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NAVIGATION SYSTEM PROTOTYPE FOR VISUALLY IMPAIRED USING VISIBLE LIGHT COMMUNICATION

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ABSTRACT:

Wireless communication is vital for way of data communication. Due to continuous increase in the demand it's necessary to develop alternate ways of data transfer. Authors have proposed the study of Visible light communication systems. The medium of communication is LED light signal in this method. The blinking of LED at high rates is useful for this technology.

This paper is about how to use visible light communication to navigate visually impaired users. We believe that the application of visible light communication belongs to location-based services. For this application, users are able to know the information associated with a transmitter. Suppose a transmitter is present at a building, location information will be obtained and conveyed to receiver using LED light. Indoor navigation is convenient for everyone, and it is especially useful for visually impaired.

KEYWORDS: Navigation system, Visible light communication, LED, etc.

I. INTRODUCTION:

As societal dependence upon wireless systems continues to grow, wireless technology needs to expand to meet the demand. Phones, laptops, and global positioning systems are all devices that implement certain forms of wireless communication to send information to another location. However, the availability of current forms of wireless systems is very limited, and it is not necessarily safe to implement wireless radio, making it necessary to explore other alternatives to wireless communication to allow continued expansion upon communication systems and to ensure safe use.

In addition to the crowding of the frequency spectrum, interference is also a concern for many existing wireless systems. Any simultaneous use of a frequency band will cause interference due to the electromagnetic nature of most wireless devices, which could result in incorrect or loss of information. A principal example of this is the use of cell phones on planes, which directly affects safety. Wireless devices cause interference to the aircraft's navigation and communication.

VLC system is useful as it is more flexible. There is no way to retrieve and access the information unless a user is in a direct path of the light being used to transmit the data. In addition, LEDs are highly efficient and becoming more durable, adding to the integrity of these systems.

II. ALTERNATIVES IN PROGRESS:

Currently, several alternatives to radio frequency communications exist. For example, there are cognitive radio and laser communication systems.

A. COGNITIVE RADIO:

A cognitive radio is programmed to adapt to its surroundings. It constantly analyses the frequency spectrum to determine how the surrounding spectrum is being used, but that would require an antenna that has a large bandwidth. Since most antennas operate at a range of frequencies, cognitive radios will monitor that specific bandwidth and determine how it is occupied. Once the radio has determined, it will choose non-occupied frequencies to transmit its information. While it is transmitting information, it continues to monitor the spectrum to determine whether other signals are attempting to access the same frequencies. If there are other signals, the radio will stop transmitting and switch to another unused frequency slot. This whole process is called Dynamic Spectrum Access and is a vital part of how a cognitive radio functions. The idea for optimizing the use of the frequency spectrum will require the systems to focus on more than one frequency band. Since a majority of these bands have been dedicated to certain organizations, those organizations have priority or full control over the frequencies.

B. LASER COMMUNICATION:

Laser communication systems utilize wireless connections through the atmosphere, transmitting data through free space by shooting a laser. This form of wireless communication can be effective because it is not regulated by the government as it operates in a near

infrared spectrum, hence avoiding any additional overcrowding of the spectrum with this form of communication. The system can work for a distance of up to 6 km with bitrates up to 1.25 Gbps. The system requires a line-of-sight path from the transmitter to receiver. This renders the two functional blocks relatively immobile. If the path is not calibrated precisely, the laser could miss the receiver by a large distance, resulting in no data transmission. In addition, although invisible to the naked eye, the lasers used could result in damage to one's eye if there is an extended exposure to the laser.

C. VISIBLE LIGHT COMMUNICATION(VLC):

Sending some form of data using visible light LEDs from a transmitter, and decoding it with a receiver. Information will be converted into bits through some coding scheme by a microcontroller and will be transmitted with blinking LEDs. The blinking of these LEDs will not be visible to the human eye as they are blinking at a high frequency. Photodiodes on the receiving side will detect the fluctuation of the LEDs from the transmitter and will send signals to a microcontroller which is integrated with a computer to determine the originally transmitted message. The transmitting system will be powered from a wall outlet whereas the receiving system will be powered by batteries.

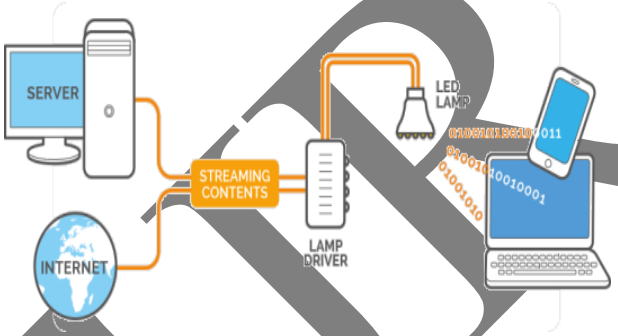

Figure 1 Basic working of VLC

Visible Light Communication can be used for indoor applications very effectively. Such as

1. Navigation system using VLC as a communication medium.
2. For IOT applications.
3. Internet sharing for multiple users using VLC instead using Wi-Fi

III. LITERATURE REVIEW:

LED lights used widely in day to day life due to the benefits associated with it. Visible light communication (VLC) is a new way of wireless communication using visible light. LEDs are used as the transmitters of the data in such system [1].

VLC Technology is limited by its use over the short range of transmitting the signal. To increase the distance between transmitter side and receiver side by implementing the repeater for VLC [2].

Recent advancements have triggered research in Visible Light Communication (VLC) which enables us to use Light Emitting Diodes (LEDs) for illumination as well as low cost, high speed, power efficient and secure data communication. VLC technology is considered to be a green technology which helps in the reduction of hazardous gases emission.

VLC is a promising technology not only to increase not only the capacity of indoor wireless communication but also the security. Market penetration of white LEDs is very rapid and they can be used both for lighting and communication. VLC provides a cost effective technique of duplex communication not only for home users but can also satisfy the requirements of a small LAN. No doubt, there are many challenges which are being faced by the researchers such as ambient noise etc. yet VLC presents a realistic and promising supplement technology to radio communication [3].

IV. SYSTEM OVERVIEW

We believe that the application of visible light communication belongs to location-based services and new graphical user interfaces that combine visual imagery with visible light communication. For this application, users are able to know the information associated with a transmitter. If a transmitter is present a fixed place, location information will be obtained. Indoor navigation is convenient for everyone, and it is especially useful for visually impaired.

This is a navigation system prototype for the visually impaired as shown in Figure 2. LED lights emit visible light with location data and a smartphone or blind person's stick with a visible light receiver receives the data. The controller with receiver calculates the optimal path to a designation and speaks to the visually impaired through a headphone or turns stick left or right with the help of motor.

Figure 2 Indoor Navigation system for Visually Impaired using VLC

V. ARCHITECTURE OVERVIEW:

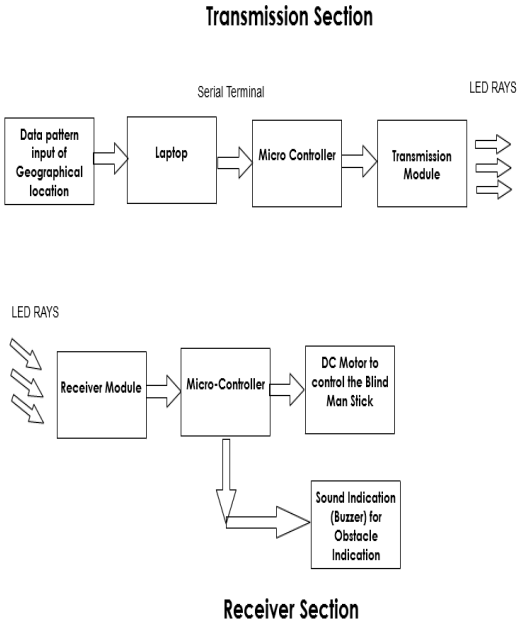

Figure 3 Functional block of indoor navigation system

Figure 3 shows the overall functional block diagram of our system. Our prototype composes one transmitter and one receiver as shown. The transmitter section consists of a user interface, a microcontroller, and analog circuitry of transmitter module incorporating LEDs, all of which are powered in some fashion. The receiver section is similar, containing analog circuitry of receiver module incorporating phototransistors, a microcontroller and a display device capable of receiving and interpreting the output, all of which are also being powered in some fashion.

The microcontroller is used as the signal source for our design by utilizing a binary system to transmit text. Each voltage maximum corresponds to a single binary 'high' digit and each voltage minimum corresponds to a single 'low' digit. This scheme is used in conjunction with the ASCII binary values, to encode a text message which is sent to the receiver side of the design utilizing LED flashes.

The microcontroller of the transmitter section receives data from user's computer through the USB port and sends data out using RS-232 serial communication interface. The byte data type is converted into light signal data type by using the on-off keying modulation (OOK) technique and is transmitted via LED. Then phototransistor at the receiver section receives light from the LED of the transmitter through air and send light signal to the microcontroller. The micro controller then converts this signal into byte data and sends it to user's computer through USB port. Software at the receiver side receives byte data and combines each set of bytes together then the file can be saved.

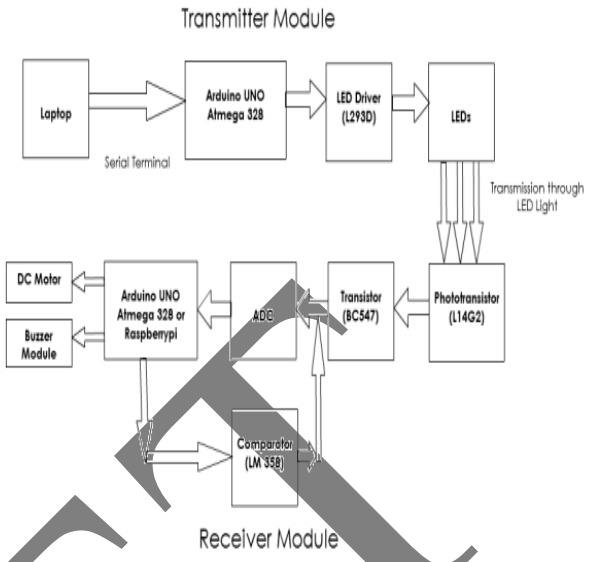

Figure 4 Experimental Setup

Our system prototype comprises transmitter and receiver circuit where Arduino UNO ATMEGA328 microcontroller is used. The transmitter comprises components LED driver L293D, array of white LEDs to transmit the data, receiver comprises phototransistor L14G2, transistor BC547, comparator LM358 to receive data and converted from text to speech for directing visually impaired.

VI. CONCLUSION:

The transfer of data takes place in presence of LED lights whatever may be the band width. Transmitting the data or information will be great and also sufficient information and anything can be downloaded using very high speed and less time. VLC can be incorporated with IOT applications as well will be advantageous as for safe and secure communication.

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