Secure Transmission Of IOT Mhealth Patient Monitoring Data

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Abstract- *Telemedicine is a rapidly developing application of clinic medicine where medical information is transferred through the phone or internet or other networks for the purpose of consulting and performing remote medical procedures or examinations. Telemedicine can be applied to a greater extend in the field of bio-medical. This paper elaborates the experience; a methodology adopted and highlights various design aspects to be considered for making telemedicine in patient monitoring system effective. In our work, the patient's authentication is notified. Also, the patient's vital sign of pulse rate is captured and the values are entered into the database. It is then uploaded into the web based server and sent to the government database using ANDROID technology. For this implementation, Arduino mega controller has chosen to monitor the status of the patient. This paper describes the monitoring human health using Internet Of Things (IOT) from a remote location .The main aim of this paper is a doctor can monitor individual health condition from anywhere in the world. This can be achieved by fetching the measured data from the Sensor node located on individual premises and send the same to the Central Node through wireless communication modules. This data can upload to the web world which could be accessed by the doctor using a web interface. Sensor Node: This includes two sensors for measuring patient body temperature and Heartbeat. These measured parameters can be transmitted to the Central Node using GSM Network.*

Keywords- Arduino mega, Liquid crystal display (LCD), Pulse sensor, Wi-Fi

I. INTRODUCTION

In this busy life, people don't have enough time to visit a doctor for the routine check-up so the health issues go on increasing and people suffer from it. The Same scenario is faced by senior citizen's they cannot visit the hospitals regularly. People are also not ready to wait in the queue and appointments for the check-up. Sometimes if the person is suffering from a major health condition and the treatment is not available in the nearby locality so he has to travel all the way to the place where the treatment is available. With the help of the remote health monitoring system, you can check your health parameters by sitting at your home and you can also share these parameters with your doctor who is not in the nearby locality. If the patient is suffering from a major health issue and the present doctor is unable to help him, he can also show the parameters to the doctor who can help him in any condition. If the treatment is not available in your country you can also go for doctors in abroad, and take suggestions from them. With the use of remote health monitoring system using Internet of Things (IoT) the death rate due to simple health issues can be reduced and lifestyle of people can be improved. The remote health monitoring system is small and portable, the patient can take the device with himself wherever he wants to. This device is a kind of one-time investment the servicing is very low and is very durable. If any major changes are identified then it is notified.

Among the panoply of applications enabled by the Internet of Things (IoT), smart and connected health care is a particularly important one. Networked sensors, either worn on the body or embedded in our living environments, make possible the gathering of rich information indicative of our physical and mental health. Captured on a continual basis, aggregated, and effectively mined, such information can bring about a positive transformative change in the health care landscape. In particular, the availability of data at hitherto unimagined scales and temporal longitudes coupled with a new generation of intelligent processing algorithms can: (a) facilitate an evolution in the practice of medicine, from the current post facto diagnose-and treat reactive paradigm, to a proactive framework for prognosis of diseases at an incipient stage, coupled with prevention, cure, and overall management of health instead of disease, (b) enable personalization of treatment and management options targeted particularly to the specific circumstances and needs of the individual, and (c) help reduce the cost of health care while simultaneously improving outcomes. In this paper, we highlight the opportunities and challenges for IoT in realizing this vision of the future of health care. The modern visionary of healthcare industry is to provide better healthcare to people anytime and anywhere in the world in a more economic and patient friendly manner. Therefore for increasing the patient care efficiency, there arises a need to improve the patient monitoring devices and make them more mobile. The medical world today faces two basic problems when it comes to patient monitoring. Firstly, the needs of health care's provider's presence near the bedside of the patient and secondly, the patient is restricted to bed and wired to large machines. In order to achieve better quality patient care, the above cited problems have to be solved.

As the bio instrumentation, computers and telecommunications technologies are advancing, it has become feasible to design more portal vital sign Tele-monitoring systems to acquire, record, display and to transmit the physiological signal from the human body to any location. Recent works in communication technologies have inspired the development of telemedicine to a large extent. Telemedicine benefits not only the customers who are able to receive health care more efficiently; it also benefits the doctors who can streamline their efforts to assist more patients.

II. PROPOSED SYSTEM

This thesis is organized into four chapters including this chapter, the descriptions about each chapter is as follows the Arduino platform provides an integrated development environment (IDE) based on the Processing paper, which includes support for C and C++ programming languages. Every circuit needs a source to give energy to that circuit. The Source wills a particular voltage and load current ratings. An LCD is a small low cost display. It is easy to interface with a micro-controller because of an embedded controller(the black blob on the back of the board).This controller is standard across many displays which means many micro-controllers have libraries that make displaying messages as easy as a single line of code.

III. SYSTEM ARCHITECTURE

A wearable device is placed on human's waist. The system can detect the elder's falling by acceleration analysis. Then it will get the elder's geographic position and send fall alarm short message to caregivers. So the elderly who has fallen can get timely help to minimize the negative influence.

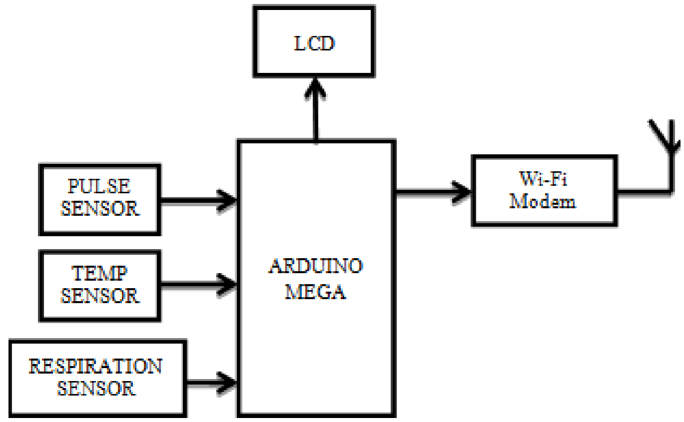

Fig 1 Wireless sensor network

A. System and Sensors

A multi-functional data acquisition board has been used incorporating temperature and humidity sensors. Besides, it offered a convenient solution to add any custom sensing application in future research. To detect the impact of accidental falls, a small low power tri-axial accelerometer is used as shown in Fig. 2. It can measure the static acceleration of gravity in tilt-sensing applications. Also, it can measure the dynamic acceleration results from motion, shock, or vibration. This specified accelerometer will output acceleration in all three axis at every sample point, with units of m/s2. The output is an analog signal which must be converted by an ADC before sending to the MCU. However, the other smart sensors used in this system are utilized to detect the heartbeat pulse with sensitivity 0.2mv/pa.

A. MCU System

The key component of this system is a MCU with 128K flash memory. It is a compromise between relatively high performances vs. low-power (2.7-5.5V). This high-density nonvolatile memory based MCU provides an embedded 8- channel, 10-bit ADC, and provides a highly flexible and cost effective solution to many embedded control applications. Information gathered by accelerometer is converted in the chip and forwarded to the wireless communication module along with pulse signals.

The data gathered from a participants body is appended with a unique ID and transmitted to a remote laptop by the wireless receiver with type number of the base station being used. As is shown in Fig. 3, a user interface is designed to display the accelerometer and heart rate signal. The interface can monitor four participants' data at the same time. In each part, data curves are illustrated on upper left and real-time data are shown on the right of the curves. Once the alarm is triggered, a red marked warning will be shown at the bottom left part of the monitors. In order to assure that a caregiver, or relatives, get real-time and accuracy information, the location of the wireless sensor network is significant. Modern wireless sensor networks have been highly normalized by ZigBee, but they cannot efficiently handle the specific tasks due to the constrained environment. In order to do so, the wireless communication stack in the wireless sensor network needs to be optimized so many sensor nodes need to be put in one base station. Every sensor node can be freely configured as a master or slave. Considering ZigBee transmission power, propagation does not reliably pass through modern construction walls to the base station. Therefore the base station usually does not receive the signal transmitted from a neighboring room. The sensor nodes represent the accelerometer or cardio tachometer, which could be located anywhere in the house. The signal from wireless module can be transmitted directly to base station or through the fixed access point. The system employs mesh networking to enable communication when it encounters problems of connecting to the base station directly.

B. Arduino Mega

The Arduino MEGA 2560 is designed for this paper that require more I/O lines, more sketch memory and more RAM. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotic papers. This gives your paper plenty of room and opportunities maintaining the simplicity and effectiveness of the Arduino platform.

Fig 2 Arduino Mega

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

C. Power

The Mega 2560 can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

D. Memory

The ATmega2560 has 256 KB of flash memory for storing code (of which 8 KB is used for the boot loader), 8 KB of SRAM and 4 KB of EEPROM (which can be read and written with the EEPROM library).

IV. LIQUID CRYSTAL DISPLAYS

An LCD is a small low cost display. It is easy to interface with a micro-controller because of an embedded controller(the black blob on the back of the board).This controller is standard across many displays which means many micro-controllers have libraries that make displaying messages as easy as a single line of code. LCDs with a small number of segments, such as those used in digital watches and pocket calculators, have individual electrical contacts for each segment.

An external dedicated circuit supplies an electric charge to control each segment. This display structure is unwieldy for more than a few display elements. Small monochrome displays such as those found in personal organizers, or older laptop screens have a passive-matrix structure employing super-twisted pneumatic (STN) or double-layer STN (DSTN) technology—the latter of which addresses a color-shifting problem with the former—and color-STN (CSTN)—wherein color is added by using an internal filter. Each row or column of the display has a single electrical circuit.

The pixels are addressed one at a time by row and column addresses. This type of display is called passive-matrix addressed because the pixel must retain its state between refreshes without the benefit of a steady electrical charge. As the number of pixels (and, correspondingly, columns and rows) increases, this type of display becomes less feasible. Very slow response times and poor contrast are typical of passive-matrix addressed LCDs.

High-resolution color displays such as modern LCD computer monitors and televisions use an active matrix structure. A matrix of thin-film transistors (TFTs) is added to the polarizing and color filters. Each pixel has its own dedicated transistor, allowing each column line to access one pixel. When a row line is activated, all of the column lines are connected to a row of pixels and the correct voltage is driven onto all of the column lines.

V. EXPERIMENT RESULTS

A. Pulse Sensor

The front of the sensor is the side with the heart logo. This is where you place your finger. On the front side you will see a small round hole, from where the Kingbright's reverse mounted green LED shines. The LED is a small ambient light photo sensor is used in cell phones, tablets and laptops to adjust the screen brightness in different light conditions. On the back of the module you will find the rest of the components including a microchip's MCP6001 Op-Amp and a bunch of resistors and capacitors that make up the R/C filter network. There is also a reverse protection diode to prevent damage if the power leads are accidentally reversed. The module operates from a 3.3 to 5V DC Voltage supply with a operating current of < 4mA.

Optical heart-rate sensors are very easy to understand in theory. If you've ever shined a flashlight through your finger tips and seen your heartbeat pulse, you have a good handle on the theory of optical heart-rate pulse sensors. A pulse sensor or any optical heart-rate sensor, for that matter, works by shining a green light (~ 550nm) on the finger and measuring the amount of reflected light using a photo sensor. This method of pulse detection through light is called Photoplethysmogram.

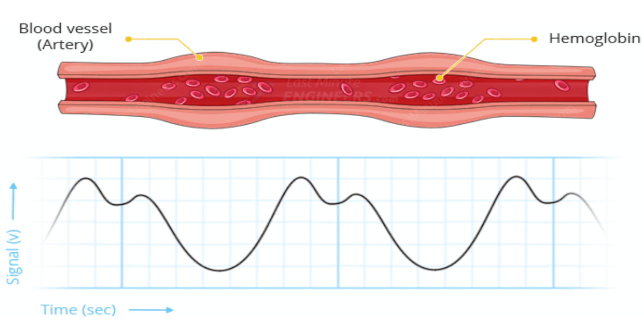

Fig 3 Pulse Detection

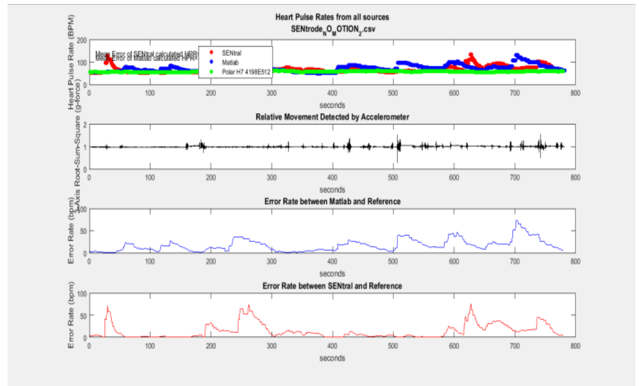

Fig 4 Pulse rate Sensor

The oxygenated hemoglobin in the arterial blood has the characteristic of absorbing green light. The redder is the blood (the higher the hemoglobin), the more green light is absorbed. As the blood is pumped through the finger with each heartbeat, the amount of reflected light changes, creating a changing waveform at the output of the photo sensor.

B. Respiration Sensor

Air and gas flows as well as line and therapy pressures have to be monitored and controlled in numerous medical instruments such as respiratory devices, anesthetic devices, sleep diagnosis devices, sleep apnea therapy devices (CPAP), Spiro meters and oxygen concentrators. High-quality sensors in respiratory devices measure minute flow rates around the zero point of the respiratory flow and also detect flow rates of several hundred l/min. Applications in anesthetic devices call for sensors with high resistance to anesthetics. In controlled CPAP devices, pressure sensors continuously monitor the therapy pressure, thereby improving the comfort and quality of the treatment. Spiro meters utilize special pneumotachographs that measure the respiratory flow using efficient differential pressure sensors. First Sensor develops and manufactures highly reliable sensors and customized sensor systems as a strategic partner to medical product manufacturers in the area of breathing and respiration. Our complete advisory, development, production and service processes comply with the high requirements for medical products according to EN ISO 13485.

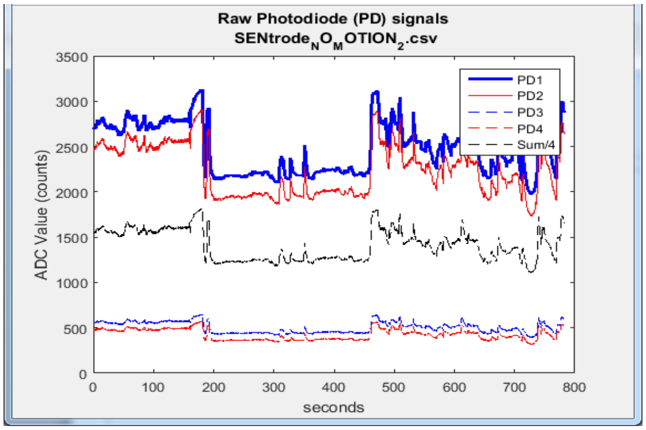

Fig 5 Respiration Sensor

Flow rate measurement with mass flow sensors, Volume flows in respiration can be measured directly with highly sensitive and rapid thermal mass flow sensors. The air or gas flow from a heating element located between temperature-sensitive resistors is heated slightly here. If the temperature profile in the medium is shifted by a mass flow, a flow-dependent voltage signal is generated via the temperature difference at the resistors. First Sensor develops and manufactures customized thermal MEMS mass flow sensors within a modular technology platform. At the same time, we offer complete packaging technologies so as to realize complex integrated solutions from individual chip elements. First Sensor provides integrated analog or digital signal processing along with individual sensor calibrations and programming for all sensors. For the demanding requirements in respiratory devices, special solutions are available with very fast response times <2 ms as well as very high resolutions and, at the same time, large dynamic ranges for measurements up to 300 l/min. To this end, the sensor element can be located in the main flow or in a bypass channel. Customized flow sensors from First Sensor enable easy integration in end devices, cost savings during instrument development and competitive advantages thanks to short development cycles for you as a medical product manufacturer.

Flow rate measurement with differential pressure sensors, an indirect method for volume flow measurement involves measuring the pressure drop via a flow element. If respiratory air or gas flows through an artificial constriction in the flow line with a very low flow resistance, for example a screen or a laminar flow element, a minimal pressure drop results over the element, this representing a measure for the volume flow. These low differential pressures can be logged with highly accurate sensors and converted into an electrical signal. The differential pressure sensor is located in a bypass to the main flow line.

C. Body Temperature Sensor

A temperature sensor is a device used to measure temperature. This can be air temperature, liquid temperature or the temperature of solid matter. There are different types of temperature sensors available and they each use different technologies and principles to take the temperature measurement. These types of temperature sensor vary from simple ON/OFF thermostatic devices which control a domestic hot water heating system to highly sensitive semiconductor types that can control complex process control furnace plants. We remember from our school science classes that the movement of molecules and atoms produces heat (kinetic energy) and the greater the movement, the more heat that is generated.

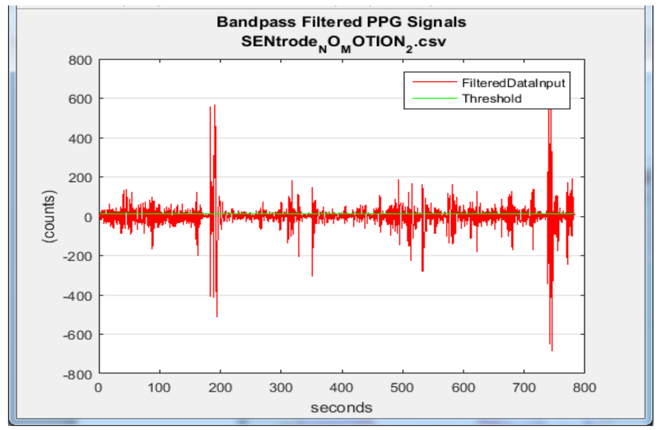

Fig 6 Temperature Sensor

Temperature Sensors measure the amount of heat energy or even coldness that is generated by an object or system, allowing us to “sense” or detect any physical change to that temperature producing either an analogue or digital output.

VI. CONCLUSION

The Remote viral fever recording system has been completed successfully and the output results are verified. The results are in line with the expected output. The paper has been checked with both software and hardware testing tools. In this work LCD, Arduino controller, Pulse sensor, Relay, RF Module along with Android mobile are chosen are proved to be more appropriate for the intended application. The paper is having enough avenues for future enhancement. The paper is a prototype model that fulfills all the logical requirements. This paper with minimal improvements can be directly applicable for real time applications. Thus the paper contributes a significant step forward in the field of bio medical Monitoring system, and further paves a road path towards faster development s in the same field. This paper is further adaptive towards continuous performance and peripheral up gradations.

This work can be applied to variety of industrial and commercial applications

Data Acquisition is performed by multiple wearable sensors that measure physiological biomarkers, such as ECG, skin temperature, respiratory rate, EMG muscle activity, and gait (posture). The sensors connect to the network though an intermediate data aggregator or concentrator, which is typically a smart phone located in the vicinity of the patient. The Data Transmission components of the system are responsible for conveying recordings of the patient from the patient's house (or any remote location) to the data center of the Healthcare Organization (HCO) with assured security and privacy, ideally in near real-time. Typically, the sensory acquisition platform is equipped with a short range radio such as Zigbee or low-power Bluetooth, which it uses to transfer sensor data to the concentrator. Aggregated data is further relayed to a HCO for long term storage using Internet connectivity on the concentrator, typically via a Smartphone's Wi-Fi or cellular data connection. Sensors in the data acquisition part form an Internet of Things (IoT)-based architecture as each individual sensor's data can be accessed through the Internet via the concentrator. Often a storage/processing device in vicinity of a mobile client, sometimes referred to as a cloudlet, is used to augment its storage/processing capability whenever the local mobile resources do not fulfill the application's requirements. The cloudlet can be a local processing unit (such as a desktop computer) which is directly accessible by the concentrator through Wi-Fi network. In addition to providing temporary storage prior to communication of data to the cloud, the cloudlet can also be used for running time critical tasks on the patient's aggregated data. Moreover, the cloudlet can be used to transmit the aggregated data to the cloud in case of limitations on the mobile device such as temporary lack of connectivity or energy.

Physiological data is acquired by wearable devices that combine miniature sensors capable of measuring various physiological parameters, minor preprocessing hardware and a communications platform for transmitting the measured data. Table I summarizes various biomarkers that can be measured by current or soon-to-be-available wearable sensors. The level of applicability of these biomarkers to diagnosing four common disease categories is also indicated in the table. The wearability requirement, poses physical limitations on the design of the sensors. The sensors must be light, small, and should not hinder a patient's movements and mobility. Also, because they need to operate on small batteries included in the wearable package, they need to be energy efficient. Though the battery may be rechargeable or replaceable, for convenience and to ensure that data is not lost during recharging or battery replacement periods, it is highly desirable that they provide extended durations of continuous operation without requiring charging or replacement.

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