

Li-Fi Based Patient Monitoring System

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Abstract: Patient monitoring system using Li-Fi technology. Li-Fi stands for Light Fidelity. Li-Fi technology was invented and developed by the German Physicist Harold Haas provides transmission of knowledge through illumination by sending data through varies intensity faster than human eye can follow. Li-Fi may be a bidirectional, high speed and fully networked wireless optical communication and may be a sort of light communication. The proposed model helps within the patient monitoring within the hospitals and may be done by using the concept of Li-fi rather than Wi-Fi technology to avoid the frequency interference with the human body. Sensors such as temperature, heartbeat, motion, ECG cardiogram graph are used in the prototype to perform its respective functions. These sensors collect the data from the human body and then the data is sent to the ATmega8 microcontroller and then it converts digital signal into optical signal which is emitted by led or lasers and at the receiving end we have photo detectors to receive the light emitted signals and then it sent to another micro controller and then its connected to pc or display where it shows the readings of all the sensors attached to the patient's body.

Keywords: Li-Fi technology, patient monitoring system, visible light communication, wireless, high speed, low latency, ecg cardiogram graph, heart rate, blood oxygen

1. Introduction

The upcoming world needs easy and reliable solutions for patient monitoring systems, so here is the prototype proposed by me on *Li-Fi* based patient monitoring system. This helps to monitor patients anywhere from any remote location. The main reason to use this technology is that this Li-Fi does not emit any harmful electromagnetic radiations which harms to human body it uses the same led lamps which we normally use in our house so in ICU where such electromagnetic radiations are prohibited so doctors have to physically go and monitor the readings but in many cases there is chance to doctors get infected by such harm full disease and there are other circumstances too which can also cause damage to patient so its advisable to monitor patient outside the ICU. So, I have prototyped the device which can transmit and receive the patient monitored data wirelessly using led and lasers and it uses Li-Fi technology so the electromagnetic radiation is not harmful for the human body so it can also be used in intensive care unit (ICU) too. And patient monitored data can be seen any were we want we can modify as per requirement.

2. Literature Review

The problem faced by the existing patient monitoring system is that we have to manually check the patients reading and note them in record sheets. Till date there is not any harmless wireless solution for patient monitoring so in this we are going to discuss about the solution for patient monitoring system. There is some flaws in [1] Harshith H S "patient monitoring system using lifi" this prototype only show the readings of the patient but as ECG cardiogram plays vital role in patient monitoring system it is necessary to display it. [2] Ms. Neha R. Laddha (Laddha, 2013) this helps us to understand the UART protocol used for the communication using and also the software backends.

Many people have worked on this technology and [4] (Haas, 2012) Harald Haas in the month of December in year 2013 worked upon the Li-Fi modulation and networked Li-Fi attocell concept, along with Prof. Svilen Dimitrov, Prof. ThiloFath, Prof. Irina Stefan and many others contributed to

make this technology a big success. [5] (Priyanka Das, 2015) he explains working of parent monitoring system and what all sensors are mandatory for patent monitoring system. (D. Janusek, 2011).

3. The Prototype Mainly consists of two units:

3.1 Transmitter Section

This section consists of sensors Atmega8 micro controller and transmitting component. We can use transmitting component's such as led or lasers we can use as per our requirement both gives us similar results. Here I have used led for transmitting and it also consist of many other passive components.

Sensors

In this prototype I have used mainly four types of sensors which are:

- 1) Heart rate sensor/pulse rate sensor: this measures the heart rate and also blood oxygen in patients body the heartbeat sensor is based on the principle of photoplethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ it gives us analog output then this output is sent to micro controller
- 2) Temperate sensor: this sensor helps us to monitor temperature of the patient it uses MAX30205 human body temperature sensor it provides us 16-bit resolution so we can get the accurate reading and then this data is sent to the same microcontroller.
- 3) ECG sensor (Electrocardiography): I have used ED8232ecg sensor it is used to display the graph and ecg reading in this sensor all the raw data is collected and then sent to microcontroller and then it processed and send it to our main transmitting microcontroller and then data is converted Into optical signals.

We can also use other sensors such as blood pressure sensor and many other sensors we need to monitor patient.

Microcontroller

Here, atmega8 microcontroller is used this is mounted on

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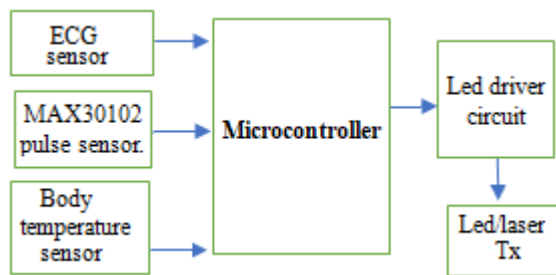
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Arduino development board it makes easy to connect all the sensors to the microcontroller and this is programmed to analyses and transmit data in optical signal in UART protocol and then its transmitted using led and lasers and encode signals easily using led drivers.

Led used as transmitting light

As led have high switching feature so it uses its blinking property to create high and low logics here, I have used array of T1 3/4 5mm led as its commonly used led and it also has high intensity and consumes low current of 20mA each. It also consumes less voltage of 3.2v so it can be used without led driver. We can also use laser diode instead of led to get more precise result we can use 650nm 5mW Focusable Dot laser Module Sensor to get more precise results.



3.2 Reciver Section

Receiver section consists of two section microcontroller and receiver circuit. Microcontroller is used for process the data received by led and also linking microcontroller to pc to display the received data, microcontroller is used to convert optical signal received to by receiver circuit to digital UART protocol. Then the data is sent to pc or screen to display the received data.

Receiver circuit

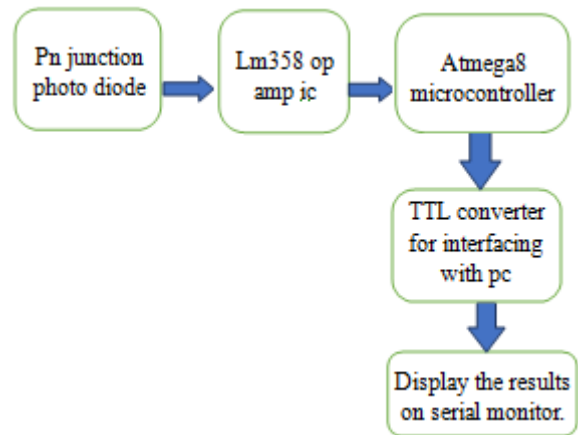
It consists of PN junction diode and lm358 op amp integrated circuit to convert it to hex/digital signal for UART protocol and it's balanced with many passive components and also it consists of 10k variable potentiometer to change the bandwidth of it. It gives us digital as well as analog signals. Here then this digital received signal is sent to ATmega8 microcontroller with Arduino development board to make work easy and simple.

Microcontroller:

Here microcontroller is programmed to convert digital signals received by receiver is now processed and then further displays it to the computer screen we can display received data anywhere as per our requirements. Micro controller used here is ATmega8 that processes signal with very low latency to improve result we can use more powerful microcontroller

Result display the received data

Currently I'm displaying the result in the serial port monitor in the pc there we can see all the patient's data received from the sensors we can also display on led screens or any were as per our requirement.



4. Summary

in this 21st century day by day there are new and harmful and infective viruses are found so there are many chances to get infected easily and spared it to others easily if he/she comes in contact with the person therefore doctors have to physically monitor patients so this is the solution by which doctors can remotely monitor the patient without getting infected and also it has many other advantages too.

5. Future Scope

In future we can use image processing for fetching data from the old patient monitoring system so we can use image processing and we can get medical level standards and it will be also more reliable and cost efficient too.

6. Acknowledgement

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