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EPILEPSY PATIENT MONITORING SYSTEM USING WIRELESS AND EMBEDDED PLATFORM

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ABSTRACT

This paper presents the architectural design of a system for smart Epilepsy Patient Monitoring System using Wireless and Embedded Platform. In this proposed system, patients carry a batch of body-sensors to collect their physiological parameters. The LPC-2148 microcontroller is attached on the wearable device which facilitates the sensor nodes like (EMG, Temperature, Pulse-Rate, MEMS) and sends sensor data to the server using Wi-Fi. Wi-Fi being used in many hospital applications provides very less interference to the functionality of other devices. The server detects the abnormal conditions of epileptic patients using the threshold value and sends the SMS and e-mail to the physician along with video-feed. The system allows the mobility of the patient wearing the sensors and the video-feed improves the communication with the doctor. Through this system the quality of treatment for the epileptic patients who may require the continuous remote health monitoring can be improved.

Keywords-Electronic healthcare, Embedded Platform, Video surveillance, Wireless sensor networks,Web Services

I. INTRODUCTION

Epilepsy is a chronic neurological disorder characterized by involuntary recurrent convulsions [1]. There are about 65 million people affected all around the world, with a high and dramatic impact not only on the patient's quality of life, but also on the professional development and social behavior, the health system budget is highly affected as well. The illness anamnesis improves with the existing platforms for patient monitoring and weblogs. The main part of these platforms has been developed for two different and most frequent kinds of epilepsy crisis: the generalized tonic-clonic seizures and the typical absence seizures [2].

In these two cases, the detection of a seizure can be efficiently faced using wearable sensors (WDs) including a Electromyography sensor, tri-axial accelerometer (ACM) and/or a heart rate (HR) sensor: the former type detection has been reported in [3], the latter one has been characterized in [4], and an HR-based detection system has been proposed in [5]. Another main aspect of the anamnesis process is where the data is gathered.

The main part of the literature deals with constrained spaces, that is, research laboratories or hospital rooms [6], or even the patient's house [7], but without considering the normal everyday life [8, 9]. We claim that the data should be gathered in everyday life, allowing the patient to freely decide what to do and how to do it. This is important because, firstly, the data is gathered from normal activities performed before and after a seizure, and secondly, the analysis and procedures should adapt to this unconstrained world, making the whole detection process much more difficult. A careful in-depth analysis of the seminal papers concerning epilepsy monitoring platforms [10] and Mobile Cloud Computing (MCC) let us conclude that the current available platform, either in the scientific literature or in the market, lacks several main features that are not comprehensibly integrated.In this paper a prototype of epileptic patient monitoring system based on LPC-2148 micro-controller and web-server is implemented. Various basic physiological parameters such as MEMS, EMG, Heart-rate, and body temperature are measured using relevant sensors and sent to the microcontroller board for processing.

Various basic physiological parameters such as MEMS, heart-rate, body temperature and EMG using are measured using relevant sensors and sent to the micro-controller board for processing. LPC-2148 and the sensors together makes the Body Sensor Network [BSN], helps to measure above specified parameters. The computed parameters values are then sent to a web-server for display on the web page and stored in a database. ESP8266, a Wi-Fi module is used for communication between LPC-2148 and Server. The necessary software is developed using Keil version 4, Flash Magic, Embedded C and Mat-lab programming language. The measured physiological readings are updated in every 60 seconds. If the value of these physiological parameters cross threshold value the doctor/caretaker gets alerted.

II. SYSTEM HARDWARE AND SOFTWARE REQUIREMENT

In this section, the signal flow information is discussed along with the various hardware and software components being used in the system.Fig.1: Shows the block diagram of Epilepsy Patient Health Monitoring System Using Wireless and Embedded Platform. It consists of a wireless sensor node and a web-server. In the wireless sensor node, EMG and Heart-rate module, Accelerometer [MEMS], temperature sensor are connected to the LPC-2148

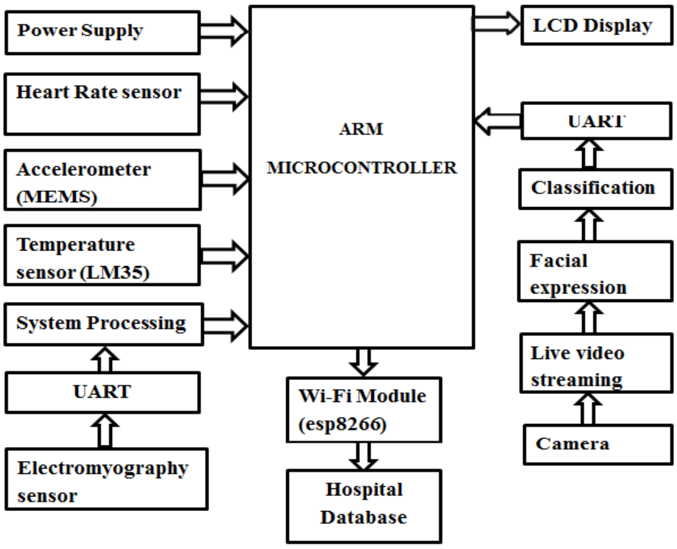

Fig.1: Block Diagram of Epilepsy Patient Monitoring System Using Wireless and Embedded Platform.

. The LPC-2148 saves the incoming data from the sensors mentioned above in separate variables and provides an appropriate delay to them based on the calculation delay requirement of the particular sensor. Then the physiological readings from sensors are transmitted to web-server using the ESP8266 Wi-Fi transmitter which is connected to LPC-2148 port. The web-server receives the data and check it with the threshold value for the registered patient. If the parameters are within threshold the data is stored displayed on website, otherwise an e-mail along with the link of live video-feed will be sent to Doctor/caretaker's account and a SMS will be sent as offline alert. The incoming data is first analyzed for the threshold before getting saved to reduce the response time of notification.

Hardware Requirements

A. Temperature Sensor: The normal human body temperature range is 36.5-37.5 in Celsius [97.7-99.5 in Fahrenheit]. The LM-35 is used as temperature sensor shown in Fig.2a. It measures temperatures from -55 to +150 in Celsius.

B. Heart-Rate Sensor: Heart rate is the heartbeat rate measured by the number of contractions of heart per minute (bpm). The average normal resting human rate is 60 to 100 bpm. Heart rate module shown in Fig.2b and operates on a +5V DC.

C. **MEMS Sensor:** MEMS Sensor is a 3-axis accelerometer sensor based on ADXL335 integrated circuit. The ADXL335 is a triple axis accelerometer with extremely low noise and power consumption. There is an on-board 3.3V Voltage Regulator to power the ADXL335 so power should be between 3.3V and 6V DC as shown in Fig.2c

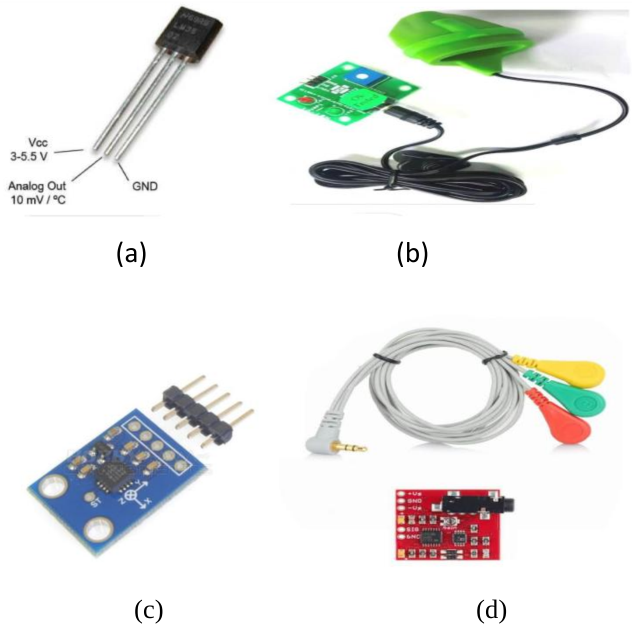

Fig.2: Physiological Sensors: (a) LM-35 Sensor; (b) Heart rate Sensor;
(c) GY-61 MEMS Sensor; (d) EMG Sensor

D. ESP-8266 Wi-Fi Module: The ESP8266 Wi-Fi Module is a System of Chip [SOC] with integrated TCP/IP protocol stack that can give access to any micro-controller to a programmed Wi-Fi network as shown in Fig.2d. The ESP8266 is capable of either hosting an application as well as offloading all Wi-Fi networking functions from another applications processor.

E. EMG Sensor: EMG measures muscle response or electrical activity in response to a nerve's stimulation of the muscle. The test is used to help detect neuromuscular abnormalities. The Fig.2e shows EMG Sensor with operating voltage of 3.3V.

F. LPC-2148 Micro-controller: LPC-2148 is an ARM7TDMI-S based high-performance 32-bit RISC Microcontroller. It has two 32-bit General Purpose I/O ports. It has 12MHz crystal for system clock and 32KHz crystal for RTC. Power consumption is less with operating voltage of 3.3V.

Software Requirement

1. **Flash Magic**: Flash magic is a PC tool for programing flash based microcontroller from NXP using a serial or Ethernet protocol while in the target hardware. Flash magic only obtain access to the selected COM Port when ISP operations are performed.
2. **Embedded C**: Embedded C is a set of language extensions for the C Programming language by the C Standards. Embedded C is used for microcontroller based applications.
3. **MATLAB**: Matrix Laboratory is a fourth generation high-level programming language and interactive environmental for numerical computation, visualization of facial expression.

III. METHODOLOGY

This Section will give a detailed description of the functioning of bio-medical sensors to form a Sensor node, the wireless communication of data from node to server and deliver of notification.

1. Working of Wireless Sensor Node

The working of sensor Node is shown in Fig.1 the node is a junction of physiological sensors including heartbeat (pulse)sensor, EMG sensor, MEMS and temperature sensor which is made using LPC-2148. Function of node is to collect data from various sensor and save them in different variables with proper delay.

The Heart rate sensor provides output at J6 with total calculation delay of 10 seconds. After recording the pulse rate the temperature sensor is initialized and which will provide output at AD 0.1 that can be recorded with in a calculation delay of 10seconds according to duty cycle. After this the values of MEMS sensor at AD 0.3 are recorded with the calculation delay of 10 seconds. The sensor data is then send via ESP8266 to the web – server The node goes into idle mode for 30seconds to avoid the overlapping of next set of data, thus updating the data at web server in every 60seconds.

2. Working of web server

The web server works as a real time application to provide notification service. The Wi-Fi module will use TCP/IP protocol to connect and send the data to the web server. The web server will receive the data and process it according to physiological sensor. The web server will have algorithm which compare the data coming to an account, with threshold designated for the patient registered to that account. If the data is within the limit range it will be stored on a text file which will be later displaced on the web site. The data on the web site can be later used as the patient's authentic report, by logins in the account. In case the threshold is crossed by one or more physiological sensor data, an alert notification will be send to the doctor\ care taker's e-mail id and mobile registered to that particular account, and a link of live streaming video. Then then data will be stored on the web site. While altering, the data is saved after the notifying the process so as to lessen the delay in sending the notification.

3. Working of Live-Stream Video

The generation of Live-Stream video is to capture the facial expression of the epileptic patients for the recognition of images. The format of images is 24 bit color JPEG with resolution of 4320*3240 pixels. To maintain the distance of 4-5 feet the camera is placed and to capture the various facial expression of patients. This feature of image processing is done through Mat-lab by a tool named Support Vector Machine (SVM) mainly for bedridden patients. From this we can continuously monitoring the patients and if they get any attack the alert notification will be send to doctor/caretakers.

IV. EXPERIMENTAL RESULTS

The alert notification is sent in two forms: Online and Offline notifications: Online by e-mail and offline by SMS. Both will be sent to caretakers and doctor.Wireless Communication module is created with the help of TCP/IP protocol ESP8266 sensor acts as the server and it is wirelessly connected to the Mobile and System database with a separate IP address Port ID as shown in Fig 4.2.

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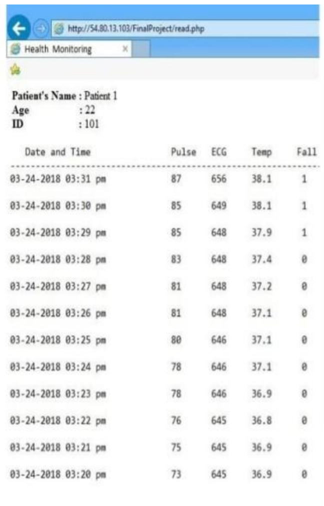
Fig4.2: Alert system

The sensor continuously sends the sensed values to the Alert systems once the connection is established between them. Fig 4.3a represents the image of the display window which continuously receives the data of the person suffering from Epilepsy.



http://54.80.13.103/FinalProject/read.php

Health Monitoring

Patient's Name : Patient 1
Age : 22
ID : 101

Date and Time	Pulse	ECG	Temp	Fall
03-24-2018 03:31 pm	87	656	38.1	1
03-24-2018 03:30 pm	85	649	38.1	1
03-24-2018 03:29 pm	85	648	37.9	1
03-24-2018 03:28 pm	83	648	37.4	0
03-24-2018 03:27 pm	81	648	37.2	0
03-24-2018 03:26 pm	81	648	37.1	0
03-24-2018 03:25 pm	80	646	37.1	0
03-24-2018 03:24 pm	78	646	37.1	0
03-24-2018 03:23 pm	78	646	36.9	0
03-24-2018 03:22 pm	76	645	36.8	0
03-24-2018 03:21 pm	75	645	36.9	0
03-24-2018 03:20 pm	73	645	36.9	0

Fig4.3a: Connection Indication and Values Display System   Fig4.3b: Values stored in database

Fig 4.3b represents the sample image of values stored in the database. This database system will be at the respective hospitals in which the patient is medicated. The website acts as a history of patient's physiological readings. Each patient has their own account in which their prescribed threshold is fed.The parameters are displayed on the website that can be accessed through log-in.

V. CONCLUSION

In this paper, Epilepsy Patient Monitoring System Using Wireless and Embedded Platform is implemented. The Bio-medical parameters are stored on a web site, which can be used as epileptic patient medical history in future. Several epileptic patients can register their device to the server, and can access their parameters using accounts log-in (each account have different threshold value defined by doctor). When the value of the physiological parameters exceeds designated threshold, the doctor/caretaker is alerted through SMS. This robust system is useful for monitoring the health status of elderly and small children patients who are unable to visit hospital on daily basis and require constant assistance in critical conditions. This system aims to make the patient mobile, so that it won't hurdle their day to day activity. Several future advancement can be applied for further progress of this work. One of most important future work aspect is making the system even more portable by redesigning the sensors. Customization of sensors and node controllers will help in increasing portability, reliability and even reduce power consumption compared to market available sensors. Additionally, a mobile application can be designed, which being easier to access can replace the functionality of website. Integration of Google assistant in the system will provide a great support to patients to seek advice at any point of time.

REFERENCES

[1] Sander JW. The epidemiology of epilepsy revisited. Curr Opin Neurol 2003;16(2):165–70.

[2] Camfield P, Camfield C. Incidence, prevalence and aetiology of seizures and epilepsy in children. Epileptic Disord 2015; 17(2):117–23.

[3] Forsgren L. Prevalence of epilepsy in adults in northern Sweden. Epilepsia 1992;33(3):450–8.

[4] Banerjee PN, Filippi D, Allen Hauser W. The descriptive epidemiology of epilepsy – a review. Epilepsy Res 2009;85(1):31–45.

[5] Mac TL, Tran DS, Quet F, Odermatt P, Preux PM, Tan CT. Epidemiology, aetiology, and clinical management of epilepsy in Asia: a systematic review. Lancet Neurol 2007;6(6):533–43.

[6] Kwan P, Brodie MJ. Early identification of refractory epilepsy. N Engl J Med 2000;342(5):314–9.

[7] Forsgren L, Beghi E, Oun A, Sillanpa¨a¨ M. The epidemiology of epilepsy in Europe – a systematic review. Eur J Neurol 2005;12(4):245–53.

[8] Sidenvall R, Forsgren L, Heijbel J. Prevalence and characteristics of epilepsy in children in northern Sweden. Seizure 1996;5(2):139–46.

[9] Christensen J, Pedersen CB, Sidenius P, Olsen J, Vestergaard M. Long-term mortality in children and young adults with epilepsy – a population-based cohort study. Epilepsy Res 2015;114:81–8.

[10] Bell GS, Sinha S, Tisi Jd, Stephani C, Scott CA, Harkness WF, et al. Premature mortality in refractory partial epilepsy: does surgical treatment make a difference? J Neurol Neurosurg Psychiatry 2010;81(7):716–8.