

A Novel Architecture for the Future Wireless Technology – Li-Fi

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Abstract: We are in the era of internet. We have brought the evolution of using air as a medium for data transfer which is called the Wi-Fi. Though it provides the better speed but with the large number of users the radio spectrum is congested. To address this problem we can go for alternate way of using light as a medium. Professor Harald Hass who teaches at the University of Edinburgh in UK brought the visible light communication into picture through the concept of “data through illumination” and it was called “Li-Fi Light Fidelity”. Li-Fi is a new paradigm for short range wireless technology to provide unprecedented connectivity within a localized data-centric environment. In this the data transmission is achieved by varying the intensity of LED very faster than human eye can follow which is brought through Visible light communication (VLC). The development by the University of Edinburgh’s Li-Fi R&D Centre uses a solar panel to receive high speed Li-Fi transmitted data while also generating electrical power for the operation of the function. Using this technique, two functions namely energy harvesting as well as decoding of light signals into useful information can be performed.

Keywords:- Li-Fi(Light Fidelity) , VLC(Visible Light Communication), LED(Light Emitting Diode), Solar Panel.

I. INTRODUCTION

Optical way of transmission has reached its next level with transfer of data through Visible Light Communication (VLC). As per German physicist professor Harald Hass University of Edinburgh, UK., considered as father of Li-Fi - “data through illumination”. Li-Fi is the use of visible light portion of the Electro Magnetic spectrum to transmit information at very high speed. With Li-Fi data is transmitted by modulating the intensity of the light which is then received by the photosensitive detector and this light signal is demodulated into electronic form. It is a 5G technology that uses VLC.

Over 4.3 billion people are without access to the internet, thus for the convenience of them we are using solar cell. By 2020, 50 billion devices such as car, water heater, etc., will be connected to internet. According to recent survey about 100 nuclear power plants are required for the power supply, thus in order to reduce it LEDs and solar panels are used as LED consumes very less amount of power. The main aim is to avoid network traffic or congestion and reduce the consumption of power supply.



Fig 1 Comparison between Wi-Fi and Li-Fi

II. LITERATURE SURVEY

Contents	Wi – Fi	Li –Fi
Latency	milli seconds	Micro seconds
Power	600 bps 80 milli watt	150 Mbps 1 watt
Speed	150 Mbps	>10 Gbps
Range	3 Khz to 300 Ghz	400 Thz to 800 Thz
Direction	Bi directional	both uni and bi directional
Cost	Expensive	Cheaper

Photo detectors which detect photons or optical signals and convert them into electrical signals via internal photoelectric effects. Photovoltaic cells are electrical

device that converts light energy directly into electricity by photovoltaic effect. Photovoltaic effect is the creation of voltage when it is exposed to light. Construction of photodiodes and photo voltaic cell remains the same as both of them use p-n junction for creation of charges. Hence solar cells are also known as large area photodiodes. Photodiodes are designed to be operated in reverse bias whereas photovoltaic cells are operated in forward bias. Photodetectors operates in the third quadrant whereas photo voltaic cells are operated in the fourth quadrant of the I-V characteristics.

III. IMPLEMENTATION OF Li-Fi

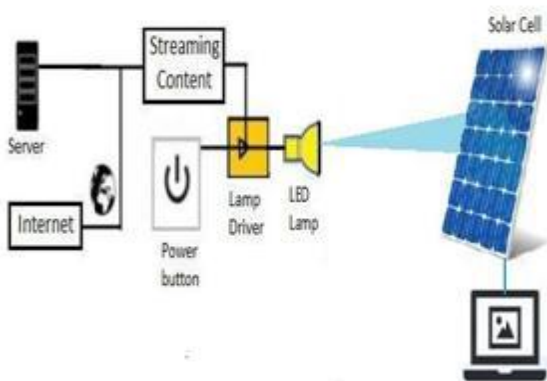


Fig 2 Solar Li-Fi system

The new revolution of light-emitting diodes forms the heart of light fidelity technology. The principle behind the working is simple. If the LED is ON the digital data 1 is transmitted. If the LED is OFF the digital data 0 is transmitted. The rapid flickering rate of LEDs allow them to be switched on and off very quickly so that the data can be transmitted through light.

Implementation of Solar Li-Fi is given in the figure. In figure an internet connection is connected to the lamp driver which in turn is connected to the LED lamp through fibre optic cable. Data will be streamed to the lamp driver when the LED is switched on the microchip converts the digital data or the logic data into light form. The data can be encoded in the light by varying the flickering rate of LEDs to generate different strings of 1s and 0s. The LED intensity is varied so rapidly that human eye cannot notice, so the light appears constant to humans. Thus the on-off activity of the bulb which seems to be invisible enables data transmission using binary codes switching on an LED is a logical '1', switching it off is a logical '0'. This method of using rapid pulses of light to transmit information wireless is technically referred to as Visible Light Communication (VLC).

Solar Li-Fi uses solar cell in the place of photo diode. Solar cell decodes the encoded data transmitted by LED lamp; the data is encoded with sudden change of brightness of light segments. The solar panel is connected

with the system which will receive the decoded data and display on the screen. The solar cell does two functions namely energy harvesting as well as decoding of light signals into useful information. Solar cell functions satisfactorily till it receives changes in brightness properly in distinguishable manner.

IV. BASIC BLOCK DIAGRAM

SYSTEM TO SYSTEM CONFIGURATION:

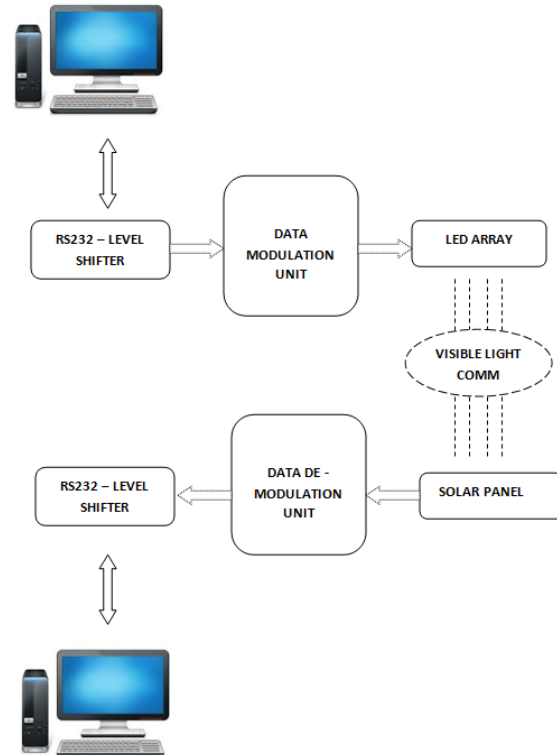


Fig 3 Basic Block Diagram

The basic prototype is considered by the data transmission between two PC. The character or the image to be transmitted is first selected. It is then transmitted with the help of RS232 level shifter. Then the data to be transmitted is modulated for the transmission through light using the data modulation unit. It is then encoded into the LED array. Thus the binary data is transmitted. The solar panel thus receives the data and also harvests the energy as it converts the varying intensity of light into current. The data is again decoded in the data demodulation unit and thus the image output is received in the system.

IV. ADVANTAGES

SOLAR Li-Fi is based on LED luminaries and the solar panel for the transfer of data it removes the limitations that have been put on the users by previous technologies. We know that light wave does not penetrate

through walls and thus provides high data security. It provides 10,000 times a larger bandwidth than the available radio waves and hence it can be used without congestion. Since the LED possesses longer durability the maintenance cost is much low, the usage of solar panel results in lesser power consumption and low electricity cost, thus by using solar panel we can accommodate internet facilities in rural and remote areas. Due to strong signal absorption there occur many data losses when transmitted through radio waves, but light can easily penetrate through water. Solar Li-Fi does not require any fuel and there is no pollution. It is an eco friendly project.

VI. LIMITATIONS

LI-FI can be used as a complementary with Wi-Fi because the light cannot pass through the objects and if the receiver is blocked with any objects the signal is cut off. We cannot have a light bulb that will provide data to a high speed moving objects and also remote areas where there are trees, walls and other obstacles. Interference from external sources like sunlight and normal bulbs will cause interruption in the communication.

VII. APPLICATIONS

SOLAR INTERNET: The solar energy which is the renewable source is converted into electricity with solar panel and now this is brought into the evolution of receiving data thus the solar panel is used for reception purpose along with Li-Fi.

INTERNET IN CHARGELESS MOBILE PHONES: The mobile phones are just toys without battery charge within them, thus by implementing solar cells in mobile phones. It can act as receiver which can receive the data which helps in streaming the internet and also the phone gets charged, as the variation in the intensity of light is converted into appropriate current.

HEALTHCARE: Li-Fi never gives any side effects on any living things like radio waves and any other communication waves which affects on birds human bodies etc., Operation theatres do not allow Wi-Fi due to radiation concerns, Li-Fi can be used for accessing the internet and to control medical equipments that are used in robotic surgeries.

TRANSPORTATION: LED headlights and tail-lights are being introduced. Street lamps, signage and traffic signals are also moving to LED. This can be used for vehicle-to-vehicle and vehicle-to-roadside communications. This can be applied for road safety and traffic management.

SOLAR WATCHES: Solar power watches are a major part of the range of watches. Nowadays Wi-Fi is used to access

internet in watches. By using solar cells in watches it can act as both power supply and thus internet can also be accessed through the light received.

VIII. CONCLUSION

The evolution of the next generation wireless communication has started up with the technology, Li-Fi. With this technology every bulb can be used as a Wi-Fi hotspot to transmit data wireless and thus proceed towards the cleaner, greener, safer and brighter future. The concept of Solar Li-Fi is attracting a huge hearts because it offers a very efficient alternative to radio spectrum congestion as well as it serves as the next milestone for energy harvesting. Thus the Solar Li-Fi makes use of the varying intensity to produce current and thus receive the information.

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