Accident Avoidance using Visual Light Communication

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Abstract— Visual light communication or Li-fi was invented by Professor Harald Haas of university of Edinburgh. This is the latest technology in present day communication system which makes the use of LEDs, Light Emitting Diodes that helps in the transmission of data much faster and more flexible than the data that can be transmitted through Wi-Fi. It is basically a 5G technology of visible light communication system which utilizes light emitting diodes as a medium of high-speed communication in similar manner as Wi-Fi. In this project we are implementing li-fi technology using white leds and arduino UNO board. Arduino is used to encode the data and transmit it through led and decode the received and display it. Here ultrasonic sensor is used to sense the distance between object and sensor. The distance data is transmitted through li fi technology. Second arduino will receive it and accordingly it will control the DC motor speed. As the distance decreases motor speed decreases.

Key words: Accident avoidance, Visual Light Communication

I. Introduction

Visual light communication or Light fidelity (Li-Fi) refers to 5G visible light communication. It uses light from light-emitting diodes as a medium to deliver data to networked, mobile, high-speed communication in a similar manner as Wi-Fi. Li-Fi is used to off-load data from existing Wi-Fi networks. Li-Fi can be used as internet access points. To transmit information from one system to another system, it uses Visible Light Communication (VLC). This system is based on white LEDs using THz visible light spectrum in provision of both lighting and wireless access. Visible light communications (VLC) signals work by switching bulbs on and off. Wi-Fi has potential spectrum crisis because Wi-Fi is close to full capacity. Li-Fi has almost no limitations on capacity. This project also discusses the working, implementation and improvements in Li-fi technology.

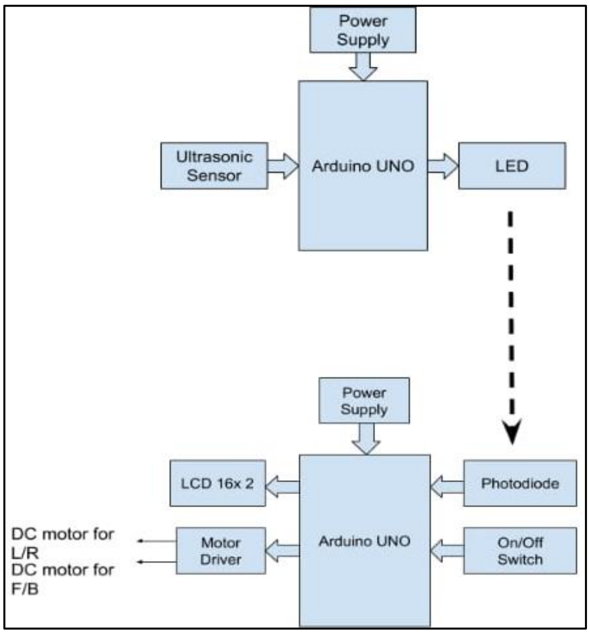
What is LIFI technology? Data transmission using optical wireless has been identified as a technology that can be utilized for communications in critical environments, such as aircrafts or hospitals, where radio frequency (RF)-based transmissions are usually prohibited or refrained to avoid interference with critical systems. Moreover, a huge amount of unregulated bandwidth is available at infrared and visible light frequencies. Researchers around the world are fine-tuning technologies that use standard lighting equipment to cheaply transmit high-speed data streams wirelessly, even while the equipment appears to be producing nothing more than normal illumination. Generally, the technologies rapidly and subtly fluctuate the intensity of light-emitting diodes, or LEDs, in a way that is imperceptible to the human eye. The idea of using light to send information, a field now known as visible light communications, has been around for well over a century. In fact, Alexander Graham Bell sent a wireless phone message in 1880 using his invention known as the Photo phone. But academic and commercial interest in visible light communication has accelerated in recent years.

The increasing popularity of LED lights, which can be more finely controlled than traditional incandescent bulbs, makes light-based technology more practical and economical. Also, the exponentially growing demand of wireless communication devices has taxed radio spectrum, resulting in a need to find alternatives. In addition, commercially available light emitting diodes (LEDs) and photo-diodes (PDs) can be utilized for data transmission and reception. In addition, transmissions can be stopped simply by blocking the light, and thus can be stopped by walls, so there is less risk of data leaking out of a house or office. And researchers say they believe that signals can piggyback on lights that are already in use street lamps, car headlights or room lighting. The Li-Fi consortium reckons more than 10 Gbps is possible. In theory, that would allow a high-definition film to be downloaded in 30 seconds. Dr Povey believes that adapting existing LEDs to work with the sensors and light sources cameras, ambient-light detectors, screens, flash bulbs, torches and so on already found in smartphones and similar devices will be the fastest way to bring Li-Fi to market.

II. Features

1) Li-fi technology to transmit data between distance measurement unit and vehicle control unit.
2) 2 Arduino UNO- Transmitter and receiver.
3) LCD to display the received data.
4) Ultrasonic sensor to sense distance.
5) Vehicle control according to the distance measured by the sensor.

III. Block DIAGRAM



IV. Flow of Project

1) In this project 2 arduino UNO board is used, one for transmitter side and second is receiver side.
2) Ultrasonic sensor and led is interfaced with transmitter side arduino.
3) Ultrasonic sensor will give data about the distance between sensor and object to arduino and arduino will convert this data into binary.
4) Binary data is transmitted through led by making it on and off.
5) Receiver side photodiode is interfaced with arduino, which will receive the data from led into binary format.
6) Receiver side Arduino will decode the data received from photodiode and it will display the calculated distance on LCD.
7) According to distance, DC motor will get operated through motor driver. If the distance is more than motor will be in its normal speed, if distance decreases then motor speed will also get decreased.
8) If the distance is very less then motor will stop.

V. Hardware & Software Requirements

A. Hardware:

1) Arduino UNO
2) Ultrasonic sensor HC- SR04
3) LED
4) LCD - 16X2
5) Photodiode (photo receiver)
6) Motor driver - L293D
7) DC motor - 12V, 30 rpm
8) Battery

B. Software:

Arduino IDE - Arduino programming

VI. Component Details

A. Arduino Uno Controller:

The Arduino Uno is a microcontroller board based on the ATmega328.

It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Revision 3 of the board has the following new features:

1) 1.0 pinout:

Added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.

- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

B. Ultrasonic Sensor:

Ultrasonic sensors work on a principle similar to sonar which evaluate distance of a target by interpreting the echoes from ultrasonic sound waves. Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm.

The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

1) Using IO trigger for at least 10us high level signal,
2) 2. The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
3) 3. IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2.

C. 16X2 LCD Display:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

1) Specification:

1) 5 x 8 dots with cursor
2) Built-in controller (KS 0066 or Equivalent)
3) + 5V power supply (Also available for + 3V)
4) 1/16 duty cycle
5) B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
6) N.V. optional for + 3V power supply
7) Photodiode (photo receiver):

L14G2 is an NPN phototransistor. It acts as a photodetector in the sense that it can convert the incident light into electric response. They are commonly used as sensors usually paired with a light source like LED.

These are the bipolar transistors having a transparent case. This transparent case exposes the base collector region of transistor to external light. When light incidents on this junction, electrons are generated by the photons. These electrons are injected in the base of phototransistor. The current gain of the transistor amplifies the resulting photocurrent at the base collector junction. Thus a phototransistor conducts in the presence of light and remains in off mode in absence of light. The maximum dark current is 100nA; while in light its current is 500µA.

A phototransistor is different from a simple transistor in the way that in the latter, voltage applied to the base is replaced by light striking it. Simply put, a phototransistor amplifies variations in the light striking it.

Phototransistors may or may not have a base terminal. If a base terminal is available, it is used to bias its light response.

Photodiodes can also be used for similar function as phototransistors, but they have much lower gain and thus lower photocurrent. Phototransistors cannot detect low intensities of light but are more responsive to the exposed light. Also, the transistor response lasts for a longer period as compared to a photodiode.

The required light source is a gallium arsenide LED with peak wavelength is 940 nm. The emitter lead is indicated by a protruding edge in the transistor case. The base is nearest to the emitter. The collector is at the other extreme side of the casing.

VII. Advantages

1) Efficiency: Li-Fi works on visible light technology. Since homes and offices already have LED bulbs for lighting purposes, the same source of light can be used to transmit data. Hence, it is very efficient in terms of costs as well as energy. Light must be on to transmit data, so when there is no need for light, it can be reduced to a point where it appears off to human eye, but is actually still on and working.
2) Availability: Wherever there is a light source, there can be Internet. Light bulbs are present everywhere – in homes, offices, shops, malls and even planes, meaning that high-speed data transmission could be available everywhere.
3) Security: One main advantage of Li-Fi is security. Since light cannot pass through opaque structures, Li-Fi Internet is available only to the users within a room and cannot be breached by users in other rooms or buildings.

VIII. Applications

1) Aviation
2) Smart Lighting
3) Hazardous Environments
4) Traffic management

IX. Conclusion

The Li fi technology is implemented successfully. The transmission is based on the assumptions of direct LOS (line-of-sight) channels and simplex channel conditions. The encoding and decoding could be used in the transmitter part and receiver part to reduce the error in transmission. the data transmission rate could be enhanced by using fast switching LED. It was demonstrated that the white LED based visible light data transmission system is indeed technically feasible. The tests were carried out under moderate indoor ambient light conditions.

X. Future scope

Data through illumination taking the fiber out of fiber optics by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. It's the same idea behind infrared remote controls, but far more powerful.

D-Light, can produce data rates faster than 10 megabits per second, which is speedier than your average broadband connection. We expect a future where data for laptops, smartphones, and tablets is transmitted through the light in a room. And security would be a snap if you can't see the light, you can't access the data.

You can imagine all kinds of uses for this technology, from public internet access through street lamps to auto-piloted cars that communicate through their headlights. And more data coming through the visible spectrum could help alleviate concerns that the electromagnetic waves that come with WiFi could adversely affect your health.

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