i2cat

THE INTERNET
RESEARCH CENTER

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INNOVATION

LEDGO

3D Indoor Positioning System with single code LED transmission

LedGO can be used to provide high precision localization in indoor environments based on Visible Light Communications (VLC). It is based on Optical Camera Communication (OCC) to make use of LED landmarks and a CMOS camera (e.g. a common smartphone camera) and operates well even when the receiver is not directly under light sources. Besides, it does not require additional hardware and provides orientation in yaw, roll and pitch. This technology has a wide range of applications in retail, industry and entertainment domains.

Technical info

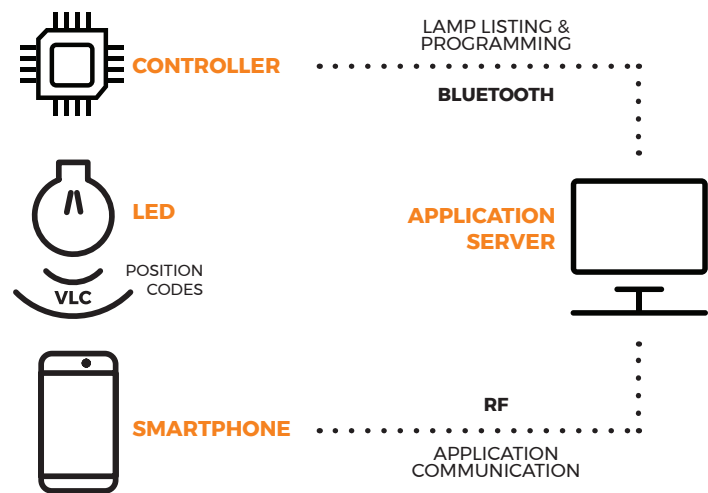Only 4 lights are required to triangulate a 3D position and 2 lights for a 2D position

Real time positioning depending on smartphone camera shutter speed (e.g., a shutter speed of 30fps can obtain a position every 33.33ms)

High positioning precision of 5cm in 3D mode and 3cm in 2D mode

Working temperature range between -20ºC and 85ºC

LedGo SW toolkit supports Iphone and Android (API level 21+)

Required distance between transmitter and receiver depends on the LED type, distance between LEDs and the camera lens aperture to be able to detect 4 (3D) or 2 lights (2D) simultaneously

CONTROLLER

LAMP LISTING & PROGRAMMING

BLUETOOTH

LED

POSITION CODES

VLC

APPLICATION SERVER

SMARTPHONE

RF

APPLICATION COMMUNICATION

System description

The system is composed by the following elements:

- **LED:** Light source used to transmit positioning codes using VLC

- **Controller:** Component that switches the LED ON and OFF according to the set codes1. It also includes a Bluetooth Low Energy (BLE) module that allows remote configuration of the driver.

- **Smartphone with CMOS camera sensor** to capture the codes transmitted.

- **Smartphone SW:** SDK and application that uses an online algorithm to calculate the position based on the codes received.

- **Server SW:** Application that allows the configuration of actions associated to the obtained position.

Main features

- **3D positioning:** Unlike other indoor positioning methods such as RF based ones, LedGO provides the position in the X, Y and Z coordinates. This enables using this technology in height sensitive use cases.

- **Orientation:** Using VLC to localize the device allows to obtain information of the receiver orientation. Not only can you know where the user is located, but also where its device is pointing to.

- **Update rate:** Our positioning algorithm requires a single image in order to locate the device's position. This means that it can run as fast as the shutter speed of the smartphone camera. This is crucial for applying this technology to virtual reality.

- **Scalability:** Unlike Bluetooth, WiFi or RFID, LedGO requires only unidirectional communication from the LED to the receiver, allowing unlimited number of devices to receive the required positioning codes simultaneously.

Key Benefits

Wide adoption: LED lighting is gaining popularity and will become industry standard everywhere, due to its efficiency and reliability, opening the door to almost any application field.

Reduced costs: The cost reduction of LED lights over the past years and the inexpensive drivers used by LedGO make it an affordable solution to enable VLC in any indoor environment.

Easy configuration: LedGO drivers support Bluetooth for easy remote configuration and management of each of the lights independently, which are seen as Bluetooth beacons.

Smartphone ready: Cameras present in regular smartphones can be used to decode moderate data rates, sufficient to deliver context and position information.

LEDGO coding system for 3D positioning has been patented under the PCT Ref. PCT/EP2017/069232

OCC is being standardized as the 802.15.7r1 specification, currently under development

About i2CAT

i2CAT is a non-profit research and technology center that promotes R&D activities in Internet and advanced digital technologies. The center has pioneered a new model of innovation based on collaboration between companies, public administrations, the academic environment and users.
The activities and initiatives developed by i2CAT are focused on three objectives:

- **Research:** playing a key role in EU Framework Programme for Research and Innovation, participating in 23 H2020 projects.

- **Strategic projects:** leading local initiatives and projects to deploy digital strategies and policies of the public administrations.

- **Technology Transfer:** Fostering R&D collaboration with companies to develop innovative market-oriented solutions.

Applications & uses cases

Retail: Using accurate user location information can be extremely useful for retailers, that can create movement heatmaps to extrapolate users' behaviour and optimize product offerings and target advertising.

Industry: Autonomous guided vehicles are increasingly being used in industrial warehouses. LedGO can help to create accurate and configurable paths thanks to the knowledge of real-time location, which can also be used to perform dynamic route corrections if needed.

Entertainment: Location-based enhanced information can help indoor entertainment services (e.g., museums, VR gaming) to provide a better immersive experience, giving the user a higher degree of interaction with the consumed service.