**LI-FI BASED NAVIGATION SYSTEM FOR VISUALLY IMPAIRED BLIND PEOPLE**

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**Abstract** - Li-Fi (Light fidelity) is transmission using visible light by sending through a LED light. The term Li-Fi refers to visible light communication (VLC) technology that uses light as a medium to deliver high-speed communication in a manner similar to Wi-Fi. The Wi-fi is useful for wireless coverage within buildings while Li-Fi is ideal for the high density wireless data coverage in confined areas where there are no obstacles. Since the visible light is present everywhere, the main idea of our paper is to create internal navigation systems for the bigger areas to create automatic navigation for the visitors who are visually impaired using Li-Fi technology.

Navigation in indoor and outdoor environments is highly challenging for the severely visually impaired, particularly in spaces visited for the first time. Several solutions have been proposed to deal with this challenge. So the technology used to overcome this problem is Li-Fi (Light Fidelity). The term Li-Fi refers to visible light communication (VLC) technology that uses light as medium to deliver high-speed communication. Since visible light is present everywhere, the main idea is to create automatic indoor navigation systems for the visually impaired people using Li-Fi technology.

**Index terms** – LI-FI , Visible light , LED , GPS, Photodetector

**INTRODUCTION**

The light reaches everywhere and if certain information is to be passed using light as a medium, not only will the communication get fast but also the possibilities coming with it. Such a technique of using light as a medium is named as the Li-Fi.

The Li-Fi technology can transfer the data through LEDs. It is a high speed and low cost wireless communication system, compared to Wi-Fi. It can provide high security, large bandwidth, and low cost. Li-Fi uses common household LED (light emitting diode) light bulbs to enable data transfer, boasting speeds of up to 224 gigabits per second. The concept of Li-Fi is currently attracting a great deal of interest, not least because it may offer a genuine and very efficient alternative to radio based wireless.

As a growing number of people and their many devices access wireless internet, the airwaves are becoming increasingly dogged, making it more and more difficult to get a reliable, high speed signal. This may solve issues such as the shortage of radio-frequency bandwidth and allow internet where traditional radio based wireless isn’t allowed such as aircraft or hospitals. Best part of visible light communication is that we can get advantage of high speed data communication at the same time we can use it for lighting purpose. Li-Fi can be technology for the future where data for laptops, smart phones and tablets will be transmitted through the light in a room.

The blind often try to use router that are known and have the least obstruction in their daily commute. A visually impaired person usually relies on feeling floor surfaces with their feet or using footstep echo’s to detect obstruction which is not a foot proof mechanism.

By integrating augmented reality with obstacle detection the visually impaired person can be given location and orientation information instantly. This research aims at improving the conventional navigation systems that is used.

**I. PROBLEM STATEMENT**

- According to the World Health Organization (WHO), 285 million people are estimated to be visually impaired: 39 million are blind
and 246 million have low vision. Moreover, ninety percent of this population live in a low income setting. Visually impaired people are dependent on a cane stick, specially trained guide dogs or, in certain circumstances, a good Samaritan to help them navigate.

- There are a variety of obstacle avoidance mechanisms that can be used such as electromagnetic tracking devices to detect obstacles RF (Radio Frequency) localization. None of these techniques, if used independently can offer a concrete solution to aid the visually impaired.
- Even though there are numerous prototypes and product designs available, none of them are economically feasible for a majority of the blind population.
- Through our project, we aim to develop a prototype which will incorporate technologies such as GPS, and Li-Fi that can communicate with each other to increase the accuracy of the navigation system.
- Functionalities such as location detection with accurate GPS co-ordinates and navigation for the user with real-time obstacle detection are prime objectives of our prototype.
- This project is also designed to measure the feasibility and reliability for creating an augmented reality based navigation system. Finally, after lab testing, our real-world tests aimed to measure the feasibility of our prototype to replace the cane stick or the guide dog and we used with android mobile.

II. PRESENT SCENERIO

In present scenario wireless communication uses radio waves. Spectrum is necessary for wireless communication. With the modern technology and the number of users, the existing radio wave spectrum fails to resolve the issues of durability, availability, scalability and security, we have come up with new technology of transmitting data wirelessly through LEDs, which is called as Li-Fi. Li-Fi is a modern technology which helps in the transmission of data much more faster and flexible than Wi-Fi technology. At the heart of this technology, a new generation of high-brightness light-emitting diodes. Very simply, if the LED is ON, user can transmit a digital string of 1, if it’s OFF then user can transmit a string of 0. It can be switched ON and OFF very quickly, which gives instant opportunity for transmitting data. It is possible to encode data in the light by varying the rate at which the LEDs flicker ON and OFF to pass different strings of 1s and 0s. The modulation is so fast that the human eye doesn’t notice. There are over 14 billion light bulbs used across the world, which needs to be replaced with LEDs ones that transmit data.

III. SYSTEM ARCHITECTURE

In order to augment a visually impaired person’s pedestrian experience and help them travel comfortably in known and unknown environments, the navigation system should provide enough information to give him a whole picture of the environment and deliver the information along the visually impaired person’s path in real time through auditory cues.

![Transmitter module](image)

The environment may include various scenarios such as crowded walkways, infrastructures, daily routine usable things etc. In sample indoor environment it consists of a kitchen, a living room, a bedroom and a bathroom. The proposed system shows how to use voice command to switch from one navigation to indoor navigation when the visually impaired person first enters the smart house and illustrates the sample communication between the user and the system. The system introduces the indoor facility to give the user a broad picture of the indoor environment. While the user is walking, he may request the current location and ask for the optimal route to get to a destination. With the user’s current position a step-by-step guidance is provided with the orientation and angles the user should turn.

**Transmitter Module** – generates the corresponding on-off pattern for the LEDs.

**Receiver Module** – has a photo diode to detect the on and off states of the LEDs. It captures this sequence and generates the binary sequence of the received signal. A typical optical receiver’s front end
Figure 1. Receiver Module

COMPONENTS

**Atmega16**

It is an 8-bit high performance microcontroller of Atmel’s Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing). Know more about RISC and CISC Architecture architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.

Atmega16 has 16KB programmable flash memory, static RAM of 1KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively.

Atmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD.

Atmega16 has various in-built peripherals like USART, ADC, Analog, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals.

**Crystal Oscillator 11.0952MHz**

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. This frequency is commonly used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillator, but other piezoelectric materials including polycrystalline ceramics are used in similar circuits.

**HC-05**

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

**LCD**

Liquid crystal Display (LCD) displays temperature of the measured element, which is calculated by the microcontroller. CMOS technology makes the device ideal for application in hand held, portable and other battery instruction with low power consumption.

**Photodiode**

A photodiode is a semiconductor device that converts light into current. Photodiodes may contain optical filters, built-in lenses, and may have large or small surface. Photodiodes can be used to detect the presence or absence of minute quantities of light and can be calibrated for extremely accurate measurements from intensities below 1 pW/cm² to intensities above 100mW/cm².

**IV. RESULT**

In addition to the uses of Li-Fi, it also satisfies the requirements of providing indoor navigation and also helps the visually impaired people to avoid obstacles and will also let them know about their current location. This technology will not only allow a user with visual disabilities to ambulate into an indoor environment while avoiding obstacles, but it could also help them interact with the environment. In the future we will not only have 14 billion light
bulbs, we may have 14 billion Li-Fi deployed worldwide for a cleaner, greener and even a brighter future. 

Fig. Transmitter module

Fig. Receiver module

V. CONCLUSION

The use of Li-fi technology gives a golden opportunity to replace or to give alternative to the radio based wireless technologies. For future short range applications and VLC present promising supplemental technology to radio wireless systems. Although there are many challenging issues, VLC remains one of the most promising technologies in the future. The blind person navigation system helps blind person by indicating them with a voice message whenever a person enters the room. This will inform the blind people about the person who has entered into the room. In existing system, the reliability is poor, data can be easily hacked. This method provides a cheap and highly reliable way to transmit data securely. Hence this method can be implemented to transfer data. The proposed method can be integrated into medical devices and in hospitals as it can easily used in navigation beacons.

VI. FUTURESCOPE

1) Achieving seamless interoperability with other networks in a way such that it can be operated in the outdoor environment.

2) Driving illumination grade LEDs at high speed.

3) Overcoming the line of sight.

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