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Arduino Based Human Health Care Monitoring And Control System

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Abstract: *Now a days health monitoring is essential for all human beings. In recent years several technique is used for health monitoring purpose. Here I proposed a Wi–Fi based wireless sensor network for monitoring purpose. Because, it has both data acquisition and data transmission principle. Each of us requires a periodic monitoring of vital parameters and correct treatments based on this data. These processes become even more crucial when people reach a certain age and are not capable to follow their health condition properly without a special medical personnel or sophisticated equipment to perform the monitoring. Therefore, a particular interest is focused on continuous monitoring techniques. For continuous monitoring, Atmega328 microcontroller is used. In this case several sensor unit is considered. Namely, Temperature sensor, Heart beat rate sensor, human Blood pressure sensor. All of sensors are used only for sensing purpose. If the sensed value is equal to normal value, it stops further process. Otherwise it sends control signals to patient via Actuator.*

Index Terms*: Atmega328 microcontroller, sensor unit, data acquisition, data transmission.*

I. Introduction

Many architectures for remote health monitoring procedures were developed in the recent years such as smart phone based remote health monitoring application. In remote health care monitoring application we cannot make use of the available bandwidth successfully, if we use the traditional mode of transmitting the data continuously. It reduces the node life time, even leads to failure of data due to delay and buffer overloading, which is not acceptable particularly in the health care application.

The problems that occur due to the improper data association collected from patients have been discussed. The architecture proposed is consists of a central gateway which gathers the data from all the users and transmit it to the central server periodically, where clinicians can classify the user's health status.

Therefore, a particular interest is focused on continuous monitoring techniques. Unlike the spot checking, this type of monitoring is able to providing a long term information about the patient, helps to record emergency situations and react effectively to any significant change in person's health conditions in a real time.

Health care is an important part of everyday life for all human beings on the planet. Each of us requires a periodic monitoring of imperative parameters and right treatments based on this data. These processes become even more crucial when people attain a certain age and are not able to follow their health condition properly without a special medical recruits or sophisticated equipment to perform the monitoring

The older person gets, the wider spectrum of possible diseases and unexpected emergency situations might occur. In order to avoid this, he or she needs to be elated to the hospital, observed by medical staff and provided with immediate help if some of the parameters are abnormal.

II. Literature Review

A smart phone based platform offers comprehensive, secure and modular patient monitoring clinical environment. Using both virtualization of the phone OS and virtual mobile networks of sensors with full Internet Protocol (IP) connectivity, we allow real-time remote sensor readings of patient Body Area Networks (BANs) to be stored, processed and forwarded securely to healthcare practitioners [1].

Pervasive healthcare using remote health monitoring offers solutions to many of today's healthcare challenges, including chronic diseases and an ageing population [2]. Reliability of such remote medical monitoring systems depends on reliable data association. This article first identifies and characterizes the data association problem, it sets the requirements for correct data association, and it presents a taxonomy for the problem.

The intelligent indoor positioning algorithm that fuses a PDR system and an RSS-based Wi-Fi positioning system is proposed without requiring the initial user location and initial user moving direction information in advance. In this case, the initial user location and moving direction are determined sequentially [3]. A tradeoff between the locations estimated by the Wi-Fi and the PDR positioning systems.

Existing space suits use conventional wired sensors that collect very limited physiological data to monitor health of astronauts during missions[4]. Adding more wired sensors would involve significant modifications and complexity to the suit. Deploying a wireless body area network (WBAN) is preferred and would provide a number of advantages such as flexibility in sensor complement and positioning.

The application area we consider is that of remote cardiovascular monitoring, where continuous sensing and processing takes place in low-power, computationally constrained devices, thus the power consumption and complexity of the processing algorithms should remain at a minimum level [5]. Experiments carried out on ECG signals from publicly available databases, covering both standard 12-lead and ambulatory recordings, as well as on a non-commercial data base show that the performance is very close to the state of the art ECG delineators

. The collected medical data from bio-medical sensors should be transmitted to the nearest gateway for further processing. Transmission of data contributes to a significant amount of power consumption by the transmitter and increase in the network traffic. In this paper we propose a low complex rule engine based health care data acquisition and smart transmission system architecture, which uses IEEE 802.15.4 standard for transferring data to the gateway. In this paper, ECG data acquisition and transmission architecture is considered [6]. The metrics used for performance analysis are the amount of power saving and reduction in network traffic. It is shown that the proposed rule engine gives a significant reduction in energy consumption and network traffic generated.

Frequency overlap across wireless networks with different radio technologies can cause severe interference and reduce communication reliability. The circumstances are particularly unfavorable for ZigBee networks that share the 2.4 GHz ISM band with Wi-Fi senders capable of 10 to 100 times higher transmission power [7]. Our work first examines the interference patterns between ZigBee and Wi-Fi networks at the bit-level granularity.

Smart grid is an intelligent power generation, distribution, and control system. ZigBee, as a wireless mesh networking scheme low in cost, power, data rate, and complexity, is ideal for smart grid applications, e.g., real-time system monitoring, load control, and building automation. Unfortunately, almost all ZigBee channels overlap with wireless local area network (WLAN) channels, resulting in severe performance degradation due to interference [8].

Energy consumption is the core issue in wireless sensor networks (WSN). To generate a node energy model that can accurately reveal the energy consumption of sensor nodes is an extremely important part of protocol development, system design and performance evaluation in WSNs [10]. In this paper, by studying component energy consumption in different node states and within state transitions, the authors present the energy models of the node core components, including processors, RF modules and sensors. Furthermore, this paper reveals the energy correlations between node components, and then establishes the node energy model based on the event-trigger mechanism.

The attached sensors on patient’s body form a wireless body sensor network (WBSN) and they are able to sense the heart rate, blood pressure and so on. This system can detect the abnormal conditions, issue an alarm to the patient and send a SMS/E-mail to the physician [11]. The system is able to carry out a long-tem monitoring on patient’s condition and is equipped with an emergency rescue mechanism using SMS/E-mail.

The application area we consider is that of remote cardiovascular monitoring, where continuous sensing and processing takes place in low-power, computationally constrained devices, thus the power consumption and complexity of the processing algorithms should remain at a minimum level [12]. Experiments carried out on ECG signals from publicly available databases, covering both standard 12-lead and ambulatory recordings, as well as on a non-commercial database show that the performance is very close to the state of the art ECG delineators.

The interference effect of the Wi-Fi signals on ZigBee channels has been investigated based on real experiments in different noisy wireless environments [13]. The collected medical data from bio-medical sensors should be transmitted to the nearest gateway for further processing. Transmission of data contributes to a significant amount of power consumption by the transmitter and increase in the network traffic [14]. In this paper we propose a low complex rule engine based health care data acquisition and smart transmission system architecture, which uses IEEE 802.15.4 standard for transferring data to the gateway. In this paper, ECG data acquisition and transmission architecture is considered. The metrics used for performance analysis are the amount of power saving and reduction in network traffic. It is shown that the proposed rule engine gives a significant reduction in energy consumption and network traffic generated.

We aim to develop practical ZigBee deployment guideline under the interference of WLAN. We identify the "Safe Distance" and "Safe Offset Frequency" using a comprehensive approach including theoretical analysis, software simulation, and empirical measurement. In addition, we propose a frequency agility-based interference avoidance algorithm [15]. The proposed algorithm can detect interference and adaptively switch nodes to "safe" channel to dynamically avoid WLAN interference with small latency and small energy consumption.

III. Existing System

In existing system, FPGA based ubiquitously connected remote health monitoring applications with smart transmission mechanism was introduced. This FPGA based hardware architecture of adaptive rule engine is requires two 16 bit comparators, two 3 bit adders, one 3 bit comparator and one 16 bit subtractor. The 16 bit subtractor serially calculates the PR, QRS and QT data intervals of ECG signal from their respective start and end points from the input data. For monitoring purpose, the signal acquisition acquire ECG data from patient. ECG data of 20 patients with different age groups were monitored and then the evaluated results are compared with original values.

IV. Proposed Hardware Architecture

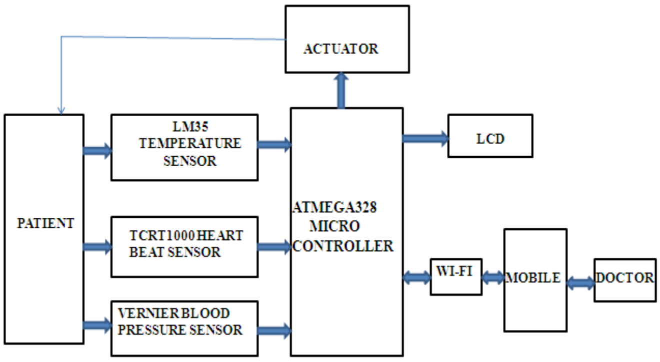

Fig: 1 Block diagram of health monitoring and control system

The proposed system architecture consist of three main units namely monitor unit, sensor unit, and control unit. The sensor unit acquires the multi parametric medical data such as Electro Cardiogram (ECG), body temperature, glucose levels, heart beat etc. from different sensors using various signal processing techniques. Better proactive analysis can be given only if the data collected from the patient is classified properly.

The collected parameters are given to controller unit.It compares collected data values to original values.If any deviation occur, it produce control signal to patient via actuator.For monitoring purpose LCD display is used.

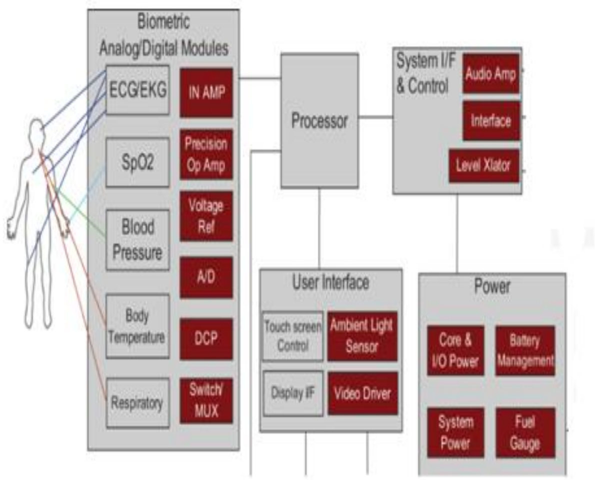

Fig:2 Typical health monitoring system

Other issue, the Internet of Things (IoT) architectures face is the anywhere or ubiquitous connectivity, especially in Wireless Body Area Networks (WBAN) applications where the patient is needed to be under constant supervision of the clinicians for proactive diagnosis. Bluetooth, ZigBee and Wi-Fi are the primary suite of high level communications used in WBANs. WBAN systems would have to ensure seamless data transfer across standards such as Bluetooth LE, ZigBee and Wi-Fi etc. to promote information exchange, plug and play device interaction. ZigBee and Bluetooth LE assists in a low energy consumption with low data rate but offers very low range compared to Wi-Fi. Being a non-static user under monitoring, the chances of user loosing connectivity by crossing the range is very high which makes the delivery of proactive diagnosis a difficult aspect.

Sensor unit

A sensor is a transducer whose purpose is to Sense some characteristic of its environments. It detects events or changes in quantities and provides a corresponding output, generally as an electrical or optical signal. A sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.

A sensor's sensitivity indicates how much the sensor's output changes when the input quantity being measured changes. For instance, if the mercury in a thermometer moves 1 cm when the temperature changes by 1 °C, the sensitivity is 1 cm/°C (it is basically the slope Dy/Dx assuming a linear characteristic). Some sensors can also have an impact on what they measure; for instance, a room temperature thermometer inserted into a hot cup of liquid cools the liquid while the liquid heats the thermometer.

The sensor unit consist of three sensors namely, Temperature sensor, Heart Beat sensor and blood pressure sensor. It acquires body temperature, heart beat rate and blood pressure level from patient.

A. Temperature Sensor

LM35 is one of the most precision IC temperature sensor. Temperature measurement is more accurately than a thermistor. The range of operating temperature is from -55°C to 150°C. The sensor circuitry is fully sealed and there is no oxidation and other processes. The output voltage is proportional to ambient temperature varies by 10mV in response to every ^{o}C rise/fall in temperature.

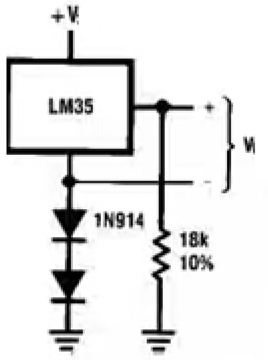

Fig: 3 LM35 temperature sensor

B. Heart Beat Sensor

In this project TCRT1000 sensor is used, which is a reflective optical sensor with both the infrared light emitter and phototransistor located side by side and are enclosed inside a leaded package so that there is minimum effect of surrounding visible light. A fingertip placed over the sensor will act as a reflector of the incident light. The quantity of light reflected back from the fingertip is monitored by the phototransistor.

Fig: 4 Heart beat sensor

C. Blood Pressure Sensor

The purpose of Vernier Blood Pressure Sensor is used to measure systemic arterial blood pressure in humans (non-invasively). it can measure arterial blood pressure and estimate both the systolic and diastolic blood pressure using the oscillometric method. The dynamic sensor in this unit is the SenSym SDX05D4 pressure transducer. It has a membrane which flexes as pressure changes. This sensor is prearranged to measure differential pressure. It includes special circuitry to minimize errors caused by changes in temperature. We offer an amplifier circuit that conditions the signal from the pressure transducer. In this circuit, the output voltage from the Blood Pressure Sensor will be linear with respect to pressure.

Fig: 5 Blood pressure sensor

Controller Unit

D. Atmega328 Microcontroller

The ATmega328 is a single chip miniature size controller produced by Atmel and belongs to the mega AVR series. The controller voltage range 1.8-5.5 V. The controller achieves throughputs approaching 1 MIPS per MHz; A common option to the ATmega328 is the " Pico Power " ATmega328P. The ATmega32 provides the following features: 32Kbytes of In-System Programmable Flash memory with Read-while-Write facilities, 1024bytes EEPROM, 2Kbyte SRAM, 32 general purpose I/O lines.

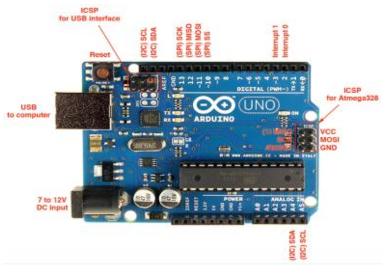

Fig: 6 Atmega328 microcontroller

Monitoring unit

E. LCD Display

A liquid-crystal display is an electronic display, even panel display, or video display. Liquid crystals don't turn out light directly. Liquid crystal displays are accessible to display random images (as in a general-use computer display) or fixed images which can be showed or hidden, such as preset words, digits, and seven-segment displays as in a digital clock. LCD displays are used for many more applications including computer monitors, instrument panels, aircraft cockpit displays, televisions, and signage. They are proverbial to end user devices such as DVD players, clocks, watches, calculators, gaming devices, and telephones.

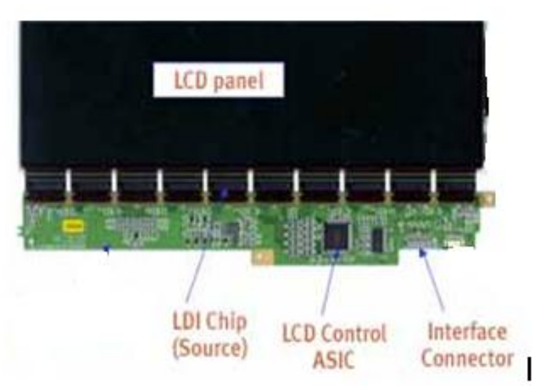

Fig: 7 LCD Display

F. WI-FI

Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. A common misconception is that the term Wi-Fi is short for "wireless fidelity," However this is not the case, Wi-Fi is simply a trademarked phrase that means IEEE 802.11

The Wi-Fi Alliance, the organization that owns the Wi-Fi registered trademark term specifically defines Wi-Fi as any "wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards."

Initially, Wi-Fi was used in place of only the 2.4GHz 802.11b standard, however the Wi-Fi Alliance has expanded the generic use of the Wi-Fi term to include any type of network or WLAN product based on any of the 802.11 standards, including 802.11b, 802.11a, dual-band, and so on, in an attempt to stop confusion about wireless LAN interoperability.

Many devices can use Wi-Fi, e.g. personal computers, video-game consoles, smart phones, digital cameras, tablet computers and digital audio players. These can connect to a network resource such as the Internet via a wireless network access point. Such an access point (or hotspot) has a range of about 20 meters (66 feet) indoors and a greater range outdoors. Hotspot coverage can be as small as a single room with walls that block radio waves, or as large as many square kilo metres achieved by using multiple overlapping access points. Depiction of a device sending information wirelessly to another device, both connected to the local network, in order to print a document.

Fig: 8 Wi-Fi module

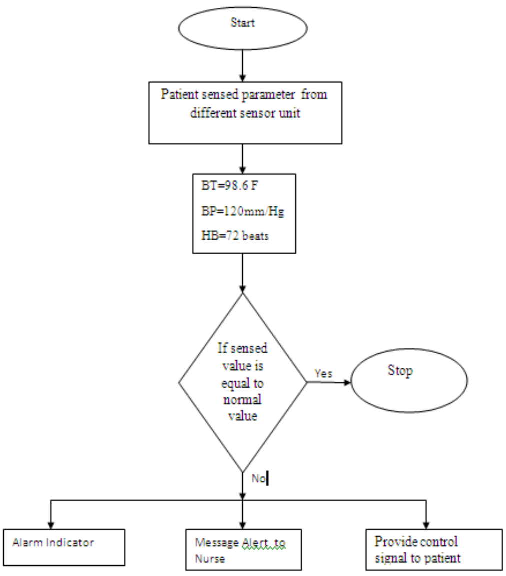

Fig: 9 Flow chart

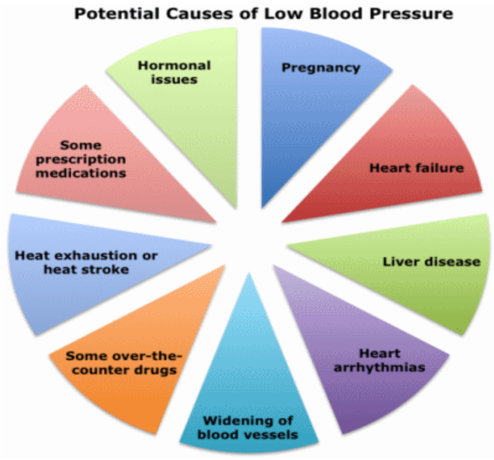

Fig: 10 Graphical representation

V. Software Requirement

A. Arduino

Arduino is a type of computer software and hardware company that offers open-source environment for user project and user community that intends and fabricates microcontroller based inventions for construction digital devices and interactive objects that can sense and manage the physical world. For programming the microcontrollers, the Arduino proposal provides an software application or IDE based on the Processing project, which includes C, C++ and Java programming software. It also support for embedded C, C++ and Java programming software.

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control the physical world.The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino platform provides an integrated development environment (IDE) based on the Processing project, which includes support for C, C++ and Java programming languages.

An Arduino board consists of an Atmel 8, 16 or 32-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which lets users connect the CPU board to a variety of interchangeable add-on modules known as shields . Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²C serial bus so many shields can be stacked and used in parallel. Official Arduinos have used the mega AVR series of chips, specifically the ATmega8 , ATmega168.

An Arduino's microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer. This makes using an Arduino more straightforward by allowing the use of an ordinary computer as the programmer. Currently, opti boot loader is the default boot loader installed on Arduino UNO.

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Fig: 11 Arduino software

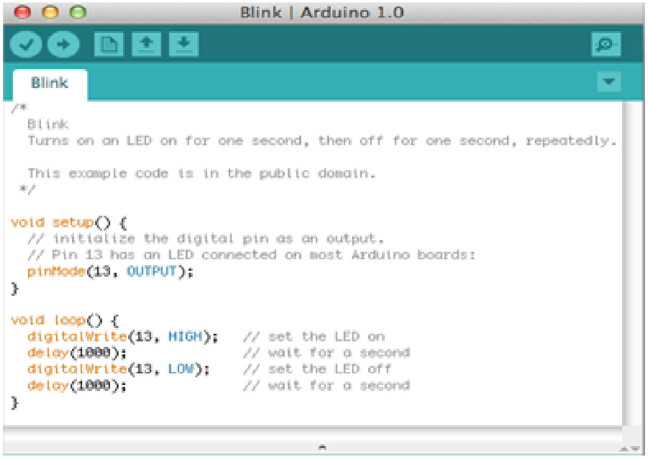

Fig: 12 Program Compilation

B. Proteus isis7 simulator

Proteus is design software urbanized by Lab center Electronics for electronic circuit simulation, schematic capture and PCB design. Its plainness and user friendly design made it popular among electronics hobbyists. Proteus is commonly useful for digital simulations such as microcontrollers and microprocessors. It can simulate LED, LDR, and USB Communication etc...

C. Embedded C

An embedded system is an application that contains at least one programmable computer (typically in the form of a microcontroller, a micro processor, digital signal processor chip) and which is used by individuals who are, in the main unaware that the system is computer-based.

Computers (such as microcontroller, microprocessor or DSP chips) only accept instructions in 'machine code' ('object code'). Machine code is, by definition, in the language of the computer, rather than that of the programmer. Interpretation of the code by the programmer is difficult and error prone.

All software, whether in assembly, C, C++, Java or Ada must ultimately be translated into machine code in order to be executed by the computer. There is no point in creating 'perfect' source code, if we then make use of a poor translator program (such as an assembler or compiler) and thereby generate executable code that does not operate as we intended.

Embedded processors like the 8051 have limited processor power and very limited memory available: the language used must be efficient. To program embedded systems, we need low-level access to the hardware. This means, at least, being able to read from and write to particular memory locations(using 'pointers' or an equivalent mechanism).

VI. Simulation Results

Proteus ISIS7 simulator is used for simulation purpose. For program computing purpose, Arduino IDE tool is used. The simulation results are given below:

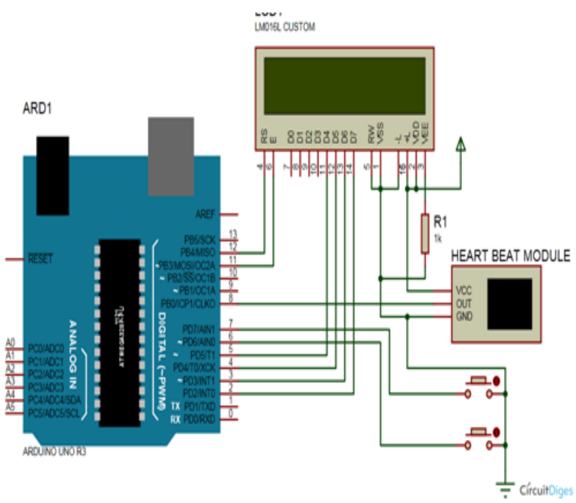

Fig: 13 Typical simulation module

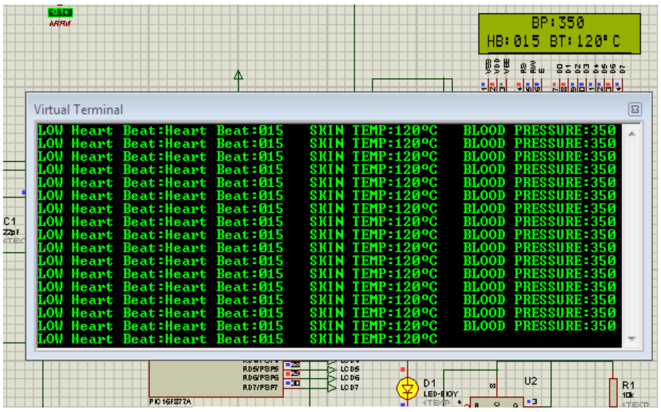

Fig: 14 Simulation output

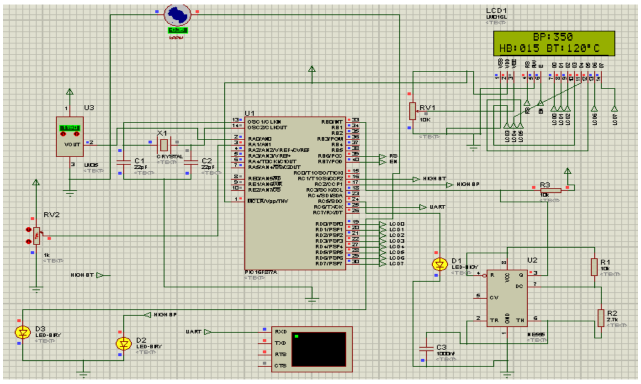

Fig: 15 Circuit diagram

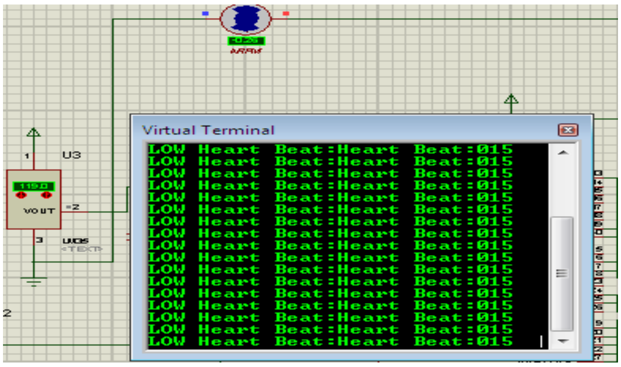

Fig: 16 Detection of low heart beat

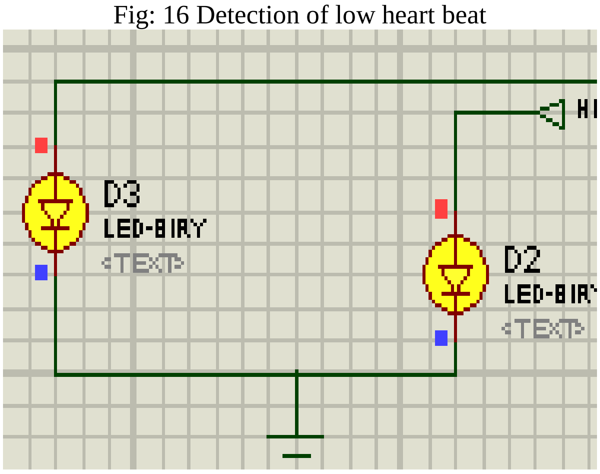

Fig: 17 Glow of LED

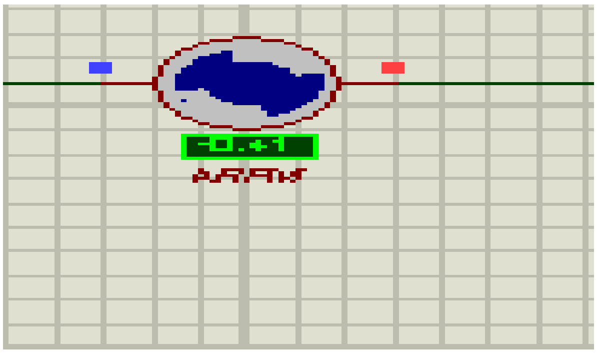

Fig: 18 Control action

VII. Conclusion And Future Work

In this paper, we proposed a Wi-Fi based remote health monitoring and control system using atmega328 microcontroller, which is capable to continuously monitor the patient's heart beat, blood pressure and other critical parameters in the hospital. We also proposed a continuous monitoring and control mechanism to monitor the patient condition and store the patient statistics in server. For the performance valuation, simulation results are taken by using PROTEUS 7 simulation tool.

Our future work is to explore the hardware multiplexing between the two radios and achieve a significant area reduction in the development of multiple radios based communication devices like an "IoT chipset". Envisaged IoT chipset will have features like adaptive rule engine based smart transmission technique to achieve low power and seamless hand-off controller (SHC) integrated for seamless hand-off between multiple on-chip radios to enable ubiquitous connectivity.

References

[1] M. A. Chowdhury, W. McIver, and J. Light, "Data association in remote health monitoring systems," IEEE Commun. Mag., vol. 50, no. 6,pp. 144–149, Jun. 2012.
[2] B. Priya, S. Rajendran, R. Bala, and R. Gobbi, "Remote wireless health monitoring systems," in Proc. Innovative Technol. Intell. Syst.Ind. Appl. (CITISIA), Jul. 2009, pp. 383–388.
[3] L.-H. Chen, E. H.-K. Wu, M.-H. Jin, and G.-H. Chen, "Intelligent fusion of Wi-Fi and inertial sensor-based positioning systems for indoor pedestrian navigation," IEEE Sensors J., vol. 14, no. 11, pp. 4034–4042, Nov. 2014.
[4] M. Taj-Eldin et al., "Wireless propagation measurements for astronaut body area network," in Proc. IEEE Int. Conf. Wireless Space Extreme Environ. (WiSEE), Nov. 2013, pp. 1–7
[5] M. P. R. S. Kiran, P. Rajalakshmi, K. Bharadwaj, and A. Acharyya, "Adaptive rule engine based IoT enabled remote health care data acquisition and smart transmission system," in Proc. IEEE World Forum Internet Things (WF-IoT), Mar. 2014, pp. 253–258.
[6] E. B. Mazomenos et al., "A low-complexity ECG feature extraction algorithm for mobile healthcare applications," IEEE J. Biomed. Health Informat ., vol. 17, no. 2, pp. 459–469, Mar.2013.
[7] Y. Tao, X.-Y. Li, and C. Bo, "Performance of coexisted WiFi and ZigBee networks," in Proc. IEEE 33rd Int. Conf. Distrib. Comput. Syst.Workshops (ICDCSW), Jul. 2013, pp. 315 –320.
[8] P. Yi, A. Iwayemi, and C. Zhou, "Developing ZigBee deployment guideline under WiFi interference for smart grid applications," IEEE Trans. Smart Grid, vol. 2, no. 1, pp. 110–120, Mar. 2011.
[9] S. Phaiboon, "An empirically based path loss model for indoor wireless channels in laboratory building," in Proc. IEEE Region 10th Conf.Comput., Commun., Control Power Eng. (TENCON), vol. 2, Oct. 2002, pp. 1020–1023.
[10] Y. F. Solahuddin and R. Mardeni, "Indoor empirical path loss prediction model for 2.4 GHz 802.11n network," in Proc. IEEE Int. Conf. Control Syst., Comput. Eng. (ICCSCE), Nov. 2011, pp. 12–17.
[11] A. Q. Bhat, V. Kumar, and S. Kumar, " Design of ECG data acquisition system," Int. J. Adv. Res. Comput. Sci. Softw. Eng., vol. 3, no. 4, pp. 1–5, Apr. 2013.
[12] L. Y. D. Marco and L. Chiari, "A wavelet-based ECG delineation algorithm for 32-bit integer online processing," Biomed. Eng. OnLine , vol. 10, no. 2, Apr. 2011, Art. ID 23.
[13] E. B. Mazomenos et al., "A low-complexity ECG feature extraction algorithm for mobile healthcare applications," IEEE J. Biomed. Health Informat., vol. 17, no. 2, pp. 459–469, Mar. 2013.
[14] C. Li, C. Zheng, and C. Tai, "Detection of ECG characteristic pointsusing wavelet transforms," IEEE Trans. Biomed. Eng., vol. 42, no. 1,pp. 21–28, Jan. 1995.
[15] Y. Tao, X.-Y. Li, and C. Bo, "Performance of coexisted W-iFi and Zig Bee networks," in Proc. IEEE 33rd Int. Conf. Distrib. Comput. Syst.Workshops (ICDCSW), Jul. 2013, pp. 315–320.