Cloud Computing based real time telemedicine System

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***Abstract*—In this paper, we have presented a cloud computing based telemedicine system. Main aim of this system is to provide the patients timely and proper help. Telemedicine system allows the patient to be monitored remotely from their home itself. The patient monitoring system is used to monitor basically a patient's heart and respiratory rates. In this paper we have proposed cloud based design. We proposed to transfer this data via public cloud from local PC to physician network to monitor the remote patient health status and take necessary aid. We also studies advantages and challenges of proposed system. The system is useful for monitoring the patient's condition from a distance. Due to use of zigbee, this system is Flexibility, Low Cost, Small Hardware Low Power Consumption.**

Keywords— Telemedicine System, Cloud Computing, Distributed System, Introduction

I. INTRODUCTION

Remote Patient Monitoring system allows the patient to be monitored remotely from their home itself. The patient monitoring system is used to monitor basically a patient's heart and respiratory rates. It accomplishes this by using electrodes to obtain an ECG signal to measure heart rate and by using a pressure sensor to measure a person's diaphragm contractions as they breathe. The patient monitoring system collects heart rate information via electrodes, and respiratory rate information via a patient monitoring system placed around a patient's stomach. Data is digitized with an 89s52 microcontroller This information is then communicated with a laptop or pc using a ZIGBEE module.

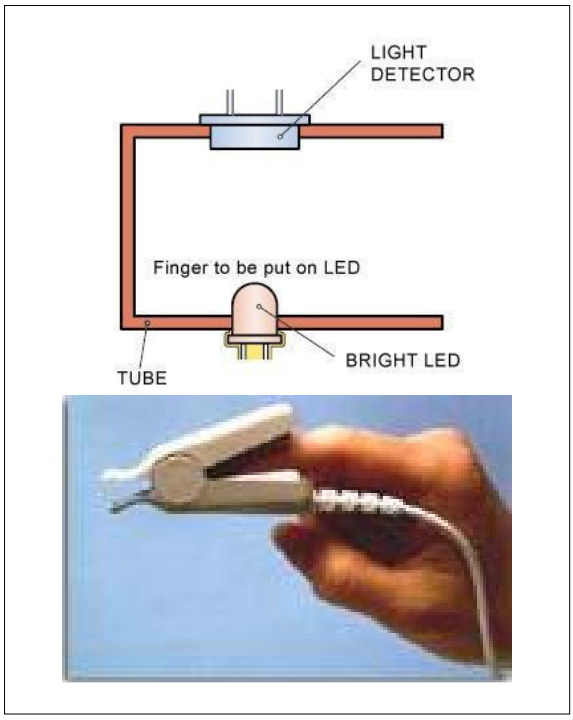
We proposed to transfer this data via public cloud from local PC to physician network to monitor the remote patient health status and take necessary aid. Software on the physician PC will displays the information in a useful format, and provides alerts to medical staff when a patient's heart or respiratory rate falls outside of normal bounds. The patient monitoring system both improves the quality of patient monitoring and eliminates the need for nurses to repeatedly manually perform these measurements.

II. *SIMPLE DESIGN OF PATIENT MONITORING SYSTEM- AN EXAMPLE*

A. Pulse Rate Measurement

The sensor consists of a super bright red LED and light detector. The LED needs to be super bright as the light must pass through finger and detected at other end. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque 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 on top by a LED which blinks on each heart beat.[3][4]

Fig. 1. Pulse Rate Measurement



B. ECG

The circuitry will consist of protection circuit, an instrumentation amplifier, isolation circuit, a high-pass filter, low pass filter, amplifier, notch filter, and adder. Two electrode of chest connect to input of instrumentation amplifier through protection circuit of diodes. 10Kohm resister used for current limiting purpose [5][17]

C. Temparature circuits

The following schematic shows typical application circuit diagram of LM35 on temperature to digital converter. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. This IC features: Linear + 10.0 mV/°C scale factor; Calibrated directly in ° Celsius; 0.5°C accuracy guarantee able (at +25°C); Low impedance output, 0.1 W for 1 mA load; etc. The resolution of LM35 is 1o mv / 10 degree centigrade. So when the sensor is placed on the arm pit of the patient the o/p of the LM35 sensor is 370 mv (37 degree centigrade) ,which is more than enough for the internal 10 bit ADC of PIC µC to digitize the analog signal . So the LM35 sensor is directly attached to the ADC i/p of PIC µC and no signal conditioning is required.[2]

D. Microcontroller

The microcontroller used for the patient monitoring system project is an 8-bit microcontroller. This component was chosen for its on-chip 8-channel ADC, its straight-forward serial communications interface, and its ease of use. In our design, the heart rate and respiratory rate circuits feed into the first two ADC pins of port a (pins 39 and 40). It is also critically important that at least one of the other pins of port A is connected to ground through a pull-down resistor. This is to provide the microcontroller software with a way to reset the values on the ADC multiplexer, and is described in more detail in the software section. Serial communication is accomplished through the first two pins of port D (pins 14 and 15). These pins feed directly into the RS232 transmitter.

E. Zigbee Module

Zigbee Features:

1. Indoor/Urban: up to 100' (30 m)
2. Outdoor line-of-sight: up to 300' (100 m)
3. Transmit Power: 1 mW (0 dBm)
4. Receiver Sensitivity: -92 dBm

The XBee RF Modules interface to a host device through a logic-level asynchronous serial port. Through its serial port, the module can communicate with any logic and voltage compatible UART; or through a level translator to any serial device (For example: RS-232/485/422 or USB interface board).Data enters the module UART through the DI pin (pin 3) as an asynchronous serial signal. The signal should idle high when no data is being transmitted. The module UART performs tasks, such as timing and parity checking, that are needed for data communications. Serial communications depend on the two UARTs to be configured with compatible settings (baud rate, parity, start bits, stop bits, data bits) XBEE module works on TTL TxD and RxD pins so we can directly connect the µC TxD pin to the XBEE RxD pin and the G RxD pin to the XBEE TxD pin.Advantages of Zigbee are [1]

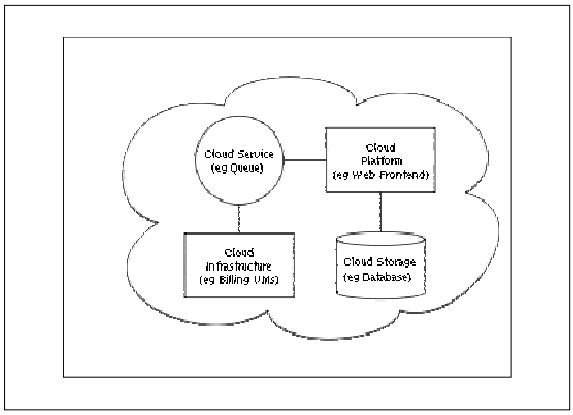
- Flexibility
- Low Cost
- Small Hardware
- Low Power Consumption

F. RS232 Standards and MAX232

An interfacing standard RS232 was set by the Electronics Industries Association (EIA) in 1960. The standard was set long before the advent of the TTL logic family, its input and output voltage levels are not TTL compatible. In RS232, a 1 is represented by -3 ~ -25 V, while a 0 bit is +3 ~ +25 V, making -3 to +3 undefined. We need a line driver (voltage converter) to convert the R232's signals to TTL voltage levels that will be acceptable to 051's TxD and RxD pins.[16]

III. *CLOUD* COMPUTING AND PROPOSED SYSTEM

Fig. 2. cloud computing sample framework



Cloud computing is a phrase used to describe a variety of computing concepts that involve a large number of computers connected through a real-time communication network such as the Internet. [6] Many expert defined meaning of Cloud computing in their own way. Generally Accepted definition given by the National Institute of Standards and Technology (NIST) is "Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (such as networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."[7][8] Cloud computing is increasingly becoming popular in between researches, academicians, student, business organizations and their consumer and even government organization. Cloud computing is on demand computing that does not reside at the users' premise.[14][15]

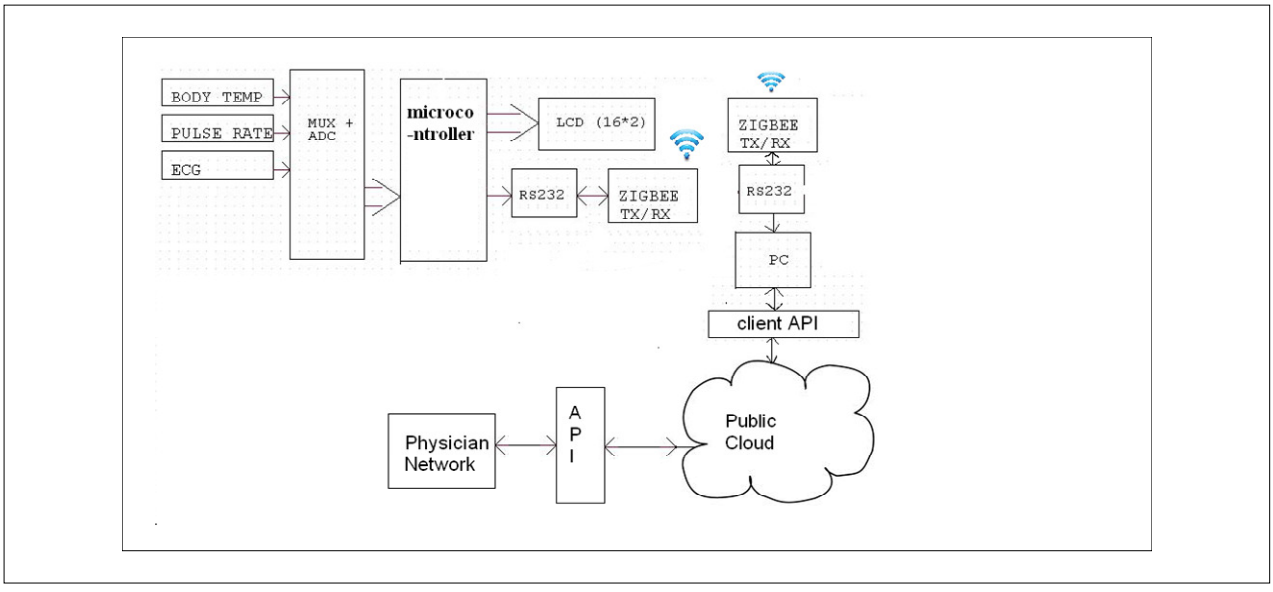
We have proposed a hybrid frame work by integrating embedded system application with cloud computing to monitor the remote patient health status and take necessary aid. In this paper we have given simple example of designing a low cost ECG machine, Pulse rate measurement and Body Temperature measurement machine and certain discrete components then Data digitization with a microcontroller. We also revisited use of ZIGBEE RF MODULE to transfer this data to local PC. Finally we also explored a way to transfer data over public cloud to the physician and other medical staff for monitoring, diagnosis and patients care at a significantly low cost, regardless of patient's location. The information becomes available in the cloud from where it can be processed and/or assessed by expert systems and distributed to medical

staff.[9] The use of Cloud computing not only allows us to avoid upfront infrastructure costs but also allows getting process speed. It also improves manageability .And over all it requires no maintenance cost. Cloud is full of big amount of memory, high bandwidth and other features which makes the data processing faster and also provide quick response to medical staff [10].

Due to Communication between Local PC to Remote PC (Medical Staff Network) over cloud, it also simplifies healthcare management by supporting notifications for prescribed medications from doctor, taking doctor appointments etc.

The sensors proposed and utilized used in our article are of cheaper and build quality and therefore accuracy has to be kept in mind when we take this approach to build a highly sensitive system where a patient's life is of great importance. In future, if we are going to build a same system with high accuracy sensors, then the system will be very much effective and possess excellent quality. System can be effectively extended by adding more devices like BP monitors, SpO2, Weighing Scales, Pedometers, Bedside Monitors and more. Also challenges discussed in this paper must be considered while developing this type of system. System can be effectively extended by developing remote patient monitoring applications for Android and iOS devices for real time remote patient management.[18][19][20][21]

Fig. 3. Proposed cloud based patient monitoring System



IV. ADVANTAGES OF CLOUD BASED REMOTE PATIENT MONITORING SYSTEM

Main advantages of the system are agility, reliability, portability, real-time, flexibility etc. [11] Brief Advantages are given below.

- Reduce spending on technology infrastructure-It requires less cost and money to be spent on technology infrastructure.
- Incremental Growth- dynamically scalable services.
- Reduce capital costs.
- Improve accessibility. Monitor projects more effectively.
- Less personnel training is needed.
- Minimize licensing new software.
- Improve flexibility-Cloud Computing ensure on-demand access to a pool of computing resources.
- Speed and Performance.
- Easier maintenance
- Disaster Recovery
- Work from anywhere- Location Independence
- Availability of Historical as well as present Information for Data Mining.

V. CHALLENGES OF CLOUD BASED REMOTE PATIENT MONITORING SYSTEM

Main challenge of this Cloud based system is the servers are out of your hands. What this means is that you need to choose a company for hosting that has a strong and reliable cloud server system. Continuous data connectivity is needed between end patient sensor network and Cloud server also between cloud server and Medical Staff network. [12] Cloud infrastructure is vulnerable and more prone to complicated distributed intrusion attacks e.g distributed denial of service, cross-site scripting etc [13]. Another challenge is there is no standardization and there are thousands of medical devices that operate on a variety of protocols. Design of a standardized and secure data transmission solution between medical devices and back-end systems is big Challenge.

VI. CONCLUSIONS

The system is useful for monitoring the patient's condition from a distance. Due to use of zigbee, this system is Flexibility, Low Cost, Small Hardware Low Power Consumption. Cloud computing is a type of computing that relies on sharing computing resources rather than having local servers or personal devices to handle applications. Use of Cloud computing not only allows us to avoid upfront infrastructure costs but also allows getting process speed. It also improves manageability. Over all it requires no maintenance cost.

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