Indoor Navigation System

For autonomous vehicles and robots

(±2cm precision)

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Idea

- High-precision indoor navigation system for autonomous robots and systems (“indoor GPS”)
- Indoor tracking and positioning 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 centimeters (required indoor)
- Other indoor navigation systems - Bluetooth beacons, odometry, magnitometers, WiFi RSSI, UWB, etc. - have their **own serious limitations** – usually, either precision, or price, or size
- Without precise and timely knowledge of location autonomous delivery impossible

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Solution

- **Off-the-shelf indoor navigation system** based on stationary **ultrasonic beacons** united by radio interface in license-free band
- Location of a mobile beacon installed on a robot (cart, 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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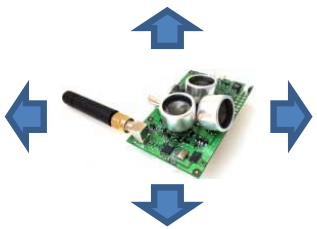
Indoor Navigation System (“GPS”) ±2cm

For robots and humans

Beacon 1

Stationary beacons:
- Mounted on walls or ceilings
- Measure distance to other beacons (stationary and mobile) using ultrasonic pulses
- Communicate with router wirelessly in ISM band
- Powered by LiPol battery or USB or ext. power supply
- Up to 24h in active mode when power from battery. Months in standby mode

Beacon 2



Mobile beacon:
- 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
- Up to 24h in active mode when power from battery. Months in standby mode

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 3

Router:
- Central controller of the system
- Calculates position of mobile beacon up to **16 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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Proposition

- Starter configuration*:
  - 1 mobile beacon – 49 USD
  - 4 stationary beacons – 4x49 USD
  - 1 router – 49 USD

Ready to use system for 299 USD

* Protecting case and the board itself will be produced based on your spec, if needed

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Capabilities

- Absolute location precision – 1-3% of the distance to the beacons. Differential precision – **1-2 cm**
- Distance between beacons - up to **50 meters**
- Coverage area of starter configuration set - up to **1000** m^2
- Coverage of larger territories done similar to cellular networks
- Beacons form the navigation system **automatically** – no manual coordinates measurements or entering required

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Requirement

- **Unobstructed sight** by a mobile beacon of 3 or more beacons simultaneously (like in GPS)
- Unobstructed sight between 3 or more stationary beacons simultaneously during the process of forming the navigation system. After forming the system unobstructed sight between stationary beacons is not required

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Use cases

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Use case – automatic delivery

- **Automatic** delivery of small packages inside large buildings: airports, warehouses, hospitals, assembly plants, factories, hotels, zoo, small parks
  - There are many very different types of autonomous vehicles, but our solution suits most of them

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Use case – autonomous vehicles

- Assisting **parking for autonomous vehicles** in complex environment – existing systems are simply not precise enough to operate in complex and dense environment
  - A few centimeters precision required, which is not economically achievable with other solutions

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Use cases - advertising

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

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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 – sport, gaming and hobby

- **Autonomous** mobile indoor robots - hobby
- Upgrading high-end RC toys to autonomous/robotics mode – gaming/hobby
- Autonomous indoor copters: removing location drift; automatic landing/taking off - professional
- High-tech indoor paintball with automatically moving targets-robots; carting tracing and similar - sport

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Use case – security system

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

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Thank you!

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