Design and Implementation of Remote Healthcare Monitoring System Using Internet of Things

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Abstract-*In day Today life people are facing multiple physical, physiological problems. In remote area they have no facility to visit doctor frequently. Internet Of Things is emerging technology, it contains huge amount of smart objects and smart devices communicate to internet to connected each other. Remote health care Body Area Networks are very popular but demand low Price and energy consumption due to very constrained resources. For it several protocols, such as ZigBee, BlueTooth, WiFi etc, have been proposed but non has delivered the optimum results. Internet Of Things used many Real Time Human day to day life with more comfortable. IoT has evolved from the convergence of wireless Technologies, micro-electromechanical systems and the Internet. Recently a protocol RS232 provides such features and strengthens the goals for Internet of Things (IOT). The authors describe a software architecture which flexibly integrates RS232 protocol enabled sensors to deliver health care services. The approach is validated on a health care application that integrates heart rate, cadence, distance, foot steps and environmental temperature sensors. Described architecture is modular, flexible, scalable and possess several features.*

Keywords-body networks, sensors, healthcare, heart rate, footpod, temperature.

I. INTRODUCTION

The usage of wireless technology is evident in many disciplines, such as observation of lives of rare species , smart homes , medical assistance and security surveillance. Monitoring body parameters, through wireless Body Area Networks (BAN), is becoming important due to recent focus on healthcare to provide services, such as remoteclinical care, diagnostics, monitoring, individual security, enhanced sports and fitness training applications . It demands a wearable technology that serves to monitor the body parameters and can transmit wireless signals. Although wearable body sensors possess such valuable features but they also hold unavoidable constraints, such as optimum energy consumption, data exchange and cross domain message interpretation among nodes.

Wearable sensors are actually low power devices that operate in environments where monitoring operations are required for extended period of time and frequent battery replacements are not possible. This fundamental constraint has triggered many researchers to develop different Media Access Control (MAC) protocols with the objective of bandwidth maintenance and low energy consumption.. Its battery prevails up to 3 years comparitive to BLE and ZigBee with 1 year and 6 months respectively [11]. This ultra-low power wireless technology supports different kinds of low data rate network topologies, such as peer-to-peer, star or mesh. It establishes communication channels among sensor nodes transmitting signals at 2.4 Ghz frequency. This protocol is being used in abundance with over 60 million deployed nodes. Such wireless devices are integratable only when they abide by RS232 standards, defining communication formats, to support interoperability. In order to provide general services the wireless device sensors are applied together in a group. Such integration is vital to achieve aggregate results and to apply mining mechanisms for prediction and description analysis. It has made the application developers much inflexible as they have to deal with different device drivers, ad-hoc APIs and no interpretable different data formats. Every time a new device is added, from a different vendor in order to provide a new service, they have to rescan the previously written code to deal with different APIs and drivers. They demand a framework that would seamlessly integrate different devices following their APIs and would be able to exchange the data between the applications. The exchanged data and wire-less devices must be interpretable across the wireless node boundaries after proper identification. The interoperability among devices demands interoperable data models, flexible dynamic device configuration and their smooth integration. Our application is an effort towards achieving such a flexible framework.Remote healthcare services have taken care of the ag-ing and young society, while utilizing telecommunication network and information technology. We have taken the advantage from the wearable computing devices and have developed an application in the domain of healthcare to monitor patients remotely for later descriptive and predictive analysis Our system is flexible, uses parametric approach to auto start the sensors with their configuration settings. It is scalable to add more sensors later. The system uses a modular approach but interprets the data messages from the different devices uniformly while using a single data interpreter module. Any user can build up his profile and uses it on his personal computer to monitor his body parameters, such as heart rate, cadence, distance, foot steps taken and environmental temperature. Our system stores the data locally on a collecting device and also securely share it remotely for the analysis purpose.

II.RS232 PROTOCOL

Serial port is a serial communication physical interface through which information transfers in or out one bit at a time (contrast parallel port). The name "serial" comes from the fact that a serial port "serializes" data. That is, it takes a byte of data and transmits the 8 bits in the byte one at a time. The advantage is that a serial port needs only one wire to transmit the 8 bits (while a parallel port needs 8). The disadvantage is that it takes 8 times longer to transmit the data than it would if there were 8 wires. Serial ports lower cable costs and make cables smaller. There are two basic types of serial communications, synchronous and asynchronous. With synchronous communications, the two devices initially synchronize themselves to each other, and then continually send characters to stay in sync. Even when data is not really being sent, a constant flow of bits allows each device to know where the other is at any given time. That is, each character that is sent is either actual data or an idle character. Synchronous communications allows faster data transfer rates than asynchronous methods, because additional bits to mark the beginning and end of each data byte are not required.RS232 to transfer data between PIC microcontroller to IOT modem.

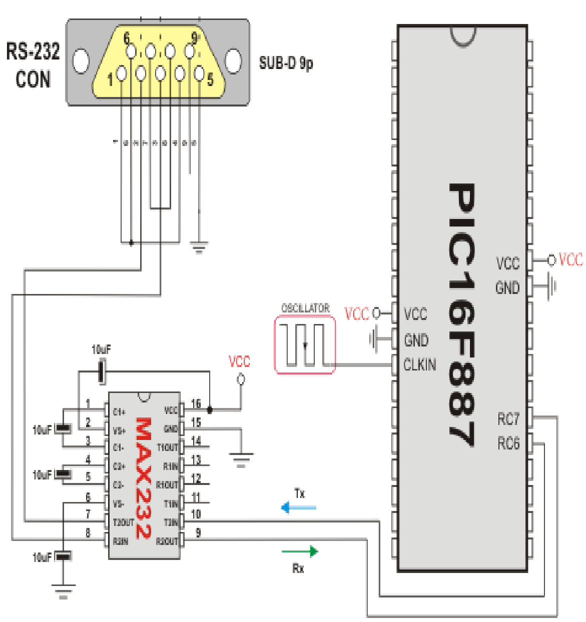

Figure.1:Rs2332 communication with PIC Microcontroller.

III.HEALTH CARE SYSTEM

Managing disease and health issues is getting expensive worldwide. Summarized research has shown that independent health management, exercise and physical monitoring has contributed greatly to prevent diseases and to improve health conditions. ANT Alliance has committed provide simple and effective sensor devices that make the monitoring for health care easy and reliable.In addition to the technology for data gathering, storage and access, medical data analysis and visualization are critical components of remote health monitoring systems. Accurate diagnoses and monitoring of patient's medical condition relies on analysis of medical records containing various physio-logical characteristics over a long period of time.

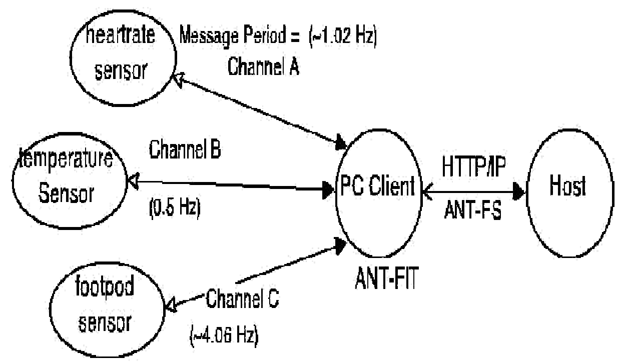

Figure 2. Wireless Sensor Nodes in the System network operating on 2.4 GHz frequency

There are around 22 million people effected with heart failure [19]. Carefull heart monitoring, regular exercises with better daily physical activity routine can strengthen the heart and cardiovascular system, improve circulation and lower the blood pressure. Weight, blood pressure, daily foot steps taken, bike speed during cycling, distance covered and calories burned are the core fundamental elements, that if managed carefully, will help in maintaining a healthy body. Such parameters contribute to achieve healthy routine, timely diagnostic decisions, medicos and medical checkups - hence leading towards a healthy society.

A system, body area network based, is developed that allows the connection of elderly people with their physicians and friends over the Internet. The resulting system uses automatic configurations, flexible architecture, desktop interface and wearable devices to acquire and deliver information about a person's wellbeing. The information can be selectively storable and sharable, with other devices and people, using a secure technology.

IV. SYSTEM ARCHITECTURE

The architecture of the implemented system, shown in figure 4, describes different modules and high level logical components with their relationships. The users interact with the system through the interface and can take advantage from the system services after secure authentication. Both normal and admin users have different levels of access rights. Each sensor communicates with the system through enabled USB stick interface.

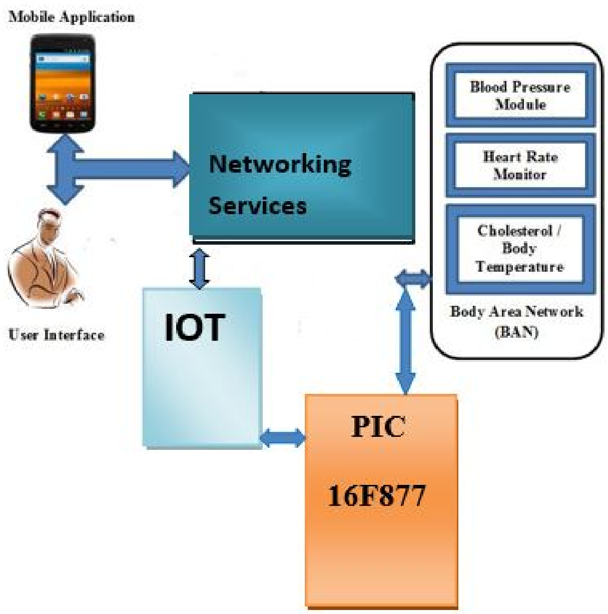

Figure 3: System Architecture of Remote health care monitoring System.

a) POWER SUPPLY:

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an ac voltage, a steady dc voltage is obtained by rectifying the ac voltage, then filtering to a dc level, and finally, regulating to obtain a desired fixed dc voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the same even if the input dc voltage varies, or the output load connected to the dc voltage changes. The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an ac voltage, a steady dc voltage is obtained by rectifying the ac voltage, then filtering to a dc level, and finally, regulating to obtain a desired fixed dc voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the same even if the input dc voltage varies, or the output load connected to the dc voltage changes.

b)PIC MICROCONTROLLER:

PIC16F877A is the heart of this system. It consists of clock circuit and power on reset circuit. Clock circuit is build around crystal oscillator and ceramic capacitor. Purpose of crystal oscillator is to stabilize the frequency and the capacitor is to stabilize the amplitude if the clock. These devices feature a 14-bit wide code memory, and an improved 8-level deep call stack. The instruction set differs very little from the baseline devices, but the two additional opcode bits allow 128 registers and 2048 words of code to be directly addressed. There are a few additional miscellaneous instructions, and two additional 8-bit literal instructions, add and subtract. The mid-range core is available in the majority of devices labeled PIC16. The first 32 bytes of the register space are allocated to special-purpose registers; the remaining 96 bytes are used for general-purpose RAM. If banked RAM is used, the high 16 registers are global, as are a few of the most important special-purpose registers, including the STATUS register which holds the RAM bank select bitsThe PCLATH register supplies high-order instruction address bits when the 8 bits supplied by a write to the PCL register, or the 11 bits supplied by a GOTO or CALL instruction, is not sufficient to address the available ROM space.

C) SENSORS:

(i)Temperature Sensor:

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 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.

(ii)Heart Beat Sensor:

This circuit made from an infrared phototransistor and infrared LED. This transducer works with the principle of light reflection,in this case the light is infrared. The skin is used as a reflective surface for infrared light. The density of blood in the skin will affect on the IR reflectivity. The pumping action of heart causes the blood density rises and falls. So that we can calculate the heart rate based on the rise and fall of intensity of infrared that reflected by skin.

(iii)Blood Preasure sensor:

Blood pressure sensor is a device used to measure blood pressure, composed of an inflatable cuff to collapse and then release the artery under the cuff in a controlled manner, and a mercury or mechanical manometer to measure the pressure. It is always used in conjunction with a means to determine at what pressure blood flow is just starting, and at what pressure it is unimpeded. Manual sphygmomanometers are used in conjunction with a stethoscope. A sphygmomanometer consists of an inflatable cuff, a measuring unit and a mechanism for inflation which may be a manually operated bulb and valve or a pump operated electrically.

D) Internet Of Things:

The Internet of Things (IoT) is an environment in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT has evolved from the convergence of wireless technologies, micro-electromechanical systems (MEMS) and the Internet. The concept may also be referred to as the Internet of Everything.A thing, in the Internet of Things, can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low -- or any other natural or man-made object that can be assigned an IP address and provided with the ability to transfer data over a network.

V. FUTURE WORK

We aimed to extend our system in different ways. First of all we shall integrate other sensors into this architecture especially the blood pressure sensor. We are working on these factors and shall soon integrate such sensors to deliver more robust services. Secondly, we shall target more dis-eases in future. Study has shown that such a patient, with heart failure threats at some time in their life may also adopt other diseases, such as Alzheimer's, Asthma, Depression, Diabetes, Heart Failure and Obesity. Thirdly, we shall make the system flexible to upload whole data to a remote server for storage into more flexible and managable format for later predictive and descriptive analysis. Fourthly, we shall integrate the existing system with patient's caretakers such as doctors and relatives for realtime monitoring and feedback. Lastly, the same like service features will be developed for different mobile platforms.

VI. CONCLUSION

We have developed a system that facilitates a user to monitor and manage his health by observing his body parameters with the help of wearable technology and Body Area Wireless Networks. The system captures the heart rate, cadence, distance, foot steps taken and environmental temperature of a user to deliver health services. It integrates and encodes information into FIT files, such as heart rate, user profile etc. These FIT files are available for download to the other applications which have the access rights and decoding capability based on FIT data format. Such applications can store this data into different format for predictive and descriptive analysis. The system is under development and possess a very flexible architecture to integrate more sensors to deliver more robust services. It uses an automatic parametric approach to buildup a flexible and scalable architecture.

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