A Novel Light-Sensor-Based Information Transmission System for Outdoor tracking to the Indoor Positioning system

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Abstract

The objective of this project describes a novel light-sensor-basedInformation transmission system for indoor positioning andNavigationwith particular benefits for mobile and wearable computers. It canseamlessly extend outdoor GPS tracking tothe indoor environment.In a novel manner, fluorescent lightis used as the mediumto transmit information. The userreceives the encoded light information through a photoreceiver. The information ispassed into the wearable or mobile computer after the data aredecoded. This information allows positioning information to begiven to indoor mobile and wearable computers.The proposedsystem can be used in indoor guidance and navigation applications.An embedded system is a combination of software and hardware to perform a dedicated task.Some of the main devices used in embedded products are Microprocessors and Microcontrollers.

Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output.Itusing PIC16F72, PIC16F877A microcontroller is an exclusive project which is used to find the position identification for the different blocks in the organization by using the Zigbee module. This information is provided by the GPS with the help of the data it receives from the satellites.

Index Terms—Augmented reality (AR), electronic ballast, fluorescentlamp, navigation, wearable computer.

I. Introduction

MOBILE or wearable computers and augmented realitytechnology are finding applications in human positionguidance and navigation [1]. Commonly, GPS sensors havewidely been used with these interactive technologies for navigationand positioning. For example, GPS-based positioningfor wearable computers has been used in the applicationof outdoor augmented reality (AR).AR merges virtual objects or text information into a realenvironment and displays this combination in real time. Unlikevirtual environments, AR supplements reality, rather than completelyreplacing it. This property makes AR particularly wellsuited as a tool to aid the user's perception of and interactionwith the real world. The information conveyed by the virtualobjects helps a user perform real-world tasks.Although AR technology combined with wearable GPS is mature, the information transmission method for wearable GPScannot provide information indoors or in crowded urban areas since the signals from the satellite would be shielded by thearmored concrete structure of the building. One might instead use active badges or beacon architectures, but installing and maintaining such systems involves substantial effort and high expense. 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. Thus, there is a problem that such commercially available sensing systems for indoor tracking of mobile and wearable computers are accurate but impractical and expensive for wide areas.

This project aim is to identifying the different blocks in the organization by using the Zigbee module. And the employer can be able to find where the employee in the organization. All the multinational companies are having more than 50 blocks in a single building those are working for different projects. So it is difficult to find by the new employee to know which block is belongs to which category. For this we are going to develop a new project which is apt for the new employee's to know the different blocks in the organization.

II. Comparison with Other Systems

To extend GPS data for indoor applications, some researchers used computer-vision-based tracking algorithms to perform the tracking. For instance, put fiducialmarkerson the walls and used a marker-based tracking algorithm forindoor tracking of a mobile user. Although this kind of trackingis only software based and there is no need for any specialhardware, except for the paper markers, if we want to use thismethod, we need to have many different markers and put themin every place to cover the whole area, and in the state of artin computer vision tracking systems, we can detect less than100 markers at the same time. Furthermore, all the markersmust be predefined for the users, and the user's mobile devicemust know which position each marker is located, which is notpractical when the user arrives to a new building.

Other proposed methods for indoor tracking aremainly basedon ultrasound, radio frequency, and IR. In addition to these technologies, because of the popularity of wireless networks inrecent years, many works have been done to infer the locationof a wireless client based on Wi-Fi technology on the IEEE802.11 standard. For instance, the Finnish company Ekahau has developed a software-basedWi-Fi location technology.In their system, they only need three wireless stations for theircalculation, and the rests are done in software. Although eachtechnology has its own advantages and disadvantages, in general,there is a tradeoff between the accuracy of the tracking andthe total cost of the system. For example, ultrasound trackingcan be highly accurate, such as the IS-900 system developed bythe Intersense Company, with a price of over 15 000 USD,or it can be designed in a cheap way like the system proposed by Randell and Muller, which costs about 150 USD withan accuracy of 10–25 cm. In Table I, we listed the cost andaccuracy of different indoor tracking systems in comparisonwith our system. As can be seen in this table, the proposedsystem has the lowest tracking performance (on the order ofoutdoor GPS), but it is the cheapest one as well. As a result, oursystem is not suitable for applications that need highly accuratetracking, such as virtual reality applications, and because it is one of the cheapest methods for indoor tracking, it is a goodcandidate for applications such as navigation and guidance(which does not need highly accurate tracking).
In comparison with different technologies for indoor tracking, the proposed system is similar to IR tracking systems such as the method used in [14], which used an IR tracking systemin an AR application.

	Cost in USD	Accuracy	Technology
Intersense IS 900	Over15000	1mm	Ultrasound
Randell's system	150	10-25cm	Ultrasound
Ekahau	100-200	1 m	Wi-Fi
Proposed system	Less than 10	3-4 m	light

III. Hardware System Design

In this section, we will outline the hardware system used forconstructing novel and economical navigation and positioningsystems using fluorescent lamps. The whole system is dividedinto two parts: the transmitter and the receiver. The transmittersends out messages encoded by the fluorescent light whoseflicking is imperceptible to human vision, while the receiverdetects the light using a photo-detector.

In the transmitter section, information can be encoded intothe light through arc frequency variation [see Fig. 1(a)]. Here,we use a fluorescent lamp for our system since, first, it is highlyused in office buildings and, second, nowadays, it is triggeredby electronic ballast circuits, so there is no need to design acostly circuit for controlling the arc frequency of the lamp,and by simple modifications on the current widely cheap andavailable circuit, we can furnish our goal.We add a simple lowcostmicrocontroller chip to control the light frequency from 35 to 40 kHz.

The receiver circuit [Fig. 1(b)], with a photodetector detectingthe fluorescent light, processes the data that are eventuallyfed into the wearable computer. With the information received,the wearable computer can tell the user what the surroundingsituation is.

In the rest of this section, we detail our transmitter andreceiver circuits, and then,we explain the wearable computersystem in terms of how the receiver and other components areintegrated together.

A. Transmitter Circuit

The hardware for the developed transmitter is shown inFig.2, and the schematic circuit diagram is depicted in Fig.3.As shown in this figure, the electronic ballast circuit used for the transmission purpose consists of three parts: the ac–dc rectifier,the dc–ac converter (inverter), and the resonant filter circuit.

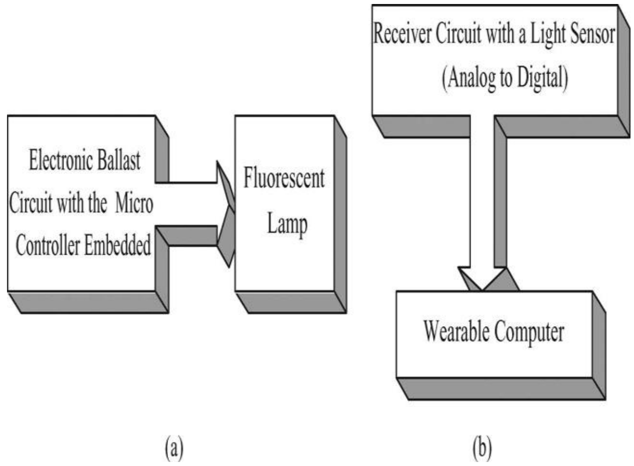

Fig: 1Simple schematic scheme of the system. (a) Transceiver. (b) Receiver.

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1. Transmitter section

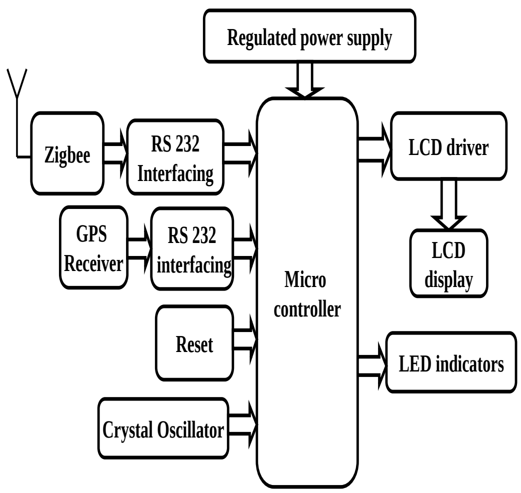

Fig 2: Block diagram of transmitter section

Fig 3: Transmitter hardware.

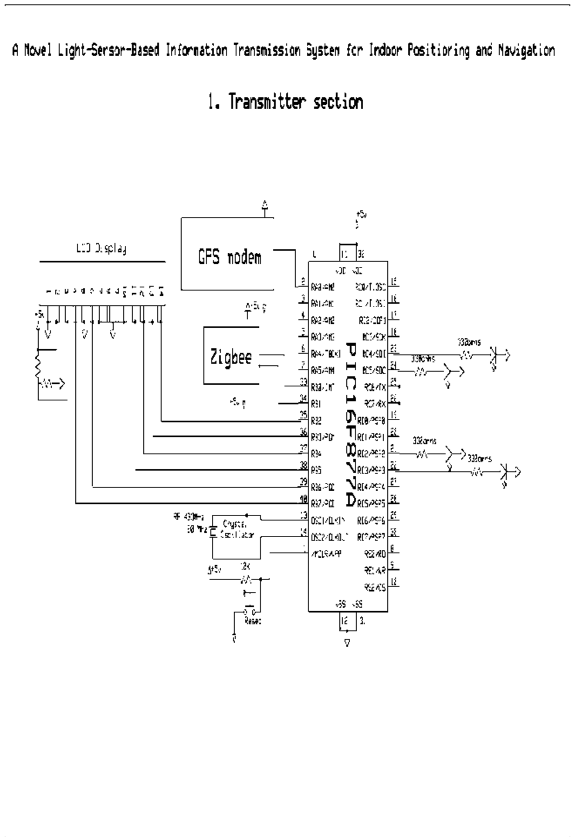

Fig 4: Schematic diagram of transmitter section

B. Receiver Circuit

The receiver detects the fluorescent light and transforms theanalog signals to the digital ones that can be sent to the user's mobile/wearable device. Fig. 5 shows the block diagrams of thereceiver part with a wearable computer. The core part of this receiver system is the receiver circuit, which is shown in Fig. 6. As can be seen in Fig. 5, the main parts of the receiver circuit are as follows:

a) Bandpassfilter:

The bandpass filter is designed to removenoise that is received together with the Manchester-codedinformation in the light.

b) Zero-crossing detector: This block converts the analoginput signal to digital signal. Note that only the frequency of the signal contains information and not itsamplitude.

c) Phase-locked loop (PLL):

This block converts the incoming digital signal to an analog voltage proportional to thefrequency of incoming signal.

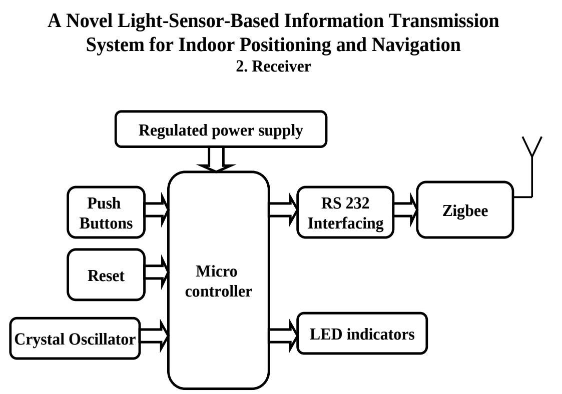

Fig 5: Block diagram of receiver section

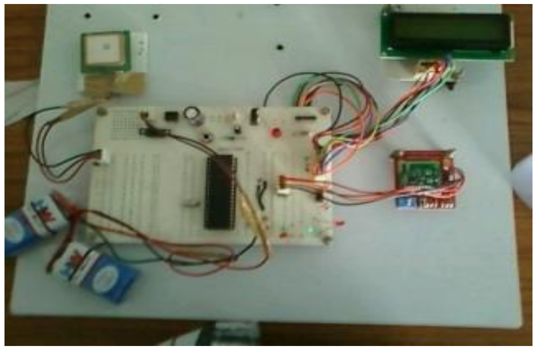

Fig 6: Receiver hardware.

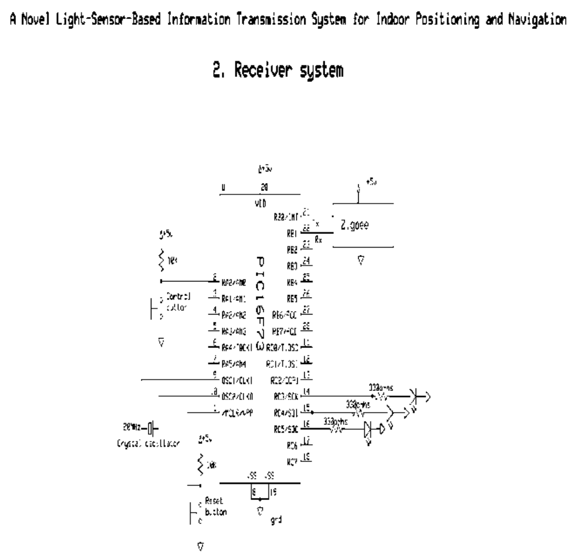

Fig 7: Schematic diagram of receiver section.

IV.EXPERIMENTS OFSYSTEMAPPLICATIONS AND RESULTS

In the previous sections, we discussed the hardware of the indoor navigation system in detail. The indoor system can seamlessly be activated by simply switching from the tra-ditional outdoor GPS system to this indoor system.a GPS signal is no longer received, a fluorescent lamp data code is sought after by the wearable computer. The data codes of the fluorescent lamp are directly tied to a GPS position relative to the outdoor GPS reading. Thus, the indoor fluorescent lamp position is direction correlated to an outdoor GPS position.

Fig. 9 shows the transition from the outdoor environment to the indoors and the screenshots on the HMD at the user's different positions (outdoor and indoors), and Fig. 9 shows the selected screenshots at outdoor and indoor locations. The messages and information appear on the left bottom corner of the HMD, which does not affect the user's eyesight range, providing the user with real-time environmental information. Fig. 10 presents the data flow of the proposed indoor tracking system.

What is more, in the large urban indoor environment, a 3-D digital map stored on the wearable computer can be developed to display on the HMD. The user exactly knowshis or her location by watching his or her place on the map,with the position recognized by the fluorescent light tracking system.

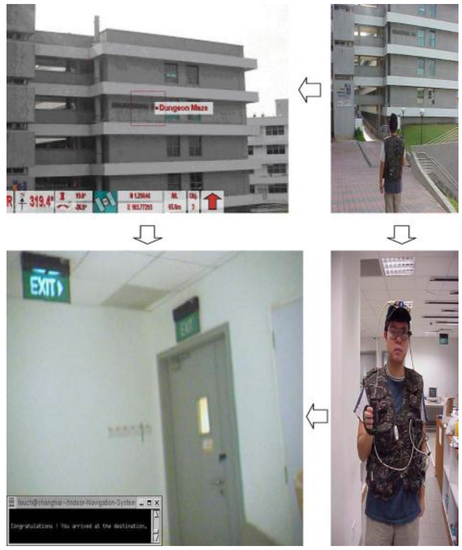

Fig 9: Selected screenshots from the HMD when a user is at outdoor and indoor locations

The project "**A Novel Light-Sensor-Based Information Transmission System for Indoor Positioning and Navigation**" was designed such that to identifying the different blocks in the organization by using the Zigbee and GPS modules.The locations are displayed on LCD when the person reaches those particular locations.Main Applications, This system can be used by blind people in order to know the present location.The system can also be used for tracking the locations

Fig 10(a): Indoor tracking display

Fig 10(b): Indoor tracking display

VI. Conclusion And Future Works

This paper has addressed the problem of enabling economical indoor tracking systems, which are similar to GPS, available with seamless transition function from outdoor GPS tracking environment to indoor. We have focused on the task of indoor navigation and positioning, where the particular aspect of the user's state that is of interest is the user's physical location. Byusing an economical light sensor to build this indoor tracking system, we have been able to infer the user's location in anindoor environment. For example, we can put the system on both sides of the doors of each room in a building; then, a user will receive the proper data by entering or leaving the room.

When data, which are encoded in the fluorescent light, is receivedby the receiver and analyzed by the wearable computer, it will provide location and navigation messages. Specifically, this light-sensor-based navigation and tracking system is robust and much cheaper than those using electromagnetic ultrasonic sensors. Furthermore, the receiver circuit is light and small, and it can be well suited to wearable computer applications. Aside from thetechnical achievements of our work to date, it is significantto point out that the application of this system provides an innovative and economical form of indoor positioning and navigation method. It must be noted though that the proposed system has limited bandwidth and is therefore more suitable for transmitting text messages to the user's wearable computer rather than images or graphics.

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

The project "A Novel Light-Sensor-Based Information Transmission System for Indoor Positioning and Navigation" is mainly intended to alert the person through location names displayed on LCD when he enters into a particular location by using GPS and Zigbee module. This system consists of a GPS receiver, Zigbee modules which are interfaced to the micro controller. The location names are displayed on LCD. The micro controller is programmed in such a way that depending on the satellite information of location the predefined location name will be announced and also displays on the LCD and also GPS receiver.

This project can be extended using high efficiency GPS receiver and a GSM module. The GSM module gives the intimation of the person with this system through SMS.

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