Li-Fi BASED REAL TIME VIDEO TRANSMISSION FOR PATIENT MONITORING SYSTEM

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Abstract - The aim of this work is to achieve live surveillance of the patient using LI-FI (light fidelity). Li-fi is an advanced and promising technology can be used in many medical applications. In this paper, a prototype of live video broadcast using LEDs is proposed. The prototype presented transfers the data with single LED, and is capable of illumination as well as data broadcast. Whole process is kick started by converting analog signal into digital form in transmitter section. LM359 IC amplifies video signal with two inverting amplifiers which possess high gain bandwidth and allows high frequencies and it is coupled to LED which accelerates the transmission process and it’s geared at high speed by receiving the high frequency video signal in digital form by a photo detector. The output from the receiver circuit is analog output given to television module using a RCA cable. Keywords: Li-Fi transmission, Transmitter chip, receiver chip, Android application, prolific cable.

1. INTRODUCTION

In this electronic world, using radio wave frequencies for wireless communication cause a loss in data rate, light fidelity (Li-Fi) modulation technique is used as an alternative. The light emitting diode is a semiconductor device that emits light when an electric current pass through it. The light can transmit the data in the binary form, which cannot be visualized by a human naked eye. The bandwidths of radio frequencies are limited now-a-days due to increase in the wireless communication technology. Visible light communication is point to point communication (Line Of Sight LOS). Li-Fi has the advantage of being useful in electromagnetic sensitive areas such as in aircraft cabins, hospitals and nuclear power
plants without causing electromagnetic interference [3]. Li-Fi is expected to be ten times cheaper than Wi-Fi. Different types of photo detectors can be used to detect the transmitting light and convert the binary information into electrical form. A photo detector has a P-N junction which uses reverse bias technique to convert light photons into electrical form. The main objective is to transmit the high frequency video monitoring signal through illumination. Visible light communication is an effective high bandwidth communication system serves point–to-point communication [3]. Visible light communications (VLC) have many advantages over radio links. One of these advantages include the availability of huge bandwidth. The schematic structure of visible light communication system is shown in figure 1. With increase in demand of video and high quality image transmission this paper reviews without any modulation techniques and improvement in channel capacity. In home environment, the combination of illumination and transmission is captivated in specific scenarios which are healthy and secured.

![Fig.1 Block Diagram of Li-Fi](image)

The next sections include existing system and proposed work with methodology describing about experimental setup and final result and conclusion.

## 2. EXISTING WIRELESS COMMUNICATION SYSTEM

The hospital area contains much critical care equipment which is used to monitor patient medical status. For the officials of hospital, to monitor the status of patient they have to use electronic devices such as cell phone or personal computer for the data communication. Most of the hospitals around the world use Wi-Fi (Wireless Fidelity). Wi-Fi is hazardous in such situations as the electromagnetic frequencies radiates in low-gigahertz frequencies. The Electromagnetic interferences due to this, results in potentially harmful events related to medical equipment operations [4,7]. According to researches done 20% patients suffer insomnia due to the effect of electromagnet radiations. Since these routers should work for whole day, patients are effected by electromagnetic frequencies who are being exposed by it 24/7. Some patients’ lives are endangered from equipment malfunctioning in intensive care room in such situations. Due to this, the Wi-Fi connection are prohibited completely in some parts of the hospital building. The CCTV in the hospital environment are connected to the Wi-Fi routers to transmit the video broadcast to the doctor or officials to monitor the patient continuously from their rooms. Figure 2 shows wireless communication system used in hospitals [13]. It can overcome such limitations by Li-Fi (light fidelity) [16,18]. The light fidelity can act as illumination as well as data transmission which is an efficient alternative. The main components of this communication system are LED, Which acts as a Transmitter source. Photodiode which shows good response to visible wavelength region serving as the receiving element [9]. This system gives the lower data rates transmission and its cover very less distance System integrate with Embedded Plat form. In the Hospitals the light fidelity system is limited to send only data, audio and images of sensing elements like heartbeat sensors, EEG sensors, temperature, respiration sensor, glucose level, and other related sensors [14].
3. PROPOSED LI-FI BASED REAL TIME VIDEO TRANSCIEVER SYSTEM

The CCTV surveillance of hospitals especially in ICU’s using light fidelity reduces health related issues of patients. The camera installed in hospitals (in intensive care) can communicate each and every information to the doctors monitor with the use of LED. The light fidelity (Li-Fi) technology is one of the promising solutions to increase transmission capacity, one issue in implementing light fidelity is to select the appropriate access technique in the multiuser environment. In this paper we explore the transmission of video through LI-FI, which requires higher frequency to transmit and in equal to that we need such a receiver circuit to hold such a high frequency signal. This receiver circuit is linked to a television with a RCA input jack which display the transmitted video.

The prototype presented below transfers the data with single LED, and is capable of supporting both illumination and data broadcast for monitoring the situation of patient. The following scenarios explain about transmitter section, receiver section and the components which allows the video broadcast through the LED’s.

4. PROTOTYPE OF Li-FI BASED REAL TIME VIDEO TRANSMISSION
   - TRANSMITTER
In the transmitter section, the electric signal comes from CCTV or TV signal using a VGA to RCA converter, the signal received as video/analog signal is converted into electrical signal. LM359 integrated circuit is used to amplify the received signal from the input. The optical source used in this work is a light emitting diode which emits radiation at 650 nm. The maximum output of optical LED is power of 5v. Transistor type BF859 is used to allow the high frequency received from LM359 to the LED and biased it with a suitable resistance and capacitors as shown in figure. The capacitors used in the transmitting section is to reduce the dc components and different ohms of resistors are used to lower the voltage levels, reduce the current and each resistor has capacity to allow maximum frequency of its own.

- **LM359 INTEGRATED CIRCUIT**

The high speed LM359 operational amplifier is used to provide high gain bandwidth. LM359 consist of two inbuilt inverting amplifiers which allows high frequencies. It can be used as general purpose video amplifiers and has wide frequency range waveform generations. The amplifiers in LM359 are designed to operate from a single supply and can accommodate input voltages greater than the supply given. The output of LM359 is amplitude modulated and the amplified signal is converted into optical form through the source connected with driver circuit[17]. The pin diagram of LM359 is shown below.

- **BF859 NPN TRANSISTOR**

BF859 is NPN high voltage transistor. The main application is to use in video output stages of black and white and color television receivers. The first pin emitter is grounded, the second pin collector, connected to mounting base cathode of LED and third pin base connected to output of the LM359. In the transmitter section BF859 is used to allow the high frequency through the LED which should transfer the video broadcast of high frequency.

- **LED DRIVER CIRCUIT**

The high speed LM359 operational amplifier is used to provide high gain bandwidth. LM359 consist of two inbuilt inverting amplifiers which allows high frequencies. It can be used as general purpose video amplifiers and has wide frequency range waveform generations. The amplifiers in LM359 are designed to operate from a single supply and can accommodate input voltages greater than the supply given. The output of LM359 is amplitude modulated and the amplified signal is converted into optical form through the source connected with driver circuit[17]. The pin diagram of LM359 is shown below.
The light emitting diode transfers the information in the digital binary form 1’s and 0’s. The LED flickers 1500 times a second which cannot be observed by a human naked eye. The basic concept of LED is when the light glows it is considered as 1, when it is off it is considered as 0.

Fig6. Prototype of Transmitter

- RECEIVER

The photodetector receives the information through the light and is responsible for converting the received optical form into electrical form of equivalent pulses. The information received from the photodetector is fed to the amplifier LM359 to amplify the signal received. A dual high speed LM359 preamplifier in the receiver unit amplifies the output signal from the photodetector. The inverting schematic trigger amplifier 7414 is connected to the amplifier LM359. The received signal from the photodetector may not match with frequency or information sent by the transmitter so perfect square wave shaping circuit used. The stages in receiving unit are designed to amplify the signal as much as possible, around of ten times. The regulator integrated circuit 7805 is used to maintain the output voltage. The capacitors used in the receiver section is to reduce the dc components and different ohms of resistors are used to lower the voltage levels, reduce the current and each resistor has capacity to allow maximum frequency of its own. The circuit diagram of receiver section is shown in figure.

Fig7. Receiver Circuit Diagram

- PHOTODETECTOR

Photodetectors receive the information from the LED and converts the received the optical information into electrical pulses. A photo detector has a P-N junction which converts light photons into current which uses
The image sensors present in photodetectors transform an optical image into an electrical signal. The photodetector type BPX 65 with a required rise time and peak responsivity is used. Figure 8 shows the circuit diagram of PhotoDetector.

**INVERTING AMPLIFIER 7414**

A 7414 inverting amplifier is connected to the amplifier LM359 which has less input impedance, this is because of the feedback resistors. This is used to eliminate the noise near reference point which would cause problems in analog comparators. It operates from very slow edges, it has improved line receiving characteristics and high noise immunity. It can give clean, jitter free output signals.

**7805 REGULATOR**

The 7805 regulator is connected to the unit to maintain the output voltage at a constant value. The 7805 regulator integrated circuit provides 05 volts as the output with provisions to add heat sink, preferred size of heat sink should be selected.

Heat generated = (input voltage-5)*output current
6. RESULTS AND DISCUSSION

Li-Fi is advancement in wireless communication systems which possess high security, speed than existing wireless data transmission systems. Each and every LED can act as a transmitting device if it is perfectly implemented in real time. The main advantage of Li-Fi is its unregulated bandwidth unlike radio frequencies which contains a limited bandwidth. Now-a-days increment of radio frequencies usage led to limit some application which can be achieved by Li-Fi. All the equipment by default uses 2.4 Ghz frequency, which makes the equipment very difficult to function as they are interfered. If the medical equipment is interfered with the radio frequency it may fall under faulty condition and can menace patients’ lives. The problems of CCTV surveillance in the hospitals are vanquished by the proposed system which is reviewed in this paper. The output of receiver section is the analog form which can be displayed in television module or monitor as shown in the below figure 11.

![Prototype of Real Time Video Transceiver](fig11)

The blurriness or noise is due to the conversion of VGA input to RCA which is the input transmitter section. The following figure Figure-13 shows the output of the proposed system. This can be vanquished by using high voltage tuners at the input side as shown in the figure 12.

![Transmitted Real Time Video](fig12)
7. CONCLUSION

This paper concludes that the safe usage of CCTV or camera in the sensitive area like hospital especially in the ICU’s or intensive care. The existing systems cause unhealthy effects on the patients’ in hospital due to the radio frequency interferences. The proposed system overcomes the effects by replacing the radio frequency components with Li-Fi equipment. The transmission of high frequency live broadcast video transfer is successful. By comparing the original video with the output there are some disturbances due to conversion of VGA to RCA this can be overcome in future work.

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