Application Note: Domiciliary Healthcare using the Omnisense Series 500 Geolocating Sensors

This application note describes how the Omnisense Series 500 geolocating sensor products can be used to support domiciliary healthcare applications such as the care of people with dementia.

Omnisense has created a genuinely new wireless sensor network system with real time geolocation capability to track people, animals and assets anywhere, without the need for permanent or pre-installed infrastructure.

The Series 500 system consists of a family self-initialising devices which communicate with one another to form a mesh network. Each device knows where the others are in relative terms by measuring the ranges of interconnecting radio links. Associate a small number of them with known positions and the absolute locations of all of the devices within the network become known.

Series 500 devices incorporate inertial sensors, GPS and optionally GPRS and have the ability to carry data from many other types of sensor. The system is low cost, extremely flexible, and provides true position and behavioural information indoors and outdoors.

Being able to integrate low-cost low-power wireless sensor network technology with true location capability on a standards-based platform opens up exciting new opportunities in healthcare.

Context for Domiciliary Care

There is increasing interest by health service providers around the world to make use of technology in order to improve the quality of care provided to those who need it and to improve the cost-effectiveness of providing this care. A specific example is care for people living with dementia. There are about 700 thousand people in the UK living with dementia of whom only around one third have received a formal diagnosis.

The UK National Dementia Strategy published in February 2009 sets out a vision for the positive transformation of dementia services in which all people with dementia have access to the care and support they need. A system in which the public and professionals alike are well informed; in which early diagnosis and treatment is the rule rather than the exception and which enables people with dementia and their carers to live well with the condition in their own homes, in the community, care homes and hospitals.

Research has shown that people with dementia are happier and live longer if they are able to live at home with their families rather than in a care home or hospital. Domiciliary care is about providing better care and support to people with dementia and their families whilst enabling them to live longer in their own homes before their condition deteriorates to the point where they need to be moved into specialist care.

Domiciliary care is also advantageous for people with long term disabilities and those recovering at home from illness and injury and in post-operative care.

Knowing the location context of a person's activity over time can be used as the basis for real advances in the understanding of physiological, psychological, psycho-social and socio-cultural components of living with long-term conditions. This will offer healthcare providers the opportunity to deliver advanced assisted living lifestyle services that scale.

Whilst this paper focusses on the use of the Series 500 products in domiciliary care, the system described may have similar capability and application to care within care homes and hospitals.

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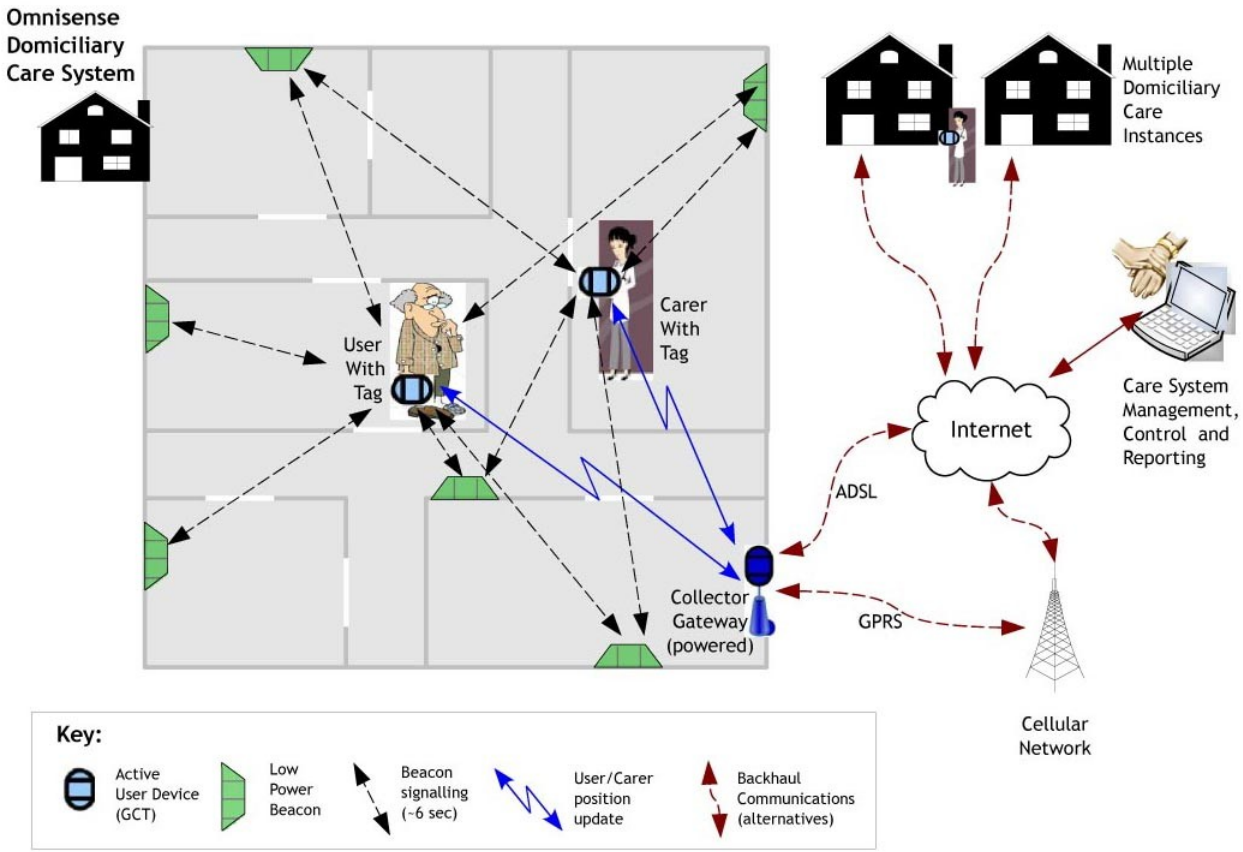
Geolocation within Domiciliary Care

Knowing the location, movements and behaviour of people with dementia or other long term disabilities can be used to provide information about their state of health and wellbeing. Mobility, specifically change in mobility, is a good indicator of wellbeing and the ability to detect accidents such as a fall, or the fact that the person has been away from their house for longer than usual, can all be used to inform care workers and relatives and improve the quality and timeliness of care.

The Omnisense Series 500 geolocating wireless sensor network can be used to measure mobility and activity levels of both people in care and their carers. This involves providing those involved with small neck, wrist or belt worn devices that they carry at all times. This device may incorporate additional functions such as a small pager or mobile phone type display, emergency call button, audio or vibratory alerts. The intention is to produce a user device that builds up the confidence of people in care by supporting their links with carers and family in a positive way that reduces their stress and ensures that they are not alone.

In addition to monitoring users around their home, the Omnisense Series 500 system can provide seamless coverage of outdoor areas such as garden and garage and it can be linked with other environmental sensors such as PIR motion detectors, can monitor temperature or even provide alerts when the doorbell is rung.

The diagram below illustrates how the Omnisense technology could be used in the home situation.



Omnisense is working with application developers and partners who provide the care systems, application software and those parts of the system other than the geolocating wireless sensor network.

Being based on low-power protocols in the 802.15.4 band, compatible with those promoted by the Continua Alliance, it is the intention that Series 500 will fit into the emerging vision for wireless healthcare.

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Description of System

The Omnisense Series 500 system for Domiciliary care comprises three main elements:

- ☑ User Devices (1 to 4 typically) worn or carried by the service User and Carer;
- ☑ Small battery powered Beacons (6 to 18) used to identify rooms or zones around the home;
- ☑ a Collector Unit that acts as a gateway connecting the system to the care application.

The system is designed for ease of use and can be self-installed on a DIY basis by lay or non-technical people. The system is self configuring and required no special cabling or calibration.

User Device

The User Device (GCN-511) is small and light enough to be wrist worn, neck worn or clipped to a belt (45 mm diameter Fob that weighs 22 g). It can be powered by either a primary cell (currently allowing 2-4 months continuous operation) or rechargeable battery (at least 2 to 4 weeks between charging). The exact size, weight and form factor can be tailored to specific application needs.

It communicates with the Beacons every 6-15 seconds accumulating geolocation data and it monitors the internal motion sensors to derive behavioural information. This data is sent to the care application via the Collector Unit, or using an optional internal GPRS modem. Partial processing of location and motion data is done by the User Device, but it is the responsibility of the care application to interpret this data in the clinical context. The User Device may have additional functionality such as a small display or buttons that can be used to interact with it.

A GPS receiver may be used for wide area coverage and has been included in the GCN-52x units, and additional GPRS modems and WiFi modules can be added for wide area connectivity (as done for the GCN-53x devices). See Series 500 Product sheet for further information. Whilst attractive these features add cost to the product and increase the size and weight, so the decision as to their inclusion depends on specific user requirements.

Beacons

Beacons are small low cost devices (95 x 45 x 25 mm, 70 g) which run off alkaline batteries providing a battery life from 6-12 months (depending on use profile). There would typically be a beacon placed in each relevant room or zone (including garage and garden) of the user's home, typically in the corner of the room like a PIR motion sensor, or ceiling mounted like fire alarm devices. By measuring ranges between the User Devices and Beacons (and between Beacons), the Omnisense Series 500 system is able to extract accurate geolocation data for the user delivering accurate room level and mobility information.

Collector

The Collector is a mains powered (with battery backup) device that is used to manage the sensor network and data flow to the care application either via a broadband internet connection or via a GPRS data link. It also has additional local processing capability and data storage which can be used to store additional data logs that could be useful should more in-depth data analysis be required. The device looks much like a wireless access point or broadband modem and is typically placed in a fairly central location within the home, but out of sight.

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Requirements and Performance

The Omnisense Series 500 system for healthcare has the following attributes:

- ☑ Operates throughout conventional residential houses as found in the UK, Europe and the USA, including coverage outdoors around the garden and outbuildings to ranges of up to 100 metres.
- ☑ Typically 6 to 18 beacons and 1 to 4 User Devices for a domiciliary system; can be scaled to provide care home or hospital level coverage.
- ☑ Provides accurate geolocation information (approximately 2 m) indoors and outdoors yielding reliable zone (room) level assignment and measurement of mobility.
- ☑ Detects when the User leaves the premises and if the User device is fitted with optional GPS and GPRS connectivity can report geographic position over a wide area.
- ☑ Able to identify carers and visitors to the User's home when they are carrying their own User Device.
- ☑ Easy installation and completely self configuring with no need for cabling apart from power lead and network cable to connect the Collector to mains power and the broadband router.
- ☑ Battery life of at least 2-4 weeks for rechargeable User devices (2-4 months primary cell) depending on use profile, and 1 year for Beacons (alkaline replaceable batteries) with battery condition monitoring and early replacement warning. Further power management savings are under development.
- ☑ Operates in the 2.4 GHz band using over 802.15.4, providing robust operation in the presence of WLAN and Bluetooth devices.
- ☑ Low cost and small size.
- ☑ Provides location, mobility data and optionally data from auxiliary sensors, to healthcare and other third party applications using standard IP protocols and freely available APIs.

The Series 500 products are based on 802.15.4 and 802.15.4a radios which are compatible with Wireless Networking standards adopted by the Continua Alliance. This potentially allows the system to interface to other wireless healthcare devices in the future.

About Omnisense and Series 500

Omnisense Limited is based in Cambridge UK developing innovative products that add true geolocating and behavioural monitoring capability to wireless sensor networks.

The Series 500 Products are now available for order.

More information, including details of individual devices and the technology behind them may be found on the website http://www.omnisense.co.uk/

Prices and availability supplied on request: info@omnisense.co.uk.

The technology is covered by granted and pending patents owned or licensed by Omnisense.

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