



Indoor Navigation System for Blind People Using VLC

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Abstract

We propose an indoor navigation system that utilizes visible light communication technology, which employs LED lights and a geomagnetic correction method, aimed at supporting visually impaired people who travel indoors. To verify the effectiveness of this system, we conducted an experiment targeting visually impaired people. Although acquiring accurate positional information and detecting directions indoors is difficult, we confirmed that using this system, accurate positional information and travel direction can be obtained utilizing visible light communication technology, which employs LED lights, and correcting the values of the geomagnetic sensor integrated in a Smartphone.

Keywords: Indoor navigation, visible light communication, visually impaired people, and Location-based services.

1. Introduction

Now a day's Wi-Fi is widely used in all the public areas like home, cafes, hotels, airports. Due to this radio frequency is getting blocked day by day, at the same time usage of wireless data is increasing exponentially every year [1]. Transfer of data from one place to another is one of the most important day-to-day activities. The current wireless networks that connect us to the internet are very slow when multiple devices are connected [2]. Localization is one of key techniques that gain the increasing attention of researchers recent years. The location information, especially the indoor location, is important for navigation systems, heating and air conditioning systems, illumination adjustment, humidity control, robot service, and so on [3]. LED's are the mediators to transfer the data for Li-Fi technology. when compared to Wi-Fi, It has high speed and low cost. Main attractions are high security, large bandwidth. Li-Fi uses common household LED light bulbs (used for illumination) to enable data transfer [4]. 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 [5]. Visible Light Communication has been broadly studied as a promising

Technology, predominantly in the indoor environments [6]. In today's world we use various technologies for navigation like GPS, voice navigation, guide dogs etc. Most of these can also be used by the visually impaired people for navigating outdoors [7]. Communication is one of the integral parts of everybody's life for exchanging information on devices in wired or wireless networks [8].

2. Problem Statement

People with visual disabilities, either partially or totally blind, are often challenged by places that are not designed or their special condition. Examples of these are bus and train terminals, hospitals and shopping malls. Several "everyday" objects that are present in most built environments become real obstacles for blind people, even putting at risk their physical integrity. Simple objects such as chairs, tables and stairs, hinder their movements and can often cause serious accidents. This Li-Fi technology helps the visually impaired to move within indoor environments. The main objective of the system is to provide, in real-time, useful navigation information that enables a user to make appropriate and timely decisions on which route to follow in an indoor space. Indoor navigation is convenient to everyone and it is especially indispensable for the visually impaired. Li-Fi makes use of a free, unlicensed spectrum and is not affected by RF noise. Furthermore, since Li-Fi cannot penetrate through wall, most indoor locations would have an enough amount of light sources and provide surplus security [9]. The concerns of the lack of radio frequency bandwidth may be ruled out by Li-Fi and high data transmission rates of up to 15Gbps can be attained. With the increasing use of Wi-Fi, the existing radio frequency is getting clogged deliberately and simultaneously, there are an increasing number of people who want to connect to the internet. LI-FI uses the Visible Light Communication, is a data communications medium which uses visible light and will contribute the visually impaired people for the navigation and helps them to travel autonomously at indoor places.

3. Proposed System

High brightness LED which act as a communication source. The transmitter unit is fitted to the wall/ceiling. In the transmitter the

modulated information is transmitted through LED. Silicon photo diode which serves as a receiving element. The receiver unit modulates the encoded binary data and give the response in the form of voice to the person. The receiver unit consists a phototransistor which receives the information from the LED connected to the transmitter. The information consist of location, and whenever receiver module comes in the range of that transmitter area than corresponding location message is send to receiver is stored in the IC APR33A3 and processed further to initiate voice to guide the person and vibrator motor to navigate the person which can assist visually impaired people at indoor places. The performance of the system depends upon a number of factors such as the integrity of location database and the calculation of correct direction. The system latency also needs to be considered when taking performance into consideration.

4. Components Required

Arduino UNO



The Arduino UNO is a microcontroller board with the implementation of ATmega328. 14 digital Input /Output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16MHz ceramic resonator, USB connection, a power jack, an ICSP header and a reset button has been used here. It is provided with everything needed to support the microcontroller. Simply connect it to computer with a USB cable or power it with an AC-to- DC adapter or battery to get started. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform [10].

Ultrasonic Sensor



Ultrasonic sensors works with the same principle as that of a radar or sonar systems which assess attributes of a target by deducing the echoes from radio or sound waves correspondingly [11]. Ultrasonic sensors generate high frequency sound waves by which the echo that is received back by the sensor is evaluated. Also the time interval between sending the signal and receiving the echo to determine the distance to an object is calculated using the sensors. Systems typically make use of a transducer to generate ultrasonic sound waves of the range, above 18,000 hertz. This is done by converting electrical energy into sound, and then upon receiving the echo convert the sound waves into electrical energy which can be measured and displayed [12].

PIC Microcontroller



PIC16F877 is one of the most advanced microcontrollers from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is supreme for applications such as machine control applications, devices measurement, study purpose etc.[13]. [21]

Photo Diode



A photodiode is one of the type of photo detector which can able to convert light into either voltage or current, depending upon the mode of transmission. Photodiodes are identical to regular semiconductor diodes except they may be either visible or wrapped with a window or optical fibre connection to allow light to extent the sensitive part of the device. Many diodes deliberated for the use of a photodiode will also use a PIN junction rather than the typical PN junction [14].

DF Mini Player



The DFPlayer Mini MP3 Player is a minor and small price MP3 module with has an simplified output directly to the speaker. The module can be used as a impartial module with involved battery, speaker and push buttons or used in combination with an Arduino UNO or any other with reception and transmission capabilities [15].

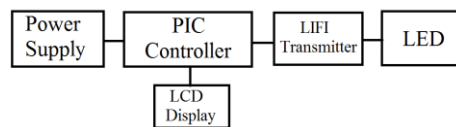
5. Block Diagram

Transmitter

The PIC microcontroller PIC16f877a is appropriate to use, the coding or programming of this controller is much easier. One of the main benefits is that it can be write-erase as many times as possible because it uses flash memory [16]. It has a total number of 40 pins out of which 33 pins for input and output. PIC microcontroller is based on Harvard architecture. Now a days PIC microcontrollers are widely used for industrial purpose due to its capability of high performance at low power consumption. It is very known among due to its tolerable cost and easy obtainability of its supporting software and hardware tools like debuggers simulators etc. [17]

In this research, pic controller is coded with TL866A UNIVERSAL EEPROM PROGRAMMER using Mat lab IDE

with a name that is going to transmit in that certain area. TL866A has read only memory, like a regular ROM chip which uses an electrical impulses and grid in order to generate binary data. The data is processed and transmitted through LED light which will toggle continuously according to the code embedded. The toggling of Led is based on transistor, BC548 which acts as a switch [18].



Receiver

Arduino is connected with three ultrasonic sensors for three directions like front, right, left, back direction will not include since a person cannot walk backward. The receiver consists of a photodiode; connected to digital pin 6 of Arduino, which when comes under the flashes of LED retrieves the data and processed back by the pic microcontroller [19]. In detail, PIC controller converts back the digital data acquiring from LED transmitter to analogue data. Every signal received by the pic controller is processed by DF mini player and output is sent to speaker [20]



6. Outcome



7. Conclusion

The use of Li-fi technology stretches a golden opportunity to swap or to give alternate to the radio based wireless technologies. For future short range applications and VLC present a viable and promising extra technology to radio wireless systems. Although there are many thought-provoking issues, VLC remains one of the most capable 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 transfer 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 be used in navigation beacons.

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