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HOME AUTOMATION USING LI-FI TECHNOLOGY

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Abstract - *In a world of wireless technology, the number of bias penetrating the internet is growing every second. Utmost of the bias use wireless communication to pierce internet for participating data, this has unfortunately led to an increase in network complexity, deficit of wireless radio bandwidth and an increased threat of hindrance of radio frequentness. Li-Fi technology is used to transmit the data signals using visible light as medium by using light- emitting diodes (LEDs). Signals are transmitted from one system to another by using LED as a Li-Fi transmitter and photodiode (usually solar panel) as a Li-Fi receiver for effective transmission of information. This is a much more secure system of transmission compared to being technologies. Visible Light Communication (VLC) has increased extraordinary enthusiasm for the most recent decade because of the quick advancements in Light Emitting Diodes (LEDs) manufacture. Acceptability, durable and long-life expectation of LEDs make them a promising private lighting tackle and also an option seedy and quick information exchange gear. Also, the data transmission rate is veritably high around many Gbps. This design describes and implements the design of Li-Fi audio transmission system.*

Key Words: Light Fidelity (Li-Fi); Wireless Fidelity (Wi-Fi) bandwidth; Visible Light Communication (VLC); Light Emitting Diode (LED); Amplifier; Data transfer.

1. INTRODUCTION

Li-Fi is shortened as" Light Fidelity" is recent advancement used for numerous operations like road light control, data communication, navigation for eyeless people and audio transmission etc. In this paper, an attempt is achieved to transmit audio, data and controlling the bias. In this paper, by using the visible light, pc to pc communication is achieved and controls the bias as well as audio transmission like music player to play the song is done. The father of Li-Fi is "Harald Hass". He innovates the idea of Li-Fi in 21st century and he say that the main thing of this invention is present in power and capacity of LEDs. Through the light we can control the bias like home accoutrements, any electronic bias can be ON and OFF by exercising the switches. As an ever-adding number of bias coming up step by step still the Li-Fi is more effective and profoundly secured and constantly transmit sound, voice in simple light force. It works in road to- vehicle communication in outside operation so it's designed in such a way that it has to transmit the data same as Wi-Fi but security and speed must be further than Wi-Fi. Li-Fi also controls the bias and spare the vitality applications and sitting in one place to control every bias in home. So, this technology is also used in home robotization operations. The data communication without network is little complicated so this Li-Fi transmits the data without any redundant networks. In airplanes, such a large number of lights are used and Wi-Fi can't be adequately employed so to overcome this issue Li-Fi can be used. The main advantage of Li-Fi is it's ok for people since light, not at all like radio frequency, can't enter mortal body. Therefore, worries of cell change are relieved.

1.1 LIFI MODULE

Light Fidelity (Li-Fi) is a bidirectional, high- speed and completely networked wireless communication technology analogous to Wi-Fi. Visible light communication and a subset of optic wireless dispatches (OWC) and could be a complement to RF communication (Wi-Fi or cellular networks), or indeed a relief in surrounds of data broadcasting. It's line and uv visible-light communication or infrared and near-ultraviolet rather of radio- frequency diapason, part of optic wireless dispatches technology, which carries much further information, and has been proposed as a result to the RF-bandwidth limitations.

Visible light dispatches (VLC) works by switching the current to the leds out and on at a veritably high rate, too quick to be noticed by the mortal eye. Although Li-Fi leds would have to be kept on to transmit data, they could be bedimmed to below mortal visibility while still emitting enough light to carry data. The light swells cannot access walls which makes an

important shorter range, though more secure from hacking, relative to Wi-Fi. Direct line of sight isn't necessary for Li-Fi to transmit a signal; light reflected off the walls can achieve 70 Mbit/s.

1.2 CHARACTERISTICS OF LI-FI

Effectiveness Li-Fi works on visible light technology. Since homes and services formerly have LED bulbs for lighting purposes, the same source of light can be used to transmit data. Hence, it's veritably effective in terms of costs as well as energy. Light must be on to transmit data, so when there's no need for light, it can be reduced to a point where it appears off to mortal eye, but is actually still on and working. Vacuity Wherever there's a light source, there can be Internet. Light bulbs are present everyplace – in homes, services, shops, promenades and indeed airplanes, meaning that high- speed data transmission could be available everyplace. Security One main advantage of Li-Fi based transmission is security. Since light cannot pass through opaque structures, Li-Fi Internet is available only to the druggies within a room and cannot be traduced by druggies in other apartments or structures. The speed of voice communication and data transmission. Li-Fi is veritably cheap, because it doesn't need any license like Wi-Fi. Due to use of Li-Fi the device switching is veritably simple.

1.3 OBJECTIVES

- The ideal of the proposed work is outlined as below
- To design and apply a prototype module of Li-Fi (visible light communication).
- To transmit and admit textbook Data and Audio information using light as a carrier.

2. LITERATURE SURVEY

D. G. Aller, D. G. Lamar, P. Miaja, Juan Rodríguez, J. Sebastián 2021 [1]. Taking Advantage of the Sum of the Light in Outphasing Technique for Visible Light Communication Transmitter.

H. Haas, L. Yin, +5 authors M. S. Islim – 2020 [2] . Introduction to indoor networking concepts and challenges in Li-Fi.

Helin Yang, W. Zhong, Chen Chen, A. Alphones, Pengfei Du – 2020[3]. QoS-Driven Optimized Design-Based Integrated Visible Light Communication and Positioning for Indoor IoT Networks

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by Hongyan Jiang, Hongbing Qiu, Ning He, W. Popoola, Zahir Ahmad, S. Rajbhandari – 2020 [5] . Performance of Spatial Diversity DCO-OFDM in a Weak Turbulence Underwater Visible Light Communication Channel

N. Chi, Meng Shi – 2019 [6] . Enabling technologies for high-speed LED based underwater visible light communications

Chentao Li, K. Dong, F. Jin, Junlei Song, W. Mo – 2019 [7] . Design of Smart Home Monitoring and Control System Based on Zigbee and WIFI.

Asad Lesani, L. Miranda-Moreno – 2019 [8] . Development and Testing of a Real-Time Wi-Fi-Bluetooth System for Pedestrian Network Monitoring, Classification, and Data Extrapolation.

Kornpisit Imlimtan, N. Sutthisangiam – 2018 [9]. Real-time WIFI Mapping Using Smart Phone Sensors with Personal Dead-Reckoning Technique

Xiping Wu, H. Haas – 2018[10] . Load Balancing for Hybrid Li-Fi and Wi-Fi Networks: To Tackle User Mobility and Light-Path Blockage.

3. EXISTING SYSTEM

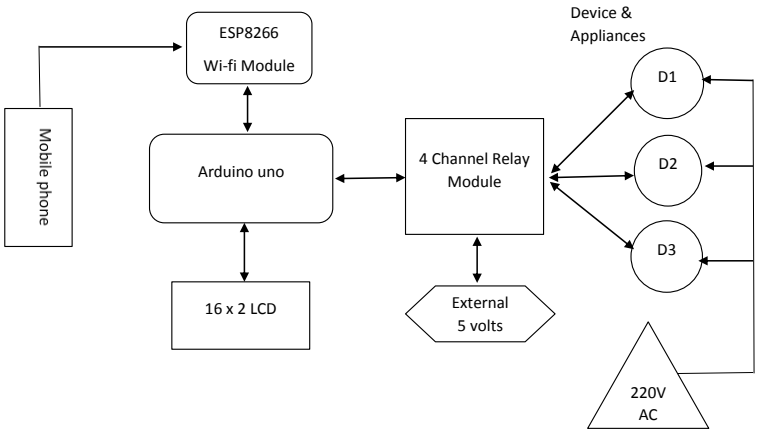

Fig-1: Existing system block diagram

The being Wireless communication makes use of electromagnetic swells for communication system. For case, the deployment of Wi-Fi obviously brings several important benefits. Because it's veritably accessible that figures of outfit connect to each other using wireless networks. Home- grounded Wi-Fi enabled device helps you to connect PC, game press or laptop. There are no boundaries if you're using Wi-Fi, you can move from one room to another or indeed down from home you have the liberty to pierce internet within the range of radial distance. Wi-Fi hotspots conception is getting fashionable among business communities and mobile workers. For this reason, ISPs are consolidating Wi-Fi switches to multitudinous spots for the compass of wide range. The conception of voice transferring from one mobile to another mobile is anatomized then.

Wi-Fi connectivity is the connection which can be used to as a link to partake data among bias. The VOIP (Voice Over Protocol) is the data transferring voice telephony over mobile is supported using service provider similar as GSM or by IP service provider at low cost. The GSM voice channel is the world's most extensively used mobile network.

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3.1 ADVANTAGES

- This technology is used to connect computers anywhere in office without the need of wires.
- Communication between mobile phones using Wi-Fi in P2P (peer to peer) or wireless area network at no cost.
- Adaptability and usability are very good while it comes to real life implementation.

3.2 DISADVANTAGES

- Threat of data theft and cybercrime attacks are very high.
- Wider operating range not only enhances the usability but also paves the way for unknown strangers to access our information.

4. PROPOSED SYSTEM

The transmitter section consists of an audio Bluetooth, Li-Fi transmitting module, MIC and the receiver section consists of a Li-Fi entering module, ATMEGA 328 microcontroller, an amplifier, speaker and a motor.

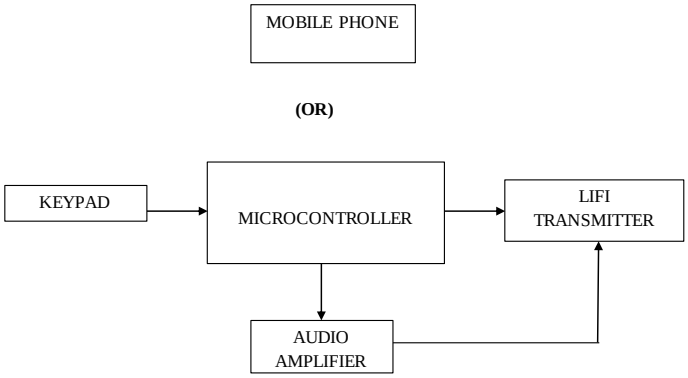

Fig-2: Proposed block transmitter

On the base of visible light communication technology, the advanced technology called Li-Fi give binary function of visible light LED for illumination and data transmission. Li-Fi is veritably rearmost interpretation of Wi-Fi which uses visible light in place of radio swells. Hence, visible light data transmission rate has advanced speed than other broadband. It overcome the problem related with Wi-Fi, because Li-Fi has wider network area so business running capacity bettered and it's cheaper than Wi-Fi. LAN is available in veritably short range and it isn't mobile. And Wi-Fi has low business running capacity as number of stoners increases Wi-Fi becomes unfit to achieve stoner's need. It transmits data by switching LEDs on and out fleetly by changing light intensity which isn't detected by mortal eye. The data transmission rate is about 10 Gbps by using white bright LED. The inner visible light communication uses visible light diapason to give high rate data transmission which at the same time used as energy effective illumination. In this way, the idea of the binary function of communication and illumination offers occasion for effective cost reduction and carbon footmark reductions.

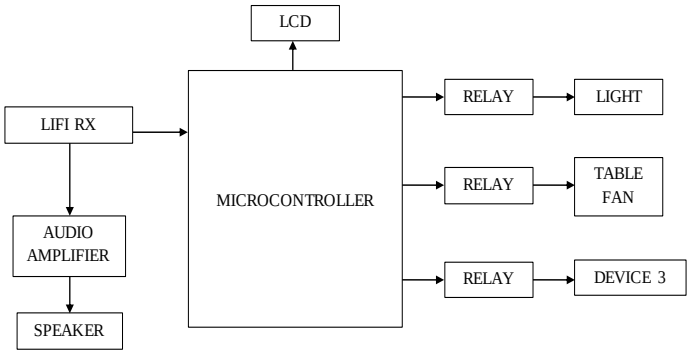

Fig-3: Proposed block receiver

Hence, visible light data transmission rate has advanced speed than other broadband. It overcome the problem related with Wi-Fi, because Li-Fi has wider network area so business running capacity bettered and it's cheaper than Wi-Fi. LAN is available in veritably short range and it isn't mobile. And Wi-Fi has low business running capacity as number of stoners increases Wi-Fi becomes unfit to achieve stoner's need. Wi-Fi has low business running capacity as number of stoners increases Wi-Fi becomes unfit to achieve stoner's need. It transmits data by switching LEDs on and out fleetly by changing light intensity which isn't detected by mortal eye. The data transmission rate is about 10 Gbps by using white bright LED. The inner visible light communication uses visible light diapason to give high rate data transmission which at the same time used as energy effective illumination.

4.1 ARDUINO UNO

The Arduino Uno is grounded on the ATmega328 microcontroller. It has 14 digital input/ affair legs (of which 6 can be used as PWM labors), 6 analog inputs, a 16 MHz demitasse oscillator, a USB connection, a power jack, an ICSP title, and a reset button. It contains everything demanded to support the microcontroller; simply connect it to a computer with a USB string or power it with an AC-to-DC appendage or battery to get started. The Uno differs from all antedating boards in that it doesn't use the FTDI USB-to-periodical motorist chip. Rather, it features the Atmega8U2 programmed as a USB-to-periodical motor.

"Uno "means one in Italian and is named to mark the forthcoming release of Arduino1.0. The Uno and interpretation1.0 will be the reference performances of Arduino, moving forward.

4.2 TECHNICAL SPECIFICATIONS

Microcontroller – Atmega328

Operating Voltage – 5V

Input Voltage (recommended) – 7 to 12V

Input Voltage (limits) – 6 to 20V

Digital I/O Pins – 14 (of which 6 provide PWM output)

Analog Input Pins – 6

DC Current per I/O Pin – 40mA

DC Current for 3.3V Pin – 50mA

Flash Memory – 32 KB of which 0.5 KB used by bootloader

SRAM – 2 KB

EEPROM – 1 KB

Clock Speed – 16 MHz

4.3 LIFI TRANSMITTER

Light Fidelity is a high-speed wireless communicating device which uses visible light as a medium of communication. Li-Fi has the advantage of being useful in electromagnetic sensitive areas similar as in aircraft cabins, hospitals and nuclear power shops without causing electromagnetic hindrance. LIFI set up comprises a transceiver unit. LIFI audio input is given to the transmitter section by means of a voice play back from which the voice data is transmitted and gets entered in a LI-FI receiver. The data which entered gets amplified by an audio amplifier and the affair is given to the speaker.

Fig-4: Li-fi Audio

4.4 FEATURES OF LIFI TRANSMITTER

- Power supply: DC +12V
- Data input: UART(TTL)
- Larger Bandwidth (10,000 times the radio bandwidth)
- High Efficiency

4.5 APPLICATIONS

- Intelligent transportation systems
- Cellular communication
- RF Restricted Areas

4.6 LIFI RECEIVER

The Li-Fi receiver is nothing but a photodetector used to descry the light source transmitted from the Li-Fi transmitter. We're using a solar panel as photodetector and the Li-Fi receiver as well. Li-Fi solar panel won't only produce solar power but also act as a data receiver of Li-Fi signals. The idea is that an LED light source combined with a solar panel can form a transmitter-receiver system. The intensity of signal falling on the solar cell is dependent upon the distance between the light source and the solar cell and on the exposure of the solar cell with respect to the source given by the equation

 = (∗ cos ( ))/ 2 (1) Where P is the Power entered, l is the distance between transmitter and receiver, k is a constant that depends on the environmental factors and theta is the angle between normal of solar plate and source

4.7 SOLAR PANEL TECHNICAL SPECIFICATIONS

Place of Origin	Zhejiang, China
Model Number	OL-200-60P
Cell Material	Monocrystalline silicon
Panel Dimensions	1320*990*40mm
Cell array	4*9
cell colour	Dark
Frame	Anodized aluminium alloy
Front sheet	High transmission low iron tempered glass
Back sheet	TPE quality plastic

4.8 SOFTWARE DESCRIPTION (MATLAB X IDE 1.8.9)

The MPLAB integrated development terrain (IDE) is a cross platform operation (for Windows, macOS, Linux) that's written in the programming language Java. It's used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other seller development boards. The source law for the IDE is released under the GNU General Public License, interpretation 2. The Arduino IDE supports the languages C and C using special rules of law structuring. The Arduino IDE supplies a software library from the Wiring design, which provides numerous common input and affair procedures. Stoner- written law only requires two introductory functions, for starting the sketch and the main program circle, that are collected and linked with a program end main () into an executable cyclic superintendent program with the GNU tool chain, also included with the IDE distribution.

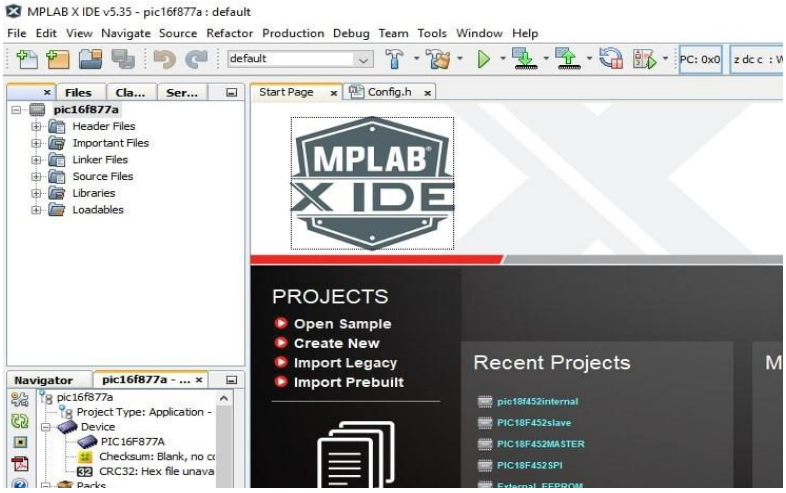

Fig-5: MPLAB Starting window

4.9 WORKING OF MATLAB X IDE 1.8.9

The Arduino ecosystem is comprised of a different combination of tackle and software. The versatility of MPLAB and its simple interface makes it a commanding choice for a wide range of druggies around the world from potterers, contrivers, and artists to product prototypes. The Arduino board is connected to a computer via USB, where it connects with the MPLAB development terrain (IDE). The stoner writes the Arduino law in the IDE, also uploads it to the microcontroller which executes the law, interacting with inputs and labors similar as detectors, motors, and lights. The MPLAB Integrated Development Environment (IDE) is the main textbook editing program used for Arduino programming. It's where you 'll be codifying up your law before uploading it to the board you want to program. Arduino law is appertained to as sketches. There are only 5 headlines on the menu bar, as well as a series of buttons underneath which allow you to corroborate and upload your sketches. Basically, the IDE translates and compiles your sketches into law that Arduino can understand. Once your Arduino law is collected it's also uploaded to the board's memory. The tool window consists of the toolbar with the buttons like corroborate, upload, new, open, save, periodical examiner. It also consists of a textbook editor to write the law, a communication area which displays the feedback like showing the crimes, the textbook press which displays the affair and a series of menus like the Train, Edit, and Tools menu. The most important advantage with Arduino is the programs can be directly loaded to the device without taking any tackle programmer to burn the program. This is done because of the presence of the0.5 KB of Bootloader which allows the program to be burned into the circuit. All we've to do is to download the Arduino software and writing the law.

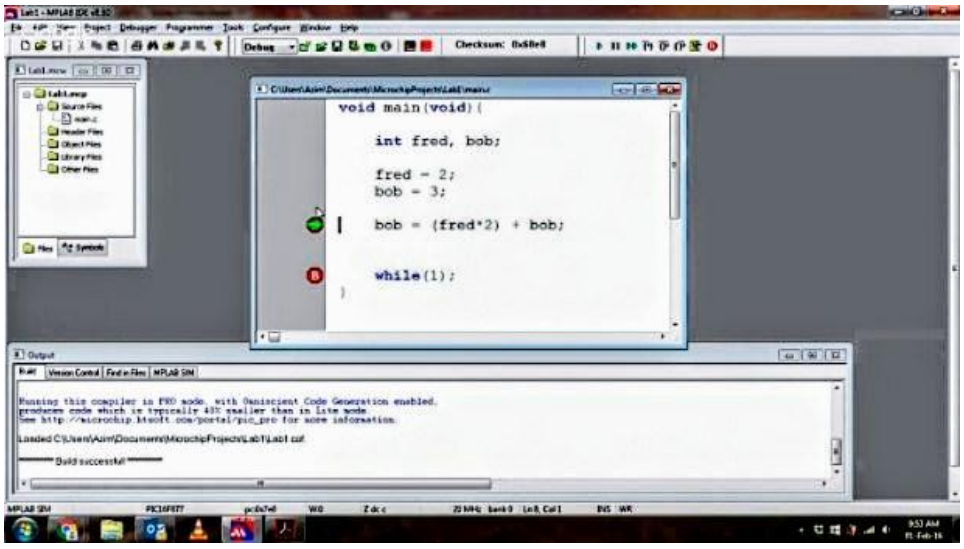

Fig-6: MPLAB compile window

5. RESULT

The LED acts as the Li-Fi transmitter and the photodetector (solar panel) acts as the Li-Fi receiver. In which the input signal is first given from the keypad (or) mobile phone. Then the signal is been processed by the ATMEGA328 microcontroller situated in the transmitter side. After that the signal is transmitted using light as medium by the Li-Fi transmitter. The signal is received by the solar panel after that it triggers the switch to be turned ON.

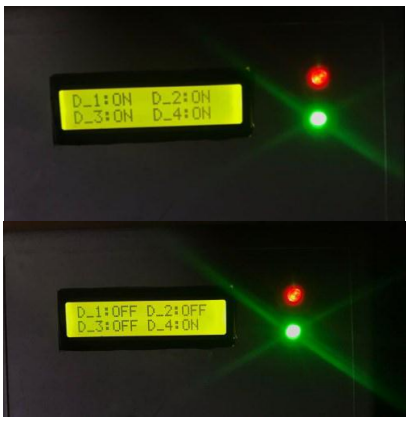

Fig-7: Output screen

In the device control system our mobile phone or the keypad used in the Li-Fi module can be used to give inputs. Mobile phone can be connected to the Li-Fi module via Bluetooth. For providing the input we are using a third-party Bluetooth application, in which the switch to be operated is coded as per the user's convenience. With this we can easily operate any electrical device such as fan, bulb, mixer, grinder etc. Here we have a better optimized audio system too. Since the mobile phone's microphone can also be used as receiver, it is easy to transmit voice signals to any audio output devices i.e speaker.

Fig-8: Device control system

The vehicle parking system using Li-Fi technology is shown in the above image. Here the vehicle's headlamp is an LED unit and acts as Li-Fi transmitter. The gate implemented here acts as Li-Fi receiver. It is achieved with the help of photodetector (solar panel). The vehicle is programmed in such a way that when a particular code is transmitted to the gate by the vehicle's headlamp, the code will be checked by the ATMEGA 328 microcontroller. If the code syncs perfectly with the previously programmed code, the gate opens, else the gate remains closed.

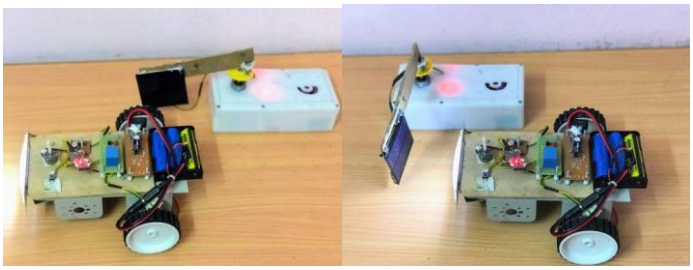

Fig-9: Vehicle Parking System

6. CONCLUSION

Li – Fi is an arising technology, as the radio wave communication has certain downsides. This technology can transmit data with the speed of 100gbps roughly which is entirely greater than radio waves. Li – Fi is distributed as dependable communication technique as it provides high data security transmission with low cost. In the proposed work, Li-Fi module for transmitting and receiving the text data and audio is erected and tested successfully. It's possible to achieve text data transmission of over to 2m by using LDR as the detector. Audio transmission of around 15 feet using solar panel in the receiver side.

• Nonpublic business enterprises – As the data transfer in Li-Fi is much secured when compared with Wi-Fi, It can be used in business enterprises for sharing nonpublic data.

• Under water operation – Visible light can be used for under water communication as it has wide range and bandwidth. Radio wave communication isn't possible as radio waves cannot access under water, and high attenuation terrain. And by using Li-Fi technology, energy consumption of the aquatic vehicles is also reduced.

• Aircrafts and petrol bunks – Li-Fi can be used in largely ignitable areas as there would not be any hindrance with the ignitable objects.

• Nuclear power shops – In electromagnetic sensitive areas like nuclear power plants, Li-Fi can be used as the use of Wi-Fi is interdicted.

• Indoor Navigation – Li-Fi can be used for are amplified using audio amplifier and these amplified signals are given to speakers

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