Indoor “GPS”

For autonomous vehicles, robots, copters and VR

(±2cm precision)

Sk Resident

Marvelmind robotics

Idea

- High-precision (±2cm) indoor navigation system for autonomous robots, vehicles, copters and virtual reality
- Indoor tracking and positioning of objects and humans equipped with mobile beacons

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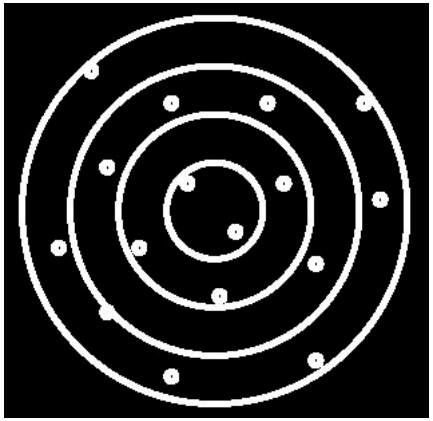
Problem to solve



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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 - UWB, Bluetooth beacons, odometry, magnitometers, WiFi RSSI, laser triangulation, optical, etc. - have their **own serious limitations** – usually, either precision, or price, or size
- Without precise and timely knowledge of location, autonomous navigation is 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 (vehicle, 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 “GPS” (±2cm)

- Starter Set configuration:
  - 1 mobile beacon – 69 USD
  - 4 stationary beacons – 4x69 USD
  - 1 router – 69 USD
  - All required SW included

Ready to use 3D (x, y, z) system for 399 USD

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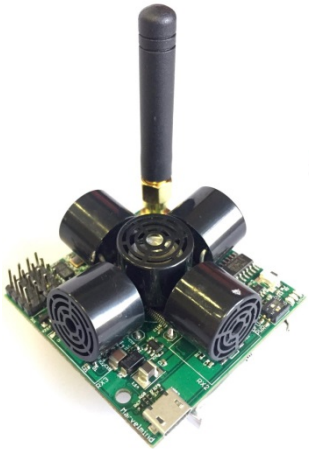
Indoor “GPS” – close up view



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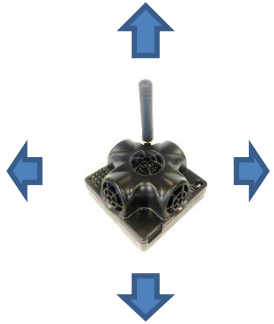
Indoor “GPS” (±2cm) – architecture

Beacon 1

Stationary beacons:
- Mounted on walls or ceilings
- Measure distance to other beacons using ultrasonic pulses (time-of-flight)
- Communicate with router wirelessly in ISM band

Beacon 2

Key requirement for the system to work well: **unobstructed sight** by a mobile beacon of 2 or more stationary beacons simultaneously (like in GPS)



Mobile beacon:
- Installed on robot and interacts with it via UART or SPI or I2C or USB
- Receives location update from router up to 45 times per second
- May contain IMU (accelerometer + gyroscope + compass module)

Submaps:
- Advanced feature that allows building independent maps/clusters of beacons in separate rooms and thus covering large buildings (with area of thousands of m2) similar to cellular network coverage

Indoor Navigation System consists of:
- 2 or more stationary beacons
- 1 or more mobile beacons
- 1 central router

Beacon N

Distance between beacons-neighbors is up to **50 meters**.

Beacon 3

Router/modem:
- Central controller of the system
- Calculates position of mobile beacon up to **45 Hz**
- Communicates via USB/virtual UART with Dashboard or robot

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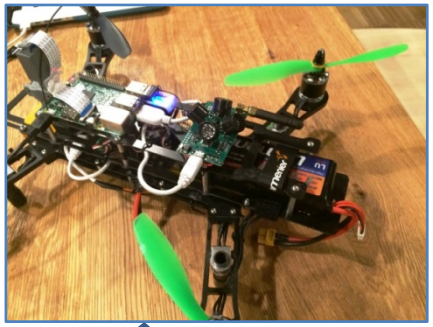
Selected customers

Customers in 40 countries

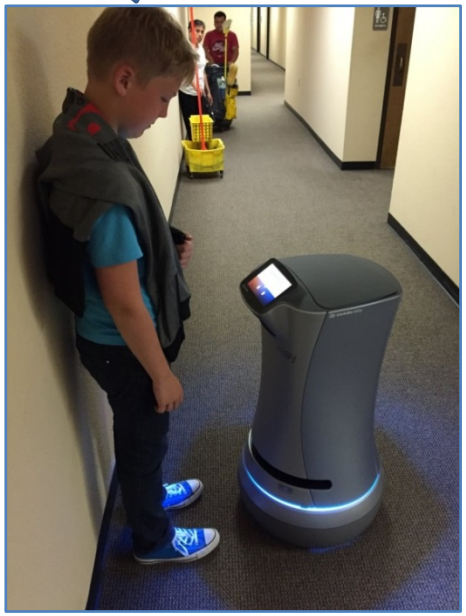
Use cases

Virtual reality



Autonomous drones indoor

Automatic delivery inside large buildings



Tracing people – safety + productivity

Advertising **robots** with high-tech charm - shows, shopping malls

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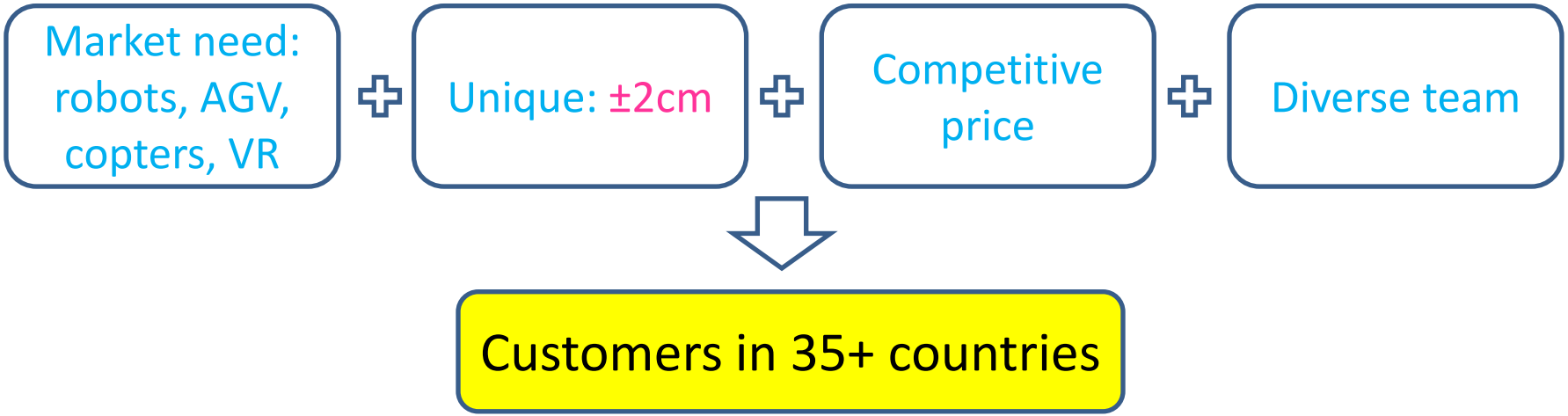
Summary



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http://www.marvelmind.com/#video – selected video demos

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Thank you!

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