How IDRATEK Automation Technology Supports Independent Living and Care at Home

"You know your home is smart when you don't notice its smarts"
(Karam Z Karam, IDRATEK LTD)

Introduction

Who hasn't heard of the maturing demographic time bomb? How will we all cope with our extended life spans and consequent need for increasing support? Health services around the world are already creaking at the joints... Anything which can help us to live comfortably for longer in our homes whilst reducing the need for care interventions must surely be of value to the challenges our societies face and to our own dignity. So how does the world of home automation fit into this?

Unfortunately there has been a rush to get 'minimum viable products' to market and then over egging their potential in futuristic tones. Consequently public perception struggles to believe that home automation is anything more than hyped-up gadgets providing limited real benefit. In reality smart home technologies vary tremendously. Simply labelling something as 'IoT', 'Connected' or 'AI' does not make it 'smart', nor even that it will become smart. The fog of hype is hiding some shining examples of what can really be achieved. This is where IDRATEK comes into the picture.

IDRATEK's home automation technology was not specially designed to target the care market but its unique features and affordability have proved to be particularly well suited to this.

Intelligent, pervasive and immensely flexible, the IDRATEK system is one of the worlds most advanced technologies for running any type of home, but in a care situation its highly integrated and unobtrusive "no hands" philosophy delivers a particularly poignant experience both for occupants and their carers.

The "combination effect" of integrating automation features greatly enhances the separate benefits of each and creates a general wellbeing ambience – even a feeling of companionship. This is well illustrated in the true life example described below. And whilst this gives focus to details of a host of individual features, what is ultimately important is the **overall effect**. In particular, that the occupant reports feeling a sense of comfort and companionship as well as reduced anxiety with memory related issues. Re-assured knowing that carers are in close touch, are automatically alerted about issues, and that quick assistance is available.

For the carers it has become an indispensable support and investigative tool.

It should be emphasised that the IDRATEK system is not some kind of telecare or monitoring system on steroids, nor is it some fancy remote control thermostat or lighting controller. Its comprehensive and deeply integrated approach is what makes it incomparable to such unitary concepts. We call it **H2A** – **Holistic Home Automation**. However, what makes it additionally exciting in a care application is the wealth of detailed information that it generates as a matter of course. It is already apparent how this can yield early indicators, potentially reducing the frequency of emergency interventions and their costs. Better still that a great deal of such information can be gleaned ambiently - before resorting to more intrusive techniques such as wearables or cameras.

The focus in this article is on a care application, but it should be clearly understood that the IDRATEK smart home system is for anyone's use. A wide variety of users are already utilising its compelling capabilities in areas such as energy efficiency, smart lighting, security, monitoring, remote access and so on. The fact that it can adapt and assist them in future years will just be an ever growing bonus. This is why we believe that a change of paradigm is needed - Rather than applying many future rounds of not inexpensive, sometimes ineffective, plasters and sticky tape gadgets, we should be considering incorporating such technology as infra-structure in new or re-development homes targeted at the care or retirement markets right now.

Live Example

Independent Home Living at over 80 and with memory impairment

Presented in three parts

- ❖ The Setting
- ❖ System Headlines
- ❖ Some Details

The Setting

In 2011 a two bedroom flat situated in Newcastle upon Tyne and occupied by an elderly relative was fitted with an IDRATEK home automation system. Initially this was done to provide enhanced comfort, security and economy for the occupant. When later diagnosed with Alzheimer's disease several features of the system proved particularly important not just for supporting daily life but also for maintaining the occupant's and carers' close contact and peace of mind, thus enabling the occupant to continue to enjoy life in her own home.

System Headlines

The following headlines signpost just some of the features:

1. **Reliable Room Occupancy Information** – *services directed and my carers re-assured*

2. **Fully Zoned Heating Automation** - *my home is always comfortable but also efficient*

3. **Full Lighting Automation** – *no fumbling for light switches and it feels alive!*

4. **Speech and Sounds** - *my home feels friendly and alert*

5. **Communications & Messaging** - *in close touch with everyone, help with memory*

6. **Internet Connectivity & Remote Access** – *keeps my carers informed, I'm re-assured*

7. **Security & Safety** – automatically *watching out for my safety*

8. **Electricity Metering** – not *just for checking energy consumption*

9. **Miscellaneous** – TV control, intelligent reminders, exhaust fan that keeps quiet at night, spy hole discrete lighting, you name it... *Sometimes the minutiae have more importance to me than the headlines!*

10. **Data Logging & Analysis** – *helps my carers to help me*

11. **Flexibilty** – *my home adapts to my changing needs. New features implemented over the years.*

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(Further detail can also be found here: http://www.idratek.com/example-install/case-study-7-2/)

The Detail…

24/7 Reliable Room Occupancy Information

Features:
- Reliable room occupancy information is fundamental for good service delivery and carer oversight. Room occupancy is inferred from a combination of sensory signals and other information. This yields much more accurate assessments than 'dumb' motion sensing alone. It does not require doors to be closed and the occupant can remain sedentary for long periods without a room becoming considered unoccupied. Conversely, vacant rooms are quickly registered as unoccupied.

Benefits:
- Occupancy rather than simply motion sensing makes many potentially useful functions a practical reality instead of wishful thinking and irritating in practice. This includes intelligently zoned heating, fully automated lighting, direction of messaging, information to carers, automated alerts or actions based on room/house occupancy anomalies, and of course provides a feed for security functions.

Fully Zoned Heating Automation

Features:
- Heating is fully zoned (down to individual rooms), with independent 24/7 set point profiles implemented for each zone.
- Heating is automated based on room occupancy and other inputs such as external conditions.
- To us, good automation means minimal need for user interaction. However depending on user choice, interaction can be simple up/down overrides via wall buttons, a handset, touch screen, or potentially voice.
- Spoken feedback
- Intelligent mediation of user requests based on prevailing conditions. E.g.: it may not be wise to raise the set point, despite the user requesting 'up', whilst the heating has not yet reached the present setting. Similarly the system makes automated decisions about when to remove user overrides.
- Extensive data gathering and energy efficiency analysis tools.

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- Detailed and remote access to controls and data are provided via other methods such as smart phone (primarily useful for carers)

Benefits:
- <u>The occupant feels comfortable at all times</u>
- Automation works in the background to reduce energy bills by continuously monitoring room occupancy and other signals, delivering heating only where and when it is required. Zoning is far more important than geo-fencing for homes that are occupied at most times.
- The occupant has no concerns about fiddling with heating controls (in fact they have never been touched by the occupant of this particular installation).
- The carer has a detailed view of what is going on with the heating and peace of mind that the occupant is comfortable. The carer is also able to remotely assist the occupant with the heating should the need arise.
- Rich data set allows carer or third party to make well informed decisions on overall heating strategies based on real information specific to that home and that occupant.

Lighting Automation

Features:
- All fixed lights are connected into the system and therefore available for all manner of control.
- Main living area and passageway lights are dimmable. Internal lighting is fully automated based on: occupancy, room light level sensing, time of day, user overrides and other signals. So, for example, lights automatically turn on when an occupant enters a dark room and automatically turn off in a vacated room, or if the room has brightened up by increased daylight. On the other hand lights in a bedroom will relinquish automation during the night.
- Lighting in an occupied room will not turn off as a result of prolonged sedentary behaviour, yet will turn off quite promptly in a vacated room.
- The occupant can override any automation decision but the system will automatically clear the override at a judicious time (this means that the background automation is never rendered pointless!).
- Lower lighting levels are automatically enforced in passageways overnight.
- Lighting levels can be linked to inverse measured light level to provide gradual augmentation
- Circadian lighting schemes possible to implement with adjustable colour lamps
Other titbits:
- External rear light automated based on video based motion detection.
- Porch light turns on when dark if the front door is opened, but not at all times (anecdotal reason).
- Porch light flashes when the door bell button is pressed (Caller feedback).
- Lighting in the entrance hallway is held off or subdued when a caller rings the doorbell at night – providing the occupant with better conditions for seeing through the spy hole as well as reducing indications of occupancy. However, full lighting immediately resumes once the door is opened.
- Lighting can be automated to simulate presence, although rarely used with the mostly home bound occupant.
- Any internal lights can flash in response to door bell.
- Lighting control and lighting data accessible remotely, e.g. via smart phone.

Benefits:
- <u>The occupant does not have to concern themselves fumbling for light switches when entering a dark room</u>.
- Automated lighting does not need regular arm waving to maintain an on state.

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- The occupant does not have to remember to turn lights off – energy efficiency gains
- The occupant does not have to worry about whether they have left lights on when they leave the home - less anxiety.
- Dimmable lights provide for a gentle to the eye fade up/down effect which is particularly useful when lighting operation is continuously automated. Also various lighting levels can be set throughout the home depending on requirements.
- The constant dynamics of lighting automation adds to the occupant's sense of companionship – as reported by the occupant: "..feels like the house is 'alive' - my friend..".
- Subdued light levels on the way to the toilet at night mean less of a glare shock for someone who has just woken up.
- External lighting automation improves security and visibility for the occupant.
- Flashing external porch light in response to door bell provides positive feedback to caller.
- Flashing internal lights in response to door bell can help where auditory impairment exists.

Speech and Sounds

Features:
- Through audio capable panels in all rooms the system can deliver spoken information, pre-recorded phrases or arbitrary sounds in response to a wide variety of events or schedules.
- Door bell sound/tune can be arbitrarily (distinctively) chosen
- Speaking clock tells the user the present date and time at any location, by pressing a wall button, remote handset, or automatically - for instance to greet them on first entering the lounge in the morning.
- A family member's recorded voice warns of icy conditions if the front door is opened on a sufficiently cold day (but will not do so if the door is opened in response to the door bell).
- Reminders and direct carer messages can be delivered in recorded or synthesised speech.
- If desired/useful to a particular user, entire navigation menus can be rendered in speech.

Benefits:
- <u>User friendly and more attention grabbing way of delivering information</u>
- The use of speech, even synthesised speech, has been constantly reported by the occupant as very important in providing a sense of companionship and reassurance.
- Ability to elicit spoken date/time information when waking up in the middle of the night is repeatedly reported by the occupant as 'very comforting'.
- Enhancement of occupant safety
- Will become even more important should the occupant have visual impairment or reduced mobility.

Communications & Messaging

Features:
- All rooms including bathroom contain audio capable panel units allowing hands free conversation either as internal intercoms (not so useful in a small flat) or for external calling..
- Incoming calls from specific carer IDs can be auto picked up without any physical user interaction – allowing a carer to talk to the occupant even if they are incapacitated
- Outgoing calls can be initiated by a variety of methods
- Incoming calls will automatically mute the TV and then unmute when the call has terminated.
- Notice Board feature provides sophisticated textual messaging functions on tablet format displays

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- Notice Board feature provides customisable real time information for carers on tablet format displays.

Benefits:
- Ability to communicate with the occupant without them having to reach for a button or telephone has obvious benefits for both carer and occupant.
- For the occupant the Notice Board feature has become an indispensable tool for providing visual reminders and alerts, which can range from simple date and time to scheduled reminders and direct messages from carers.
- For the carers the same Notice Board feature provides real time information derived from the wealth of system data (with occupant consent), such as when a cooker was last used, how long the house has been unoccupied? In which room did movement last occur?

Carer side notice board

- Easier access for making normal or 'panic' outgoing calls.
- Detailed features such as the automatic TV muting improve the communication experience (no loud TV in the background) and reduce anxiety and confusion for the occupant (cacophony of sounds from different sources) when such a call comes through.

Internet Connectivity & Remote Access

The system is NOT dependent on the Internet, but such connectivity adds many useful features:
- E-mails containing any chosen information as well as file attachments such as video clips can be automatically sent to chosen recipients upon selectable events.
- A highly detailed server with Transport Layer Security (SSL/TLS) is implemented which provides app style remote access and control for use on smart phones or tablets either within the property or from anywhere in the world with internet access
- Server implements multiple user capability with each user able to have different access privileges on an object by object basis.
- Skype connectivity provides a telephony service and also one route for sending SMS messages with any desired information content and upon selectable events.
- An FTP facility is provided for automated file uploads
- A unique feature known as an 'IDRANet Bridge' service allows elements of this installation to appear as elements within another IDRATEK system (for example the carer's) and vice versa.
- Fully featured secure Web API including both client and server functions

Benefits:
- The benefits of having a system which can automatically send out alerts via e-mail or SMS are fairly obvious and some specific uses are mentioned elsewhere.
- Being able to remotely access the system with all of its information and controls using a single smart phone interface is immensely useful to the carer and indirectly so to the occupant. The carer can get a very good picture of events in spite of confusion or memory lapses by the occupant.
- Ability to provide different access levels to different users means that carers of different types can still make use of remote access features whilst guarding occupant privacy.
- The system's highly integrated structure means everything is accessible via one user interface
- The Web API allows the system to interact bidirectionally in a standardised protocol (RESTful JSON and XML) with other IoT entities. For example IDRATEK's noticeboard tablet apps, querying met office weather reports or interacting with 3rd party automation products such as Philips Hue lights, Amazon Echo etc. (Not included in this install).

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Security & Safety

Features:

- All rooms contain one or more motion sensors and all door states are sensed, providing comprehensive coverage for intruder detection and detection of unusual occupant behaviour.
- Front door opening at unusual hours will alert carer/s.
- Room temperature sensors (for heating control) are also used to provide overheat detection (absolute and rate of change).
- Smoke detectors fitted in two locations provide independent battery backed sirens but also feed trigger information to the automation system so that alerts to carers can be generated.
- External camera with motion detection and buffered recording.
- External alarm sounder and strobe under system control.
- Lighting will automatically simulate presence during absence when it is dark.
- Almost any abstracted event or direct signal which the system has access to can trigger alerts and sending of relevant data to carers by e-mails and/or SMS. Also possible to auto-call with spoken information content if a telephony interface is connected.
- Data such as camera clips can be automatically uploaded to offsite storage.
- All information logged 24/7 enabling detailed and chronological event analysis.
- Comprehensive remote accessibility e.g. using smart phone.
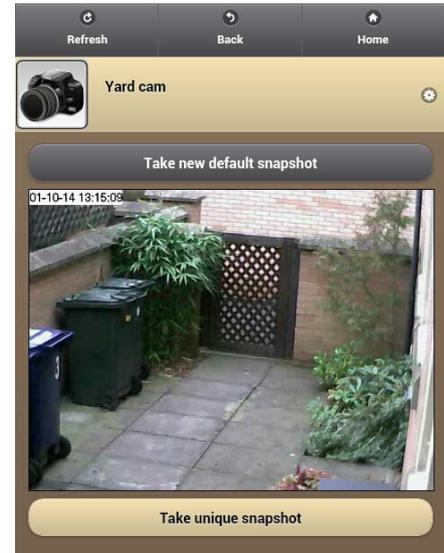
Benefits:

- This combination of features provides self explanatory benefits but the overall important effect is much greater awareness and peace of mind for any carer who is not physically present. Carers are not only alerted in the case of unusual activity but can also 'look in' at any time to re-assure themselves about the well being of the occupant. The multiplicity of sensory signals greatly improves the ability to deal with 'false positives' – a common scourge of unitary alert products.

Electricty Metering

Features:
- Electricity consumption is metered at individual circuit ring level.
- Electric cooker is metered on its own dedicated spur, providing clear visibility of usage and ability to alert when appropriate.
- Cumulative and rate data provided.
- All data is logged 24/7 and accessible either locally or externally.

Benefits:
- Detection of unusual cooker activity to generate alerts, provides carer with improved peace of mind.
- Inference of activities. E.g did the occupant actually cook their dinner last night? Did they use the toaster, the kettle, the microwave? Such information often used by the carers to better assess whether the occupant needs further support.
- Consumption data can be used by carers to check general utility consumption and guide some aspects of energy efficiency analysis.
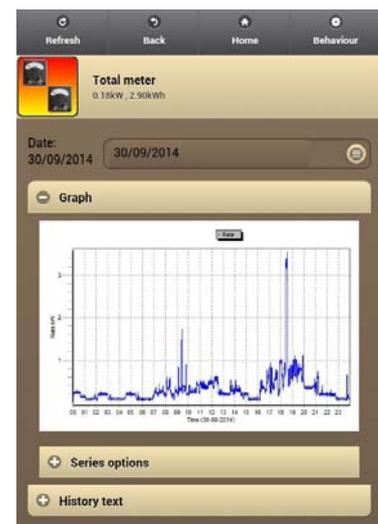
Miscellaneous

Features:
- Infra-Red (IR) remote control transceivers in all rooms provide a route for the user to operate functions or elicit spoken information using a simple remote control handset or fob. Conversely they provide for automated control of 3rd party devices.

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- Using IR, the system automatically mutes and unmutes the TV in response to an incoming call.
- Using IR, the system implements a TV control simplification process, whereby the pressing of a designated button on the occupant's familiar TV handset is intercepted by the system and is then used to automatically navigate the TV's source selection process such that the occupant is able to watch programs via their external set top box. This process would normally involve a sequence of button presses which unfortunately became beyond the abilities of the occupant some time ago.
- The extractor fan in the bathroom is automated such that it does not come on for very brief visits and overnight does not automatically come on at all (though manual override always possible).
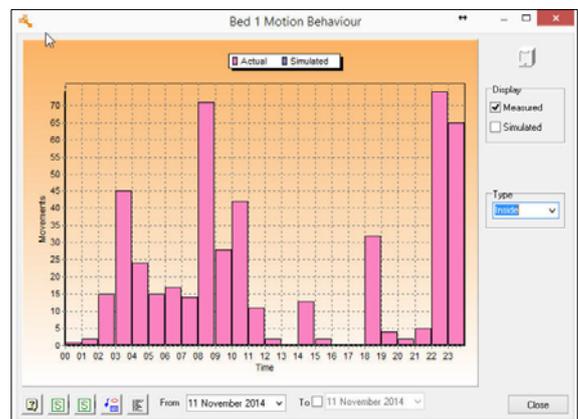
Benefits:
- IR features mentioned above make life easier for the occupant.
- <u>TV control simplifier is absolutely indispensable</u> in this case, since the occupant relies heavily on the set top box for their preferred TV viewing content.
- Less disturbance from the extractor fan seems like a minor feature but such minor details add up to provide a more comfortable and peaceful environment.

Data Logging & Analysis

Features:
- Data from sensors and logic objects continuously logged in minute detail.
- Analysis tools such as single and multiple data plot graphing provided.
- Energy efficiency analysis based on real logged data.
- 'Playback' feature allows step by step analysis of activity for any period of time.
- Numerous technical diagnostics and logging features for capture and resolution of any abnormal behaviours.

Benefits:
- <u>Carers not only have a view of the present but can also examine what has happened in the past</u>. For example, did the occupant really get out of the house today? Did someone ring the door bell yesterday? When did they arrive and when did they leave? Does the occupant get up during the night, how often, and where to? (signs of infection, wandering), etc. Information can help to pro-actively maintain the occupant's well being without the need for overly strict regimes. For example the occupant will invariably report that 'they have gone out for a walk today' truly believing that they have (dementia). However the carers can tell when this has in fact not been the case, so can 'fill in' with extra efforts to assist the occupant to do so. Similarly, general sedentary level measurements can provide other indirect ways for assessing the occupant's state of health and demeanour when their dementia makes it impossible for them to provide accurate responses to direct questions.
- Quick assessment of effectiveness of energy conservation strategies.
- As alluded to above, rich data sets can yield valuable indicators and predictors of well being or otherwise. (Not studied in any methodical depth by IDRATEK themselves).
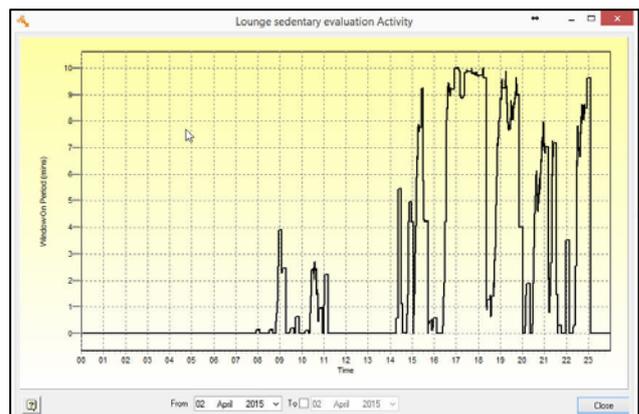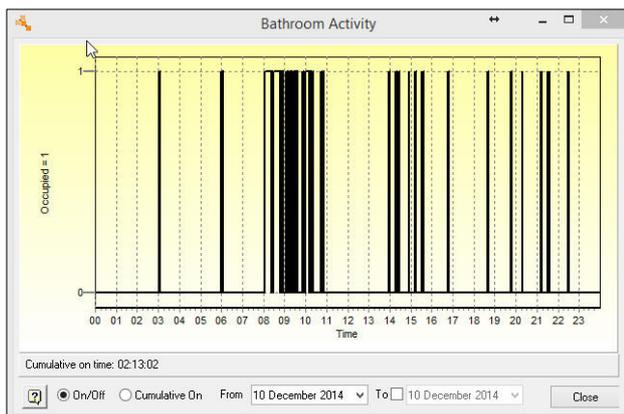
Flexibility & Adaptability

Features:
- Modular hardware and software structures
- Unlike other technologies the hardware is mostly of generic functionality until directed.
- 'Pre-canned' functions deliver sophisticated integration without complex programming skills.
- Hugely extensive bespoking capability where required.
- Fully featured Web API interface facilitates interaction with other IoT entities.
- IDRATEK continually learn from customer feedback to introduce new enabling features.

Benefits:
- A system can be built up to suit different needs and budgets, from a small flat to a mansion, for the gadget freak, to the technology averse. In this particular installation the emphasis was on the latter but also the system was generously specified in order to provide maximal flexibility at the outset.
- The features delivered even by an existing set of fitted hardware can be changed through relatively simple menu option programming. This means the same fitted system can adapt considerably as the user requirements change. This without even needing to physically visit the property. In this particular installation many functions have been adjusted over time and new features created as the carers observed more about the occupant's behaviour and as new ideas came to mind.
- Tailoring complex functions made feasible. By this we don't necessarily mean an outwardly complex looking function but rather the complexity that is required to make it practically viable and not irritating or disturbing to the occupant. Take the seemingly very simple example of a feature that warns the occupant of icy conditions on exiting the home. The system already provides the flexibility and ease to utilise a recorded warning using one of the carer voices. However there is then the issue of WHEN to deliver such a warning. Easy for our system to link this to an external temperature threshold and to the front door opening, and also to deliver the warning only at the location of the door. But that is not enough, because you wouldn't really want the warning to occur when you simply opened the door to a visitor, or for it to continuously be spoken when you were indecisively opening/closing the door on your way out (not uncommon behaviour for someone with dementia). Such details, intractable to many other technologies yet easily solved with the IDRATEK system, are the crucial difference between an irritating gadget and a product that you forget is even there - until you visit another home without it….