Perspectives in Communication, Embedded-Systems and Signal-Processing (PiCES) – An International Journal
ISSN: 2566-932X, Vol. 5, Issue 2, May 2021

Li-Fi Technology Based Patient Health Monitoring and Tracking System

Prof. Venkatesha G
Professor, Department of ECE, Brindavan College of Engineering, Bangalore, Karnataka, INDIA, gv@brindavancollege.com

Dr. Dinesh S
Professor & HoD, Department of ISE, Brindavan College of Engineering, Bangalore, Karnataka, INDIA, hodise@brindavancollege.com

Dr. Manjunath M
Associate Professor, Department of ECE, Brindavan College of Engineering, Bangalore, Karnataka, INDIA, manjuec043@brindavancollege.com

Dr. K B Raja
Professor, Department of ECE, UVCE, Bangalore, Karnataka, INDIA, rajakb@gmail.com

Dr. Rangaswamy Y
Associate Professor, Department of ECE, Dr Ambedkar Institute of Technology, Bangalore, Karnataka, INDIA, ranga.ace@gmail.com

Abstract: Generally, today in this busy & bustling fast moving world, everybody is occupied in his or her own part of life. It is to be noted that health and patient monitoring is a very tedious job to be done. They have to be traced, tracked & monitored continuously at all times. They have to keep monitoring the patients, who are admitted to intensive care unit (ICU) and other observation units, when these patients are in serious illness conditions and can't be said what happens in next instance to them. There are hundreds and thousands of diseases which are threatening the population all over the world which is actually a mental pressure & alarming situation to all. The wellbeing observing framework proposed here keeps specialist constantly refreshed wellbeing data of patient utilizing different sensors used to screen the soundness of patient. It allows doctors to monitor and track a patient over the long distance and to consult others. Light-Fidelity(Li-Fi) innovation is utilized here into refresh data rapidly and it can be seen on the monitor screen of the specialist. Simultaneously it can also record the data of the patient in the CPU. This data can be viewed on the internet for reference while consulting the patient. This whole process can actually reduce the work of a nurse and doctors and also make the work easier and more accurate.

Keywords: CPU; ICU; Li-Fi

I. INTRODUCTION

Now a days as the world is moving faster & technology is growing in high speed henceforth health concern has become top most priority, Continuous measurement & monitoring of patients different parameters namely such as heart Pulse rate & rhythm, oxygen level in blood, respiratory system rate, blood flow pressure, blood-oxygen saturation levels, and many other parameters has become a common feature of the care of critically ill patients. When the accurate and immediate decision-making is been very crucial for the effective patient care, so different electronic monitors frequently are been used to collect all the different types of data and display the physiological data. Increasingly, such type of data are collected using a non-invasive type of sensors from less seriously ill patients in a hospital's medical-surgical units, labor wards and delivery suites, ICU & HDU, Private nursing homes, or patient's own houses to detect the unexpected life-threatening conditions and also to record routine but required actual data efficiently.

Now a day's innovation has entered in all parts of normal life, and the medical field is not a special case for that. The electronics technology has entered almost in all aspects of day-to-day life, and the medical field is not the exception for that. In biomedical fields, special units are used, such as intensive care unit or intensive coronary care unit. All of these units are designed to offer the advantage of the low Nurse - Patient ratio and concentration of the equipment and the resources needed; to take care of critically ill or seriously injured units. Generally, today medical world faces two basic set of problems when it comes to the patient monitoring and tracing, tracking, first the basic need for front line healthcare workers present bedside the patient and second the patient is restricted to bed itself and wired to large type of medical equipment's & machineries. In order to achieve good quality patient's care, the above problems have to be taken care & solved immediately. As the technologies are growing & advancing, it has become feasible to design a home based vital sign monitoring system to display, monitor, and record, also transmit the signals from human body to the doctor, the computer based real time signal segregation, acquisition, processing, and analysis system using Liquid Crystal Display to monitor display status.

This project discusses different aspects of the acquisition of physiological Real Time signal Parameters like Heart rate, pulse rate, Temperature, spo2 level, Heartbeat pre-processing them and displaying it on a graphical user interface for being viewed by the doctor's and also observe the clinically useful data, firstly on the Doctors LCD screen and secondly on laptop, desktop or mobile phone etc.

This type of systems is expected to monitor different patients who are under critical condition care, they more conveniently and accurately for diagnosing the actual disease in which it can be interfaced with a computer/laptop to bring this under a common computer network system especially for the doctor's to monitor the patient's condition sitting in their own office or elsewhere without being physically present near to the patient's bed to monitor the results.

The main aim of our project is: we discuss the use of computers to assist caregivers in the collection, display, storage, and decision-making, including interpretation of clinical data, making therapeutic recommendations, and alarming and alerting. Earlier, most of the clinical data which were in the form of blood pressures, and flows, heart rate, respiratory rates, but today they include integrating most of the valid data from bedsides available medical instruments which measure the gases in the blood, chemistry, and hematology as well as integrating the different data from many sources outside the intensive-care unit (ICU). In general, we deal with patients who are in intensive-care unit (ICUs), the general principles and techniques are also applicable to other hospitalized patients with different medical related problems.

For instance, monitoring of patient may be performed for the diagnostic purposes in the case of emergency rooms or for therapeutic purposes in the operating rooms itself, there are techniques that just a few years ago were used only in the ICU that are now routinely used in general hospital units and in some situations by the patients who are at home. It also saves the patient's valuable time and effort by reducing their back and forth travels to the far of places Primary health centers across them, it also provides the patients with an opportunity to save their lives by sending them critical situation message who are resided in remote locations.

II. BLOCK DIAGRAM

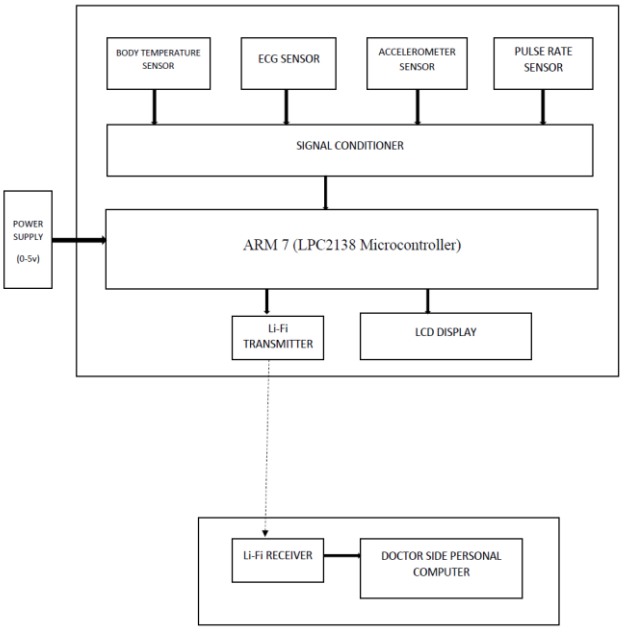

Fig 1. Block diagram of Health monitoring system

III. WORKING

Usually patients are constantly monitored as something that watches for & give information about serious or life-threatening events in patients whether the patients are critically ill or not, patient monitoring can be rigorously defined as repeated/continuous observations or sometimes measurements of the patients conditions, whether he or she are physiological functions, and these functions of life support equipment's for the purpose of guiding private and hospital management decisions, including when to make the interventions, and assessment of those interventions. The figure below shows the block diagram of a Health monitoring system.

Here are various sensors that are connected to the patient's body which is used to monitor the various health conditions. The temperature sensor LM35 converts the temperature of human body radiated into the voltage waveform.

The ECG sensor monitors the heart rate of the patient. In addition, accelerometer ADXL335 keeps checks on the body position of the patient. Further, the pulse rate sensor monitors the rate of blood flow in the body. All the output from various sensors is fed into the signal conditioner.

The signal conditioning manipulates the analog signal output for next stage of processing. The microcontroller present converts the analog output to digital output. This output is fed into the Li-Fi transmitter to transmit the data to the doctor or the concerned person. Simultaneously the data is displayed on a LCD screen.

The Li-Fi receiver receives the data and displays it on various remote devices such as a computer screen, mobile devices, a smart watch etc.

IV. FLOWCHART

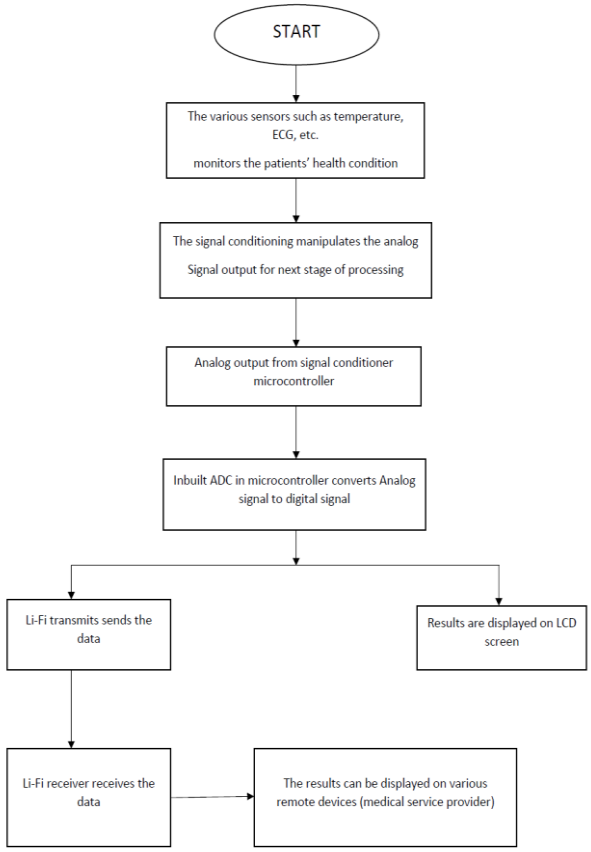

Fig 2. Flowchart of Health monitoring system

V. HARDWARE & SOFTWARE

A. *TEMPERATURE SENSOR:*

LM35 is a temperature sensor that outputs an analog signal which is proportional to the instantaneous temperature. The output voltage can easily be interpreted to obtain a temperature reading in Celsius. The advantage of LM35 over thermistor is it does not require any external calibration.

The Temperature sensors are used to measure the temperature of a human body. It can be used in diverse application such as medical devices.

These sensors tend to measure the heat to ensure that the process is either Staying within a certain range, providing safe use of that application or meeting a mandatory condition when dealing with the extreme heat, hazards or extreme points.

B. *ECG SENSOR:*

Electrocardiogram sensor allows us to assess different muscular & electrical functions of the heart, Heartbeats are triggered by different intervals bio-electrical signals of very low amplitude which is been generated by the special set of cells in the heart.

ECG enables the translation of these electrical signals into digital numerical values which further enables them to be used in a wide array of applications in all fields. Our sensor will allow the data acquisition not only at the hand palms but also at the chest and works both all types of electrodes. The bipolar configuration is ideal for low noise applications.

C. *PULSE RATE SENSOR:*

The heart rate data recorded can be really useful whether we are designing an exercise routine or studying our activity, anxiety levels or just wants our shirt to blink with our heart beat. The general problem is that heart pulse rate can be difficult to measure at all the time; the Pulse Sensor can solve that problem. The sensor combines a simple optical (light) heart rate sensor with noise cancellation & amplification circuitry making it easy and fast to get reliable pulse readings accurately. Also, it takes power with less amount current i.e. 4mA at 5V so this is enough for cellular mobile applications.

D. *LCD DISPLAY:*

Liquid Crystal Display is generally used in the project to visualize the output of the applications. Here in this project, we have used 16x2 LCD which indicates 16 columns and 2 rows. So, we can write 16 characters in each line and total 32 characters we can display on 16x2 displays. LCD can also be used to check the output of different set of modules interfaced with the microcontroller and its other sets.

E. *POWER SUPPLY:*

To drive ARM7 we require 3.3V and for various sensors and we require 5V to drive ECG, LM35, SpO2, Accelerometer and pulse rate etc. So to do this we will have to build variable power supply unit using voltage divider circuit and regulator ICs. HC-SR04 Ultrasonic high frequency sensor with 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground. This type of sensor is most popularly used in many applications where measuring distance and sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic TX and Rx.

HC-SR04 ultrasonic sensor is used in sonar to determine the actual distance to an object. It offers excellent non-contact range of detection with high accurate values and stable readings in an easy-to-use package. The operating frequency is 30-40 KHz. This module also contains both TX and Rx. There are 4 pins in this module one is receiver, and other is transmitter and two are Vcc and ground.

Applications HC-SR04 Ultrasonic Sensor are:

- It is used to avoid and detect obstacles with robots like, obstacle avoider robot, path finding robot etc climber robot etc.
- It is used to measure the distance within a wide range of 2-400cms

- It can also be used to map different set of objects surrounding the sensor by rotating it accordingly.
- In certain places like deep wells, sanitary pits etc can be measured since the waves can penetrate through water for a certain range.

F. ARDUINO UNO

The Arduino UNO is a microcontroller board. It is a 14 pin digital I/O pins & 6 analog inputs, 4 UARTs and a 16 MHz crystal oscillator, a USB connection, a power jack, and a reset button. To program Arduino Uno, the software used in ARDUINO (IDE). The Arduino Integrated Development Environment software contains a simple text editor for writing codes, a message area, toolbar with different set of buttons for common functions and a series of menus. It connects to the Adriano hardware to upload programs and establish communication with them.

VI. APPLICATIONS

RF waves are harmful for patients. Li-Fi technology is much safer option. This module uses light for transmitting data which makes it much safer. Also the module can be used to monitor the health status of the patient continuously. The information about a patient can be monitored over various devices such as a smartphone or a wrist watch.

VII. ADVANTAGES AND ISSUES

Speed of the Li-Fi communication is high, hence it reduces the time. Due to high speed of the system, we can send more accurate and less noise signal compared to the previously existing system.

In addition, visible light spectrum is 10000 times bigger than RF spectrum. It is predicted that will we run out of the RF spectrum by 2020. Also, light cannot penetrate walls, but radio waves can, thus security is higher in using Li-Fi. Transmission of data: Data transmission on Wi-Fi is serial, whereas Li-Fi transmits data streams in parallel thus offering higher speed. Infrastructure: It already exists. Inexpensive devices, mostly powered by LED, so it is cost effective, compared to base stations.

The issue related to this project is that the range of li-fi technology is not much longer and people are not aware of li-fi technology.

VIII. CONCLUSION

Generally Li-Fi system will provide accurate, faster, greener, safer, better & healthier future for the future communication system, When such a type of systems are developed each light source can be used as a Li-Fi application i.e. wherever light is there is an internet. Also it will shape the better future for mankind by reducing the energy consumption, data as well as light at low cost, of investment, minimal cellular infrastructure and creating the employments opportunities at larger scale. Henceforth Li-Fi system will be a change scenario of wireless communication in many different ways.

IX. RESULTS & DISCUSSION

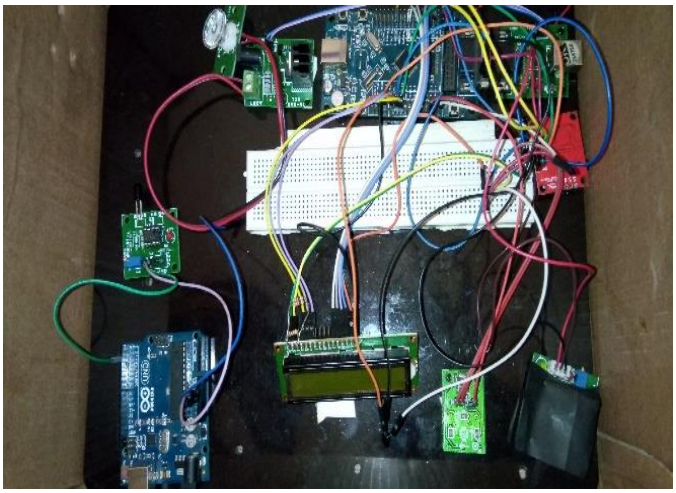

Fig 3. Circuit developed

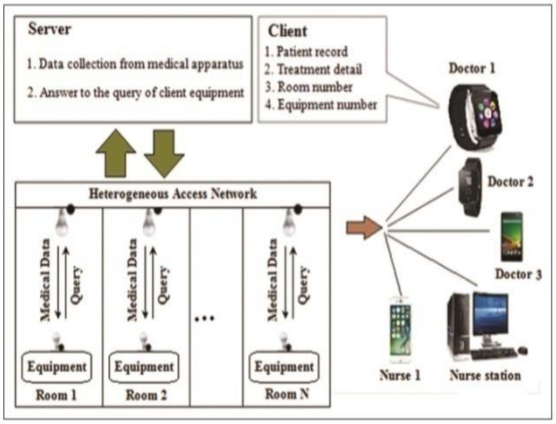

Fig 4. Data flow

Parameter	Li-Fi	Wi-Fi
Speed	H	H
Range	L	M
Data density	H	L
Security	H	M
Reliability	M	M
Power availability	H	L
Transmit/receive power	H	M
Ecological impact	L	M
Device-to-device connectivity	H	H
Obstacle interference	H	L
Bill of materials	H	M
Market maturity	L	H

H: High, M: Medium, L: Low, Li-Fi: Light fidelity, Wi-Fi: Wireless fidelity

Fig 5. Observations made

REFERENCES

[1] Nitin VijaykumarSwami, "Li-Fi (LIGHT FIDELITY) – THE CHANGING SCENARIO OF WIRELESS COMMUNICATION", IJRET, Volume: 04 Issue: 03 | Mar-2015

[2] B Prathyusha, T SreekanthRao, D. Asha, Extraction of Respiratory Rate from PPG Signals, International Journal of

Research in Engineering and Technology, Volume: 01 Issue: 02 | Oct-2012

[3] R.S.Khandpur, Handbook Of Biomedical Instrumentation, 2E.

[4] ARM7 LPC2131/32/34/36/38- NXP semiconductors datasheet and user manual.

[5] Dr. Rammanohar Mishra, Quick Recovery Temperature Sensor: Design& Study, IJETAE, Pg26, Volume 1, Issue 2, and December 2011

[6] Suhas Kaie, C.S. Khandelwal," Design and Implementation of Real Time Embedded Tele-Health Monitoring System", ICCPCT-2013, 978-1-4673-4922-2/13/$31.00©2013 IEEEE.

[7] Dr. Manjunath M, Dr. Dinesh S, Prof. Venkatesha G, "Automatic Irrigation, Pesticide Sprinkling and Solar Operated Tractor" published in Journal of Advances in Communication Engineering and Its Innovations Volume 4| Issue 2 | 09 July 2019 |Page 1-12 |MANTECH PUBLICATIONS, Ghaziabad 201014, Uttar Pradesh, INDIA 2019 .

[8] Dr. Manjunath M, Prof. Venkatesha G, Dr. Dinesh S, "Survey Paper on Classifiers for Machine learning" published in Journal of Artificial Intelligence, Machine Learning and Soft Computing Volume 4| Issue 2 | 14 Sep 2019 |Page 17-27 |MANTECH PUBLICATIONS, Ghaziabad 201014, Uttar Pradesh, INDIA 2019 .

[9] Dr Manjunath M, Venkatesha G, Dr Dinesh S, "Visual Display Matrix Computation Bases Smart Object Detector" was reviewed by experts in this research area and accepted by the board of 'Blue Eyes Intelligence Engineering and Sciences Publication' which was published in 'International Journal of Emerging Science and Engineering (IJESE), Scopus Indexed journal, ISSN: 2319–6378 (Online), Volume-5, Issue-12, January 2019. Page No.: 7-10, The B | Impact Factor of IJESE is 5.02.

[10] Dr. Manjunath M, Dr. Dinesh S, Venkatesha G "SEPD Technique for Removal of Salt and Pepper Noise in Digital Images" was published in International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, p-ISSN: 2395-0072, Volume: 06 Issue: 03 | Mar 2019 | Impact Factor value: 7.211 | ISO 9001:2008 Certified Journal |Scopus Indexed Journal.

[11] Dr. Manjunath M, Prof. Venkatesha G, Dr.Dinesh S "Agriculture Crop Yield Prediction and Efficient Use of Fertilizer using Machine Learning" Published in Journal of Android, IOS Development and Testing Volume 5| Issue 1 | 02 Mar 2020 |Page 01-13 |MANTECH PUBLICATIONS, Ghaziabad 201014, Uttar Pradesh, INDIA 2020.

[12] M, Manjunath, and H B Kulkarni. 2018. "Analysis of Unimodal and Multimodal Biometric System Using Iris and Fingerprint". Perspectives in Communication, Embedded-Systems and Signal-Processing - PiCES 2 (8):333-37. http://pices-journal.com/ojs/index.php/pices/article/view/109.

[13] Manjunath M, Dr K B Raja, "A NOVAL APPROACH FOR RECOGNITION OF IRIS USING DESCRETE WAWELET TRANSFORMS AND PRINCIPLE COMPONENT ANALYSIS" was published in the International Journal of Advanced Networking and Applications (IJANA) Volume: 5 Issue: 1 Page 1830 – 1836 May/June 2013, ISSN (Online): 1985-2304, Thomson Reuters' Researched ID: B-8619-2016, | Impact Factor: 3.462, ICV:5.93Points, IJANA Journals, Coimbatore, TN.India

[14] Rupanagudi S.R. et al. (2015) Design and Implementation of a Novel Eye Gaze Recognition System Based on Scleral Area for MND Patients Using Video Processing. In: El-Alfy ES., Thampi S., Takagi H., Piramuthu S., Hanne T. (eds) Advances in Intelligent Informatics. Advances in Intelligent Systems and Computing, vol 320. Springer, Cham. https://doi.org/10.1007/978-3-319-11218-3_51

[15] Dr. Manjunath M, Prof. Venkatesha G, Dr.Dinesh S "Agriculture Crop Yield Prediction and Efficient Use of Fertilizer using Machine Learning" Published in Journal of Android, IOS Development and Testing Volume 5| Issue 1 | 02 Mar 2020 |Page 01-13 |MANTECH PUBLICATIONS, Ghaziabad 201014, Uttar Pradesh, INDIA 2020.

[16] Dr. Manjunath M, Prof. Venkatesha G, Dr.Dinesh S, Dr. Nagendra Kumar M "Ultrasonic & IR Sensors Based Potholes and Speed Brakes Detection System" Published in Open Journal System (OJS) in the issue of Trends in Microwave Engineering and Technology, Volume 5| Issue 1 | 01 Feb 2020 |Page 01-09 |MANTECH PUBLICATIONS, Ghaziabad 201014, Uttar Pradesh, INDIA 2020.

[17] M, Manjunath, Venkatesha G, and Dinesh S. 2021. "Raspberry Pi Based Anti-Theft Security System Using Home Automation for Multi-Level Authentication". Perspectives in Communication, Embedded-Systems and Signal-Processing - PiCES 4 (10):249-53. https://doi.org/10.5281/zenodo.4515527.

[18] Dr.Manjunath M Prof.Venkatesh G Dr.Dinesh S Abhishek R K "INDUSTRIAL GAS LEAKAGE DETECTING ROBOT" Published in Journal of Research in Instrumentation & Control Engineering Volume 5| Issue 2 | 13 Oct 2020 |Page 14-21 |MANTECH PUBLICATIONS, Ghaziabad 201014, Uttar Pradesh, INDIA 2020|

[19] Dr.Manjunath M Dr.Dinesh S Prof.Venkatesh G "Literature Review on Kalman Filter" Published in Journal of Research in Image and Signal Processing Volume 6| Issue 1 | 02 April 2021 |Page 17-28 |MANTECH PUBLICATIONS, Ghaziabad 201014, Uttar Pradesh, INDIA 2020

[20] Prof.Venkatesh G Dr.Manjunath M Dr.Dinesh S Bharat Raj D "PDKC Clustering Algorithm for Wireless Sensor Networks to Reduce Energy Consumption" Published Journal of Wireless Communication, Network and Mobile Engineering Technology|Volume 5| Issue 2 | 23 July 2020 |Page 20-34 |MANTECH PUBLICATIONS, Ghaziabad 201014, Uttar Pradesh, INDIA 2020|

[21] S, Dinesh, MeenaKumari K S, Nazia Nusrath Ul Ain, Manjunath M, and Venkatesh G. 2020. "AFM Based Manipulation for Mobile Diagnostics". Perspectives in Communication, Embedded-Systems and Signal-Processing - PiCES 4 (3):12-16. http://pices-journal.com/ojs/index.php/pices/article/view/218.