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Indoor Navigation System Based on LiFi Technology

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Abstract:
In this study we propose an indoor navigation system that utilizes visible light communication technology which employs LED lights aimed at supporting people who travel indoors. The main component of this communication system is high brightness LED, which acts as a communication source and a photo diode which shows good response to visible length region serving as a receiving element. Important factors we should consider while designing Li-Fi are presence of light and line of sight. LED can be switched ON and OFF to generate digital strings 1s and 0s. Data can be encoded in the lights to generate new data rate by varying flickering rate of LED. Although acquiring accurate positional information and travel direction can be obtaining by utilizing VLC technology with direction continuing advancements in computing communication technologies. Several commercial GPS tracking system were introduced to a consumer market. However, GPS has a major challenge when it comes to indoor positioning due to signal interference caused by walls, floors and other objects. All these challenges have shown architecture of using VLC for accurate indoor positioning and navigation

Keyword: VLC, Li-Fi, Photodiode, LED, Indoor Navigation System.

I. INTRODUCTION

In this time of remote innovation, the Wi-Fi is valuable for general remote inclusion inside structures while Li-Fi is perfect for high thickness remote information inclusion in restricted Regions where there are no obstacles. Since obvious light is present all over the place. Light fidelity is a bidirectional, rapid and completely arranged remote correspondence innovation like Wi-Fi. Li- Fi can be viewed as better than Wi-Fi on the grounds that there is some restriction in Wi-Fi. The Li-Fi innovation can exchange the information through LEDs. It is fast and minimal effort remote correspondence framework, contrasted with Wi-Fi. Indoor route is helpful to everybody and it is particularly vital for the outwardly impeded. Li-Fi makes utilization of a free, unlicensed range also, isn't influenced by RF commotion. Indoor area would have an adequate measure of light source and give extra security since Li-Fi cannot infiltrate through divider. The Li-Fi technology helps the user to move within indoor environment. The main objective of the system is to provide, useful navigation information that enables a user to make appropriate and timely decisions on which route to follow in an indoor space. Whenever LED is ON use can transmit an advanced string of 1,if it's OFF at that point client can transmit a string of 0.it can be exchanged ON and OFF in all respects rapidly, which gives moment open door for transmitting information. Li-Fi require viewable pathway for correspondence. Light reliant resistor offers limitless opposition in murkiness and offers not many ohms then there is light.

II. REVIEW OF LITERATURE

Li-Fi TECHNOLOGY

The principle of Li-Fi is based on sending data by amplitude modulation of light source in a well-defined and standardized way. LEDs can be switched on and off faster than the human eyes can detect since the operating speed of LEDs is less than 1 microseconds. This invisible on-off activity enables data transmission using binary codes. If the LED is on, a digital „1" is transmitted and if the LED is off, a digital „0" is transmitted. Also these LEDs can be switched on and off very quickly which gives us a very nice opportunity for transmitting data through LED light, because there are no interfering light frequencies like that of the radio frequencies in Wi-Fi. Li-Fi is thought to be 80% more efficient, which means it can reach speeds of up to 1Gbps and even beyond. Li-Fi differs from fibre optic because the Li-Fi protocol layers are suitable for wireless communication over short distances (up to 10 meters). This puts Li-Fi in a unique position of extremely fast wireless communication over short distances. The encoding data into light for transmission is achieved by varying the light intensity of the LED, which causes the LED to flicker ON and OFF at very high speed. These flickers represent the data being transmitted.

HOW IT WORKS:

The working of Li-Fi is very simple. There is a light emitter on one end i.e. an LED transmitter, and a photo diode (light sensor) on the other end. The data input to the LED transmitter is encoded in to the light (technically referred to as Visible Light Communication) by varying the flickering rate at which the LEDs flicker „on" and „off" to generate different strings of 1s and 0s.

The on off activity of the LED transmitter which seems to be invisible (the LED intensity is modulated so rapidly that human eye cannot notice, so the light of the LED appears constant to humans), enables data transmission in light form in accordance with the incoming binary codes: switching ON a LED is a logically „1", switching it OFF is a logically „0". By varying the rate at which the LEDs flicker on and off, information can be encoded in the light to different combination of 1s and 0s. Some of the major limitations of Li-Fi are:

- Internet cannot be accessed without a light source. This could limit the location and situations in which Li- Fi could be used.
- It requires a near or perfect line-of- sight to transmit the data.
- Opaque obstacles on pathways can affect data transmission.
- Natural light, sunlight, and normal electric light can affect the data transmission speed.
- Light waves don"t penetrate through walls and so Li-Fi has a much shorter range than Wi-Fi.

III. MATERIALS AND METHODS 3.1HARDWARE IMPLEMENTATION

Hardware configuration

- PIC16F628A microcontroller: The PIC16F627 A/62 8A/ 648A is 18-pin Flash-based members of the versatile PIC16F627A/628A/648A family of low-cost, high-performance, CMOS, fully static, 8-bit microcontrollers. HC 05 Bluetooth, 1020 LED, 5mm black transparent Photodiode.
- HC-05 Bluetooth: The Bluetooth module is a stackable shield with serial port based on the HC05 module. The shield can be connected directly to the Arduino UART port for wireless communication. Without obstacles or other interference, the Bluetooth shield can communicate in range of 10 meters.
- Photodiode: This photodiode is high speed and high sensitive PIN photodiode in a standard 5mm black plastic package. The device is spectrally matched to visible and infrared emitting diode.
- **1020 LED:** The 1020 LED is Natural white LED which as high brightness, they appear brighter to human eyes.

The proposed system navigates the user to their desired destination in indoor platform by using the predefined longitude and latitude data these data are transmitted to the mobile phone through visible light communication.

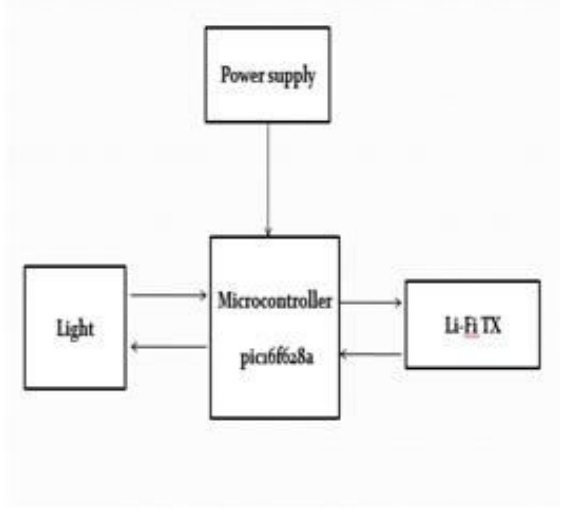

Figure .1.Transmitter

Li-Fi technology is introduced to forecast the data. In this Light-Fidelity technology, we can transmit and receive the data in a hazard less manner, will now use laser based lighting that will transmit data 10 times faster. While LED based Li- Fi could reach data rates of 10Gb/s, an improvement over the 7Gb/s maximum of Wi-Fi, using laser could boost that speed to easily beyond 100Gb/s. The transmitter side is developed with PIC microcontroller and the receiver side is developed with a HC05 Bluetooth module for the purpose of data transmitting. In the transmitter side we use three transmitters for three locations A, B, C based on this the program is coded for these three locations. When the LED light is ON the transmitter receives the data and the data are encoded at the transmitter side. The above figure illustrates the working model of the transmitter and receiver side.

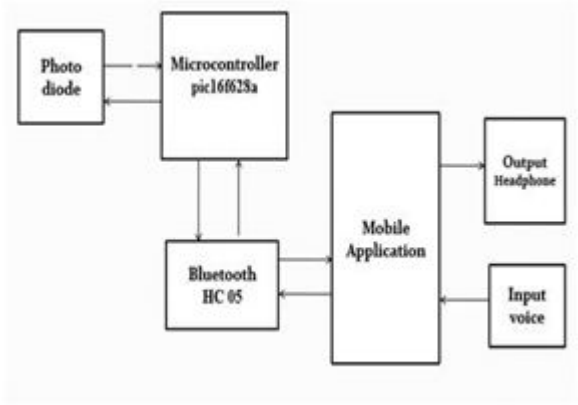

Figure. 2.Receiver

The receiver converts the incoming light into current using a photodiode. For a digital signal, the circuit cannot receive a voltage above 5 V. Therefore, the electrical circuit between the photodiode and the circuit needs to process the electrical signal so it can be interpreted correctly. The receiver"s electronics need to convert the current to voltage in order to amplify and compare it. Distance between the transmitter and the receiver can be varied, but in order to avoid too small or too high signal, an automatic gain controller (AGC) can be designed, instead a variable resistor is used here. This component amplifies or reduces the input voltage to a selected output voltage. The HC 05 Bluetooth module is an serial port protocol module, designed for transparent wireless serial connection setup. The transmitter and receiver pins of Bluetooth is connected to the connector of the receiver side, which receive the data from the photo diode and the data is wirelessly connected to the mobile phone through the Bluetooth connection. When the Bluetooth is connected with the mobile phone the application receives the data and navigates the user to their desired location.

SOFTWARE DESCRIPTION

MPLAB IDE

In order to create code that is executable by the target PIC micro MCU, Source files need to be put into a project. The code can then be built into executable code using selected language tools (assemblers, compilers, linkers, etc.). In MPLAB IDE, the project manager controls this process. MPLAB Integrated Development Environment (IDE) is a comprehensive editor, project manager and design desktop for application development of embedded designs using Microchip PIC micro MCUs and dsPIC DSCs. The initial use of MPLAB IDE is covered here. How to make projects, edit code and test an application will be the subject of a short tutorial. By going

through the tutorial, the basic concepts of the Project-Manger, Editor and Debugger can be quickly learned. This section details the installation and uninstall of MPLAB IDE. It is followed by a simple step-by- step tutorial that creates a project and explains the elementary debug capabilities of MPLAB IDE. Someone unfamiliar with MPLAB IDE will get an understanding of using the system to develop an application. No previous knowledge is assumed and comprehensive technical details about MPLAB IDE and its components are omitted in order to present the basic framework for using MPLAB.

MIT APP INVENTOR

App inventor for Android is an open source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to computer programing to create their software applications for the Android operating system (OS). It uses a graphical interface, very similar to scratch and the StarLogo TNG user interface, which allows users to drag and drop visual objects to create an application that can run on Android devices. In creating App Inventor, Google drew upon significant prior research in educational computing, as well as work done within Google on online development environment. Designer part is used to design the App‟s User interface by arranging both on and off screen components. The block is a matador that allows you to create new variables that are only used in the procedure you run in the DO part of the block.

IV. RESULT AND DISCUSION

The mobile application called **“INNAVI”** is developed by using MIT App Inventor; it consists of Bluetooth connection and disconnection button, speech recognition, indoor floor map and navigate button. The Bluetooth connect and disconnect button to check whether the Bluetooth is connected or not. Where the T box is used to shows the user current location, the user can choose the destination through the voice as the input by using the speech button, which recognise the speech and displayed in the textbox. The navigate button is used to navigate the user to the selected location through voice command.

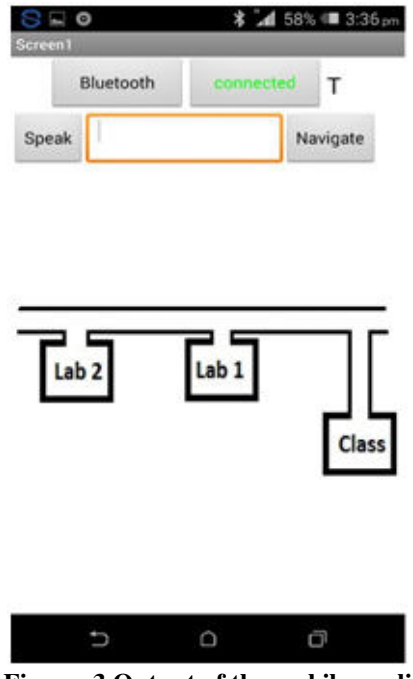

Figure. 3.Output of the mobile application.

In our mobile application there are 3 locations “Class”, “Lab1”, Lab2”, where these 3 locations are taken as ‘A’, ‘B’, ‘C’, respectively for the reference. When the user in the location ‘A’ then the app shows the user current location and the user can choose the destination, by pressing the speech button on the app screen. When the user is ready to speak, click the speech button. Speak clearly, at a normal volume in which the selected destination will be displayed in the textbox next to the speech button. Then the user should press the navigate button next to the textbox, which navigate the user to selected destination. The same procedure is followed for all the location, when the user in the location lab1 then the app shows the users current location as ‘B’ where the location lab 1 is taken as reference ‘B’. Then the user can reach the destination by using the speech button and navigate button as mentioned above. When the user is in the lab 2 location the app shows the current location of the user as location ‘C’. Then the user can select the speech button to choose the destination and navigate button to reach the destination.

V. CONCLUSION

Li-Fi is the upcoming and on growing technology acting as component for various other developing and already invented technologies. Since light is the major source for transmission in this technology it is very advantageous and implementation in various fields that can‟t be done with the Wi-Fi and other technologies. Hence the future applications of the Li-Fi can be predicted and extended to different platforms like education fields, medical fields, industrial areas and many other fields. The possibilities are numerous and can be explored further. If this technology can be put in to a practical use, every bulb can be used something like Wi-Fi hotspot to transmit wireless data and we will proceed towards the cleaner, greener, safer and the brighter future. 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 ta radio-based wireless. As a growing number of people and their devices access wireless internet, the airways are becoming increasingly clogged, 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 also allow internet where traditional radio based wireless isn‟t allowed such as aircraft or hospital, however is that it only works in direct line of sight.

VI. FUTURE SCOPE

One of the most important trends for the future is the Internet of Things (IoT). The key requirements are,

- Security of the wireless data.
- Power for sensor.
- Wireless communication.

The convergence between lighting and wireless communications gives birth to a new age of smart buildings and the Internet of Things (IoT). Philips Lighting, now partnering with Cisco, used Power over Ethernet (PoE) as the basis for a smart building at the Deloitte HQ in Amsterdam. The installation was 50% cheaper than the equivalent traditional installation. In addition to immediate cost savings, the Ethernet backbone with constantly available power enables every light to become a hub for a host of sensors. The question for the future will also be: Who will “own” the Smart Building and the solutions/ services around it? Is Lighting still the domain of mechanical and electrical (M&E) systems, or is

Lighting now part of ICT? The choice has a profound effect on the procurement and operational aspects for the lighting system and, indeed, building management. The converging market metric of the lighting industry with dollars/bit, forced by the long lifetime of LED lighting solutions, means a slow but steady shift towards more data-focused value propositions from the lighting suppliers. The IoT and the Big Data Analytics it enables demand availability of both power and wireless connectivity. And lights are perfectly positioned to provide both. This advantage in wireless capacity is compounded if you consider the amalgamation of cyber security, lighting, and wireless network planning. Li-Fi is a key enabler for each of these aspects, and them together as a whole.

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VII. REFERENCE

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