Li-Fi based Patient Monitoring System

T. M. Aarthi[1], B. Chitra Raghavi[2], A. Shanmugapriya[3]

[1,2]Student, Department Computer Science and Engg., Sri Ramakrishna Engineering College, Coimbatore, India
[3]Assistant Professor, Dept. Computer Science and Engg., Sri Ramakrishna Engg. College, Coimbatore, India

Abstract: **The patient monitoring system using 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 varies intensity faster than 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 Wi-Fi technology to avoid the frequency interference with the human body. Sensors such as temperature, heartbeat are used in the model to perform its respective functions. These sensors collect the data from the human body and convert in to the digital form using the analog to digital converter. The output of these sensors is given to the Arduino Nano. The output from the Arduino Nano is fed to the Li-Fi module which transmits the data in the form of light and the receiver end collects this data and this data of the patient is to the system.**

Keywords: **Li- Fi, Wi-Fi, VLC.**

1. Introduction

Li-Fi known as light fidelity. LiFi is based on Visual Light Communication (VLC) that using light emitting diodes (LEDs) to fully networked wireless system. LiFi enables the electronic device to connect to the internet with no wire. In order to make a communication line between node, a LiFi will need a transceiver to transmit and receive the data. This transceiver will have a modulation technique to make the LED enable to carry the data using the light.

In emerging technology, it is necessary to find better solutions for every activity. Nowadays health care expenses are increasing and to reduce this expenses it is required to have a technology based health care systems. Patient monitoring can be done in a very efficient manner using the Li-Fi technology. Patient monitoring refers to "repeated or continuous observations or measurements of the patient, his/her physiological function, and the function of life support equipment, for the purpose of guiding management decisions, including when to make therapeutics interventions, and assessment of those intervention"

Li-Fi is a wireless communication system which is used to produce visible light communication for high speed wireless communication. It acquired this name due to similarity to Wi-Fi, or an alternative to Wi-Fi that utilizes light rays instead of radio waves, this light produced by light-emitting diodes, or LEDs. So it's an internet of light, or maybe LED net. This was

developed by German physicist, Harald Hass. It is a technology that may be as fast as 500MBPS (30GB per minute), an alternative, cost effective, more robust and useful than Wi-Fi. In recent technology advanced in physical sensors, microcontrollers and radio frequency on a single chip using wireless networking and nano-fabrication have enabled a new generation of wireless sensor nodes suitable for many applications. One of the most important exciting application domains is health monitoring. A number of sensors that monitor vital signs could be integrate into a Wireless Body Area Network. The WBAN, which is consist of low cost, less weight, and miniature sensors can allow long-term, ambulatory health monitoring instantaneous feedback to the user about the health status and real-time updates of the user's medical records. In this project proposed the wireless architecture of human health monitoring, to providing with proper health care facilities. The sensors where placed on the patient's body, to monitored the human health. The function of sensor is to collect data's from the patient body and to send those information to a PC via short range wireless network. This technology doesn't deal with radio waves and produce better results than Wi- Fi, so widely useful in the area of medical science. As treatment of patient does not effected by LEDs that is if a doctor want to consult from other expertise for any treatment of patient then they can make a video conference in hospitals/OTs, so it will not affect patient's body and they can get best results.

Patient monitoring 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. Sensors such as heart beat, temperature, and motion sensor are used transmitted through the Li-Fi module. Rapid pulses are generated in the form of 0s and 1s. Photo diode is used at the receiver end. Flickering of light takes place at the rate of hundreds of megabits per seconds. By using Bluetooth, the receiver is connected to mobile. The information received in the mobile can be displayed in the mobile through an application. The range of the Li-Fi technology is 10m and secured communication is possible. The

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transmission of information by light through wireless is termed as Visible Light Communication (VLC).

2. Communication in hospitals

In hospital, there are many devices which work on Wi-Fi such as infusion pumps, lung ventilators. Apart from the interference with medical equipment, an EMI affects human body also in the form of diseases like immune dysfunction. in worst case, it may lead to cancer. Hospitals are places where both EMI sensitivity and security of medical details are issues with the uses of Wi-Fi. To combat the above limitations of Wi-Fi in health monitoring system, Li-Fi is used.

Constant monitoring of patient's health condition in hospital is either manual or wireless fidelity (Wi-Fi)-based system. Wi-Fi-based system becomes slow in speed due to exponentially increased scalability. In this scenario, light fidelity (Li-Fi) finds the places wherever Wi-Fi is applicable with additional features of high speed data network. Apart from the speed factor, Li-Fi is more suitable in hospital application for monitoring the patient's conditions without frequency interference with human body. This experiment proposes an application of Li-Fi network in the hospital for monitoring the patient's conditions such as temperature, heartbeat using respective sensors. The collected data from the sensors is transmitted to the sink, and further these data are processed using microcontroller and display the output in the system. Based on the concept of visible light communication, a prototype model is built with the Arduino UNO microcontroller.

A Li-Fi-based health-care monitoring hospital system secure patient's body from attack of many types of disease, as the resistance power of patients, is very low. Not only improving the patient's health conditions but also communications among the physicians and clinicians. Wireless technology with LiFi system enables clinicians to monitor patients remotely and give them timely health information, reminders, and support. Li-Fi technology ameliorates medical field to the next level.
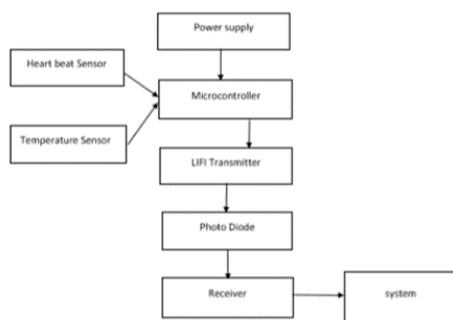
3. Proposed system

Fig. 1. Working of LI-FI

In the proposed system the patient is monitored using LiFi instead of Wi-Fi. the objective of the system is to monitoring the pulse rate and temperature of the patient using LI-FI. The sensed data is then converted into digital form in the microcontroller. The microcontroller that is used here is the Arduino Nano microcontroller (ATmega328). 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 and display the output in the system. The transmitter consists of the LED bulb and the receiver consists of a solar panel. The Operating Voltage (logic level) used here is 5 V. The input voltage recommended is 7-12v and the limited input voltage value is 6-20 V.

4. Module description

Arduino IDE, which is used to write and upload the computer code to the physical board. Arduino is a prototype platform based on an easy-to-use hardware and software. It consists of a circuit board, which can be programed. LM35 Temperature Sensor is used which is a semiconductor based sensor. The transmitter is used to receives a signal from the PC using USB Cable then from GPIO pins on the Arduino, this signal controls the transistor which open and close the power supply to the LED.

The receiver converts the incoming light into an electrical signal and feeds it into the microcontroller. The receiver filters and amplifies the signal. And, a solar panel is connected with the receiver to transmit the data. The transmitter is used to receives a signal from the PC using USB Cable then from GPIO pins on the Arduino, this signal controls the transistor which open and close the power supply to the LED. The receiver converts the incoming light into an electrical signal and feeds it into the microcontroller. The receiver filters and amplifies the signal. And, a solar panel is connected with the receiver to transmit the data.

A. 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; the voltage regulator LM7805 is used, filter capacitor of 1000muF is used to filter the noise produced from circuit. Three sensors –heartbeat, temperature sensors are connected to Arduino NANO (AT-MEGA 328) microcontroller shown FIG: 6.4.1. 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. The readings of the respective sensors are displayed on the system.

B. 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. Temperature sensor LM35 can be used to measure body temperature. The electrical output is proportional to the temperature in Celsius. With the current variations the temperature of the patient is measured. The transmitter is used to receives a signal from the PC using USB Cable then from GPIO pins on the Arduino, this signal controls the transistor

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which open and close the power supply to the LED.

Fig. 2. Temperature sensor

C. Heart beat sensor

It consists of a bright red LED and a light detector. 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 data is obtained.

Fig. 3. Heart beat sensor

D. Receiver section

A photodiode is used as a receiver in this section which works as a light to electricity convertor. 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 system. The receiver converts the incoming light into an electrical signal and feeds it into the microcontroller. The receiver filters and amplifies the signal. And, a solar panel is connected with the receiver to transmit the data.

5. Experiments and results

The output of the sensors is displayed in the system. The information regarding the patient is sent to the end user using the software application Li-Fi data monitoring.

A. Displaying the result through hyper terminal software

Fig. 4. Connection description

Fig. 5. Connect using com5

Fig. 6. Description of Com5 Properties

Fig. 7. Reset the properties to default values

Fig. 8. Displaying the results

6. Conclusion

Patient monitoring can be done efficiently using Li-Fi technology. It reduces the radio interference in human body. It monitors the patient automatically and continuously. It is shown that Li-Fi network is successfully can be used as a high-speed and safe to human body data communication to provide real-time monitoring of heartbeats, temperature, and various other parameters. Li-Fi is emerging as more suitable networks in next generation healthcare services in the hospital. Using this technology in medical field makes diagnosis faster and allows to access the internet along with the radio waves based devices. The proposed system is fully automated.

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