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Information Transmission System Based On a Light Sensor

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ABSTRACT
This paper describes a novel light-sensor-based information transmission system with particular benefits for mobile and wearable computers. Fluorescent light is used as the medium to transmit information which is in encoded form and receiver receives the encoded light information through a photoreceiver. The information is passed into the wearable or mobile computer after the data are decoded. This information allows positioning information to be given to indoor mobile and wearable computers.
Keywords– fluorescent lamp, wearable computer.

I. INTRODUCTION

LI-FI technology has the possibility to change how we access the internet, stream videos, receive emails and much more. The technology truly began during the 1990's in countries like Germany, Korea, and Japan where they discovered LED's could be retrofitted to send information.

In October 2011 a number of companies and industries formed the Li-Fi Consortium, to promote high-speed optical wireless system sand to enhance the limited bandwidth provided by radio-based wireless spectrum available. The consortium believes it is possible to achieve more than 10Gbpsspeed using this optical wireless technology also known as Li-Fi. The communication is done by deploying transmitter and receiver in direct line of sight manner. It gets affected if line of sight is not used, the speed of data transmission will reduce or data transmission will stop. It is also more secure than other wireless networks as only photo receptors are used, which can receive data within transmitted cone of light signals.

The information transmission method for wearable GPS cannot provide information indoors or in crowded urban areas since the signals from the satellite would be shielded by the armored concrete structure of the building [1]. One might instead use active badges or beacon architectures, but installing and maintaining such systems involves substantial effort and high expense [1]. Hence, indoor tracking system development becomes useful to seamlessly extend outdoor tracking into indoors. Some forms of indoor positioning, such as magnetic and ultrasonic sensing, are also available, but they are normally for a short range and expensive and require complex hardware installations [1]. We propose using common and cheap fluorescent lamps [2] to transmit information for navigation, because using fluorescent lamps to provide illumination is so popular, widespread, and economical in existing buildings. All the required information can be encoded into the light. A user who has the developed small light receiver on his or her body can receive position information. In this system, after a data stream of information is received and processed, it will be fed into the mobile or wearable computer through the serial port for further processing.

II. VISIBLE LIGHT COMMUNICATION

Visible light fluorescent lamp can be used almost everywhere. Infrared light is already used for communication such as wireless remote control, Infrared wireless LAN and Infrared inter-building communication. Visible light fluorescent lamp is a beginning to be used in every home and office, which makes visible light ideal for ubiquitous data transmitter. Growth rate of lighting is expected to triple from 2009 to 2012 & market share of fluorescent lamp lighting will be more than 30 % of total lighting market in 2016.

Image sensors can be used as receivers. The use of image sensors as receiver makes it possible to detect incoming data and accurate direction of incoming vector from transmitter to receiver. The image sensor technology will allow VLC to various new applications which can't be realized by radio wave technology like indoor navigation, augmented reality, accurate control of robots or vehicles and accurate position measurement.

Why Only VLC (Visible Light Communication):

- Gamma rays can not be used as they could be dangerous
- X-rays have similar health issues as Gamma rays.
- Ultraviolet light is good for place without people, but otherwise it is dangerous for the human body.
- Infrared ,due to eye safety regulation, can only be used with low power.

- Compared to other spectrum visible light spectrum not used so far and it is safe to use and having larger bandwidth

Comparison with Other System:

Table 1: Comparison between current & future wireless technologies

Technology	Speed	Data Density
Wireless(Current)		
WI-FI IEEE802.11n	150Mbps	*
Bluetooth	3 Mbps	*
IrDA	4 Mbps	***
Wireless(Future**)**		
WiGig	2 Gbps	**
Giga-IR	1 Gbps	***
LI-FI	>1 Gbps	****

III. HARDWARE SYSTEM DESIGN

We will outline the hardware system used for constructing novel and economical navigation and positioning systems using fluorescent lamps. The whole system is divided into two parts: the transmitter and the receiver. The transmitter sends out messages encoded by the fluorescent light whose flicking is imperceptible to human vision, while the receiver detects the light using a photodetector.

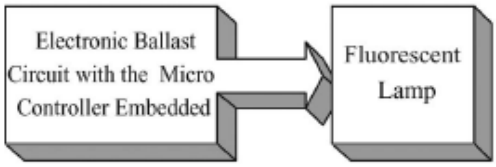

Fig.2 Transmitter

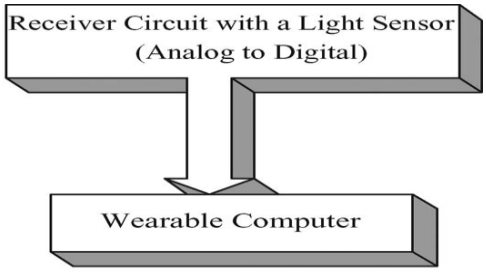

Fig.3 Receiver

In the transmitter section, we use a fluorescent lamp for our system since, first, it is highly used in office buildings and, second, nowadays, it is triggered by electronic ballast circuits, so there is no need to design a costly circuit for controlling the arc frequency of the lamp, and by simple modifications on the current widely cheap and available circuit, we can furnish our goal. We add a simple low cost microcontroller chip to control the intensity of the light. The receiver circuit [Fig. 3], with a photo detector detecting the fluorescent light, processes the data that are eventually fed into the wearable computer. The receiver circuit , with a photodetector detecting the fluorescent light, processes the data that are eventually fed into the wearable computer. With the information received, the wearable computer can tell the user what the surrounding situation is.

The lighting of the fluorescent lamp is due to the arc current running through the lamp. When the amplitude and frequency of the arc current is appropriate, the lamp will light up. Changing the intensity of the arc current may encode all the information into the fluorescent light. If it is high enough, the information will be transmitted without flickering due to the characteristic of human vision [3]. With the codes fed into the electronic ballast circuit, the fluorescent lamp is lit up, while the arc frequency is changed according to the bit patterns without perceptible flickering to the human vision.

The receiver detects the fluorescent light and transforms the analog signals to the digital ones that can be sent to the user's mobile/wearable device. The light sensor, i.e., photodetector , which is to provide an output voltage proportional to the light level, is used in our receiver system to detect the output from the fluorescent lamp in this prototype.

IV. PERFORMANCE

Accuracy is an important parameter to evaluate the effectiveness of the positioning system. Since this system only functions or detects fluorescent light signals within a certain area, the evaluation of the system accuracy can be estimated by setting the function area within which the light intensity is high enough to be detected. Fig. 4 shows how the system efficiently works within the function area. The functional reception area is defined as the area under which a single light transmitter signal can be detected by the receiver.

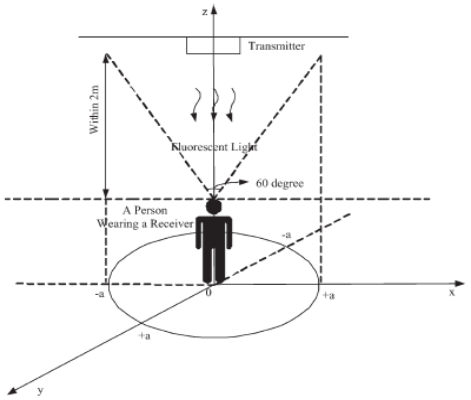

Fig. 4 Diagram of the system function area

V. CONCLUSION AND FUTURE SCOPE

When data, which are encoded in the fluorescent light, is received by the receiver and analyzed by the wearable computer, it will provide location and navigation messages. Furthermore, the receiver circuit is light and small, and it can be well suited to wearable computer applications. it is significant to point out that the application of this system provides an innovative and economical form of indoor positioning and navigation method.

In future, we can connect the transmitter circuit to each other through a server computer. This can be setup in the structure of new buildings. Then, the data transmitted by the fluorescent lamps will no longer be static, and each fluorescent lamp can have data controlled by the server or network, which interfaces to the microcontroller of the transmission circuit. It is possible for a controller in the main control room to send out a series of different messages for different locations by calling different functions in the main program embedded in the microcontroller. All the information, which is sent out by the fluorescent lamp at each location, is set in the main program. As can be seen, there are many applications for this system in various fields. Its application areas can range from computer games to industrial manufacturing, urban facilities, and household usage.

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