. Here X-axis is have the time of the reading notedand Y-axis is plotted with the values of the reading. Hereby the values vare updated instantly and periodically. So the user can view the result of the monitoring patient frome any where in the world.

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MEMS x,y,z values exceeds 200 means the condition is abnormal so the alarm rings.Temperature ranges from 25°C to 35°C at normal condition.ECG reading @ normal condition: ranges from 70 to 80. Either it may exceed or drop down due to abnormal condition.

V. Summary

our system helps user to monitor and manage the health of the person lively at any time with the aid of android application, webpage and sensors. Oru system helps to measure the temperature, heart rate and position of the patient. Our system is more flexible so that we can integrate maby more sensor to it and also integrating it to application and webpage provides mobility and also it is scalable.

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