

The Intelligent Public Swimming Pool

Category

Facility Management

Context

Swimming is one of the most popular sports in the world. Every day thousands of public swimming pools are utilised by people for swimming lessons, fitness, training, racing and other water sports. The management of a public swimming pool must be highly focussed on health and safety to operate successfully. Water quality must be maintained to a high standard and water safety must be constantly monitored. Mechanical pumps, heaters and filtration devices must be operational 24/7. Today, much of the time and effort required to run the pool is typically manual and relies on routine tasks without the use of technology. Using IoT there is opportunity for more efficient operations, better water quality, lower running costs and most importantly - improved safety monitoring.

Summary of Idea

The Intelligent Public Pool significantly extends on the traditional, manual approach for monitoring and managing the health and safety of public swimming pools.

The Intelligent Public Pool uses cameras, air & water quality sensors, equipment sensors & heat and light sensors to monitor and measure a range of the facility attributes. Data is streamed and collected, predictive analytics is used to manage and improve air and water quality, mechanical pump maintenance and staffing requirements. Current and trend information provides transparency to management and the public. New, real-time information allows for better decision making. Profitability will be traceable to ideas and improvements provided by IoT.

Detailed Ideas

Water Quality

Monitoring

There are a number of water quality tests that are undertaken manually by pool management on a regular basis. A single sensor could be installed in the motor room of the pool, regularly sampling the incoming pool water as it is pumped out of the pool and before filtration occurs. The types of tests that are typically performed include:

- Chemical testing: pH level, Free available Chlorine, Bromine, Oxidation Reduction Potential. Cyanuric acid,
- Microbiological testing: Heterotrophic Plate Count, E.Coli, Pseudomonas aeruginosa

Results are streamed to the edge for analysis against prior results and compared to known thresholds. This allows for faster response to increase in microbiological activity or adjusting chemical levels when they are too high or low.

Application of Chemicals

All swimming pools are required to add chemicals to swimming pools to ensure bacteria are controlled to acceptable levels. By recording the quantities, dates & times when chemicals are applied, predictive analysis can be used to determine how these chemicals are affecting water quality. In the longer term as the algorithm learns from data, predictions can be made to the quantities and mix of chemicals that should be applied with the aim to optimise water quality while minimising the quantity of chemicals applied. Ultimately, this will reduce the costs of chemicals while also guaranteeing public safety (lower chemical use is better for people and the environment).

Water Temperature

Several temperature sensors located in the swimming pool (possibly in corners, sides and bottom) can be used to monitor changes in temperature and locate areas where water circulation is poor. It can also be used to more intelligently control any pool heating and provide the current average temperature to the public via a website.

Air & Light Quality

Monitoring and Alerting

Indoor pools are typically heated (and even if not), chemicals will be present in the air. Air quality can be measured to ensure safe conditions exist. Alerts would be created to inform management when tolerances have been reached, so that ventilation can be improved. Sunlight is a contributing factor to microbiological activity in the water, but artificial light adds to energy costs. Light monitors will feed into the machine learning algorithms to allow management to optimise the best mix of sunlight and artificial light, assuming the option exists to control these.

Pool Safety and Utilisation

Pools will be utilised throughout each day to varying levels. Typically mornings and afternoons will have peak times with a lull during the day. Camera(s) installed at a high point to monitor over the pool will be used to intelligently determine the following:

Count of people in the pool

This will assist in pool management. Based on time of day, seasonal patterns and weather forecasts, analysis will be able to predict the requirement for upcoming staffing levels, allowing for more accurate rostering of staff and reducing costs. Potentially, real time counts of bodies in each swim lane could be provided to the public, allowing people to decide whether it is a good or bad time to head down to the pool. This will help to naturally regulate the crowd size.

Monitor bodies

A more advanced potential is to monitor for unusual or dangerous body movement. By recognising human movements that indicate the potential for harm, predictive analysis may be used to alert management in a control room. Although it is expected that a lifeguard on duty would already notice such possibility, this capability would ensure that nothing is missed. However it's acknowledged that it will take time & effort to teach the algorithm what an unusual or dangerous situation is. However the value is that it provides confidence that injury or drowning may be prevented.

Monitor Lifeguard Supervision

An optional safety measure would be to detect the number of lifeguards on duty in the swimming pool area using RFIDs. This could be used to detect the unlikely situation where people are in the pool without any lifeguard on duty within the facility, alerting management that this needs immediate attention.

Mechanical Maintenance

Pools use mechanical pumps, heaters and filtration devices and ideally these should operate without failure, so maintenance and monitoring is essential. When such equipment does fail, it usually means the pool will close to the public, causing disruption. Often the equipment is left working overnight. Sensors to monitor equipment & motor room temperatures, water flow & electricity consumption would provide the potential for alerts when normal measures are exceeded. Predictive analysis can have an impact with equipment utilisation as well. For example it's possible that the flow of water pumped through filtration systems could be slowed when the pool has low utilisation and increased slightly before and after peak periods.

Weather information and Predictive Analysis

There are several reasons why the outside weather conditions will affect facility management of a swimming pool, even if it is an indoor pool. On hot days people are far more likely to head to the pool to cool down. In winter, fewer people swim. The temperature and humidity levels may affect air quality and operations of mechanical equipment. Therefore all predictive algorithms should use external data for outside temperature and humidity into consideration for utilisation predictions.

Profitability

The Intelligent Public Swimming Pool solution would not be complete without including profitability data. While many facilities will be publicly owned and not-for-profit, it will be wise to feed the revenues earned and costs incurred into the central database for further analysis. This will allow measurement of the improvements obtained through the digital transformation.

Analytics

Management Dashboard

A pool management dashboard would be used to bring all of the relevant information together in a single view. It will provide real-time measures and statistics, alerts and camera viewing. The dashboard will be designed for a single person in a control room to have a complete understanding of the current situation

Predictive Reports

As mentioned above, there are several opportunities for predictive analytics using machine learning. High level suggestions will be linked to the management dashboard while detailed information will be available as standalone apps.

Trend Reports

Over time it will be useful to track trends in water & air quality, mechanical performance, pool attendance and profitability.

Public Website

The public will also be able to see live information about the pool, including current pool attendance & number of people in lanes, water & air quality.

Summary

The Intelligent Public Swimming Pool uses several types of physical sensors, cameras to provide a wealth of information about water quality, air quality, light, temperature, chemicals applied, machinery operation, people in the pool, staff locations. The data is streamed via SAP Edge Services to SAP Cloud, where we bring together all of this information for further predictive analytics and reporting in a management dashboard, supporting reports and a public website.

The result is a highly-utilised, digitally transformed public asset that has been vastly improved.