Smart Healthcare Monitoring System Using Wireless Technology

Arif Z. Daudi[1], Nishitha J. Anchan[2], Priyanka R. Gupta[3], Taher M. Rajkotwala[4], Prof Nargis Shaikh[5]
[1, 2 3, 4, 5] Dept of Electronics
[1, 2, 3, 4, 5] Rizvi College Of Engineering, Mumbai Maharashtra, India

Abstract- *Health monitoring systems using wireless networks has become a constant concern in various fields, not only of medical plan but also in other domains in which bio-signal data collection from field teams, such as: firefighters, rescue service or emergency medical services, is important, especially in areas lacking communications. This work illustrates the design and implementation of a smart health monitoring system. Here, a patient can be monitored using a collection of lightweight wearable sensor nodes for real time sensing and analysis of various vital parameters of patients. Also, it investigates automated diagnosis of RBC's, WBC's and platelets and helps to detect chronic disease in a patient through image processing techniques like MATLAB. The devices seamlessly gather and share the information with each other and also store the information, making it possible to collect record and analyze data.*

Keywords- Body Sensor Network(BSN), Real Time Monitoring System, RBC's WBC's and platelets, Arduino, MATLAB

I. INTRODUCTION

The development of communication technology, as well as the manufacturing technologies of microsensors has favoured the rapid growth of real-time monitoring systems for human subjects1. A BSN (Body Sensor Network) is a special purpose network designed to operate autonomously to connect to various medical sensors and implants located inside and outside of the human body. Introducing it in medical monitoring will offer flexibility of operation and cost saving options to both healthcare professionals and patients. These health status monitoring systems have experienced a spectacular growth and are currently used in several types of applications, from cardiac patient monitoring to emergency respondents monitoring ambulance emergency services, firefighters, military, mountain rescue units etc. Another reason for the accelerated growth of monitoring technologies is the population aging trend exhibited both at a national and international level2. Also, in the future, the large-scale implementation of monitoring systems in hospitals, asylums and other types of institutions will be followed in order to improve medical care and more[1].

The medical world today faces two problems in patient monitoring; firstly, the need of healthcare providers and care takers to be present at the bedside of the patient and second is that the patient is restricted to bed and is wired to large machines. In order to achieve flexible and friendly patient care, the above mentioned problems should be solved and as the bioinstrumentation and telecommunications technologies are advancing[3]. The other part of the project involves the image processing applications areas in biomedical by detecting diseases using RBC's, WBC's and platelets. The analysis of blood smear is a powerful diagnostic tool for the detection of diseases like Malaria and Sickle cell anaemia. It also include processing of CT scan images for detecting brain tumour and lung cancer. As they are life threatening diseases and an enormous global health problem, rapid and precise differentiation is necessary in clinical settings. Automation of disease detection in life science laboratories can be done by extracting the statistical features of the blood smear images taken by the digital microscope and processing it using Digital Image Processing techniques e.g. MATLAB software.

II. RELATED WORK

In [1], S.D. Grigorescu explains the model of Physiological parameter monitoring technology includes personal sensors that record heart rate and pulse rate and travelled distance and sophisticated devices that can store physiological data for further analysis. Monitoring system of groups of individuals is done in order to determine the location in the field,.

The work in Internet of things (IoT) based smart health care system. [2] explains illustrates the design and implementation of a smart health monitoring system. Here, a patient can be monitored using a collection of lightweight wearable sensor nodes for real time sensing and analysis of various vital parameters of patients.

In this paper [5], they have performed the automated classification of RBCs as falling into one of the anaemia type. The proposed system identifies RBCs using intensity ratio transformation followed by centroid contour distance for segmentation of RBC.Two geometric features are used to

distinguish between normal and anaemic RBCs: Aspect Ratio and Fourier Descriptors.

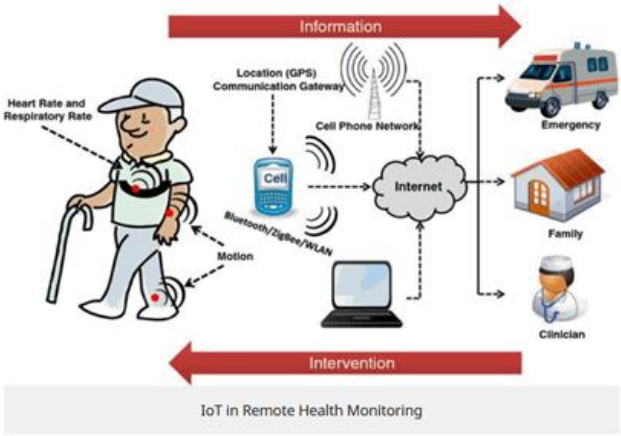

Fig1. System Representation.

Whereas, the paper[4], illustrates The method detects the blood components such as the Red Blood Cells (RBCs), White Blood Cells (WBCs), and identifies the parasites in the infected RBCs. The application also recognizes the different life stages of the parasites and calculates the parasites which is a measure of the extent of infection.

In [7], The area of the tumour can be measured by old method which consumes time in and labour demanding shows the segmentation the First the outline of the tumour has to be traced, by adding the area associated with all slices total tumour area can be found.Best segmentation can reduce misdiagnosis rate and avoid pressure on doctors. Accurate detection is vital,if there is light change in the shape of tumour,the ability to separate the abnormal tissue with normal the area involved precisely.

Whereas, in [6] it contains the required CT scan Images. The CT scan image is more reliable than other form of images. Image Smoothing, image enhancement, image segmentation are the techniques are used in pre-processing. Three main features are extracted during the process. These are area, perimeter and eccentricity of the input image.

III. SYSTEM REPRESENTATION

The body parameters are processed by Arduino Mega 2560, it will display to the patient on LCD and Waveforms on Patient side Personal Computer using MATLAB. The same data on computer it can be viewed by physician in two ways. Firstly, on the hospital website both in both the doctor's and the patients section and secondly on Android mobile. If any parameter goes abnormal then the system will sent an alert SMS to the doctor. Reports indicating that system have been a great concern for physicians with a passion for technology[3], and barriers still remain for a low cost, comprehensive and integrated use in the daily operations. It uses the Think Speak technology from IOT which provides storage off the data and give visualization of the data recorded on any platform using Arduino.

Whereas, in the other part, the microscopic slide or CT scan image is obtained by the pathology lab and is uploaded from the website from where it is obtained through FTP connection in the MATLAB and is processed through various Morphological operation and feature extraction which helps in detection of the disease and results is both uploaded at the doctor's and patient sections on the hospital website. The MATLAB GUI is created in both the cases whether in obtaining the sensor data or processing the image. Algorithms Classification methods to decrease the complexity of time and memory.

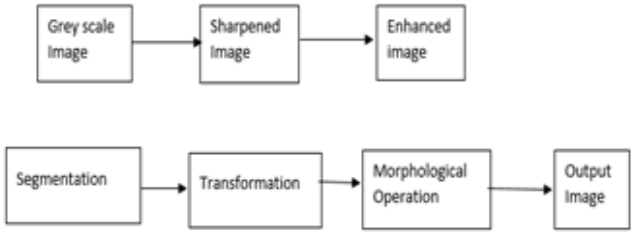

Fig 2. Flowchart for Segmentation

In Malaria,the preliminary aim of blood image analysis is to recognize different objects present in the image prior to differentiating them as parasites and non-parasites[4]. The proposed system in anaemia consists of broadly four sub-systems i.e. Automated RBC extraction, Grouped RBC segmentation, RBC classification, Automated NRBC count and WBC count correction. Calculation of area of tumour is carried out by calculating the pixel per inch of segmented image that could be calculated The specialty of this algorithm is that it deals with symmetrical structure of brain and in very simple way it segments out the brain tumour from the left or right part of image.

Whereas, in lung cancer detection, image Smoothing, image enhancement, image segmentation are the techniques are used in pre-processing. Three main features are extracted during the process. These are area, perimeter and eccentricity of the input image

IV. MATERIALS AND METHODS

A. Arduino Mega 2560 and Genuino Mega 2560

Fig3. Arduino Mega 2560 board

Fig3. showsthe Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins, 16 analog inputs, 4 UARTs , a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. . The Arduino Mega2560 has a resettable polyfuse that protects your computer's USB ports from shorts and overcurrent. Instead, it features the ATmega16U2 (ATmega8U2 in the revision 1 and revision 2 boards) programmed as a USB-to-serial converter.

B. Arduino Wi-fi Shield 101

Fig 4. Arduino Wi-fi shield

Fig.4 the Arduino WiFi Shield allows an Arduino board to connect to the internet using the 802.11 wireless specification (WiFi). It is based on the HDG204 Wireless LAN 802.11b/g System in-Package. An Atmega 32UC3 provides a network (IP) stack capable of both TCP and UDP. Use the WiFI library to write sketches which connect to the internet using the shield

C. Temperature Sensor

Fig 5. Temperature Sensor LM35

Fig5. Shows the temperature sensing is done by using an IC LM35.The LM35 is a precision integrated-circuit temperature sensor where its output voltage is linearly proportional to Celsius of Centigrade temperature.

D. ECG Sensor

Fig 6. ECG Sensor

An ECG Sensor with disposable electrodes attaches directly to the chest to detect every heartbeat. The electrodes of ecg sensor will conversion heart beat to electric signal. ECG Sensors is very light weight, slim and accurately to measures continuous heart beat and give rate data of heart beat. This device always use by trained doctor and medical assistances[9].

Electrodes of ECG Sensor have 3 pins and connected by cable with 30 inches in length. It is make ECG sensor easy to connect with controller and placed at the waist or pocket.

E. Pulse Rate Sensor

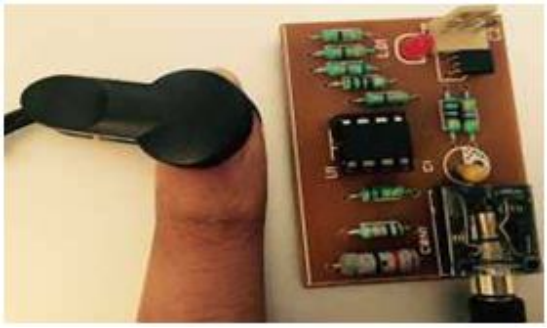

Fig7 . IR pulse rate sensor

IR sensor pair basically consist an IR LED and a photodiode, this pair is generally called Photo Coupler. IR sensor works on the principal in which IR LED emits IR radiation and Photodiode sense that IR radiation. Photodiode resistance will change according to the amount of IR radiation falling on it and hence the voltage drop across it also changes and by using the voltage comparator (LM358) we can sense the voltage change and generate the output.[2]

F. MATLAB 2014a-

The MATLAB software is used as the integrating platform for acquiring, processing and transmitting the physiological data; it is an excellent graphical programming environment to develop sophisticated measurement, test and control systems using the graphical icons and wires that resemble a flowchart. The software also includes number of advanced mathematics blocks for different functions such as integration, filters and other specialized capabilities. We have used Thing Speak technology integrated with this software to store all the data and the results of detection of image in the cloud storage. Things Speak is an IOT platform that lets you collect and store sensor data in the cloud and develop IoT applications. The Thing Speak IoT platform provides apps that let you analyse and visualize your data in MATLAB[10].

V. WORKING PRINCIPLE

A.Algorithm

- Connect the sensors to Arduino Mega 2560
- Board to the PC through the USB as well as to the patient.
- The values are acquired and are stored in the form
- of an array
- Received values are read by MATLAB at the patient side and the values are compared with threshold values to indicate any abnormal condition.
- These vital parameters are also displayed on the
- front panel.
- The values are also stored in a file in the cloud storage using IOT for further
- assistance in the treatment of the patient.
- the front panel can be seen remotely at the patient's side PC as well as on the hospital's website.

B. Working

The different sensors are placed at the respective location son the human body and are connected to the Arduino board. For the temperature sensor output from LM35 is converted to digital form with the help of ADC pins of Arduino board as shown in fig 8.. For the pulse rate sensor when the heart pumps blood through the blood vessels, the finger becomes slightly opaque and so less light reaches the detector. With each heart beat the detector signal varies and this variation is converted into electrical pulse. The pulse is also indicated by an LED which blinks on each heartbeat. The values of the sensors are transmitted to the MATLAB for analysing the health parameters. This system can be used to transmit the patient vital parameter information in real-time to remote location and can be seen by the care taker.

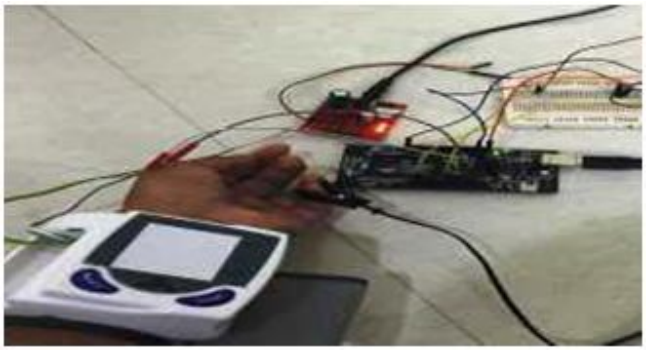

Fig 8. Project Hardware Representation

In the other part, the image uploaded by the doctor is processed in MATLAB using DIP algorithms. In Malaria, the preliminary aim of blood image analysis is to recognize different objects present in the image prior to differentiating them as parasites and non-parasites. The proposed system in anaemia consists of broadly four sub-systems i.e. Automated RBC extraction, Grouped RBC segmentation, RBC classification, Automated NRBC count and WBC count correction. Calculation of area of tumour is carried out by calculating the pixel per inch of segmented image that could be calculated The specialty of this algorithm is that it deals with symmetrical structure of brain and in very simple way it segments out the brain tumour from the left or right part of image.

Whereas, in lung cancer detection, image Smoothing, image enhancement, image segmentation are the techniques

are used in pre-processing. Three main features are extracted during the process. These are area, perimeter and eccentricity of the input image.

VI. EXPERIMENTATION AND RESULTS

The ECG Simulator is MATLAB based simulator and is able to produce Lead 11 ECG Waveform.ECG Signal is periodic with fundamental frequency determined by heartbeat. Fourier series can be used to representing ECG signal. The fig.9shows single period of an ECG signal is a mixture of triangular and sinusoidal wave forms feature of ECG signal.

1. QRS, Q and S portions of ECG signal can be represented by triangular waveforms.
2. 2.P, T and U

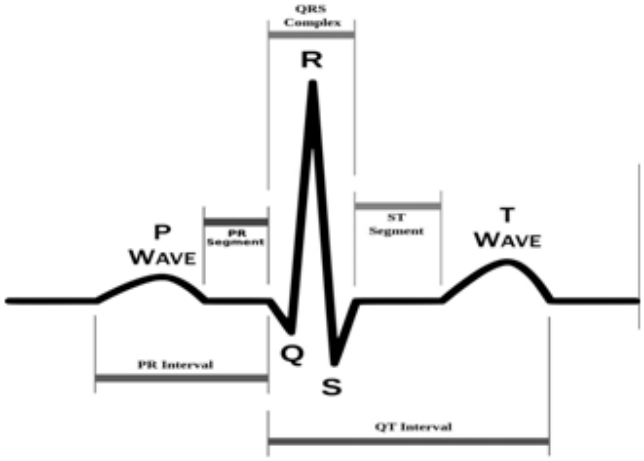

Fig 9. ECG waveform

The pulse rate waveform is also shown in the MATALAB GUI interface –

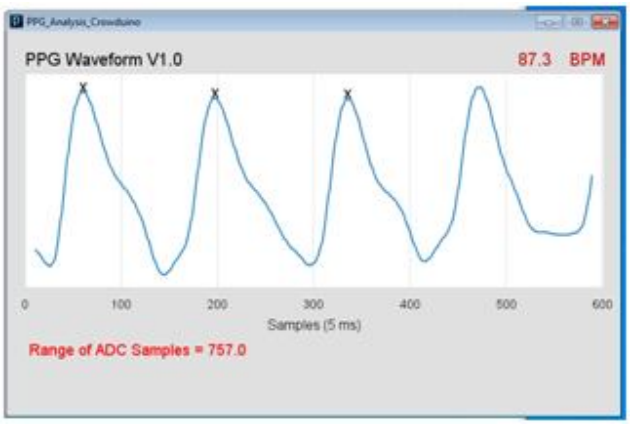

Fig 10. ECG waveform in MATLAB simulator

The other input microscopic slide or CT scan image is processed and the output is shown as –

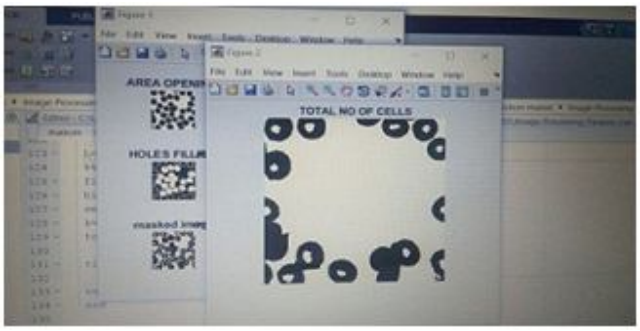

Fig11. Detection of Malaria in the blood slide

Both, the health parameters results are sent to the hospital's website and a particular threshold is set for the sensors data which will sent an alert to the doctor's mobile through SMS in case of emergency.

VII. CONCLUSION

In this paper, health monitoring through IOT application is presented which allows the doctor to view the patient's vital parameters remotely and dynamically in a Web page and in mobile in real time and doesn't need to have any special requirement on the PC; all the needs is an Internet access. For the patient side, a MATLAB GUI application which is embedded in home PC is required. In future this work can be extended by adding the Blood Pressure sensors to the existing set-up.

VIII. ACKNOWLEDGMENT

We would like thank our guide Prof. Nargis Shaikh, Dept. Of Electronics Engineering for guiding us in all our research and proceeding paper works. We would also like to thank our principal Mrs. Varsha Shah for her all-time support in this project. Also, we would like to thank our Department Faculty for providing us their knowledge and guiding us throughout our project and lastly all the authors of papers whose reference helped us to make this project successful..

REFERENCES

[1] S.D. Grigorescu1, O.M. Ghita1, C.K. Banica1, S. Potlog, A.M. Paraschiv "Health Monitoring Solution Using Dedicated ZigBee Sensor Network", THE 8th International Symposium On Advanced Topics in Electrical EngineeringMay 23-25, 2013 Bucharest, Romania.

[2] Vikas Vippalapalli, snigdha Ananthula"Internet of things (IoT) based smart health care system" , International conference on Signal Processing, Communication, Power and Embedded System (SCOPES)-2016.

[3] Suhas Kaie, C. S. Khandelwal"Design and Implementation 0f Real Time Embedded Tele-Health Monitoring System", 2013 International Conference on Circuits, Power and Computing Technologies [ICCPCT-2013]
[4] Corentin Dallet , Saumya Kareem, Izzet Kale "Real Time Blood Image Processing Application for Malaria Diagnosis Using Mobile Phones", IPB ENSEIRB-MATMECA, Bordeaux, France
[5] Nivedita Deb, Saptarshi Chakraborty"A Noble Technique for Detecting Anemia through Classification of Red Blood Cells in Blood Smear" IEEE International Conference on Recent Advances and Innovations in Engineering (ICRAIE-2014), May 09-11, 2014, Jaipur, India.
[6] [6] Pooja R. Katre, Dr. Anuradha Thakare "Detection of Lung Cancer Stages using ImageProcessing and Data Classification Techniques", 2017 2nd International Conference for Convergence in Technology (I2CT).
[7] WilliamThomas, H M, ,S C Prasanna Kumar" A review of segmentation and edge detection methods for real time image processing used to detect brain tumour." 2015 IEEE International Conference on Computational Intelligence and Computing Research.
[8] https://www.arduino.cc/en/Hacking/PinMapping2560
[9] https://www.thingspeak.com/