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Remote Temperature Monitoring Android mobile App in Telemedicine System

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ABSTRACT – In the present scenario, there are very large numbers of patients in rural areas need good healthcare support services at home. Tele monitoring is a medical practice that involves remotely monitoring patients who are living at remote locations as a healthcare provider. In some emergency case of a patient, it is necessary to monitor continuously vital signs of which are most important such as Temperature. Also, this paper presents development of a remote vital sign monitoring system by using a biomedical sensors and microcontroller unit with Wi-Fi module. The main objective of present work is to develop a body Temperature monitoring system in real time by using a smartphone, the system is tested and implemented successfully

Index terms -- Temperature, Wireless health monitoring, Arduino, Android OS.

I. INTRODUCTION

The Temperature is a physical quantity of heat which is subjected to the material characteristic that enforce the environment to undergo its effect. The action of measurement is normally done by the Thermometer where in the material's thermal radiations are mediated for the detection by the particle's intensity of colliding velocity. Thermal energy is the total energy of all the particles in the material. Temperature is a measure of average energy of the particles in the material [1]. This intensity of velocity of radiations are taken into consideration for the calibration guidance to set measuring point like Kelvin, Celsius and Fahrenheit. Temperature can be measured by using different types of sensors. In the present work we used Semiconductor Temperature Sensor.

Different methods are used for measuring body temperature produce different results. The temperature reading depends on part of the body which is being used to measured [2]. The typical temperature measuring methods are as follows:

- Rectal measurement
- Oral measurement
- Atrial measurement
- Ear measurement

As we know that in today temperature measurement has great importance. The reason is that several diseases are accompanied by characteristic changes in body temperature. Normal body temperature using oral is 37^0 Celsius or 98.6 ^{0} F. Abnormalities of body temperature regulation are presented below

Normal	36.5–37.5 °C (97.7–99.5 °F)
Hypothermia	< 35.0 °C (95.0 °F)
Hyperthermia	> 37.5–38.3 °C (99.5–100.9 °F)
Hyperpyrexia	> 40.0–41.5 °C (104–106.7 °F)

II. DEVELOPMENT OF SYSTEM

The block diagram of a remote temperature monitoring system with android app is shown in figure1 and the system consists of the following units these are

1. Temperature sensor (DS18B20)
2. ATMEGA328 Controller
3. Wi-Fi module
4. Personal computer
5. Smartphone

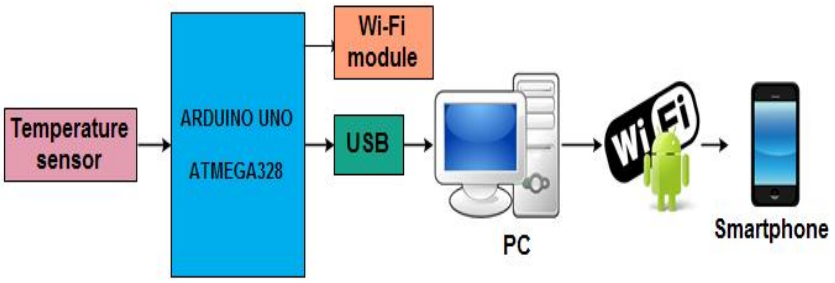

Fig-1: Block diagram of Temperature monitoring system

2.1. Temperature sensor (DS18B20)

The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with non-volatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that requires only one data line (and ground) for communication with a central microprocessor [3].

In addition, the DS18B20 can derive power directly from the data line, eliminating the need of an external power supply and it has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area. Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems. The DS18B20 can derive power directly from the data line, eliminating the need for an external power supply.

2.2. ATMEGA328 Controller

The present system Atmega328 microcontroller is used to read the data which is read by the RFID reader and process further. Atmega328 is high performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter. The atmega328p any digital line is used for serial port read and write by software serial command [4]. The serial lines are further connected to the Personal Computer through USB.

2.3. Wi-Fi module

ESP8266 can be used as a wireless network interface card (NIC) in embedded systems that require internet connectivity or device-to-device communication. ESP8266 is a WLAN module supporting IEEE 802. 11 b/g/n standards and operates in 2.4 GHz ISM frequency band. It contains Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor [5].

The use of ESP8266 Wi-Fi module has been increasing in wireless technology and it has potential to offer low cost and gives solution for the users to develop their own networking applications. This Wi-Fi module is suitable for adding Wi-Fi functionality to an existing microcontroller unit via a UART serial connection. The module can even be reprogrammed to act as a standalone Wi-Fi connected device. The ESP8266 Wi-Fi module block diagrams in shown in figure-2.

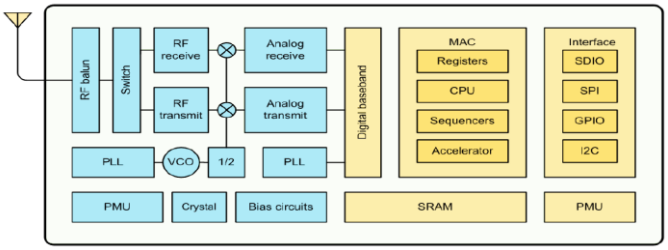

Fig-2: Internal block diagram of ESP8266 Wi-Fi module

2.4. Personal computer

Computer or workstation or laptop acts as a host system for programming, compiling, testing, Personal emulation and debugging to develop and implement the embedded systems.

2.5. Smartphone

A Smartphone based health monitoring system has been presented in this work. By using this system, the healthcare professionals can monitor, diagnose, and advise their patients all the time. The Biomedical sensors like Temperature sensor is interfaced to ARDUINO UNO board which reads sensor data, and this physiological data are stored and published online in Android app [6].

III. SOFTWARE IMPLEMENTATION

In present work we used 'C' and java languages for the development of temperature measurement system. The 'C' programming language is growing in importance and has become the standard high-level language for real-time embedded applications. The PC is the standard computing device for the 'C' compiler. The development of C programs for an ATMEGA328 is executing on a PC by using Arduino IDE. The Android App and GUI development for is Telemedicine system implemented in Android studio.

3.1. Arduino IDE

In present work The Arduino integrated development environment (IDE) is used to interface biomedical parameter like Temperature sensor. It is a cross-platform application written in C and derives from the IDE for the Processing programming language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. Arduino programs are written in C or C++.

3.2. Android Studio

Android Studio is an integrated development environment (IDE) for developing on the Android platform with Android SDK tools. It is freely available and downloaded easily from internet. It is based on Jet Brains' IntelliJ IDEA software, the Studio is designed specifically for Android development [7]. It is available for download on Windows, Mac OS X and Linux. Hardware's that support Android is mainly based on AVR architecture platform.

The interface software program is written in Arduino IDE environment and entire APP is developed using Android JAVA backend and front end is developed using XML on Android KitKat 4.4.2 Operating System.

3.3. XAMPP

XAMPP is used in present work for development of Database storage and maintenance of server. XAMPP stands for Cross-Platform (X), Apache (A), MySQL (M), PHP (P) and Perl (P). It is a simple, lightweight Apache distribution that makes it extremely easy for developers to create a local web server for testing purposes. Everything you need to set up a web server – server application (Apache), database (MySQL), and scripting language (PHP) – is included in a simple extractable file. XAMPP is also cross-platform, which means it works equally well on Linux, Mac and Windows.

3.4. Algorithm of Temperature measurement system with android App

- To Initialize central processing unit of microcontroller ATMEGA328
- To Initialize Ports, Enable interrupts.
- To Measure Temperature using DS18B20 and transfer data to microcontroller ATMEGA328.
- To Initialize the Serial port of the Arduino UNO board.
- Read the sensor data in Arduino UNO serial monitor and receive the Temperature sensor data from Arduino UNO and save it to the database server.
- Start receives the sensor data from Wi-Fi and sends it to GUI Android App in Smartphone and exit from the APP and disconnected the serial port connection.

3.5. Flow chart of Temperature measurement system with android App

The flow chart of the temperature measurement system with Android app is shown in figure 3.

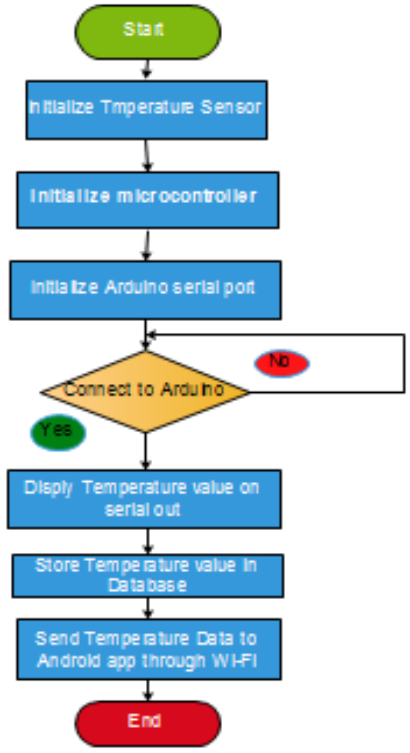

Fig-3: Temperature measurement system flowchart

IV. Results and Discussion

Results are obtained using Arduino Uno, Android and a smartphone. The output of the Temperature sensor is processed in Arduino Atmega328 controller and send to serial output in PC as shown in Figure-4.

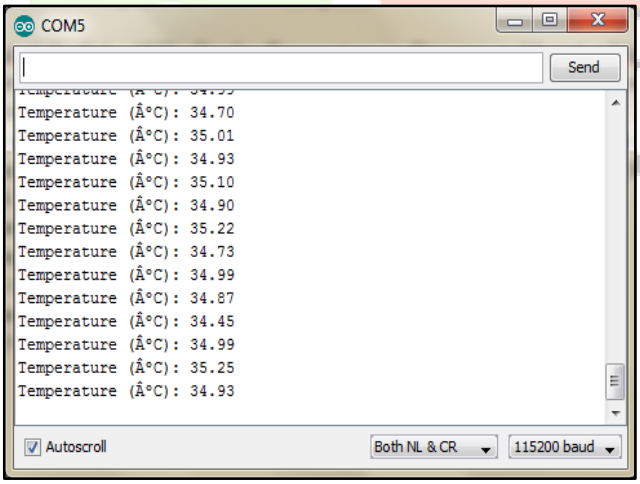

Fig-4: Arduino Uno serial output data

Practical tests have been conducted to evaluate the real time performance of the wireless Temperature monitoring system. The main aim and objective of this work is to develop an Android based Patient Care Monitoring system with Temperature measurement. Hence an attempt has been made by the author to develop a Temperature measurement system using the advanced micro controller ATMEGA328 and Android development Tools.

The TCP/IP protocol suit is used to communicate between the server and Android mobile device to display the Temperature values on a Smartphone screen in real time. The Temperature displayed values on Smartphone android app is shown in figure 5.

Fig-5: Temperature display window on smartphone

V. Conclusion

The remote temperature measurement system is calibrated with a digital thermometer, the system is tested and implemented successfully for the measurement of patient temperature remotely as a part of telemedicine system. The temperature values measured from the sensor can be displayed on doctors Smartphone and simultaneously the values are saved in database.

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