Implementation of Voice and Data based Navigation System using Light Fidelity Technology

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Abstract— With the vast growing gadgets, their usage and their developments lead to the advancement in the Wi-Fi which provides a technology so called Li-Fi. Li-Fi is a technology that makes use of LED light which helps in the transmission of data much more faster and flexible than data that can be transmitted through Wi-Fi. Light reaches nearly everywhere so communication can also go along with light freely. By using visible light as transmission medium, Li-Fi provides wireless communication. The bit rate achieved by Li-Fi cannot be achieved by Wi-Fi. Li-Fi is the transfer of data through light by taking fiber out of fiber optics and sending data through LED light. Li-Fi is the upcoming and on growing technology acting as competent for various other developing and already invented technologies. Since light is the major source for transmission in this technology it is very advantageous and implementable in various fields that can't be done with the Wi-Fi and other technologies. The Wi-Fi is useful for general wireless coverage within buildings while Li-Fi is ideal for high density wireless data coverage in confined areas where there are no obstacles. Since 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 using Li-Fi technology.

Index Terms—Li-Fi, Visible Light Communication

I. INTRODUCTION

Embedded System is a combination of hardware and software to perform a specific operation until the end of its life. Microcontroller is the heart of the embedded system. Based on its performance, embedded system is divided into small scale embedded system, medium scale embedded system and large scale embedded system. Large scale is known as sophisticated embedded system. A sophisticated system is used to develop the real time operations. The size and weight is minimum and delivers maximum performance. Embedded Systems will run continuously without errors for many years and recover by itself if error occurs. The main purpose of embedded system is data communication, data collection, data signal processing, control, application specific user interface.

Communication with light is an evolving technology. In Visible Light Communication, visible light acts as a carrier signal. Optical communication is cost effective because of the free availability of light everywhere. The intensity of light is modulated such that human eye cannot follow. A light detector is used which prevents interference from other sources. VLC is used only for indoor communication. The most important requirement is the light source with very fast ON-OFF switching. Unipolar orthogonal frequency division multiplexing technique is used. When constant current is applied, a constant beam of photons is emitted. The current varies according with high speed and this variation is detected by photo detector.

II. WIRELESS OPTICAL COMMUNICATION

The optical communication is one of the type of communication which carries information through light for a certain distance. It uses transmitter that encodes the message into optical signals and the encoded message reaches the receiver through channel. This optical communication is used in space but it is limited by geographical areas, availability of light and weather.

There are two types of ambient light sources. The first type is incandescent lamp which have maximum power spectral density around 1m. It produces interference signal in the sinusoidal form with frequency of about 100Hz. If there is a slow response then few harmonics are present. The second type is fluorescent lamp which is further divided into two types. They are fluorescent lamp driven by conventional ballast and fluorescent lamp driven by electronic ballast. In conventional ballast, the interference signal is a distorted frequency of 100Hz whereas, in electronic ballast, fluorescent lamp is driven by high frequency.

A. VLC SYSTEM

The basic configuration of VLC system is the transmitter, channel and the receiver. Visible solid state emitter is used as transmitter and based on its applications, it may be LED or semiconductor laser. VLC transmitter acts as communication transmitter and illumination device. The white light may be produced in two ways; based on LED and wavelength converters.

The VLC channel consists of number of components that corresponds to paths from different light sources to the receiver and it includes diffused components created by reflections or walls. The VLC receiver consists of optical concentrator, optical filter, photo detector and amplifier.

B. VLC MODULATION

The information should be modulated into carrier signal to send data through LED. There are three modulation schemes; 1.ON-OFF keying, 2. Variable Pulse Position Modulation (VPPM), 3. Color Shift Keying (CSK).

On-off keying uses Manchester coding that is used to embed the clock into data. VPPM changes duty cycle of each article symbol that is indistinguishable from other pulse positions. CSK is used only if the source is RGB LED's, the bit pattern is encoded to colours. Orthogonal Frequency Division Multiplexing (OFDM) is more desirable. In this technique, equalization will be performed efficiently by using single tap equalizer in frequency domain and also it allows information to be adaptively encoded into different frequency bands such that the available communication resources are always fully-utilized.

III.LI-FI

Li-Fi technology is used for short range wireless communication system. It is best suited for data transmission through LED by using illumination. For this visible light which is a part of electromagnetic spectrum is used instead of Radio Frequency part.

The data can be easily encoded in the light by varying the On-Off flickering rate (1 & 0) of LED. The intensity of LED is modulated quickly so that the human eye cannot identify the changes. Hence the output appears constant and also sophisticated techniques increase the Li-Fi data rates as like using array of LEDs, where each LED provides parallel data transmission. The other technique is by mixing Red, Green and Blue LEDs to encode a different data channel.

On one end all the data on the internet will be streamed to a lamp driver. When the LED is turned on the microchip converts this digital data in the form of light. On the other end this light is detected by photo sensitive devices. Next this light is amplified and processed and then fed to the device.

IV.NAVIGATION SYSTEM

If the person is new to buildings like college, shopping malls then they does not know the exact pathway. This system is to assist the new person by giving pathway either as voice command and also displays those command in LCD. The numeric data (0-9,*, #) can be transmitted to the receiver by using visible light communication. The keyboard is used to give input device and a speaker or LCD display are used as output device. The medium which binds the transmitter end to the receiver end is an LED source or the visible light communication. The light is encoded based on the given information.

V. BLOCK DIAGRAM

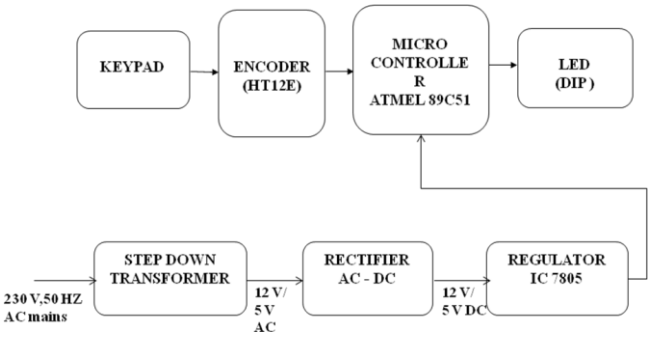

Fig.1 Block diagram for Li-Fi data transmitter

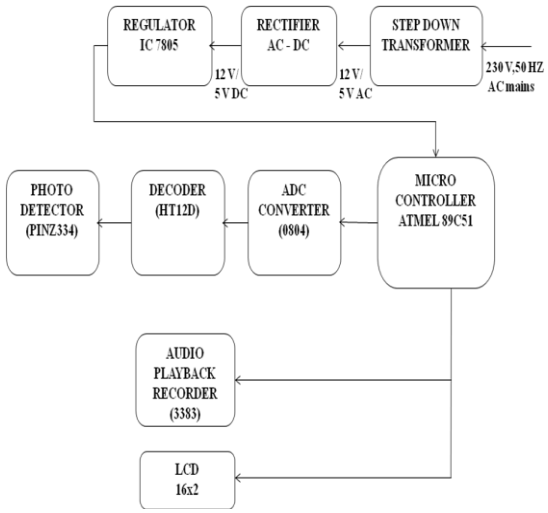

Fig.2 Block diagram for Li-Fi data receiver

VI. EXPLANATION

A.TRANSMITTER

The data is given through keyboard. Many users can give the input simultaneously, to give the data in a sequential manner encoder is used. Data is fed into LED light bulbs, it then sends data at rapid speed. DIP LED acts as a communication source.

B.RECEIVER

The light from the LED is detected by the photo detector (PINZ334) and the small changes in rapid dimming of LED bulbs is converted by the receiver into electrical signal. The signal is converted back into a binary stream and it can be recognized as audio and video applications.

Photo diode which serves as a receiving element. The receiver unit demodulates the encoded binary data and gives the response in the form of voice to the person. The information consist of location, and whenever receiver module comes in the range of that transmitter area the corresponding location message is send to receiver which is stored in the IC APR33A3 and is processed to initiate voice to guide the person to navigate the person.

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.

VII. HARDWARE REQUIRED

The basic microcontroller AT89C51 is used which has four ports and all the ports are bidirectional. It consists of 4K bytes of In-System reprogrammable flash memory and 128 x 8-bit internal RAM. It also has 32 programmable I/O lines, two 16-bit timer and counters and six interrupt sources. Simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

DIP LED is used as a light source which has 3-in-1 bulbs and size of this LED is larger than the normally used SMD LED, but the cost is more. A photo detector converts an optical signal into an electrical signal and the current is produced when photons are absorbed. When there is no light small amount of current flows.

APR33A3 is used as a audio playback recorder and loud speaker is also available which produces the voice command. It is interfaced with the speaker pins and power on module, change the switch towards the recording option, then press and hold the M1 button and speak through microphone and release the button. To play the recorded message, change the switch towards playback and click the M1 button, the recorded message will be played.

Fig.3 Transmitter

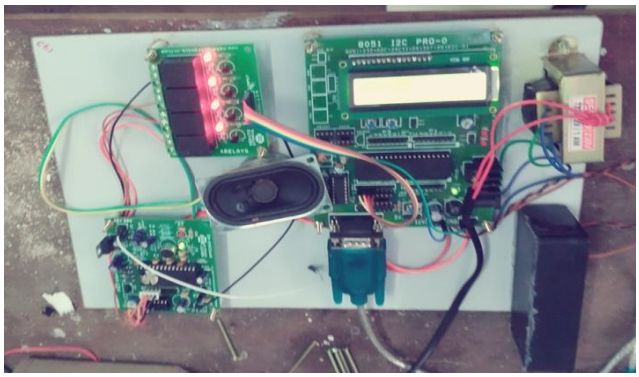

Fig.4 Receiver

VIII. SOFTWARE REQUIRED

PROTEUS ISIS 7.7 SP2 is used for designing and simulation. It runs DRC and CRC tests are performed to validate the physical connectivity and the design rule clearance. It also checks the power plane placement and the integrity through the secondary core path and the programming is in the embedded C language.

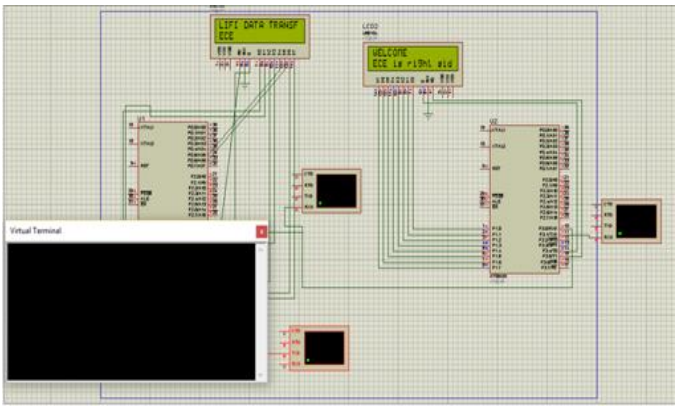

Fig.5 Simulation Output

IX. CONCLUSION

This paper provides assistance for a people who are new to the environment. For this application, Li-Fi technology is used. The numeric data is given as input which is encoded in light and the light is transmitted, this light is detected and decoded at receiver and the corresponding command is produced in the form of voice as well as displayed in LCD. So, this paper will be a promising technology in future for guiding people to reach their destination.

X.FUTURE WORK

1. To drive the illumination grade of LED at high speed
2. To overcome he line of sight problem.

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