Nextome srl

Technical Data Sheet

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SUMMARY

Introduction

Nextome patented software technology (Patent n° WO2015049660A1) is used to deliver accurate indoor positioning and navigation applications and solutions. Our system leverages commercially available technologies such as Apple compatible iBeacons or Google Eddystone beacons (small battery powered sensor with battery lasting up to five year) signal infrastructure and user device off-the-shelf smartphones such as iPhone or Android. Nextome accuracy in indoor positioning is in the range from 0.8 meter to 3 meters depending on number of beacons deployed and the environment. In average, our accuracy is about 1-1.5 meters.

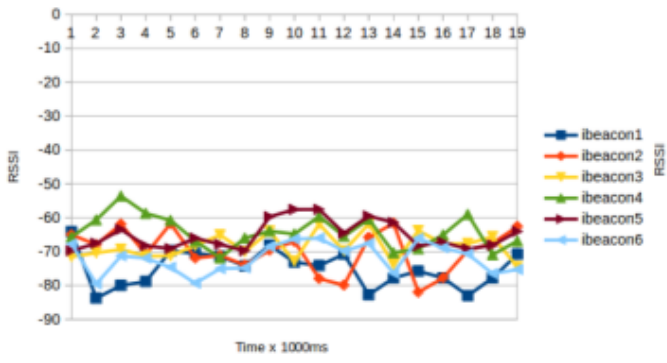
Nextome technology Core includes different technologies, among which the following internally developed and patented technologies.

Nextome is the fusion of different patented and patent pending technologies created by Nextome research:

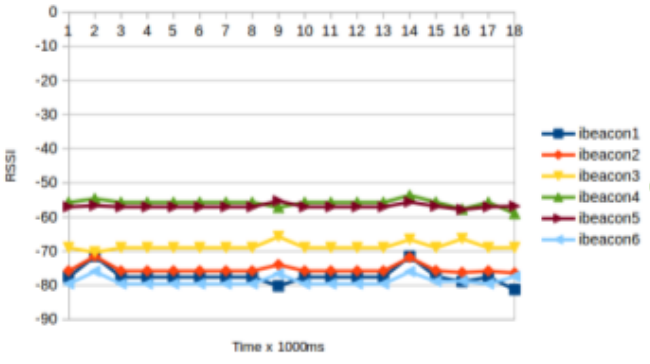
1. Novel localization methodology called MLV3: it includes the following proprietary keys of innovation:

   The innovative non-linear filtering technique of RSSI (Receive Signal Strength Indicator) limits the "multipath fading effect" by removing the non-linear noise caused by Bluetooth signal bouncing on the walls, floor, furniture and people moving around. In this way is possible to calculate the right location by using an advanced machine learning approach relying only on the true signal. This algorithm solves the theoretical problem of signals in NLOS (Non Line Of Sight). In the following pictures, you can see the effect of our nonlinear filter for multipath mitigation in action.

Unfiltered Signal coming from 6 iBeacons

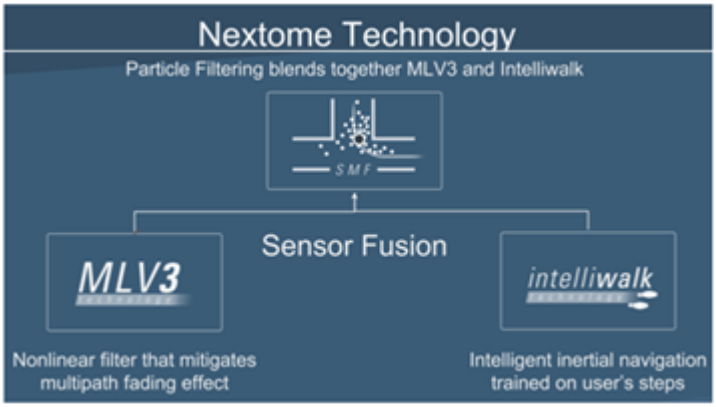


Filtered Signal wit MLV3 Technology



The true signal is extracted by exploding the noisy signal in (theoretically) infinite dimensions and capturing only those dimensions that better show to capture most of the true signal, cutting out the noise.

2. Crowdsourcing dynamic distance estimator: it allows to more accurately calculate the distance person/beacons also in the case of structural modifies of the indoor environment (for example locations of furnishings, plasterboard walls, etc...). This innovative distance estimator is critical for an accurate position calculation.
3. Crowdsourcing dynamic localization engine: it has been developed to improve the accuracy of localization even in crowded places, by creating "virtual" beacons on the fly. These virtual beacons transmit their id and coordinates on the map. In this way, during the process of localization, other user's devices can also use these additional beacons for their positioning: theoretically the accuracy increases as the number of people present in the environment increases. This definitively solves the problem of signal propagation in crowded places.
4. Innovative method for circular localization: through this algorithm, we propose the use of a weighing multilateration technique that is necessary to obtain a greater robustness with respect to the inaccuracies caused by the signal fluctuation.
5. An intelligent inertial step recognition algorithm, called IntelliWalk, capable of understanding when and where the user is moving, the step size, the orientation and the motion model of the user while walking using accelerometer, magnetometers, gyroscope and compass already present in the Smartphone. The algorithm is continuously trained on user's steps.
6. Finally, we fuse the previous described proprietary technologies using particle filtering approach (Sequential Montecarlo Filtering) together with map constraints; in this way the user won't ever be positioned in an unreachable zone and whatever error will be automatically corrected while the user is walking, saving also energy and battery on the Smartphone.



Nextome technology and all localization algorithms run within the Smartphone without making a continuous polling to the server, in fact we do not even need an internet connection making the indoor navigation possible even in those buildings that are not covered by an internet connection. In this way there are no delays caused by a slow connection or by an excessive workload on the server side. The filtered signal is useful to achieve a better accuracy in indoor positioning also without fingerprinting, in facts Nextome is the unique technology that doesn't need fingerprinting saving an important amount of time and money.

The filtered signal is useful to achieve a better accuracy in indoor positioning without performing fingerprinting (usually known also as calibration phase). As Wikipedia explains: "Traditional fingerprinting is also RSSI-based, but it simply relies on the recording of the signal strength from several access points in range and storing this information in a database along with the known coordinates of the client device in an offline phase." It is a difficult and time-consuming task leveraging its results on the maintainer/mapper skills (human being). Nextome technology does not need fingerprinting saving an important amount of time and money.

Nextome is available for customers and integrators as an SDK to be integrated in third party's apps or to develop native app.

How to evaluate an Indoor Positioning Technology

EVALUATION CRITERIA	
FOR IPS TECHNOLOGY	**FOR NEXTOME TECHNOLOGY**
Scalability in terms of simultaneous users	Unlimited users simultaneously (the computation is performed on the smartphone so naturally parallelized)
Accuracy	1.5 meter of error
Ease of setup / level of automatism	No expertise required because it is not required fingerprinting
Ease of Use (user perspective)	Just open the App and accept to turn on the Bluetooth if it's not already active
Configurable remotely	Everything is configurable remotely using backend software
Special Hardware Required (user side)	Just user's smartphone with Android or iOS
Seamless Indoor Outdoor user experience	Supported

Indoor Positioning Technologies

Indoor positioning technologies can be differentiated in two main branches: infrastructure based and infrastructure free IPS technologies.

For infrastructure-based we indicate those technologies that leverage on a dedicated infrastructure (sensors, lights, WiFi routers, satellites and so on) to be deployed in the environment. For infrastructure-free we indicate those technologies that do not require a dedicated infrastructure, like geomagnetic field and so on.

Usually most infrastructure-free technologies use also fixed beacons to increase accuracy, so most of them are semi-free infrastructure based. Also IPS technologies can be differentiated based on the accuracy and ease of installation/maintenance. The ease of installation/maintenance practically depends on the fact that a particular technology uses fingerprinting process or not.

Follows a grid with technologies comparison and differentiation based on scalability (number of users simultaneously localizing), ease of setup and maintenance, power consumption, hardware cost, special hardware required (user side).

Evaluation Metrics

TECHNOLOGY	**ACCURACY**	**SCALABILITY IN TERMS OF SIMULTANEOUS USERS**	**EASY OF SETUP FROM 1 TO 5** (1=EASY 5= DIFFICULT)	**POWER CONSUMPTION** (LOW-MEDIUM-HIGH)	**HARDWARE COST** (NO-LOW-MEDIUM-HIGH)	**SPECIAL HARDWARE REQUIRED**
WiFi Trilateration	5-10m	Limited / depends on infrastructure	2 Needs to relocate wifi access points	Medium	No (Uses existing)	No
WiFi Fingerprinting (with SLAM)	2,5-5m	Limited / depends on infrastructure	4 Needs Fingerprinting	Medium	No (Uses existing)	No
WiFi AoA/TDoA	40cm-1m	Limited / depends on infrastructure	2 Needs to relocate wifi access points	Medium	High	Yes
Bluetooth Low Energy Only trilateration	3-4m	Unlimited users	2 Needs to install BT Beacons	Low	Low	No
Visual Ligth Communication	10cm-1m	Unlimited users (theoretically)	3 Needs installation of special led lights	High	High	No
Magnetic Fingerprinting	2,5-5m	Limited / depends on infrastructure	4 Needs Fingerprinting	Medium (continuous internet polling)	No - Low (praticaly uses also beacon)	No (theoretically)
Ultra Wide Band	10cm-1m	Limited / depends on infrastructure	3 Needs to install UWB Routers	Low	High	Yes
BLE + MLV3 + IntelliWalk + Particle = Nextome	1,5-2m	Unlimited users	2 Needs to install BT Beacons at suggested positions	Low	Low	No

As you can notice, Nextome main competitive advantages are accuracy and ease of use/maintenance because no fingerprinting is necessary and thanks to ABDT software (Automatic Beacons Deployment Tool) that will automatically suggest you where to install beacons in your environment. Practically where to attach them on the ceiling/walls.

SDK Integration

Nextome SDK is available for iOS and Android. Thanks to Nextome SDK it's possible to integrate location based services in every application that requires them. Nextome SDK is designed to be modular. It provides the following advanced features:

- Nextome IPNS (Indoor Positioning and Navigation System)
  - Nextome IPNS is the library that contains all the required algorithms and interfaces to provide a state-of-art indoor positioning system. It's designed to be integrated also in existing mobile applications without effort.
- Nextome Proximity
  - Nextome interacts with the environment, sending notifications when the user is localized in a predefined area, triggering events.
- Nextome MapView
  - Nextome MapView it's an innovative component for iOS and Android that allows to integrate in your existing mobile application a high performance and customizable map component that works offline.

The component is natively attached to the Nextome IPS and allows to handle POIs and path search.

- Nextome Routing
  - Nextome allows to look for a specific POI and to calculate the shorter route to reach it, going along with the visitor step by step guiding him as a classical navigation system does.

A typical integration of Nextome SDK performed by developer with at least 3 years of professional development can take up to 4 days. For both iOS and Android manuals are provided.

Cloud Web Based Content Management System

Nextome CMS (available at https://manager.nextome.net) is a cloud platform that allows to:

- Upload maps
- Insert/edit/delete beacons and monitor battery levels for maintenance purposes
- Create/edit and delete events at a certain position
- Create/edit and delete routes
- Create/edit and delete Point Of Interest (POI) along with description
- Perform real-time tracking of users/devices within the environment
- Display venue's analytics

Nextome provides a maintenance app called Venue Configurator (https://play.google.com/store/apps/details?id=org.nextome.venueconfigurator) that support the installer with the setup of venues and beacons in the physical environment.

Nextome Requirements

For optimum installation beacons are required to be installed at a high not over 6 meters and can illuminate an area not greater than 100 squared meters, therefore attach point must be available to reach the required density of deployed beacons.