Original Research Paper

Volume-8 | Issue-4 | April-2018 | PRINT ISSN No 2249-555X

Engineering

MODULAR HEALTH CARE MONITORING FOR PATIENTS USING IOT

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ABSTRACT Resent Developments in the data and communication technologies have led to the emergence of Internet of Things (IOT). The proposed system mainly aims at paralyzed patients who stay alone at home. The important health parameters are measured and information is transmitted through a wireless communication that is further transferred to a network via a Wi-Fi module, promoting the reception of the current status of the patient at any time. The different sensors viz temperature sensors , heart beat sensor, respiration sensor, acceleration sensor and Electrocardiogram(ECG) are connected to the Peripheral Interface Controller (PIC) microcontroller board which gathers the information i.e. medical information from the sensors and the detected medical data is transmitted to the server. The sensors are interfaced to PIC using Analog to Digital Converter (ADC), Universal Asynchronous Receiver-Transmitter (UART), and Inter-integrated Circuit (I^2C) protocol. The parameter combinations can be selected using Dual In line Package (DIP) switch and can be seen on the LCD screen. The data is sent to server using IOT device. The "Thing speak" is employed here to position the detected data into the server. Any abnormality in ECG signal is not only seen in ThingSpeak app but also sent as message to the nurse.

KEYWORDS : ADC, UART, temperature sensors, heart beat sensor, respiration sensor, acceleration sensor, ECG, PIC microcontroller, DIP switch, ThingSpeak.

I. INTRODUCTION

Health is an important part that humans want for a proper life. Nowadays Internet of Things (IOT) is widely used and is a vast internetwork of things. IOT is a combination of hardware and software Technology that makes a very large amount of data by connecting multiple devices and sensors with the cloud and making sense of data with intelligent tools. Capturing and sharing of important knowledge of the network connected devices through secure service layer is what defines IOT.

A lot of advancement and important changes are occurring in the field of IOT health care. The healthcare services include collection, recording, analyzing and sharing new information packets in real time expeditiously with cheaper cost. Also because the world is adopting this ever growing technology of IOT, several inefficiencies in healthcare can be reduced. As an example, numerous medical devices like fitness bands, health monitoring systems, medication boxes has smart sensors embedded into them that permits to gather the data, store it, analyze it, and conduct tests that are more utilized by medical experts to require correct choices. For getting the complete benefits of revolutionizing IOT in healthcare, the consumers, the patients and different health expert's need to consider some advanced and more reliable methods. With the assistance of IOT's potential they're currently able to collect real time raw data from unlimited range of patients for a continuous period through smart devices connected on an interconnected network. Normally it takes lot of time to understand the technological capabilities whereas it is possible for physicians to carry out diagnosis and important tasks by way of quicker, simpler and reliable means. This ensures not only reliable results with saving of time which can be considered as a benefit of profit. The possibilities of IOT are actually unlimited and ever-growing. Heart attack has become very common among people these days. Collection of real time information from numerous sources is done with the help of sensors. The power of IOT for health and medical services are harnessed by smart sensors that accurately measures, monitors and analyzes a wide range of health status . This paper proposes an IOT primarily based health monitoring system that would collect the medical information of a patient together with his heart rate, body temperature, movement, respiration and ECG and would send alerts to the doctor concerning his/her medical data, providing quick and reliable healthcare service. The paper helps to seek out a much better and robust answer to the current challenges.

II. RELATED WORK

Lots of research projects are exploring in medical field to ensure safe, improved and quality life. Liang-Hung Wang, Member, IEEE, Yi-Mao Hsiao, Member, IEEE, Xue-Qin Xie, and Shuenn-Yuh Lee, Member, IEEE outlined "An Outdoor Intelligent Healthcare Monitoring Device for the Elderly". This paper presents an outdoor monitoring system for aged individuals, which might transmit data on physiological signals and falling events to a health care center at any time and from anywhere. To detect at the same time the incidence of any falling event with help of the relative electrocardiogram (ECG), a multi-thread technique is proposed with the target of enhancing the interval and the accuracy of detection. A health care box is employed to see the relative position of the patient through a global positioning system for fall detection; furthermore, an ECG signal acquisition thread is adopted to extend the exactness of the fall detection system. Integrating a particular map into the monitoring system facilitates understanding of a client at the right location and surrounding place using the transportable display. According to experimental results based on 4,000 samples, successful detection time with the multi-thread technique was reduced by 38th, thereby increasing rescue opportunities for aged patients who are at risk.

III. PROPOSED SYSTEM

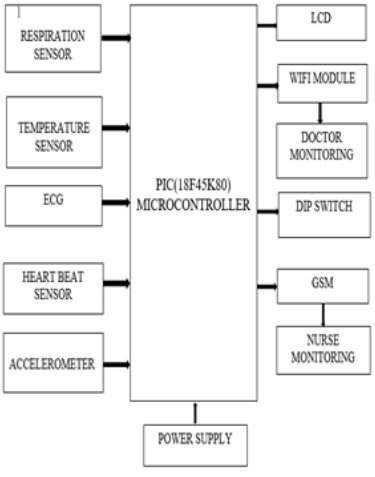

Figure 1: HEALTH MONITORING SYSTEM

The Health Monitoring System contains PIC18F45K80, ECG, temperature monitor, respiration monitor, heart beat monitor, acceleration monitor, GSM, LCD, WIFI, DIP switch and power supply. All parameters are monitored by the doctor. To give special importance to abnormality in ECG signal a SMS alert is given to the nurse. In the System there are four sensors and ECG analog circuit. The sensors viz temperature sensor, heartbeat sensor, acceleration sensor, respiration sensor and ECG are interfaced to the PIC 18F45K80. The sensor collects the values from the patient's body and send to PIC 18F45K80 .The PIC is programmed in micro C so that the changes in the sensor values according to body parameter can be detected. The measuring body parameters can be seen numerically on the LCD .The monitoring of the body parameters is done using "thing speak" app in PC/Mobile/tablet etc. using a Wi-Fi module. These values are checked by the doctor in the "thing speak" app. Dip switch helps to monitor each parameter if the user wants to monitor each of the sensor values separately.

- **Respiration sensor**

Human beings do exhale nearly 3 billion plenty of CO2 annually; however the carbon inhaled by human is the same carbon that was inhaled from the atmosphere by the plants. The average human exhales approximately 2.3 pounds of CO_2 on a median day. When speaking of respiration, most of the people thing about is that the oxygen. Human respiration has a very important role in human health condition. If there is chronic over breathing studies reveal that the heart patients have abnormally low oxygen and CO2 levels in the heart tissues and other organs. The sensor used to detect the exhaled C02 is Mq7.

- **Temperature sensor**

The normal body temperature also called physiological state or euthermia, is that the distinctive temperature range found in humans. The normal physical body temperature vary is usually declared as 36.5–37.5°C (97.7–99.5°F).The temperature sensor used here is LM35.They are precise IC temperature devices. The output voltage is linearly proportional to the Centigrade temperature. The LM35 device has a plus over linear temperature sensors mark in Kelvin. It needs accuracies of ±¼°C at temperature and ±¾°C.The range of temperature is between −55°C to 150°C. This requires linear output, low-output resistance, and precise inherent standardization thus this makes interfacing to manage PIC18F4K50 simple.

- **ECG**

Electrocardiography is study of the electrical activity of the heart muscles. The potentials initiated within the individual fibers of heart muscles are needed to supply the ECG wave form. The ECG reflects the rhythmic electrical modification i.e. the depolarization and re-polarization of cardiac muscles related to the contraction of atria and ventricles. For ECG diagnosis, 3 surface electrodes are used with jelly as electrodes. They are connected to the subsequent sites to plot the ECG: everyone on the inner surface of right and left forearm close to the wrist joint and the third one on the inner surfaces of right leg close to the ankles. The third one is to produce the reference. The electrodes are then connected to the board using protected cables(to scale back noise).The ECG signal have to be compelled to be amplified and filtered to urge sleek desired signal without any noise. The amplified and filtered signal is given to the ADC channel of the small controller. This board designs an ECG amplifier using electrodes, AD620 instrumentation amplifier and necessary range of operational amplifiers. The digital filter is intended within the software part to process the signal. The filter so designed is band pass with moving average FIR filter to filter out the peaks of ECG signal. Timer is employed to calculate the time distinction between 2 peaks that is employed to measure the pulse.

- **Heart beat sensor**

Digital output of heat beat is got once a finger is placed on this device. Once the heart beat detector is functioning, the beat light-emitting diode flashes in unity with every heartbeat. The digital output got, will be connected to microcontroller (PIC 18F45K80) on to measure the Beats Per Minute (BPM) rate. The principle of operation is light modulation by blood flow through finger at every pulse. Output is digital level at about 5V supply. The duration between pulses are helpful to calculate the heartbeat.

- **Accelerometer**

Proper acceleration is obtained using an accelerometer. Proper acceleration and coordinate acceleration are not the same. For the motion detection ADXL335 senor is used here. The ADXL335 has signal conditioned voltage outputs and is a tiny, thin, low power, complete 3-axis accelerometer. The acceleration range varies from with at least full-scale range of ±3 g. It can calculate the dynamic acceleration resulting from motion, shock, or vibration and also the static acceleration of gravity for the tilt-sensing applications. The user takes a bandwidth of the accelerometer using capacitors (CX, CY, and CZ) at the output pins XOUT, YOUT, and ZOUT. Bandwidths can be taken according to the application, which ranges from 0.5 Hz to 1600 Hz for the X and Y axes and 0.5 Hz to 550 Hz for the Z axis. ADXL335 is obtainable in a tiny, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package.

- **Microcontroller**

Microcontroller is a general purpose device, which integrates a number of components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer. The microcontroller used here is PIC18F45K80. It is 8-bit MCU with Integrated ECAN which has a high performance and includes extreme low power consumption. New options in PIC18F45K80 are low sleep current in low power application, 1.8V to 5.5V operational voltage in automotive, building control, elevator management and industrial application, Timers/Enhanced Compare/Capture/PWMs for Precision timing management, 12-bit ADC for advance analog interface and Charge Time measurement Unit for straightforward capacitive bit interface. The PIC18F45K80 family is right for applications requiring efficient, low-power will solutions with high performance and strong peripheral set.

Figure 2: PIC18F45K80

Sources:https://www.microchip.com/www.product

- **Wi-Fi Module**

Wi-Fi technology is employed to give internet access to devices that are among many of a wireless network that is connected to internet. The Wi-Fi chip ESP8266 is a low price with full TCP/IP stack and microcontroller capability made by Shanghai-based Chinese manufacturer viz Espressif. This little module permits microcontrollers to connect to a Wi-Fi network and create easy TCP/IP connections. However, there was nearly no English-language documentation on the chip and the commands it was accepted. The very low value and the undeniable fact that there were little external elements on the module which suggests that it might eventually be very cheap in volume, attracted many hackers to explore the module, chip, and therefore the software system thereon, additionally as to translate the Chinese documentation.

- **GSM**

GSM (Global System for Mobile Communications, at first Groupe Special Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI) to explain the protocols for second-generation (2G) digital cellular networks employed by mobile phones. They are used to send message of abnormal ECG

- **LCD**

LCD (Liquid Control Display) is used here for displaying the body parameters. Hitachi has discovered a mile stone by its character LCD controller IC. All the character LCD displays use constant, or anyone of the IC s based mostly upon the design introduced by Hitachi. Most of the LCD Displays on the market within the market are 16X2 (That suggests that, the LCD displays are capable of displaying 2 lines each having 16 Characters a), 20X4 LCD (4 lines, 20 characters). It has 14 pins. It uses 8 lines for parallel data and 3 control signals, 2 lines for connections to power, another for contrast adjustment and two

connections for LED back light. The LCD used in this here is of 16X2 type.

- **DIP SWITCH**

A DIP switch is an electrical switch that is made with others in a group very common place dual in-line package (DIP) and can be automated manually. A DIP switch is a set of little switches in a Dual- in-line package (DIP) that's used to change the operational mode of a tool. Dipswitches are used to configure laptop peripherals such as hard drives, modems, sound cards, and motherboards. In this project DIP switch helps to monitor the health parameters separately whenever need.

IV. SOFTWARE DESCRIPTION

The software portion is Embedded C with micro C for programming the controller. They run on MS Windows, and simple to use and helpful for quick application development and debugging. Eagle software is employed to draw the circuit diagram. An app known as thing speaks for the continual observation of the heart patients.

- **Embedded C**

They are a set of language extensions for the C programming language by the C Standards Committee to deal with harmony problems that exist between C extensions for various embedded systems.

As time advanced, use of semiconductor definite assembly only because the programming language condensed and embedded systems emotional onto C as a result of the embedded programing language of choice C is the most generally used programming language for embedded processors or controllers. As a result of the wide acceptance of C within the embedded systems, numerous types of support tools like compilers & cross-compilers, ICE, etc. came up and each one this facilitated development of embedded systems using C.

- **MicroC**

The feature affluent atmosphere got experience is the results of fifteen years of dedicated work and steady progress. The always-growing type of software suite libraries and hardware, intuitive IDE, integrated Visual TFT software suite, elaborated documentation, a full box of additional tools.

- **Eagle software**

EAGLE is scriptable electronic design automation (EDA) application. it embrace some characteristics options like schematic capture, printed circuit board (PCB) layout, auto-router and computer- aided manufacturing (CAM).EAGLE(Easily Applicable Graphical Layout Editor)and is established by CadSoft computer GmbH. The corporate was adopted by Autodesk inc. in 2016. EAGLE contains a schematic editor, for arising with circuit diagrams. Schematics are kept in files with .SCH extension, and parts are defined in device libraries with .LBR extension. Parts are often placed on several sheets and connected along through ports. The PCB layout editor stores board files with the extension .BRD. It permits back-annotation to the schematic and auto-routing to mechanically connect traces supported the connections outlined inside the schematic.

- **ThingSpeak**

Thing Speak is an open source application for and API to store and retrieve information from things using the HTTP protocol over the internet. ThingSpeak give authorizations for the making of sensing element for various work applications, a social network of things and location tracking applications with standing updates. Thing Speak was originally launched by ioBridge in 2010 as a service in support of IOT applications .ThingSpeak has integrated support from the numerical computing software MATLAB from math Works, permitting ThingSpeak users to research and visualize uploaded data victimization Matlab while not the acquisition of a Matlab license from math's works.

ThingSpeak contains a detailed relationship with math works, Inc. All of the ThingSpeak documentation is combined into the maths works' Matlab documentation web site and even authorizing registered Mathworks user accounts as valid login credentials on the ThingSpeak web site. The terms of service and privacy policy of ThingSpeak.com are between the agreeing user and Mathworks, Inc. Instructables, Codeproject, and Channel 9 etc. uses ThingSpeak has been the topic of articles in specialized "Maker" websites.

RESULTS AND DISCUSSION

A modular approach using sensor for health care of patients was done for monitoring the patient activity in the home. In this paper, a low-cost IOT system was presented. This outlined the main components of the proposed system and explained their implementation details. This built a prototype to illustrate the different performance aspects of the proposed system.

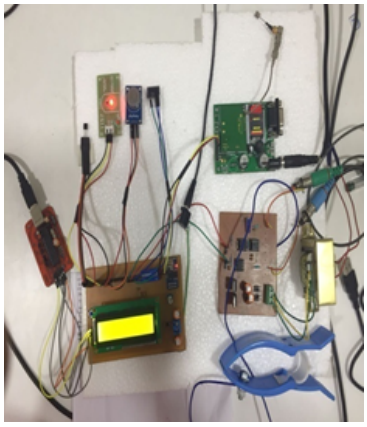

Figure 3: HARDWARE SECTION

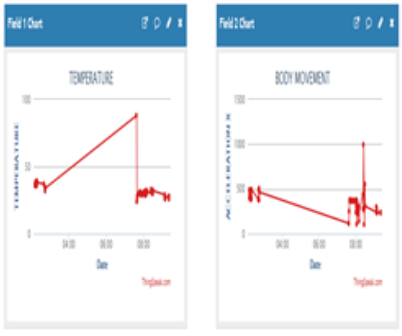

Figure 4: THE BODY PARAMETERS MEASURED USNG THING SPEAK

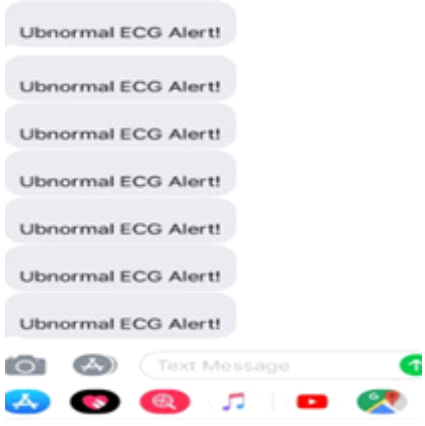

Figure 5: THE ALERT MESSAGE ABOUT ECG

CONCLUSION

A real time monitoring system is implemented with low cost design. The system measures parameters like ECG, heart rate, temperature, respiration and body movements .The variations in ECG is immediately sent to doctor via GSM module .The other parameters are displayed in LCD by using a DIP switch .The values can also be monitored through the ThingSpeak app on a continual basis. Thus this user friendly system is mainly indented for paralyzed patients who stay alone at home.

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