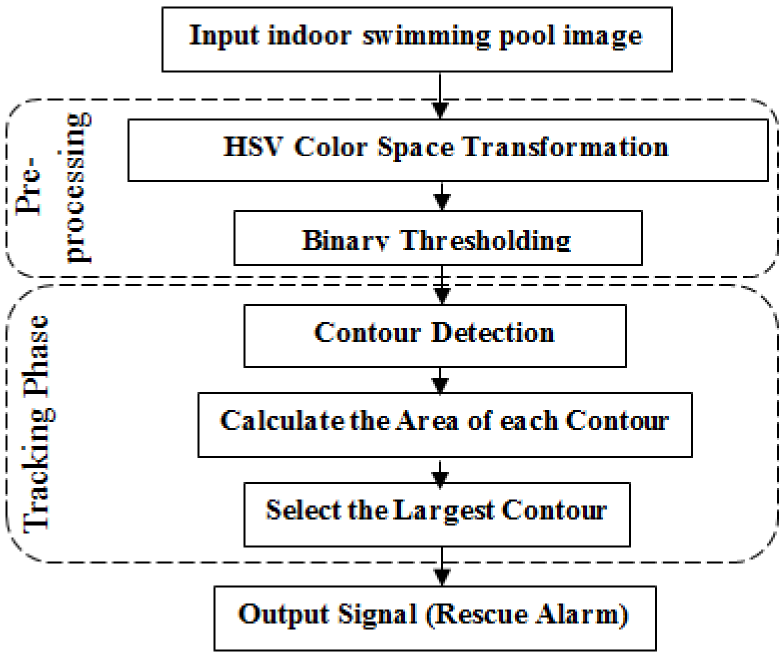
LITERATURE SURVEY ON PROJECT

Nasrin Salehi and Maryam Keyvanara: Safety in swimming pools is a crucial issue. In this paper, a real time drowning detection method based on HSV color space analysis is presented which uses prior knowledge of the video sequences to set the best values for the color channels. Our method uses a HSV thresholding mechanism along with Contour detection to detect the region of interest in each frame of video sequences. The presented software can detect drowning person in indoor swimming pools and sends an alarm to the lifeguard rescues if the previously detected person is missing for a specific amount of time. The presented algorithm for this system is tested on several video sequences recorded in swimming pools in real conditions and the results are of high accuracy with a high capability of tracking individuals in real time. According to the evaluation results, the number of false alarms generated by the system is minimal and the maximum alarm delay reported by the system is 2.6 sec which can relatively be reliable compared to the acceptable time for rescue and resuscitation.

One important environment that the need for monitoring systems is crucially sensed is the swimming pool. Each year many people including children are drowned or very close to drowning in the deeps of the swimming pools, and the life guards are not trained well enough to handle these problems . This raises the need for having a system that will automatically detect the drowning person and alarm the lifeguards of such danger. Real-time detection of a drowning person in swimming pools is a challenging task that requires an accurate system. The challenge is due to the presence of water ripples, shadows and splashes and therefore detection needs to have high accuracy.

In swimming pool monitoring intelligent systems, different approaches have been proposed. Most methods perform background processing on input video frames. Some apply background subtraction and image denoising to detect the drowning person [8, 9]. In [9], a Gaussian Mixture Model is used for describing the pixels and the parameters of the model are updated with the EM algorithm.



Victoria Laxton and David Crundall: One under-researched area of application however is that of lifeguarding. Lifeguards have an important, but extremely difficult job of supervising swimmers in a pool or beach setting. This includes searching for any swimmers that may be experiencing distress or drowning in the water. Explicit practical training in visual search of a pool is not currently part of lifeguard training in the UK, though search techniques are discussed with trainees (e.g., how to monitor a particular "zone"). Beyond problems with limited training, the swimming environment makes scanning difficult due to factors such as heat, long periods on duty and a large overlap in drowning and swimming characteristics (Griffiths & Griffiths, **2013**; Lanagan-Leitzel, Skow, & Moore, **2015**). While drowning in lifeguarded pools within the UK is incredibly rare, there are instances where supervision fails, resulting in injury or death. To prevent these fatal incidents, UK lifeguards are trained to recognize certain behaviours that are associated with drowning and distress.

A common form of drowning behaviour is termed *active drowning*, where targets typically display the *Instinctive Drowning Response* (Pia, **1974**). These swimmers will usually be vertical in the water, with their arms flailing and splashing the water. The head will typically submerge and re-emerge and will be usually tossed back as the swimmer gasps for air. They will have no forward propulsion through the water and are unlikely to respond to shouted instructions. This struggle will last for as long as the person's energy permits, however research suggests a 60 s struggle is typical before energy is fully depleted. In non-swimmers and children this struggle may only last for 20 s (Pia, **1974**). Swimmers in a crisis stage of drowning will not be able to call for help, as breathing takes precedence (Doyle & Webber, **2007**).

Although lifeguards are taught to recognize characteristics of drowning and distress, these behaviours are not always indications that a swimmer is in trouble. For example, splashing or submersion on their own are also common in swimming play behaviours, or even in swimmers with a weak technique. The lifeguard needs to be flexible in appraising these behaviours. Lifeguards also need to be aware of behaviours that could lead to drowning and distress, such as dangerous behaviour, poor swimmers entering deep areas of water, or otherwise vulnerable swimmers. These complexities have led to lifeguards differing in opinion in regard to which behaviours and events are critical. Lanagan-Leitzel (**2012**) found that when watching video footage of people swimming at a leisure facility, lifeguards disagreed on the events that should be rated as critical and in need of monitoring. Trainers reported nearly double the number of critical events compared to the lifeguards, however there was limited consistency in the different events reported. The events that were reported by the majority of lifeguards and trainers were also reported by a large number of non-lifeguard participants, suggesting that salience of many critical events was more important for detection than expertise.