

# Automatic safety



**Mike Lyons of SenTAG unveils an alternative automatic safety system**

Swimming pools are safe. Millions of pool visits every year and a declining number of deaths surely underpins this fact, albeit perhaps now we should also be looking at the incidence and outcomes of 'near drownings' with more concern. 'Near misses' may not be recorded as formally, but a proportion of them are just as devastating for those involved and it is believed that they now greatly outnumber deaths. But this is perhaps a topic for another day. What we can say is that overall the level of risk for bather and operator alike appears relatively low. So just why should we be interested in improving on an 'acceptable' state of affairs and what exactly is possible?

The argument is similar to that surrounding airline travel. We know it is relatively safe already, but we also believe we should be looking to improve matters further. People still end up as casualties and much of the time it's still down to 'human factors'. It's also in our nature to 'raise the bar' whenever we can, especially when practical solutions are cost-effective. Until recently, this has meant considering factors such as physical pool features, permitted usage, supervisory staff training and so on. Today we can add 'active' technology to the list and, in fact, are encouraged to do so.

Even in the most humble modern car, seat belts, airbags, and ABS are all now 'standard' when once they were viewed as 'exotic', unnecessary and expensive. Furthermore driving abilities are also arguably higher today on our roads, the result of more exacting training and testing than in the past. There are obviously some parallels here with pool safety. The main difference between the two is that improving car safety still further largely relies on technological innovation. Pool safety, in contrast, is still mostly determined by the skill and diligence



of individuals and, as yet, little technology has been applied that might improve the 'success rate'. So, can technology really help?

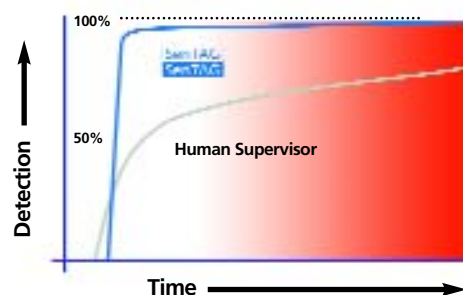
I'll risk a generalisation here and state that human supervision can be superior to 'technology' in nearly all circumstances. Humans can often anticipate trouble and the mere presence at poolside of a supervisor may inhibit unsafe behaviours as well. But before we move on, note that I've qualified the statement with 'can'. The problem of human supervisors is that they are exactly that – they are 'human'. They are not infallible and can fall short of what is really needed. The simple truth is that despite training, despite good intent and motivation, we/they occasionally fail to detect pool incidents early enough to make the difference. This is not criticism, simply observation. Some might say supervisory staff are being asked to do something that, in reality, is simply not possible – to be as capable over the long term as they might be in the next half hour when told they are being assessed themselves. We set and expect zero failure by the pool supervisors and insist on instant detection. It's simply not their fault that we as a species, while highly adaptable, find consistent 'watching' over long periods of time difficult.

Physiologically we humans have some issues to confront when it comes to basic 'incident detection'. We are 'event-driven' creatures and the timescales involved in routine supervision of pools do not correspond with the way we have evolved. The periods between 'incidents' requiring intervention are highly variable and not necessarily measured in seconds or minutes either. Training goes some of the way to keep supervisors alert, but still we can get bored, distracted, and less attentive than is needed. Add to this the well-recognised problems

associated with the constant visual interpretation of human behaviour in all its complexity, physical factors such as surface reflections, water clarity, high temperature, humidity and noise, and it is easy to see why sometimes those in difficulty are missed or spotted first by other bathers. Effective detection and reaction times can vary enormously as a consequence.

Once an incident is 'recognised', however, human supervisors are exceptional. When they know an incident is in progress, they quickly appraise the situation and react – their training cuts in and they do a fantastic job. This is both the reality and the paradox that we face today. Technology is therefore aimed at addressing the 'incident recognition' side of the pool safety equation, the holy grail of which is 'early' and 'automatic detection' of bathers getting into difficulty. If we accept the limitations of human observation as outlined above, this implies backing pool supervision practices with some degree of technology where we can run or acceptance of the current odds. Ideally, we must highlight 'events' requiring human assessment, with the 'system' acting as a 'secondary safety net' whenever needed. We hope the supervisor identifies the incident first, but we provide automatic back-up to be sure. Smoke and other common alarm systems 'trigger' a contingency plan or reaction in much the same way. All too often though, innovation follows rather than precedes a serious incident – this is another 'human' characteristic.

Currently there are just two commercially available alternatives. The first to come to market was the Poseidon system. This used artificial intelligence (AI) to assess video images from cameras either placed over pools or below water mounted in the pool walls. It identifies 'objects' and notes their location within a notional 'grid'. If a bather remained in predetermined zones (for example, near the pool bottom) for an excessive period of time the system raises an alert. Over the past seven years or so, the company has installed around about 100 pools worldwide with a small



# systems in pools

number of these in this country. There are 1.4m operator-managed pools in the developed world.

The recent alternative is the UK-developed SenTAG system. This is based upon a bather-worn wristband that analyses depth, time and motion. Each unit runs its own multiple rules, set to determine the status of the individual bather. For example, the most basic rule applies simple depth and time thresholds – if the bather is below a set depth for a pre-determined limit the device transmits a wireless alert. However, it can also consider motion in conjunction with depth or in isolation. In many respects the ‘rule sets’ of the two auto-detect technologies are similar; they apply rules and alerts are raised by exception. The SenTAG rule set also considers rates of change and has variable alert thresholds that can be set for categories of individual bather. They can transmit alerts irrespective of water depth, proximity to pool boundaries, the visual background or bather position or motion emulating closely the way a human poolside supervisor makes assessments.

As ‘object recognition’ and tracking is not necessary, SenTAG’s architecture is less computationally complex – the key ‘intelligence’ is largely distributed to the individual. It works in conditions where ‘line of sight’ could be a limiting factor as with a visually-based system, or where the overall visual backdrop is excessively complex and confused or even where there is a degree of water motion. This means it can work in shallow or deep water, indoor or outdoor pools, and in quiet or ‘busy’ pools. Its distributed architecture means that as the number of bathers increases, additional processing power is added as more and more wristbands are issued.

The SenTAG project started in earnest in 2004, initially with DTI support that produced concept demonstrators and an exacting specification developed with input from several leading pool operators. Later private investors were attracted and have funded the development of the novel technology since late in 2004. The project objectives were to develop a practical, economic wristband based system suitable for both regular supervised and non-supervised pools, such as those found in smaller hotels. The work has required the growing team to work with two key university departments and a multitude of specialist suppliers both in the UK and overseas. By late 2005, pool testing of the production version had commenced and the decision to go to full production was made recently in November 2006.

Both auto-detection technologies are intended to act as back-ups to traditional supervision, significantly raising the probability that those in difficulty are detected early. Although human supervisors detect many incidents in sufficient time, inevitably some are identified ‘late’. There is a typical ‘long tail’ distribution, where human ‘time to detect’ is concerned and within this long tail the most serious incidents are found. The only difference usually between a ‘minor’ incident and ‘serious’ one is time to detect.

Humans can detect some incidents earlier than rule-based technology, as we have argued, some around the same time and, unfortunately, some a lot later. SenTAG is intended to spot in excess of 97.5 per cent of problems within 15 seconds.



Critically though, SenTAG exhibits a much shorter detection ‘tail’. Virtually all incidents are identified around the target time and the average time is lower overall. In reality, the system can operate considerably shorter ‘time to alert’ thresholds if desired, but the 15-second target response time is felt to be a good compromise figure.

The case for technology, however, is not necessarily a mutually exclusive one. Together human and a wristband alert system provide a greatly improved safety margin, one that sidesteps the ‘long tail’ response times that humans alone produce.

In situations where pools are unsupervised for whatever reason, typically smaller commercial ones, wristband technology can obviously play a part as well. SenTAG can be used to call a duty ‘first responder’ to pool automatically when needed in place of sole reliance on periodic inspections and ‘other swimmer’ generated alerts.

The limiting factor with solely human supervision is consistency, especially over the extended period. If you tell a poolside supervisor that within the next 5 minutes there will be a detection test, they should beat ‘technology’ every time. But their typical response over the long term,

when they do not know ‘when’ or even ‘if’, is very different. Poolside supervision is concerned with periods of relative inactivity, possibly measured in weeks, months or even years between ‘incidents’ requiring timely intervention. However, the critical incident could be in the next two minutes.

Wristband-based detection may become an everyday bathing experience in the future. For the bather they are no more inconvenient than a locker wristband and it is relatively simple to combine the functionality of locker key and even access control technology within a single unit. For the operator, a basic system installation does not require major building work and can be completed in only a few hours. No cabling needs to be brought to the pool wall and the self-powered pool receiver units take no more than 30 minutes to install. When ‘alerting’, wristbands transmit a high frequency ultrasonic signal well above the limits of human hearing. Filtered signal alerts are then retransmitted by radio to a wall-mounted system unit powered via a 12v DC supply. These units further analyse received signals and can output both visual and sound indication. They have an integrated keypad and display and/or data can be reviewed remotely on a standard PC and/or they can be linked to pre-existing alert/alarm circuits. Static or roaming supervisors also carry ‘pagers’ that bring an alert direct to them and through which they can remotely cancel alerts following investigation.

Automatic detection of incidents should mean that the vast majority of incidents are picked up earlier. Detection technology does not replace human involvement, as physical intervention remains a human preserve. However the critical difference is that the average time for ‘reaction’ can be significantly reduced. Pool risk assessment can and should today take the impact of available technology and its interaction with other measures into account.

Automatic detection systems cannot always ‘solve’ all outstanding pool safety issues. But as costs fall and practicality rises, auto-detect and supervision (ADS) pools will become much more common. If the financial case becomes strong enough, the default position switches to one of general adoption – it’s the smoke detector experience. We now have to evolve ways of integrating technology with the best pre-existing practice.

Humans do a great job in relation to pool safety despite all their limitations. But ‘better’ is not just desirable; today it’s fast becoming both possible and affordable.