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Wearable Vital Signs Monitoring System

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***Abstract:** Microcontroller MSP430 adaptation with an android application is particularly expected for physiological signs observing framework and long distance communication between patient and specialists. This device obtains all sensor data and trades data through secured remote system with low bandwidth, continuously working without human interference. Power from the battery banks will be used by controller to monitor BP, temperature, heart rate levels and transmit SoS data using Wi-Fi with MQTT design exceptionally intended for low bandwidth interface. The system includes control unit, sensory unit, communication unit and battery banks. Expected outcome of this system will use devoted unit for each patient with a secured IP and QoS level three secured MQTT with settled sensors, low power controller with a energy bank will be interfaced and particular firmware using RTOS will be made to do the endeavors.*

***Index Terms:** BP, health monitoring, heart rate, MQTT, temperature, pulse oximetry, wireless.*

I. INTRODUCTION

The proposed system is used to screen the sensor status connected to the patients and sends the required information utilizing dedicated low bandwidth with secured QoS level three. This system is powered by lithium ion battery bank. Low power controller with Wi-Fi developed by Texas instruments is been utilized to design working prototype.

Development in tele-medicine devices for remote assisting purpose covers wide area. Any minor deviation or human error can lead to major uncontrollable damages or even loss of life. Observing and processing data in real time with each patient is considered as critical part due to emergency conditions, any variation can occur at any time which the dedicated personnel is not aware. Leading to severe trauma causes multiple organ failure and even death.

At first, sensor device is connected to master network to ensure linked communication is successful which is done by using MQTT protocol. After this sensor will start acquisition process. Then every acquisition data will be sent to master network which is forwarded to cloud which will be accessed by authorized doctors.

Every time data is published to cloud by device and subscribe to corresponding command by the device will be allowed to pass only through QoS, a dedicated port with a IP is been used with gadget with 1 Kb bandwidth.

System will send and receive data as a message and responds only when needed, with low power consumption and allows other unit to use the channel when it is free. Main advantage of using this technique is distinctive topic for subscribed and published messages which will be done by the allotted gateway that helps in avoiding the collision caused due to over traffic.

An incessant wearable vital signs monitoring designed for communicating in a longer distance from patient to doctors or concerned person. Existing structure running on OFC, wired and short range wireless link to exchange data amongst patients and doctors, have its own specific limitation. With instant steady upkeep, transportation, and dedicated personals which costs more to corresponding family members.

II. PROPOSED METHOD

System design as shown in figure 1 with sensory part and various other functions monitored by microcontroller (MSP430F5529). Continuous system operations and communications are done using SOC for ceaseless checking of different sensors. Wi-Fi module is interfaced with MSP controller utilizing serial peripheral interface which associates with AWS utilizing reserved IP and a gateway port with the end goal of publishing message according to corresponding subjects. Membership to comparing theme distributed by client utilizing Wi-Fi must be done to get message. Access between AWS customer and host is done utilizing light weight MQTT protocol.

Three sensors are utilized to screen essential parameters like BP, heart rate and body temperature which is measured by utilizing thermometer of one-wire protocol, BP unit with inflate and deflate controller for estimation of systolic and diastolic pressures with a PPG unit at fingertip for BPM estimation.

The entire device works at low power 3.3 V at 300 mA, however yield of the battery bank is around 5 V to diminish this voltage, 3.3 V LM1117 (LDO) voltage controllers is utilized. LCD 16x2 display data of temperature in degrees, heart rate in BPM, BP in systolic and diastolic pressures. To alarm close-by guardian or doctor, if there are any changes in the physiological data, a piezoelectric ringer working at 3 kHz is utilized

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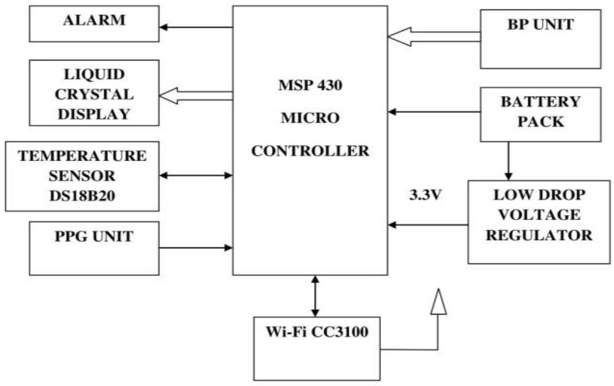

Fig. 1 System Block Diagram

Emergency assistance system represents the system design in association with client interface shown in Figure 2. This framework is divided into three sections. Section one includes sensors, section two is cloud with MQTT agent and other section has user end application. Access to MQTT broker is done by associating with particular modems through web. Wi-Fi interfaces with this modem by utilizing join organize summon with a SSID and a secret key of 128-bit. When gadget is associated with broker through AWS, it starts distributing or subscribing the messages. Client can get to the data by an application which is introduced on android phone.

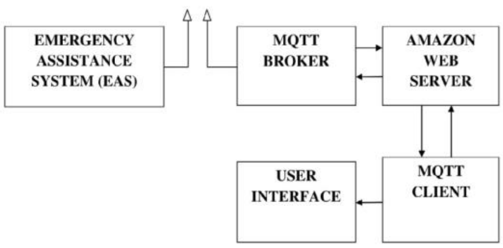

Fig. 2 Communication Unit

A. Heart Rate Unit

Heart rate estimation is done through fingertip circuit, the infrared LED and photodiode used for finger photoplethysmography. The new frame uses the TCRT1000 reflective optical sensor for photoplethysmography. TCRT100 revises the arrangement of the sensor part of the endeavor as both the infrared light emitter diode and the receiver are planned one alongside the other in a leaded package. The resulting pulse can be managed to be sent either to an ADC channel or a microcontroller for further dealing and recovering the heart rate in beats per minute (BPM).

The Figure 3 shows a fundamental reflectance PPG test to separate the beat signal from the fingertip. Hence, the reflected light power fluctuates with the beating of the blood with heart beat called PPG (photoplethysmography) signal. The PPG signal has two parts, as often as possible alluded to as AC and DC. The AC part is brought on by pulsatile changes in blood vessel blood volume, which is synchronous with the heart beat and DC part identifies with the tissues and to the normal blood volume.

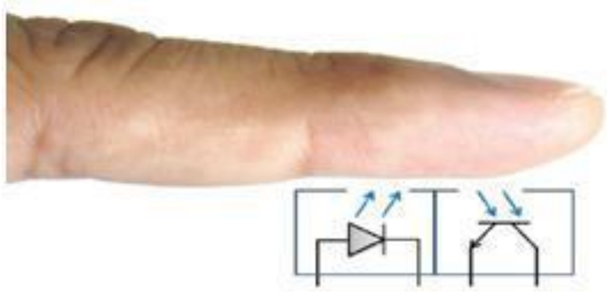

Fig. 3 Finger Photoplethysmography (Reflectance Approach)

B. Blood Pressure Unit

Blood pressure unit can measure patient's blood pressure through an inflatable cuff. The device is consist of three major parts. First is the outer hardware (for example cuff, motor, valve, and LCD), second is a simple circuit, and third is a microcontroller. The analog circuit converts the pressure value inside the cuff into readable data in the form of waveforms. The Microcontroller tests the waveforms and converts into digital form with ADC so that further calculations can be made. Later microcontroller controls the operation of the device. Since device has compact structure assembled in one bundle which permits a patient to take it anyplace and perform the operations wherever and whenever needed as shown in figure 4.

Fig. 4 Portable Blood pressure Unit.

C. Temperature Sensor

Temperature senor DS18B20 has 64-bit serial code, which works on 1-Wire protocol with one I/O to send and receive data with low speed. This protocol is utilized for small devices with low transfer speed for example thermometers, climate gadgets etc. Figure 5 shows a spill proof temperature sensor.

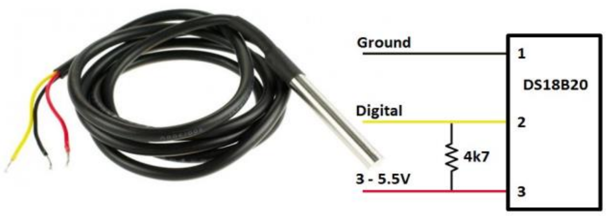

Fig. 5 Temperature Sensor

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III. NETWORK

Tele-medicine is the one of the critical part in the design network and at first, pressure will be created on the server and lags information that needs to be exchanged between the patient and specialist as shown in the Figure 6.

System linked with series of local Wi-Fi, sensors, master node and internet connection.

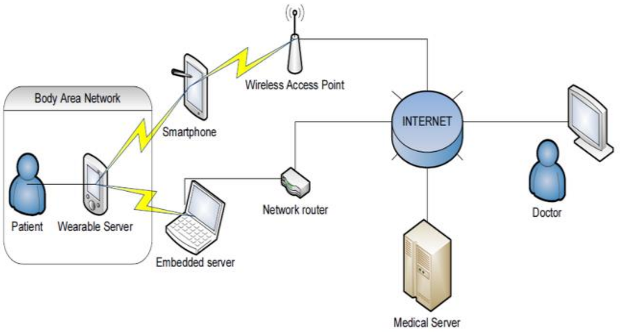

Fig. 6 Architecture of Tele-Medicine Network

Firstly, sensors are connected to a master network to make sure that the linked communication is successful using MQTT protocol. Acquisition process begins and the data will be sent back to the master network and sent to the cloud which can be accessed by only by corresponding specialists.

As data is sent continuously to cloud by the device and authorized and subscribed only with command given by the device and then passed only through QoS, a dedicated port with secured IP. Device provides acknowledgement, allowing continuous hassle free communication using 1 Kb bandwidth.

Device responds only when needed with low power consumption and allows other unit to use the channel when it is free. Main advantage of using this technique is distinctive topic for subscribed and published messages which will be done by the allotted gateway that helps in avoiding the collision caused due to over traffic.

IV. RESULTS AND DISCUSSIONS

The proposed design aims and strategizes for observing of physiological vital signs on the web in order to help the patient to maintain their health stability. Monitoring of circulatory strain (blood pressure), heart rate and body temperature are calculated and displayed with real time basics and will be continuously monitored by the doctors via alert messages.

The proposed framework is exceptionally proficient to perceive any change in essential signs and takes about not as much as milliseconds to recognize the risk levels of a patient. There is no huge memory required by the algorithm. The proposed algorithm can be tried to numerous clients can get to the data of the patient. The accompanying cases are the ac-quired results for various contextual investigations under figure no. 7,8 and 9.

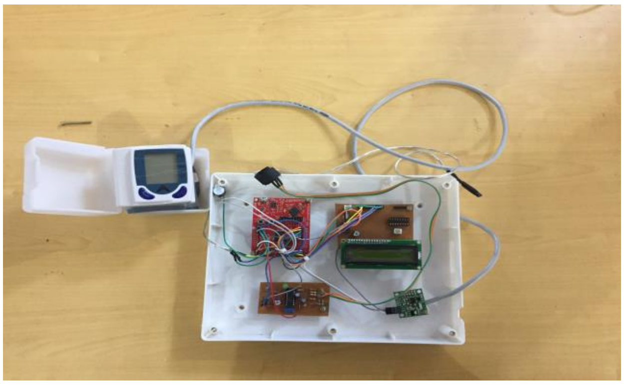

Fig. 7 System Prototype

Fig. 8 LCD Displaying Temperature and Pulse of the Patient

Fig. 9 LCD Displaying BP of the Patient

V. CONCLUSION

This system is less costly by engaging in home monitoring of patients compared to the expensive workplaces, diminishing the necessity for transportation of patients to specialists. The dynamic electronic gadget structure is to monitor the data from various sensor and heartbeat unit, helping the doctors to observe and screen the condition of the patient through web. This proposed development improves the lifestyles of the general population. By realizing the proposed work, the principal signs estimation precision (in-side allowable ±2% error).

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