Indoor Navigation System

For autonomous vehicles and robots

(±2cm precision)

Marvelmind robotics

Idea

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

Marvelmind robotics

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

Marvelmind robotics

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**

Marvelmind robotics

Indoor Navigation System (“GPS”) ±2cm

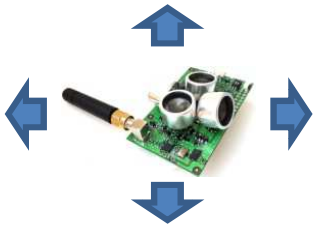
For autonomous vehicles and robots (±2cm precision)

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)

Marvelmind robotics

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

Marvelmind robotics

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

Marvelmind robotics

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

Marvelmind robotics

Use cases

Marvelmind robotics

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

Marvelmind robotics

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

Marvelmind robotics

Use cases - advertising

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

Marvelmind robotics

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

Marvelmind robotics

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

Marvelmind robotics

Use case – security system

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

Marvelmind robotics

Thank you!

Marvelmind robotics

www.marvelmind.com

info@marvelmind.com

+1 650 843 9243

Marvelmind robotics