Study of Patient Monitoring System Using Li-Fi Technology

Mr. Ashwin Shenoy M
Assistant Professor, Dept. of ISE, Yenepoya Institute of Technology, Mangalore

***Abstract*- This paper focuses on study of the patient monitoring in the hospitals using the Li-Fi technology. Li-Fi stands for Light-Fidelity. Li-Fi technology, proposed by the German physicist Harold Haas, provides transmission of data through illumination by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. Li-Fi is a bidirectional, high speed and fully networked wireless optical communication and is a form of visible light communication. The proposed model helps in the Patient monitoring in the hospitals and can be done by using the concept of Li-Fi instead of the Wi-Fi technology to avoid the frequency interference with the human body. Sensors such as temperature, heartbeat, glucose and respiration used in this model perform its respective functions. These sensors collect the data from the human body and are converted in to the digital form using the analog to digital converter and the outputs of these sensors are given to the microcontroller. The output from the microcontroller is fed to the Li-Fi module which transmits the data in the form of light and the receiver end collects this data by using photo diode and then finally displays the results in receiver end.**

***Index Terms*- Li-Fi, microcontroller, photo diode.**

I. INTRODUCTION

In the era of emerging technology [1], it is necessary to find better solutions for every activity. Patient monitoring can be done in a very efficient manner using the Li-Fi technology. Patient monitoring [2], done by the Wi-Fi is slower when compared to the Li-Fi and it also has less bandwidth. Reliability is better in Li-Fi than Wi-Fi. Since transmission of data by Wi-Fi is through RF waves, there is a high possibility that these waves might affect the human body.

The designation of these signals may be carcinogenic and this has been given by the World Health Organization. To solve this problem, Li-Fi (light fidelity) technology is used for healthy environment .Light fidelity is transmission of information through optical wireless medium. . In this study, sensors such as heart beat, temperature, and glucose level and respiration sensor are used transmitted through the Li-Fi module. Rapid pulses are generated in the form of 0s and 1s.Silicon photo diode is used at the receiver end. Flickering of light takes place at the rate of hundreds of megabits per seconds. By using UART, the receiver is connected to computer. The information is displayed in computer can be sent as a mail to the person concerned. The range of the Li-Fi technology is 10m and secured communication [4], is possible. The transmission of information by light through wireless is termed as Visible Light Communication (VLC).

II. SYSTEM DESIGN

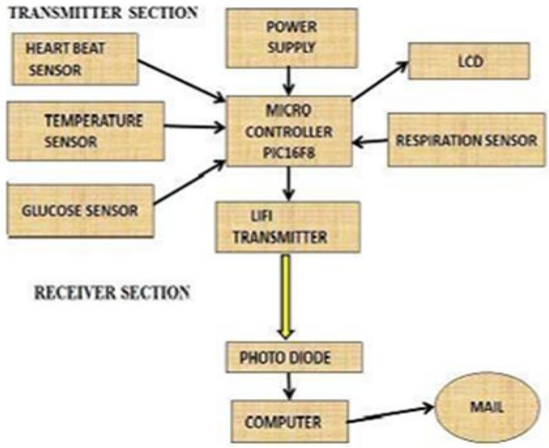

Fig 1: Block diagram

A. HARDWARE COMPONENTS

The entire circuit is categorized into two section- Transmitter and receiver

B.TRANSMITTER SECTION

The power supply is converted from AC to DC using the step down transformer from 230V to 5V DC with

the bridge rectifier. Four sensors –heartbeat, temperature, glucose level and respiration sensors are connected to PIC 16F877A. In the heart beat sensor the pulses are recorded based on optical power variation as light is scattered or absorbed during its path through the blood as the heart beat changes. Temperature sensor LM35 is used to measure temperature of patient with electrical output proportional to Celsius glucose level sensor, similarly glucose level of the patient is measured with the flow of blood and the same is done in respiration sensor. The heart beat count is displayed in the LCD display. The PIC16F877A is low power high performance microcontroller [3] with 8K bytes in system flash memory. The special feature of this microcontroller is the presence of inbuilt UART, which is used for serial transmission. The signal is transmitted through the Li-Fi transmitter and the source of transmission is LED.

C. RECEIVER SECTION

In the receiver section the data transmitted is received with the help of photo detector the receiver section is kept line of sight to the transmitter. The transmitted data is collected and transmitted to the PC with the help of Visual Basic and the transmitted values of heartbeat sensor is plotted in graph and the information is sent to the end user through email.

III. SOFTWARE COMPONENTS

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. The Keil C Compiler for the 8051 microcontroller is the most popular 8051C compiler in the world and is compatible with the other upgraded microcontrollers too. It provides more features than any other C compiler available today. This Compiler allows you to write microcontroller applications in C that, once compiled, have the efficiency and speed of assembly language. Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs for Microsoft Windows, as well as web sites, web applications and web services. It can produce both native code and managed code. Visual Studio includes a code editor supporting IntelliSense (the code completion component) as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger are glucose, temperature, pressure and respiration which will perform its necessary function. The sensed data are converted into the digital form using the analog to digital converter which is inbuilt in the microcontroller PIC16F877A.The data is then transmitted in the form of light through the Li-Fi module. The on and the off of the lights indicates the presence and the absence of the information. Rapid pulses are generated by the flickering of these LEDs which produces string of 0s and 1s.The light is detected in the receiver side by the photo detector. The received information can be depicted in the form of graph to analyze the patients' health by connecting the receiver end to the computer. The health report of the patient can be mailed to the concerned person automatically without any human intervention through the internet.

IV.WORKING OF THE MODEL

The working of the Li-Fi module is very simple [5][8][9]. It uses the concept of LEDs where logic 1 represents the data transmission and logic 0 represents that there is no transfer of data. The patient monitoring [10] using the Li-Fi is done with the help of sensors. The sensors that are used in this model

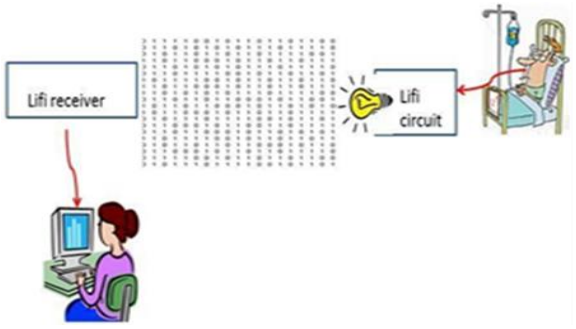

Fig 2: working model

A. WORKING OF THE SENSORS

a. Temperature sensor

The temperature sensor that is used in the proposed model is LM35. It is a thermistor that is used to

measure temperature of patient .The electrical output is proportional to the temperature in Celsius. With the current variations the temperature of the patient is measure

b. Heartbeat sensor
It consists of a bright red LED and a light detector [7]. When the finger is placed close to the sensor a certain amount of light passes through the finger and depending upon the intensity of the light detected in the detector the current is produced accordingly. When no finger is placed brighter light intensity is detected by the detector. So based on the current variations the pulses are recorded and graph is obtained

c. Respiration sensor
The respiration sensor has a small mike that amplifies the weak signals obtained from the human breath. The temperature of our breath during inhalation has a lower temperature than during exhalation the breath has a higher temperature. This temperature differences changes the resistance in the thermistor that is used in the sensor and current is produced accordingly measuring the lung capacity.

d. Glucose sensor
This sensor uses the concept of NIR (Near Infrared spectroscopy). The glucose in our body produces the weakest absorption of the NIR signals. When the finger is pressed on the sensor button it identifies the depth of the infra-red penetration through the tissues (usually 1 to 100mm) and based on the penetration depth of the infrared waves the glucose from the human body can be measured. Since data is transmitted through LED, the availability of the source of transmission is easy and available cheaply.
As light waves cannot penetrate through walls the information transmitted is much secured and cannot be misused.
It has higher bandwidth with the advent of Li-Fi one can surf the net by simply standing under the light.

B. DISADVANTAGES
Since it cannot penetrate through opaque objects it is not used for long distance transmission, it can only be used as a line of sight communication.

C. APPLICATIONS

a. Medical application
For healthy environment radio waves [6] is not suitable for patient because of its high radiation effect. So visible light waves is used for medical applications such a MRI equipment

b. Avoidance of accidents
Li-Fi technology can be used in order to communicate with LED lights in traffic signals and messages can be sent to the cars to warn the driver about the speed that he should maintain so that the number of accidents can be reduced.

V. CONCLUSION AND FUTURE WORK

The improvement in the field of wireless communication gives us flexibility to make our life easier and secure. In this study the proposed system replaces the need of Wi-Fi and lights can be used as a source to transmit information. Transmitting information through Li-Fi makes it faster and easier .The concept of Li-Fi will make the communication faster and more effective in future in various spheres across the world. It will be more efficient as it can travel through areas where human intervention is not possible. It attracts a great deal of interest in business in the communication sectors and will soon be able to utilize this technology at greater speeds in every field of communication and will thus enable ease of access of data instantly. This ultimately reduces the time consumption and the work outcome is effectively increased. Thus this technology will be a greener, safer and cleaner way of communication.
Every bulb can be used something like a Wi-Fi hotspot to transmit wireless data If this technology can be put into practical use, it will proceed towards the safer, cleaner, greener and brighter future. Solve issues such as shortage of radio frequency bandwidth and also allow internet where traditional radio based wireless is not allowed such as aircraft or hospitals. Power station is implemented for long distance transmission.

REFERENCES

[1] ”Standards for indoor optical wireless communication by boucouvalas AC Periklis chatzimiios, Zabih ghassemlooy, mura uysal and konstantionos yinnopoulo” 2015

[2] "Data Services of Li- Fi in Hospital Management" by Ankit Navalakha, Neelu Maheshwari, International Journal of Science and Research (IJSR) 2014.
[3] "Design and Development of PIC Microcontroller based Wireless Architecture for Human Health Monitoring" by Kalpana.P.M .International Journal of Innovative Research in Science, Engineering and Technology Vol. 4, Issue 4, April 2015.
[4] "Secured li-fi (secured visible light communication" by MohitHapani, Mangesh Joshi and RajkumarMaradia "International Journal of Students Research in Technology & Management Vol 1 (05), September 2013, ISSN 2321-2543 2015.
[5] "Coexistence of WiFi and Li-Fi towards 5G" by Moussa Ayyash, HanyElgala, Abdallah Khreishah, Volker Jungnickel, Thomas Little, Sihua Shao, Michael Rahaim, Dominic Schulz, Jonas Hilt, Ronald Freund. Concepts, Opportunities, and Challenges 2016.
[6] http://visiblelightcomm.com/top-10-visible-lightcommunications applications.
[7] https://www.elprocus.com/heartbeat-sensor-working- application.
[8] "Li-Fi Technology" by Rahul R.Sharma , Raunak, Akshay Sanganal Department of Computer Engineering 2014.
[9] "Visible light communication" by Rajan sagotra ,Reena Agarwal department of electronics engineering 2013.
[10] https://en.wikipedia.org/wiki/Embe