International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE)
ISSN: 0976-1353 Volume 24 Issue 4 – MARCH 2017.

Patient Monitoring System Using LabVIEW

Mohanraj T[#1] and Keshore Raj S N[*2]

[#]B.E., EEE, Mepco Schlenk Engineering College (Autonomous), Sivakasi, Tamilnadu, India

[*] B.E., EEE, Mepco Schlenk Engineering College (Autonomous), Sivakasi, Tamilnadu, India

***Abstract*— The medical treatment and diagnosis of patients in India, especially in rural regions are adversely affected due to lack of proper healthcare and a poor patient to doctor ratio. This project aims at developing a suitable monitoring system, through which the doctor can monitor patients without physically being present near the patient. This monitoring system assists the doctor in carrying out medical tests and also provides patient-doctor interaction, when the doctor cannot be physically present near the patient. The proposed system uses a variety of sensors to monitor human body parameters like Temperature, Heartbeat rate, ECG and GSR. These sensors are integrated together and their output is made available to the doctor in graphical form. The Doctor can access this from anywhere and can use it to monitor the patient's condition. This system not only allows the doctor to examine the patient's condition but also allows the doctor to share his suggestions and prescriptions. The sensors are integrated to LabVIEW through Arduino to provide a GUI based environment and monitoring parameters are displayed on the LabVIEW front panel. This LabVIEW front panel is published over the web server with both access and control permissions with a unique IP address. The doctor can make use of this IP address to access the monitoring system. This system is also capable of providing visual image/video to the doctor.**

***Index Terms*— GSR – Galvanic Skin Response, BMI – Body Mass Index, BMR – Basal Metabolic Rate.**

I. Introduction

In a developing country like India, lack of proper medical facilities has been a major concern, especially in remote villages. Lack of proper medical treatment & diagnosis in rural areas, is mainly due to the poor doctor to patient ratio. In order to increase the patient care efficacy, there arises a need to improve the patient monitoring system in a more effective way. The main drawback in the current patient monitoring system is the requirement of the physical presence of the doctor in the vicinity of the patient, which is not possible at all times. Hence it becomes necessary to develop a system which does not demand the doctor's presence for patient monitoring. Owing to the advancements in bioinstrumentation and telecommunications technologies, it has become feasible to design a monitoring system to acquire, record, display and transmit the physiological signals from the human body to any location. The proposed patient monitoring system enables doctors to monitor vital biosignals such as ECG, Respiration, Heart rate and body temperature of patients especially in ICU and CCU.

The clinical output of the biosignals are then published to the web, which can be accessed by the doctor from anywhere. The doctor can also offer his suggestions and prescriptions if required. In other words, this monitoring system measures physiological parameters like ECG, PCG, Temperature and Heart rate, pre-processes them and displays them in a graphical user interface which is published on a personalized website that can be viewed by the doctor from anywhere.

II. Existing Technology Review

Most widely used Patient Monitoring Systems comprise primarily of Wired Devices. Using wired devices restricts the patient to a room, wired to a bed and also requires a doctor's presence for monitoring. The proposed system eliminates that limitation and helps the doctor in monitoring the patients from anywhere.

Though many wireless Monitoring Systems have been proposed, they suffer from various disadvantages, depending upon the technology used for wireless communication. Bluetooth, ZigBee, Wi-Fi and Dash7 are some of the Wireless technologies that are being widely preferred for wireless communication. However, each technology has its own limitation, which makes the system inefficient. Bluetooth has the lowest Signal Range of 10m and has a relatively slower data transfer rate. ZigBee has a relatively higher Signal Range of 10 – 20m but higher setup cost and weaker security makes it unsuitable for this application.

In the proposed system, an inbuilt feature of LabVIEW known as the Web Publishing Tool is used, which overcomes the above mentioned limitations.

III. Proposed System

The Block Diagram of the proposed system is shown in fig 1. The physiological parameters of the patient are measured using different sensors and their output is processed through a microcontroller. The Microcontroller performs the function of a DAQ and simply serves the signals to LabVIEW. The Signal is processed through the LabVIEW VIs.

The output is displayed in the front panel of LabVIEW which is then published to the web server. The doctor can view the output from anywhere through the specific IP address.

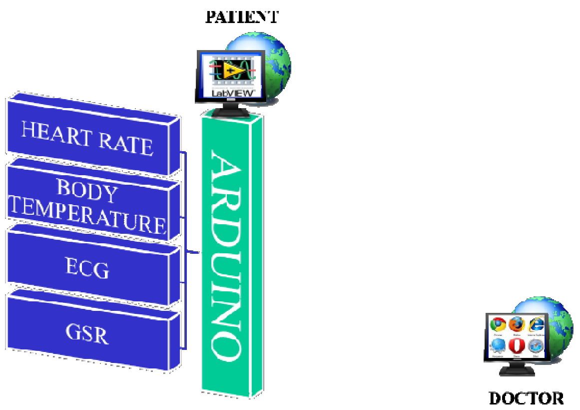

Fig 1: Block Diagram of the project

A. Hardware Required

1) Arduino UNO

The Arduino Uno is a commonly used microcontroller board based on the ATmega328 IC. It has 14 digital input/output pins - 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button, out of which 6 pins can be used as PWM outputs.

Fig 2: Arduino UNO microcontroller

Arduino is just used as a DAQ (Data Acquisition) to communicate the input signals to the LabVIEW. The Signals are manipulated using the LabVIEW VIs and not the controller.

2) Heart Rate Monitor

Pulse Sensor [4] is an open-source heart rate monitoring sensor built to work with the Arduino. It uses periodic sampling of ADC value from the light intensity sensor, and signal filtering to detect the peak-to-peak length in the data. The heart rate is measured from the finger tip of the patient. It can also be measured from the softer part of the ear lobes.

Fig 3: Heart Beat Rate

3) Temperature Sensor

MAX30205 Temperature Sensor is used for the body temperature measurement of the patient. The MAX30205 Sensor communicates through **I²C** via 2 – wire interface. The sensor has a 2.7V to 3.3V supply voltage range. It has an operating temperature range of 0°C to +50°C.

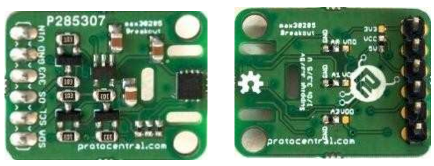

Fig 4: MAX30205 Temperature Sensor

A person's ordinary body temperature can typically vary from 36.5 °C to 37.5 °C. Variation in body temperature can be due to various reasons like fever, immediate impact of anxiety, drying out etc.

4) ECG Sensor

AD8232 ECG Sensor Module [3] is used to measure the electrical activity of the heart. The AD8232 is an integrated signal conditioning block for ECG and other bio potential measurement applications. It measures the Electro Cardiogram readings of the patient through three electrodes attached to the patient's body [2].

Fig 5: AD8232 ECG Sensor with electrode and connector cable

5) GSR Sensor

Galvanic Skin response [5] is a method of measuring the electrical conductance of the skin. Strong emotion can cause stimulus to the sympathetic nervous system which results in more sweat being secreted by the sweat glands. GSR can be used to spot such strong emotions with the help of two electrodes attached to two fingers on one hand.

Fig 6: Galvanic Skin Response Sensor with finger cuff

B. Software Platform Implementation

1) LabVIEW

LabVIEW - *Laboratory Virtual Instrument Engineering Workbench*, is an interactive programming environment in which programs can be created using a graphical notation.

The programming language used in LabVIEW is a dataflow programming language in which the execution is determined by the structure of a graphical block diagram. The programmer can connect different function-nodes by drawing wires. These wires propagate data as variables and a node can execute when all its input data is available. This graphical is highly advantageous as it allows the nonprogrammers to build programs by dragging and dropping virtual representations of lab equipment in LabVIEW.

One of the additional features of LabVIEW is that, it includes extensive support for interfacing various devices, instruments and even cameras.

LabVIEW also includes built-in support for NI hardware platforms such as CompactDAQ and CompactRIO, with a large number of device-specific blocks for such hardwares like the *Measurement and Automation eXplorer* (MAX) and *Virtual Instrument Software Architecture* (VISA) toolsets.

2) Web Publishing

LabVIEW has a built-in feature called the *Web Publishing Tool*, which can be used to publish the front panel of a VI to the web server. The Web Publishing Tool generates a unique IP address through which the VI can be remotely accessed. To access the Remote VI, for a computer connected to a common LAN Network, the IP address should be in the format - *http://PcName: Port/ViName.html*. Similarly, for a computer to access the remote VI through the Internet, the IP address should be in the format - *http://lpAddr:Port/ViName.html*. It is also mandatory for the system to have a LabVIEW Runtime Engine installed and the browser should have the Microsoft Silverlight Plugin installed.

IV. IMPLEMENTATION OF THE PROPOSED SYSTEM

The sensors are connected to the controller via suitable pins. Arduino is interfaced with LabVIEW through the LINX Toolkit. LINX provides an easier way to use the LabVIEW VIs for interfacing common embedded platforms like Arduino, chipKIT and MyRIO with LabVIEW. Using the peripheral Vis in LINX, the digital I/O, analog I/O, SPI, I2C, UART and PWM of the platforms can be accessed.

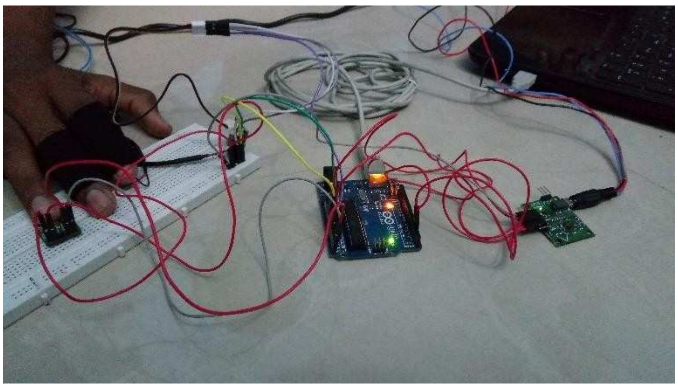

Fig 7: Photograph of the hardware kit

The Temperature Sensor – MAX30205 uses I²C communication and the SDA (Serial Data) and SCL (Serial Clock) pins are connected to the I²C pins in the Arduino UNO – A4 (SDA) and A5 (SCL). The Slave Address for the I²C VI is **x48.**

The GSR [5] Sensor's output pin is connected to one of the analog pins of Arduino. The electrodes are attached to the two finger cuffs, which are worn by the patient in any of the two fingers.

The output pin of the Heart Rate Sensor [4] – SEN-11574 is also connected to the analog pin of Arduino. Finger should be placed in the sensing part of the sensor.

The LO+ and LO- pins of the ECG Sensor – AD8232 [3] are connected to the digital pins of Arduino and the Output pin is connected to the analog pin of Arduino. The Surface electrodes are connected to the AD8232 module through connector cable and the electrodes should be placed in the patient's body [2] as shown in fig 8.

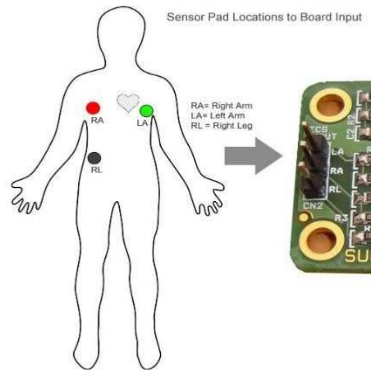

Fig 8: ECG Electrode placing position

The Arduino plays a role of a DAQ and serves the output to the LabVIEW. The output of the sensors is processed through the LabVIEW Vis and displayed in the front panel. Separate VIs are used for processing each sensor values.

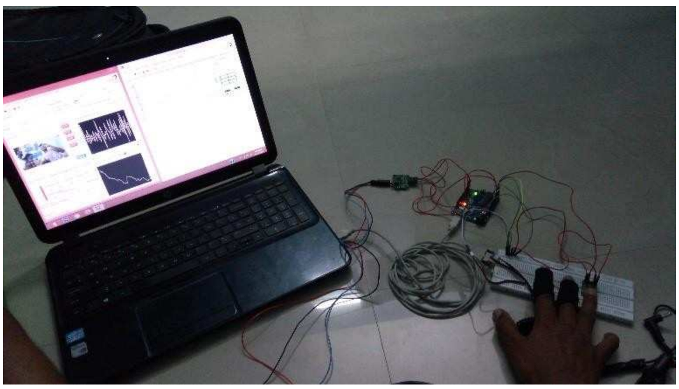

Fig 9: Hardware kit along with the output in LabVIEW

In the front panel, the personal details of the patient such as the patient's Name, Date of Birth, Gender, Contact Information, and Medical parameters like Blood Group, Height, Weight, Blood Pressure and Blood Sugar should be entered as input.

The Activity Factor which categorizes patients based on their daily exercise should be chosen from the dropdown list.

From the age, height and weight of the patient, medical details like BMI, BMR, Carbohydrates, Calories, Protein and Fat are calculated mathematically.

A Separate text box is provided for entering the Queries/Problems of the Patient and another text box for the doctor to enter the prescriptions.

Fig 10: LabVIEW Front panel

An option for accessing the webcam is provided in the front panel which gives visual image/video to the doctor. The NI VISA drivers for Webcam is used to access the built-in webcam of the Laptop. External Webcam can also be added if needed. The Doctor can access the webcam in case he needs a physical examination of the patient.

An Additional option named REPORT is also provided, through which the entire prescription (with the Patient's History) can be generated as a .txt file. The Report is also displayed in the front panel along with the Hospital details.

Fig 10 shows the LabVIEW's front panel of the proposed system, containing all the above mentioned parameters. The entire front panel is then published in the web server through the Web Publishing Tool in LabVIEW. The Web Publishing Tool automatically generates a unique IP address, through the Remote Front panel can be accessed.

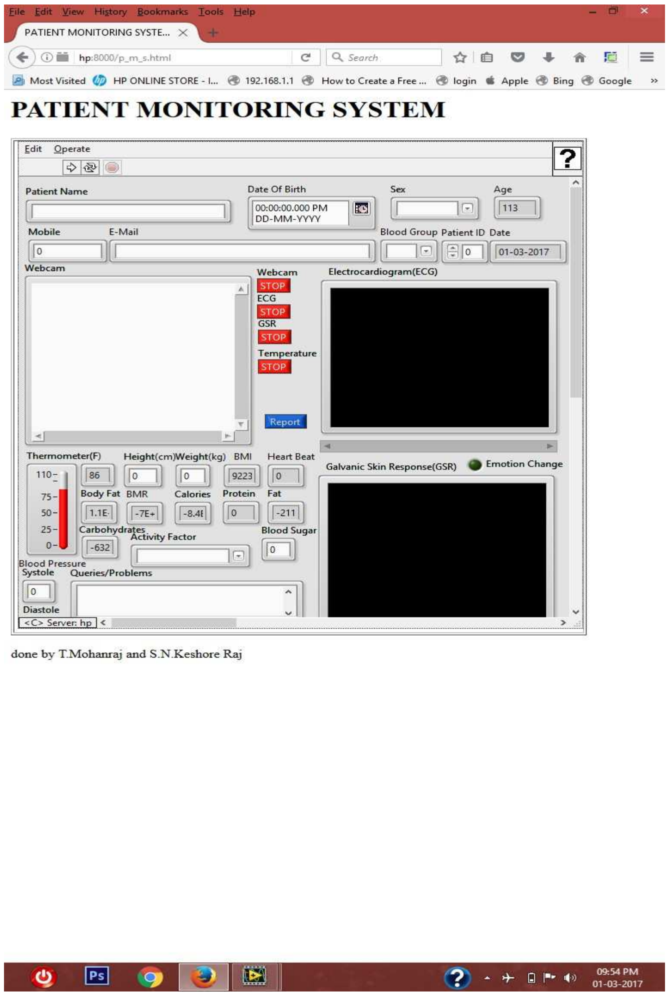

Fig 11: Front panel embedded in web browser

With the LabVIEW Runtime Engine and the Microsoft Silverlight Extension installed, a computer connected to the internet can access the Remote Front Panel from anywhere. The Remote front panel can request control of the VI to the server and the control will be transferred to the remote panel. As long as the remote panel has control of the VI, the server cannot access the VI. The front panel will be accessible only when the Remote panel releases control of the VI.

V. FUTURE SCOPE

Along with the monitoring parameters included in the system, all the available monitoring systems can also be integrated.

By integrating this system with DBMS (Data Base Management System), a database can be maintained with all the patient details and medical history.

By manipulating the output parameters, an alarm system can be implemented, which will alert the doctor in case of emergencies, through SMS or Mail.

In case of emergencies such as Cardiac Arrest, certain instruments like the Defibrillator can be triggered.

VI. CONCLUSION

The Proposed system, when employed in day to day life, will be a revolution in the Medical field and will have a great impact in rural areas where the doctor to patient ratio is very low. The proposed system will also have a low cost of implementation and hence can be employed everywhere.

REFERENCES

[1] NP Joshi, PV Patel, and P. M. Grant, "LabVIEW and Web-Server based Human Body Monitoring System," *IJAREEIE, Vol. 3, Issue 5, May 2014.*

[2] Joyanta Kumar Roy, Bansari Deb, Dip Chakraborty Satyajit Mahanta and Nairit Banik, "The Wearable Electronic Rescue System for Home Alone Elderly- Labview & Arduino Evaluation," *IOSR-JECE, Volume 8, Issue 6 (Nov. - Dec. 2013), PP 50-55.*

[3] N Natarajan, S Aparna and J Sam Jeba Kumar, "Patient Monitoring System Based on e-health Sensors and Web Services," *ECAI 2016 - International Conference – 8th Edition, July 2016.*

[4] Salomi S. Thomas, "Sensing Heart beat and Body Temperature Digitally using Arduino," *SS – AAICSP – 10 - 01.*

[5] K. Subramanya, Vishnuprasada V. Bhat, and Sandeep Kamath, "A wearable device for monitoring galvanic skin response to accurately predict changes in blood pressure indexes and cardiovascular dynamics," *IEEE, Annual IEEE India Conference (INDICON).*