Case Study - NHS Adult Respite Care Unit

Mill Lodge is an NHS adult respite care unit located just outside Norwich, UK. This state of the art facility supports individuals with a learning disability and complex physical and health needs who are living at home with their families. The premises promote privacy and dignity, including intelligent locking systems, ceiling tracking from bedroom to bathroom, specialist equipment and a hydro bath which incorporates lights and music. The unit was completed in late 2013 and opened its doors to patients soon after.

IDRATEK, in association with Your Smart Home, were approached somewhat late in the design process, when the architects were looking for a solution to what might seem to a be a relatively simple problem by human standards but not quite straight forward for conventional PLC type approaches. Essentially this care home required the sharing of bathrooms between 2 adjacent bedrooms and a corridor - due to availability of specialist equipment in the bathrooms and a hoist / rail transport system between the bedrooms and each bathroom. The problem that needed to be solved was how to ensure easy access to the shared bathroom via one of the 3 doors whilst maintaining privacy by automatically locking other doors. This had to be accomplished without the patient needing to use any manual door locking mechanisms either for ingress or egress (i.e. without push buttons or push plates). It was also necessary to allow staff to temporarily override any door locks and for the logic to revert normality automatically. In fact a number of detailed scenarios were eventually considered and catered for.

The IDRATEK system was primarily chosen for the door management task because of its unique ability to derive and use occupancy information as opposed to, for example, relying naively on motion detectors. It also offered great flexibility to cater for possible changes or future expansion. However, it soon became clear to the architects that the technology could do much more and though it was too late to reconsider larger scale deployment, the IDRATEK system was also then tasked with implementing automated lighting and ventilator control in the bathrooms and providing sensory coverage within the bedrooms. This, it was considered, might offer some useful insights into environmental effects on occupants' well being.

Physical Description of the Install

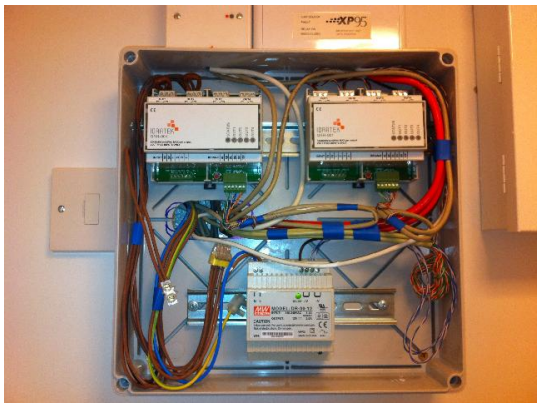
The building is in the form of a large bungalow situated in a residential area. Our remit mainly covered the two bedroom suites. Each suite comprised a bathroom with specialist facilities and two adjacent bedrooms. An asymmetric two leaf door connected each bedroom to the bathroom and a third door provided access to a corridor.

Input devices

To achieve the various tasks we required motion sensors in both the bathrooms and the bedrooms (in fact more than one was used in each bathroom). Door sensors were fitted to all doors, and light level, temperature and humidity sensors fitted in all rooms. In addition, standard IDRATEK push buttons were made available in bathrooms and in bedrooms for staff overrides. A big mushroom style button was also provided in each bathroom to allow manual egress to the corridor. A 3rd party centre neutral retractive switch was used to provide signals into the IDRATEK system for manual light dimming and on/off control. A connection to the IDRATEK system was also made from the main fire alarm system so that any alerts could be logged and potentially utilise other IDRATEK features. In the event of a fire, power to the magnetic door locks would simply be switched out by both IDRATEK and a secondary independent 3rd party device. Most of the input devices were

implemented by means of wall or ceiling mount IDRATEK modules such as LPS, BRS etc. A few remaining digital input signals were handled by QRH modules (see below)

Output devices
Locking was achieved using standard 24V magnetic plate locks fitted to all doors. QRH modules were used to manage these. Lighting was to be provided via commercial style dimmable fluorescents. These utilised an analogue (1-10V) control signal which was handled using an IDRATEK QAO (analogue output) module. The light fixtures also required a power on/off control which was handled by QRH modules The ventilator in each bathroom was controlled via a corresponding channel on a QRH module. In fact separate QRH modules were used for door locks and lighting / ventilation in each suite - in order to separate mains voltage switching from 24V DC voltage switching. QRH,, QAO modules, and 24Vdc supplies were located in small consumer unit style boxes located alongside other ancillary equipment in two small utility cupboards located elsewhere in the property.



LED outputs on IDRATEK button modules provided indication of door locking states within the bathrooms and in the corridor. LEDs were also available iin bedroom mounted modules and could be used, for example, to indicate whether the bathroom was free for use. However during project specification we were asked to maintain these in an off state so that it would not disturb the patients. Later a change was made such that indication could be provided for special door locking states.

Overall Control
An IDRATEK IPSM (intelligent power supply) module located in the care home office area provided power for all the IDRATEK modules. Also in the office area was located Cortex running on a Windows 7 platform. This connected into the IDRATEK system via a PCU (USB/IDRANet) module.

Functions & Features

Intelligent Door Locking
As described above, the IDRATEK system aimed to implement an intelligent door locking scheme which required no manual user inputs.

As a simple example imagine a quiescent state where no-one is in the bathroom and the bedrooms may or may not be both occupied. In such a situation the two bedroom doors would be unlocked but the corridor door would be locked. Since entry/exit via the corridor door would normally only be used by staff or by able visitors then operation of this door lock would be manual (via push buttons). In any case as soon as entry is made via any door then the other two doors would be locked. If entry is via one of the bedroom doors then that bedroom door would remain unlocked so that the user could traverse back to the same bedroom without having to manually unlock. The locking state would persist until the bathroom was vacated (although there were also safety timeouts). Staff could override door lock states using push buttons located above head height. Several potential scenarios of entry/exit/overrides were considered and the logic formulated to cater for these in the most sensible and user intuitive manner. In fact detailed aspects of the modes of operation and indication were later changed during the course of trials – a testament to the flexibility of the IDRATEK system.

Lighting in the bathroom was automated to come on at different dim levels depending on light kevels and time of day. The staff could also manually override to defined levels when desired – for example to override the subdued night time levels if having to deal with some patients' requirements.

Ventilation was also automated based on occupancy and potentially also on humidity levels. Delayed action was implemented to avoid activation for short visits.

Sensory data (temperature, light level, PIR, humidity, door states, button activity, fire alarm state, power supply status) and actuator data (light on/off, light dim values, door lock states, LED states) are all logged 24/7 in Cortex.

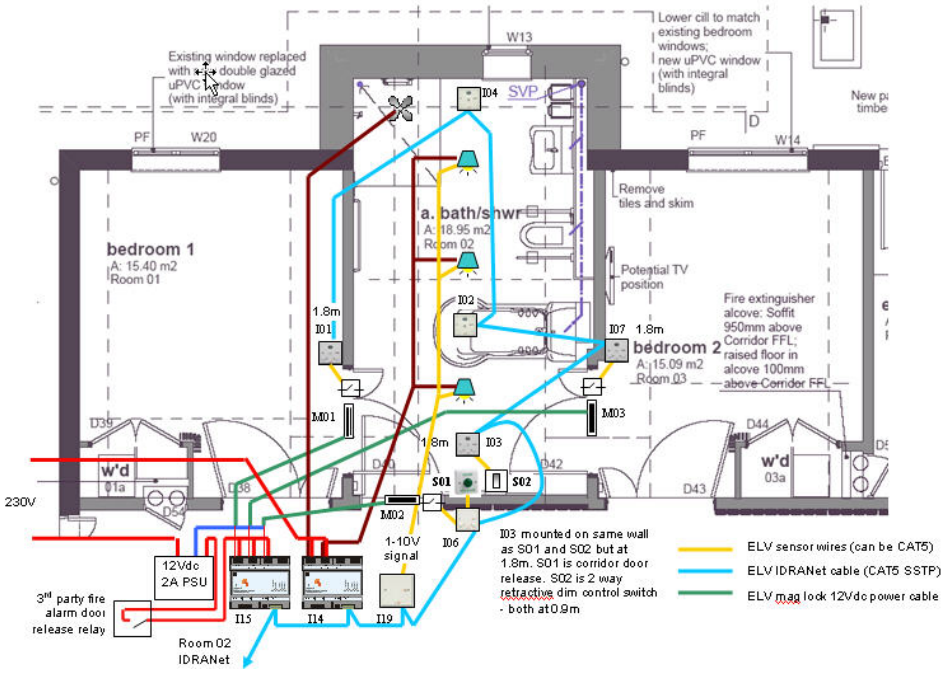
Reflex Functions
In the event of a Cortex failure the system automatically switches to a Reflex state with reduced but viable functionality. E.g. All door locks, lighting and ventilation now become manually operated. Reflex state is indicated by flashing LEDs.

Improvements Since Commissioning

A thorough exercise was carried out by the staff and architects during the design stages in order to specify the modes of operation for the various automated functions. Various scenarios were methodically explored in order to try and cover all possible permutations of use. Nonetheless it was still the case that when the system was put to work some changes became desired as a result of practical experiences. For example to improve the intuitive element of staff overrides or provide additional ways to operate the locks (which still had to co-ordinate with the existing automation scheme). These improvements were easily realised entirely through software changes, due to the highly flexible and non dedicated component nature of the IDRATEK system. In fact the changes were implemented on a software copy of the system at IDRATEK offices and these then passed on electronically to the local manager.

Conclusion

The IDRATEK system has proven to be a valuable tool outside its more traditional application area. Its versatility and ability to intelligently integrate and utilise a multitude of components is just one of its attractive features. But what also makes it stand out is the behavioural nature of its software. This greatly eases the programming task and takes away much of the burden of trying to write bespoke code to cater for all sorts of interactions that manifest in more complex structures. The result is quicker and lower cost commissioning, less scope for error, and ease of making changes.



Example of the technical layout for one of the two bedroom suites