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Li-Fi based Smart Path System for Closed Space Region

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***Abstract*: In this paper presents an elegant way to navigate a people to enclosed environment region. There are many accurate Enclosed navigation systems are developed. Even though the previous system designed to visually impaired and blind community people but that designed system doesn't met it standards in well effective manner. Our system presents a novel based per programmed navigation system designed for smart phones. This provides smarter way to guide a path normal, also very effective for visually impaired and blind community peoples. LI-FI provides a great solution as it uses optical spectrum instead of radio spectrum. We use the LI-FI to navigating the path to the rooms/block. The app contains the mapping structures of enclosed regions path of the blocks/rooms. Each of the rooms/blocks have LDR and LED. It is placed some interval of distance and it depends on the LIGHT is mounted on the ceiling roof. The Apps passes signal through light source then it will be received by LDR detector, each LED has its own id. Then according to the matching of data send by the LED. It guides us to the designation path. Our system is alternatively to GPS, RFID, Bluetooth equipments and many also it doesn't need of any web applications and internet usage.**

***Keywords*: Li-Fi, Smart Path System, Closed Space Region**

1. Introduction

Navigation is an act or process that determines the current position and from it, the planning or directing of the point along a path to a final destination. In conventional GPS (Global Positioning System) or Cellular based localization, Mobile Network Location and Bluetooth are used for directing the path at outdoor environment. The wide availability of mobile devices with multiple communication protocol support such as WI-FI, Bluetooth, ZigBee, NFC etc. has given way to novel Enclosed navigation techniques. The challenge is that a common positioning /localization system fails in enclosed environment or in scenes with a limited sky view. There is a need for new localization and path guidance system for covered environment technologies that are not using GPS, Bluetooth. LI-FI is used for new localization and path direction for covered environment. The aim of this paper is to introduce existing many technologies and possible security threats in enclosed environments and solutions. We introduce current Enclosed Positioning System techniques like using LI-FI.

LI-FI stands for "Light Fidelity". The technology uses an LED light bulb that varies in intensity faster than the human eye can follow to send data through illumination [1]. Since LI-FI uses visible light instead of radio waves as the medium of communication, LI-FI is considered as the optical version of WI-FI. In recent years, we are witnessing a steady growth of mobile terminals and Internet of Things (IOT) systems. Without accessing an internet no such activities in any mobile application. We give a solution for replacing many of the methods and technologies. Without using internet and Radio Frequency devices we developed a system to provide a navigating for normal and also for blind people. We introducing state-of-the-art LI-FI based enclosed environment navigation system.

2. Related works

Most approaches establish on literature and commercial systems use information obtained from sensors (magnetometer, accelerometer, etc.) and Radio Frequency signals (GPS, Bluetooth, WI-FI). Here we present the most salient examples found on the literature. There are several approaches which employ WI-FI, Bluetooth signals for localization.

The implementation of the Enclosed navigation system in [2] the design of a Smartphone. The method they use on-device sensors for Dead-reckoning and is supported by a web based architecture, for easily creating Enclosed region maps and providing an Enclosed location's information for navigation and localization.

In this paper Y. Endo [3] developed a navigation system for visually impaired people. In order to adapt to dynamic or transient environmental changes, such as temporary obstacles, the system makes use of a small wearable camera to estimate the user's position and construct a 3D environmental map. The Y. Endo applied large-scale direct monocular simultaneous localization and mapping (LSD-SLAM) to develop the system, one of the Visual SLAM techniques, to the system.

In this paper Sawsan Alshatnawi [4] presents an innovative approach to the precise Enclosed navigation challenge for the blind individuals using a multi-tier solution with the help of a smartphone interface. The utilize a set of different communication technologies to help users reach an object with high accuracy. As a proof of concept, they deploy a fully functional testbed and evaluated entire solution inside library by helping blind users find a specific book. The smartphone interface provides step-by-step navigation. In addition, they show that iterative improvements on smartphone's interface has improved the system's efficiency and its accuracy in reaching specific objects.

In this paper context of fingerprinting (FP) applications, the Mizmizi. M investigates the reduction of quantization levels in the Received Signal Strength Indicator (RSSI) till to its binary representation [5]. One of the common drawbacks of FP is the large data size and consequently the large search space and computational load as a result of either vastness of the positioning area or the finer resolution in the FP grid map. This complexity can be limited reducing the RSSI quantization till to a simple binary indicator at the expense of an increased number of reference points or beacons. This approach turns out to be advantageous for the deployment of FP systems based on diffused beacons equipped with inexpensive technologies, such as Bluetooth Low Energy (BLE) or other technologies for the Internet of Things (IoT). An appropriate quantization and design of RSSI signatures will make possible the deployment of FP in larger areas maintaining the same computational load and/or the desired localization performance. The experimental results confirm promising computational savings without a relevant impact on the localization performance.

In this paper [6] an Enclosed navigation system based on Bluetooth Low Energy (BLE) Beacons fingerprinting and created a testbed deployment of 30 beacons in the Center for Information Technologies of ESPOL University. A comparison study of three machine learning techniques used to improve BLE fingerprinting accuracy within testbed. Preliminary results show that Random Forest, 30% more accurate than Naive Bayes, is able to correctly estimate the location of multiple users with room-level accuracy 91% of the time.

In the work presented in [7], the A. Petcovici developed an Enclosed localization system based on Low Frequency (LF) Radio-Frequency Identification (RFID) as a reliable and low-cost solution, which is less affected by challenging indoor conditions. The presented system makes use of LF (125 kHz) magnetic fields for reliable localization in multipath and Non-Line-of-Sight (NLOS) environments. In this paper is to analyze two-dimensional (2D) positioning estimation performance of LF-RFID based localization system in comparison with the localization systems based on Ultra-High-Frequency (UHF) and Ultra-Wideband (UWB) technologies. In present results for 2D localization tests for these three systems in a challenging indoor environment of areas.

Background localization is generally provided by WI-FI fingerprinting, since GPS does not provide service in indoor environments by the R. Faragher [8]. However, the power consumption of a WI-FI scan is proportional to the number of channels scanned, and so naive full-channel scans are inefficient. Here they describe and validate SwiftScan, an intelligent, self-training WI-FI fingerprinting scheme that reduces the energy consumption of periodic background WI-FI scanning for localization. SwiftScan is tested with data from more than a thousand Android users over a six-month time period and it show that energy savings of over 90% are possible, and that the majority of users benefit from more than a 70% reduction in the energy consumption associated with a WI-FI scan for localization purposes.

This project [9] is committed towards the designing and developing of an indoor positioning tracking application system with the most optimum characteristics. This is because the Global Positioning system (GPS) is not suitable to be used Enclosed region due to signal lost within contact of building walls. The indoor positioning system is based on the application of WI-FI access points found abundantly in smart phones and buildings. The W. Joanne is maintaining both the budget and power consumption the lowest value possible while completing the project within a stipulated time. The system has two main functions which are to provide localization and navigation services.

This paper the Y. Zhuang [10] suggested an indoor navigation algorithm that uses multiple kinds of sensors and technologies, such as MEMS sensors (i.e., gyros, accelerometers, magnetometers, and a barometer), WI-FI, and magnetic matching. The corresponding real-time software on smart phones includes modules such dead-reckoning, WI-FI positioning, and magnetic matching. DR is used for providing continuous position solutions and for the blunder detection of both WI-FI fingerprinting and magnetic matching. WI-FI and magnetic matching results are passed into the position-tracking module as updates. Meanwhile, a barometer is used to detect floor changes, so as to switch floors and the WI-FI and magnetic databases.

The H. Malla [11] developed a solution should have minimal infrastructure dependence, so that it can be used in situations like disaster and rapid response scenarios, where the available infrastructure is minimal and time is of essence. The propose of Radio Frequency Identification(RFID) based approach which performs an object level mapping of the indoor environment using a portable RFID reader, RFID Ultra High Frequency (UHF) passive tags and inertial navigation sensors(INS). This method identifies each object in the indoor environment using one or more passive tags. A novel algorithm has been developed which accurately maps the objects present in the indoor space. It is easily scalable to map huge indoor environments and can be applied without any intensive manual labor or expensive equipments. Our experiments show that this approach generates object level indoor maps with high accuracy

Zigbee-based localization technique is relatively low cost and suitable for applications that require low power consumption. The J. Larranaga [12] developed a Zigbee-based indoor navigation system for the visually impaired individuals. They installed Zigbee nodes as a mesh network inside a building as Reference Nodes, and installed a similar Zigbee node on their developed handheld navigation device. The system uses Dijkstra's algorithm to find the best possible path from the users current location to the destination location. The

Table 1
Enclose positioning system

	LED	GPS	BLUETOOTH	RFID	Wireless
Position accuracy	Several meters	Several meters to several hundred meters	Very few meters	Several meters	Several meters to several hundred meters
Quality	Stable	Interference	Unstable	Dependence of noise, interference	Dependence of noise, interference
Coverage Range	Area of Light Emits	Unlimited	Greater than 10 meter	Lesser than 1 meter	Greater than 150 meter
Measurement time	Less than a second	Several seconds	Several seconds	Less than a second	Several seconds
Recognition of building floors	Possible	Difficult	Difficult	Possible	Difficult
Measurement Device	Visible light receiver	Satellite	BLUETOOTH device	RFID reader	WI-FI transceiver
Cost Management	Lesser : Existing Light are used	High	Need more number of Bluetooth device	Need more number of Cards to be placed	High
Speed	>1Gbps	Not applicable for indoor	3Mbps	Depends upon frequency	150Mbps

map file for each building is installed once the user's handheld device enters a new building. As mentioned in this paper, the system is in its design stage, the system prototype is tested and leads to encouraging results.

3. Methodology

We propose a solution composed by a LI-FI, a LDR, PIC-Microcontroller and an Android App infrastructure. With the ever-increasing utilize of WI-FI, the existing radio frequency is getting blocked slowly and simultaneously, there are increasing in number of usage of peoples who want to connect to the internet. LI-FI uses the Visible Light Communication (VLC). VLC is a data communications medium which uses visible light and also which will assist the visually impaired people for the navigation and helps them to travel independently at enclosed environment.

A. *Mounting for Visible Light Communication*

Mounting a LED is estimates from the position or, IR, Radio-frequency identification (RFID), Wireless network, Bluetooth, GPS of the access points. However, all these sensors have issues with fluctuating positional due to environmental factors such as obstacles and it is maintained and monitored by a computer server. This makes them difficult to use as a support for visually impaired people. Therefore, we have focused on LI-FI technology using LED lights. When using LI-FI, it becomes possible to identify the user's position within a range of 1–2m. This system enables guide the users with the floor wise. The enclosed region positioning system by LI-FI, IR, Radio-frequency identification (RFID), Wireless network, Bluetooth, GPS which use is being investigated, are shown in Table 1. Further, this is shown concretely in Figure 1.

B. *Creation of Enclosed map data*

Enclosed region map data represented in a local storage SQLite that does not use geographic references. However, Enclosed region map data, beginning with map portal sites, are often expressed using a geographic coordinate system. For that reason, we decided not to use geographic coordinate system instead of that unique id is passed for the enclosed region map. Enclosed region map data are built with the method for mapping each floor plan data are stored in reference with LED unique ID for mapping. The LED lights from nodes and network data linking the LED paths are created on the basis of the voice guidance's need to retrieve the route to the destination. The small round points in Figure 2 right are LED lights.

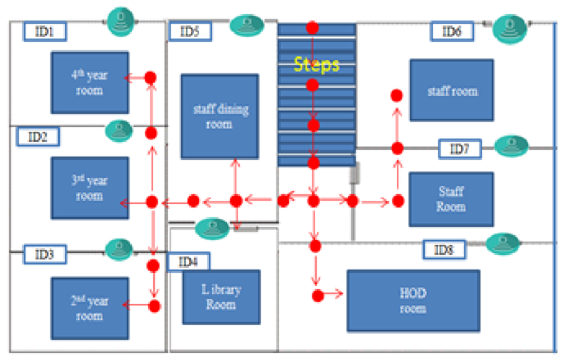

Fig. 1. Transmitting data through light source

C. *UI Application*

The application that we going to develop using android studio for the user interface design xml code we generated. The application allows the user to give input through both text and voice format. The voice command uses is Google voice recognition. Voice search is a function that allows you to use Google Search by speaking into your mobile device. calling friends, they can initiate this process pressing volume button twice, store more than two self-knowledge voice based questions to verify the genuinety of that person. Then send/receive calls, mail and text messages to the particular person. However, more functions can be done other than voice searching like getting directions, setting reminders, calendar dates, calling friends, accessing other apps, and changing the device's settings. Queries through mobile app on Android devices are now through voice search. As this search method grows in popularity, it's becoming a far more critical piece of the mobile optimization puzzle. The voice input function is categorized into source and destination for the location. The voice input function for source location uses the speech command "source" keyword followed by the input, similarly for the destination location "destination" keyword followed by the input.

4. Development of enclosed direction finding system

In this section, we present the design and implementation method for the enclosed navigation system.

A. SMART Phone App Creation

The application of mobile technology becomes more and more important in our life. To navigate the path for enclosed environment using mobile application. This application is used to access the user current location. When using the navigation application, the user can choose to view the complete enclosed region map of the area or select a destination location. It required the user source location and destination location to reach details for finding the path way. The user provides source and destination values through voice command/text message. The path tracking for enclosed environment using LI-FI technology.

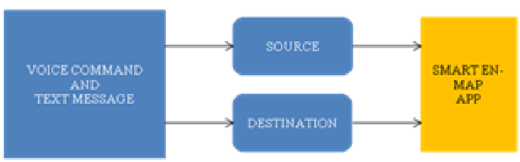

Fig. 2. Process for giving input to the Mobile application

B. LI-FI Construction

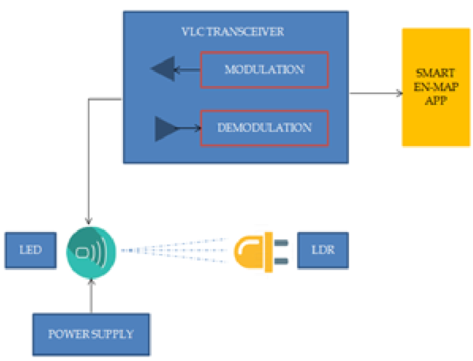

Fig. 3. Transmitting data through light source

In this module the user uses the device that contains LI-FI and Ultrasonic sensor. The server contains the detail about that building for the direction finding. If user search for the room/block then it will compare both received data and data from the server and then result is displayed in toast message and also in voice message. That communication and comparison processed through user transceiver device and room/block transceiver device. The LED is attached with ceiling that creates the own 'constellation' of navigation beacons. The device searches the path using LI-FI technology and sends details to the user application. The user LI-FI act as a receiver it will search for the nearest LI-FI transmitter. Once the data is received by the user and it will check for the destination location or the path way of the current location through the LI-FI transmitted ID passed to the Server. Ultrasonic sensor is used to sense the obstacles for the blind peoples.

C. Internal Path Assistance

The internal path assistance module is used to guide the path to the user. The user search path way for the enclosed environment using smart phone applications and LI-FI technology. The application needs source and destination details for finding the path way. Each and every blocks/rooms have unique ID. The LED sends the unique id to the LDR and that LDR detect the ID and send it back to the application. The received id Search the information from the SQLite Database. The database contains rooms/blocks name, floors, LED ID for respective rooms/blocks details and more about that structure of enclosed region. Voice commands and text messages are used to guide the path to the user. If the user took wrong direction, then it will guide to take right path through voice commands/displaying direction graphics images. Ultrasonic sensor used to detect the obstacle for the visually impaired and blind community peoples. The user wants send call/mail/text messages to the particular person they press volume button twice to initiate that process.

5. Implementation of the enclosed direction finding system

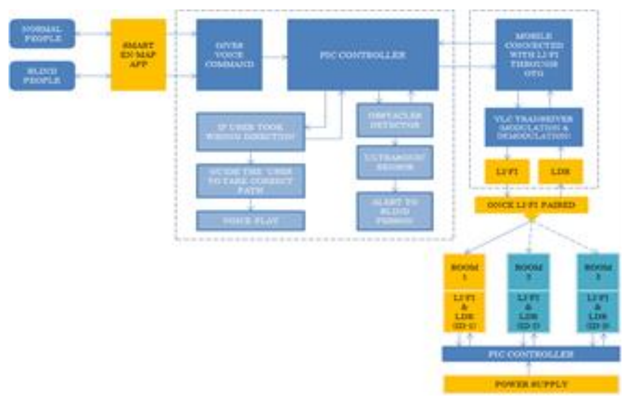

Fig. 4. Process for giving input to the Mobile application

The proposed methodology of our application was implemented and tested in our college campus premises. We designed an application using Android Studio 2 as a highly compatible integrated development environment as it needs to run on the Android OS, as shown in Table 4, and we developed the application using the Android Development Tool and JDK 8.1. In the verification test, we used a Samsung Galaxy Smartphone. A LED light id data frame as a transmitter and LDR as a receiver according to this study's specifications and transceiver using LI-FI.

Table 2
System development environment

Personal computer	Intel i3 processor (2.8GHz)
OS	Microsoft Windows 8.1
Software	Android Studio 2, Android Development Tools, JDK 8.1
Smartphone	Samsung Galaxy Core Prime
OS	Android Kitkat

6. Conclusion and future work

This project presents that navigation through LI-FI technology using smart phone through light particularly enclosed environment. If this technology is put into practical use then every bulb can be used to transmit data and it will proceed through greener, and safer future. In this work, we presented an analysis of the energy consumed by Android's localization methods and proposed a modification to the Android operating system to consider enclosed/outdoor context and make smarter decisions on which localization method to use on behalf of the user or application developer. In particular, modify the Fused Location Provider. The results have shown that an enclosed environmental localization method will drain less energy than the GPS and can also be more accurate in enclosed environments.

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