Virtual Eye - Life Guard forSwimming Pools to Detect Active Drowning

LITERATURE SURVEY

S.NO **CONTENTS**

1.INTRODUCTION

Recently, there has been growing interest around the topic of drowning detection systems (DDS) in the sport and leisure industry both across the UK and globally. Advancements in technology, coupled with the importance of pool safety, has led to its growing prominence, with mention of DDS now in documents such as HSG179 - the latest UK standards document for health and safety in swimming pools (Health and Safety Executive, 2018). However, the topic is a debated area for various reasons explored in this review.

Whilst there are plenty of academic articles dedicated to the technology and design behind these products in the fields of biometrics, computer science and electronic engineering, there is limited academic research investigating their application to real-world scenarios. Furthermore, there is uncertainty around their use alongside traditional lifeguarding; whether international testing standards (ISO standards) are robust enough; and general risks affecting the effectiveness of these products. This includes factors such as water clarity, high pool occupancy, lighting, glare and attractions such as water slides and wave machines. These concerns alongside the lack of research and high installation costs have resulted in a reluctance by some operators to incorporate DDS into their pools. This signifies the importance of independent research into DDS. Along with the specific aims outlined in chapter 2, this literature review intends to support the move towards the shared goal of improved pool safety.

This piece will begin with an overview of the different definitions of DDS, followed by an explanation of the aims and methodology of this review. It will then discuss what the current DDS standards are alongside legislation and guidance available around DDS, and provide a summary of the shared responsibilities towards the effective operation of DDS. Following this, the literature review will examine the co-existence between DDS and traditional lifeguarding, provide an analysis of its impact so far, and conclude with recommendations on the direction of future DDS research.

2.DEFINITIONS

Of the differing definitions of DDS, most outline three defining elements: 1) surveillance, 2) detection of a pool user in difficulty, and 3) raising an alarm (Health and Safety Executive 2018, ISO 2017). For example, ISO_20380 (the document published by the International Organisation for Standardization (2017) outlining the international safety requirements and test standards for DDS) defines the technology as an ‘automated system including means for digitizing series of images of people in the pool basin, means for comparing and analysing digitized images and decision means for setting off and sending an alarm to trained staff when a detection occurs’. In comparison, there are broader definitions that are inclusive of 8 DDS Research Project other technologies that focus on the surveillance aspect, for example, ‘DDS is used to describe various electronic

systems that are designed to assist with the surveillance of swimmers within the water of a swimming pool' (Sport England, 2011).

This definition would include CCTV that helps give lifeguards an underwater view but does not have the capacity to detect a pool user in difficulty or raise an alarm. For this to be effective, staff would have to make sure the CCTV is being monitored at all times, making the staff experience with this very different to the experience of using a DDS falling under the first definition. It is important to distinguish what exactly constitutes a DDS as there are different areas of responsibility required from different actors involved in the effective operation of DDS, which will be examined in chapter 4. For this literature review, research has focused on the definition used by the ISO and other sources that incorporate all three elements of surveillance, detection and alarm raising.

3.AIMS AND METHODOLOGY

AIMS

This literature review aims to:

i) Establish and outline what is known on Drowning Detection Systems.

ii) Evaluate the current literature on Drowning Detection Systems, including their use in indoor pool environments along with interaction with traditional lifeguarding.

iii) Better understand where DDS are positioned in the health and safety landscape of indoor swimming pools.

The value that can be generated from these aims stem from the recognition that currently, there are no published documents drawing together all the current DDS research. The literature review aims to contribute as independent research in this field and hopes to signpost the potential future direction of DDS research.

4.METHODOLOGY

The methodology of this review began with establishing a search plan. This involved generating a list of key search terms. As DDS are a global concept, it was important to consider the various synonyms and acronyms under which they are known. The sources identified were then shortlisted according to relevance and reviewed, keeping in mind the potential for bias in market based literature, or literature drawing from funded research that may compromise its partiality. The literature review draws from a range of sources including standards documents from international and national bodies, reports, academic articles, books, online articles, and news reports. To supplement this, a group of key stakeholders involved in pool safety were consulted to signpost towards any sources that were felt to be relevant to this review. Sources on DDS in outdoor environments are beyond the scope of this literature review and have been excluded due to the challenging variance compared with indoor swimming environments.

3. LITERATURE REVIEW

The following is a brief description of the work published by researchers on drowning prevent and avoid devices.

Mr.A.Roy proposed wearable swimming goggles with a hydrophone, a buzzer is in outside water pool .Hydrophones were sending alert to buzzer outside water. Implemented using Proteus software and demonstrated practically. Drop phones sound may be jammed by noise in public pools, and discomfort to the user to wear a mask type goggle. J.

Geetha Ramani proposed wearable inflatable wrist band system where a sudden unusual moment of a swimmer is detected with an accelerometer and a manual switch, programmed in a PIC microcontroller. This will not cover most of the drowning cases. Limited to few cases of drowning are covered.

M. A. Hayat proposes a technique to detect a drowning personin the swimming pool using video image frames. A-frame by frame difference VIBE algorithm is used to detect drowning persons is demonstrated used to determine the swimmer's position.

H. Liu proposed an arrangement of underwater communication devices like Hydraulic Pressure Sensor, Ultrasonic Sensor to continuously monitor the location of the swimmer and learning the motion behavior of the swimmer is done. Hydraulic pressure is going to sense how deep the swimmer in submerged by 3D

positioning of the swimmer. With the technique, the system is going to send a distress alarm signal to an outside system to turn alarm ON.

S. Sindhuja has proposed an embedded system of the water pressure sensor and GPS system to send SMS alert to monitoring person and actuation of the airbag, an accelerometer is also used to detect unusual motion of swimmer in the event of suffocation. Its a wearable system where power supply and continuous pressure monitor in water and, gas level checking is needed ..Suffocated swimmer will not move so rapidly in all the cases and may fail to detect drowning. It is not useful in a person going sudden unconscious, breathing diseases in the event of failure of airbag failure.

Yaswanthkumar S K ; Praveen O K have proposed a device combining SONAR and thermal-detection sensors to automatically detect the location of a living person inside the water body. SONAR is an underwater communication signaling system including image processing techniques along with thermal imaging system with image processing system together used to track a human body under water is proposed.

Muhammad Ramdhan MS1 , Muhammad Ali2 proposed a headband type wearable IoT device to detect a heartbeat pulsed from pulse-oxytomertic sensor .The sensor data is continuously detected by the controlling station outside swimming pool and transmitted to a mobile phone by internet protocols. The event of danger is detected by calculating absence of signal reception after 30 second to the out of pool

control unit built by RASBERRY pi system meaning that water is abstracting signal since water does not allow RF signal transmission .It is merely a signal sending wearable device by which an alert to alarm system and mobile alert.

A. Kulkarni has proposed a system which depends on a force sensor(piezoelectric), humidity/wet sensor and a muscular oxygen saturation detection device to evaluate early detection alarm of drowning accident using embedded processor.

Y. Nishida proposed a spherical sensor setup to detect a baby fall into any water body. It is supposed to float on water and notify an abnormal wave pattern to recognize drowning accident. It is a wearable glass sphere and difficult to classify accidents from false alarms. CAI

Xiaoyang proposed an image processing technique based on image restoration with a robust estimation method. Underwater video CC cameras were assumed in the article. A combination of image processing techniques helped to locate an underwater human body with all noise associated with water surroundings

4.CONCLUSION

This literature review has discussed the various complexities of DDS within the health and safety landscape, as well as the wider implications of their use on the sport and leisure industry. It has also shed light on needed for more evidence in this area. From reviewing what literature

currently exists on the topic, it is clear the evidence-base would benefit from qualitative research on the experiences of lifeguards and their interactions with DDS, as well as quantitative evidence showing DDS application to real-world scenarios. Claims expressing the risks of DDS negatively affecting lifeguarding performance should also be further investigated, and efforts made across the industry to ensure all publicly available information and guidance surrounding DDS is current and up-to-date.

The Drowning Detection System Briefing note (Sport England, 2011) was published before documents such as HSG179 (4th edition), which is periodically updated, and ISO_20380 – operators should ensure that the sources they are using for DDS research do not draw from predated editions of health and safety law and guidance. Again, co-operation is required between all with an interest in the improvement of pool safety, to share data, information and learning on DDS, including but not restricted to results and findings from any DDS standards tests carried out. For by building and maintaining a robust evidence-base in this area, policy makers, operators, and suppliers can feel confident in their decision-making around the improvement of safety in public swimming pools.

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