



# Lightweight Single LED 3D Indoor Localization System

**IP Status:** Pending US Patent; **Application #:** 16/179,649

## Handles Environmental Noise, Light Source Intensity, Receiver Orientation

SmartLight is a 3D digital indoor localization system that uses light emitting diode (LED) lighting infrastructures for localization. The technology places the design complexity in the light source while simplifying the receiver, an approach that eases system deployment and calibration. In one configuration the light source includes a convex lens and an array of LEDs configured as a single LED lamp. The localization system exploits the light splitting properties of the convex lens to create a one-to-one mapping between a location and the set of orthogonal digital light signals received from particular LEDs of the LED lamp. The LED lamp illuminates receivers placed throughout a room such that a user can use the output from each receiver to locate the respective receiver within the room as a function of the LEDs that illuminated the receiver.

Benefits include:

- **Digital localization.** SmartLight is robust against environmental noise, fluctuating light source intensity, receiver orientation and disturbance along light propagation paths.
- **Concurrent localization.** A single sender localizes multiple receivers simultaneously with a single round of digital light generation.
- **Low-cost localization.** The SmartLight system uses commercial projectors to localize objects equipped with light sensors, keeping receiver complexity to a minimum and requiring only a single lighting device to cover an area.

## Technology ID

20180115

## Category

Engineering & Physical  
Sciences/Design Specifications  
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## Single LED Source Minimizes Receiver Complexity

While many existing indoor localization systems perform well, due to comprehensive modeling of their envisioned working scenario or significant complexity in the receiver, their real-life deployment is often prohibited by high deployment overhead and performance degradation in dynamic environments. SmartLight shifts the complexity of the system to a single LED source with minimal complexity in the receiver (the device to be localized). The light splitting properties

of a convex lens create a one-to-one mapping between a location and set of orthogonal digital light signals at that location (LED array with LEDs that blink at a unique frequency), and the receiver requires only binary detection of the signal.

**BENEFITS AND FEATURES:**

- 3D digital indoor localization system
- Uses light emitting diode (LED) lighting infrastructures for localization
- Places design complexity in the light source while simplifying the receiver
- Eases system deployment and calibration
- Exploits light splitting properties of a convex lens to create a one-to-one mapping between a location and the set of orthogonal digital light signals
- Digital approach increases robustness against environmental noise (light), receiver orientation, and fluctuations in light source intensity
- System can localize multiple receivers simultaneously with a single source
- Low cost (system uses a COTS projector (i.e., light source) with an inexpensive light sensor (e.g., photo-diode))

**APPLICATIONS:**

- Indoor localization
- Robot/human 3D posture recognition
- Object tracking
- UAV indoor navigation
- Embedded and cyber physical systems

**Phase of Development** - Concept

**Researchers**

Tian He, PhD  
*Professor, Computer Science and Engineering*  
[External Link](http://www.cts.umn.edu) ([www.cts.umn.edu](http://www.cts.umn.edu))

**Publications**

[SmartLight: Light-weight 3D Indoor Localization Using a Single LED Lamp](#)  
*SenSys '17 Proceedings of the 15th ACM Conference on Embedded Network Sensor Systems*,  
Article No. 11

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