Patient Monitoring System Using Wi-Fi Technology

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Abstract—It is hard for the medical professionals to keep track of the health conditions of their patients in hospitals and home. A wireless monitoring system using Wi-Fi is proposed for remote patient health monitoring. This paper describes the design and model execution of real-time health monitoring using Wi-Fi technology based monitoring and governing the field equipments or sensors using mobile Phone, Tablet Laptop or any computers having Wi-Fi utility with IEEE 802.11b, g and n standards. The key objective of this system is to provide real-time health status of a patient. The project is implemented to be in command of heart rate, temperature. In this proposed system of health monitoring, the parameters are sensed by the sensors and values are transmitted through a Wi-Fi module to the medical personals. These parameters are sent through a remote internet location so that the users can view these details from anywhere across the world. This has helped to monitor important physiological data of a patient constantly. It is an easy, reliable, sheltered, and fast wireless solution.

Index Terms—Remote monitoring, Wi-Fi, heart rate sensor, temperature sensor, Blood pressure sensor, EMG sensor.

I. INTRODUCTION

In recent years there are great innovations in the Medical field which advances the health care. Most of the health care hospitals are trying to implement facilities with newer technologies and to provide an effective advanced treatment with more alert and preventions. Most health care monitoring systems which we use today works in offline mode and it’s highly impossible to record the patient’s health status in real time. It is of great need to design a system so that a patient can be monitored remotely at any time. The goal of this project is to screen and develop the health care quality of patients irrespective of their location and to promote continuous information about the patient’s health status for providing better healthcare in critical situations and to reduce the wastage of time for regular medical check-up of the aged patients and in turn it enables the monitoring the patients from any part of the world and any time apart from their consulting hours. Internet of Things (IoT) functions in such a way that it accumulates and share data from the patients and makes it possible to collect, record and analyze new data stream quicker and accurately as possible. This enables data communication capabilities. This interlinked health care environment promotes the fast transmission of information and promotes easy access. This technology is helpful to provide first aid to diseases such as hypertension, cardiac diseases. Such diseases need continuous monitoring. The capability of the devices to gather data and assessments on their own removes the limitations of manual medical interpretations and it unleashes the data-automatically and sends it to the medical professionals whenever they needed, thus it reduces the risk of error. This technology employs sensor comprehensive physiological information and also uses gateways. This turn uses the cloud to analyze and preserve the information and then send the analyzed data wirelessly for further analysis and review. It overcomes the drawback of seeking a medical professional to come at regular intervals to check the patient’s vital signs for the disease. This technology provides solution for this by giving a continuous automated flow of information. This technology develops the quality of health care through continuous attention of diseased patients and minimize the consulting the cost by eliminating the need for a caregiver to actively enhance in data collection and analysis.
Eminent wireless solutions interlinked via Internet of things are now making it possible for monitoring the patients in real time.

II. Existing System

Working space and simplified the tool to show the ECG output. Serial plotter is used to displaying the analog signal structure. The Arduino serial plotter function allows to natively graph serial data from Arduino to PC in real time. And also there is a simplified interface for two other parameters, saline level and pulse detection. They 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. They had 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 result of the electrical pulse is shown with the serial plotter. The major result of ECG analog signal is displayed on serial monitor.

III. Proposed System

In this proposed system, a serial monitor is used for displaying the digital signal structure. The arduino serial monitor function allows to digital data from arduino to any gadgets in real time. Serial monitor is an offline tool which allows visualizing data and troubleshooting code offline. In our proposed system of patient monitoring using wifi we have interfaced four parameters. The parameters include blood pressure sensor, EMG sensor, heart beat sensor and temperature sensor. We use these sensors for detecting the vital signs of the patients and have directly interfaced these sensors with the arduino processor. The processor access the input data from the sensors and processes using the program code. It is finally viewed in any electronic gadgets at any location by accessing the developed links.

The EMG sensor is operated over three led electrode system which amplifies small and micro bio-signals. The output signal is displayed on serial monitor. The temperature sensor LM35 records the temperature of the patients and calibrates the recorded temperature. The heart beat sensor is used to calculate the pulse in Beats Per Minute (BPM). A Sphygmomanometer is used to monitor the blood pressure which consists of an inflatable cuff. If the cuff is too small, it results in high blood pressure and vice versa. The results are displayed in a serial monitor. The result of the patient health can be monitor lively at any location and instantaneous results are progressed through the wifi-module which has been saved in the web server. If the link has been known the patient can be monitored from any location.

IV. System Components

**Hardware Requirements**

- Heart rate sensor
- Temperature sensor
- EMG sensor
- Blood Pressure sensor
- Atmega 328 microcontroller - Arduino
- Wifi module

**Software Requirements:**

- Embedded C coding

**Arduino Board**

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.
Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default boot loader of the Arduino UNO is the opti boot boot loader.[28] Boards are loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232.

The Current Uno provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and
six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.1-inch (2.54 mm) headers.

**Digital Heart Beat Sensor**

The heart beat sensor is designed to give digital output of heart beat when a finger is placed on it. When the heartbeat detector is working, the top-most LED flashes with each heart beat. This digital output can be connected to microcontroller directly to measure the beats per minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. Module dual output mode, digital output is simple, serial output with exact readings.

**Working**

The Heart beat sensor consists of a LED and light detector. From LED, maximum light must passes spread in finger and detected by detector. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more obscure and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified and triggered through an amplifier which outputs +5V logic level signal. The output signal is also indicated by a LED which blinks on each heart beat.

**Features**

- Heart beat indication by led.
- Compact size.
- Total heart beat count can be obtained serially (TTL) every minute.

**Applications**

- Digital heart rate monitor.
- Parameter Bio-feedback control of robotics and applications exercise machines.

**Specifications**

- Value Operating Voltage +5v dc regulated
- Operating current 100mA
- Heart beat detect Indicated by high active pulse

| Pin | Name | Details |
|-----|------|---------|
| 1   | out  | Active high output |
| 2   | +5v  | Power supply |
| 3   | gnd  | Power supply gnd |
| 4   | rx   | Receiver |
| 5   | tx   | Transmitter |

**Temperature sensor LM35**

(ACTIVE) ±0.5°C Temperature Sensor with Analog Output with 30V Capability. The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±½°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range.
(-10° with improved accuracy). The LM35-series devices are available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D devices are available in the plastic TO-92 transistor package. The LM35D device is available in an 8-lead surface-mount small-outline package and a plastic TO-220 package.

Features

- Calibrated Directly in Celsius (Centigrade)
- Linear + 10-mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at 25°C)
- Rated for Full −55°C to 150°C Range
- Suitable for Remote Applications
- Low-Cost Due to Wafer-Level Trimming
- Operates From 4 V to 30 V
- Less Than 60-µA Current Drain
- Low Self-Heating, 0.08°C in Still Air
- Non-Linearity Only ±¼°C Typical
- Low-Impedance Output, 0.1 Ω for 1-mA Load

Electromyography sensor

Measuring muscle activation via electric potential, referred to as electromyography (EMG), has traditionally...
been used for medical research and diagnosis of neuromuscular disorders. It calculates the pressure of muscles by force.

Features
- Small Form Factor (1inch X 1inch)
- Specially Designed For Microcontrollers
- Adjustable Gain – Improved Ruggedness
- New On-board 3.5mm Cable Port
- Pins Fit Easily on Standard Breadboards
- Muscle Sensor v3

Applications
- Video games
- Robots
- Medical Devices
- Wearable/Mobile Electronics
- Powered Exoskeleton suits

Wi-Fi Module
The Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. Wi-Fi module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi ability as a Wi-Fi Shield offers. The applications of ESP8266 are Smart power plugs, Home automation Wi-Fi location-aware devices, Industrial wireless control, and Security ID tags.

Features of Wi-Fi Module
- 802.11 b/g/n protocol
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLL, regulators, and power management units
+19.5dBm output power in 802.11b mode
Integrated temperature sensor
Supports antenna diversity
Power down leakage current of < 10uA
Integrated low power 32-bit CPU could be used as application processor
Wake up and transmit packets in < 2ms
Standby power consumption of < 1.0mW (DTIM3)

Benefits
Continuous monitoring: It can be used in health care units for monitoring the vital parameters of operated patients.
Record keeping: This system contains Graphical User Interface which maintains the history of patients.
Increased efficiency: The number of professionals required for monitoring the patients continuously can be reduced to a large extent.
More accurate: Chance of manual error in checking the health parameters are highly reduced.

Applications
Reduces the medical professional’s visit.
It is a multipurpose technology hence the necessary parameters are easily measured.
Operation is easy.
Compared to the compact sensors it gives better performance.
Easy and reliable for doctors.
Increases efficiency.
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