Indoor Navigation System

For robots and humans

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Idea

- Indoor navigation system for autonomous robots and systems (“indoor GPS”)
- Indoor localization of objects and humans equipped with beacons

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Problem

- **GPS does not work indoor** – (1) no direct view to satellites; (2) location precision is measured in meters rather than in cm
- Other indoor navigation systems - Bluetooth beacons, odometry, magnitometers, WiFi RSSI, UWB, etc. - have their **own serious limitations** – usually, either precision, or price, or size

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Solution

- A system of stationary **ultrasonic beacons** united by radio interface in ISM band
- Location of a mobile beacon installed on a robot (copter, human) is calculated based on the propagation delay of ultrasonic signal to a set of stationary ultrasonic beacons using **trilateration**

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Indoor Navigation System ("GPS") ±2cm

For robots and humans

Beacon 1

Beacons:
- Mounted on walls or ceilings
- Measure distance to other beacons and "hedgehog" using ultrasonic pulses
- Communicate with router wirelessly in ISM band
- Powered by LiPol battery or USB

Mobile beacon ("hedgehog"):
- Installed on robot and connected to it via UART or SPI or I2C or USB
- Calculates coordinates (±2cm) received from router and updated 8 times per second
- Powered by LiPol battery or USB or from robot-host

Indoor Navigation System consists of:
- 4 or more stationary beacons
- 1 central router
- 1 or more mobile beacons on robot(s)
- Windows PC or Raspberry Pi with Dashboard SW. PC/Pi is needed for setting up the system and monitoring. But when the system is up and running, it is not needed.

Beacon N

Distance between beacons-neighbors is up to **50 meters**. Clusters of beacons automatically assemble in a single map of beacons to cover large offices, malls, factory floors.

Beacon 2

Beacon 3

Router:
- Central controller of the system
- Calculates position of mobile beacon ("hedgehog") 8 times per second based on data from beacons
- Communicates via USB with Dashboard – telemetry SW running on Windows PC or Raspberry Pi
- Communicates with beacons wirelessly in ISM band (433.4MHz & 10mW - **up to 100m** in office environment)

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Capabilities

- Absolute location precision – 1-3% of the distance to the beacons (several cm). Differential precision – **1-2 cm**
- Coverage radius of a beacon - up to **50 meters**
- Beacons form the system **automatically** – no manual coordinates measurements or entering

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Requirement

- **Unobstructed sight** by a mobile beacon of 3 or more beacons simultaneously
- Unobstructed sight between 3 or more stationary beacons simultaneously during the process of forming the navigation system. After forming the system no unobstructed sight between stationary beacons is required

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Use cases - advertising

- Autonomous mobile advertising robots to attract customers in shows, shopping malls, museums
- Attaching a **high-tech charm** to an advertised brand

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Use case – gaming and hobby

- **Autonomous** mobile indoor robots
- Autonomous indoor copters – removing location drift
- High-tech indoor paintball with automatically moving targets-robots

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Use case – automatic delivery

- **Automatic** delivery of small packages inside large buildings: airports, warehouses, hospitals, assembly plants

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Use case – dangerous places

- **Automatic** mobile monitoring of atmosphere (gas, radiation, biohazards, etc.) in dangerous places – factories, waste houses – when deployment of a stationary monitoring system is not feasible

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Use case – security system

- Security systems with **automatic** mobile patrol capability

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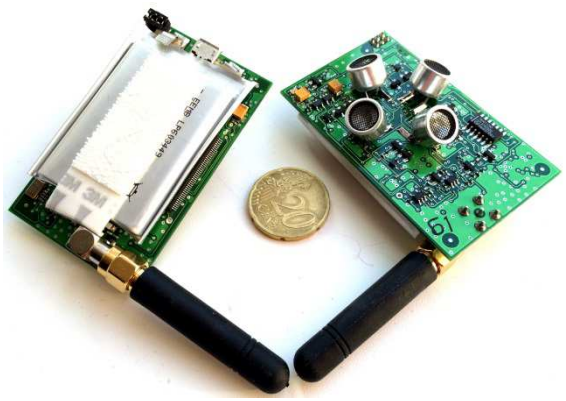
Proposition



- Starter configuration:
  - 1 mobile beacon
  - 4 stationary beacons
  - 1 router
- Beacon: 99 USD (regular price)
- Central router: 69 USD (regular price)
- Dashboard SW on laptop: free (current offer)

Complete system for 499 USD only – special offer

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