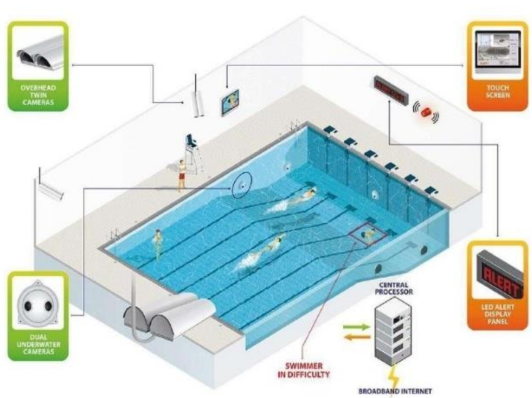
1 INTRODUCTION

1.1 Overview

Swimming is one of the best exercises that helps people to reduce stress in this urban lifestyle. Swimming pools are found larger in number in hotels, and weekend tourist spots and barely people have them in their house backyard. Beginners, especially, often feel it difficult to breathe underwater which causes breathing trouble which in turn causes a drowning accident. Worldwide, drowning produces a higher rate of mortality without causing injury to children. Children under six of their age are found to be suffering the highest drowning mortality rates worldwide. Such kinds of deaths account for the third cause of unplanned death globally, with about 1.2 million cases yearly. To overcome this conflict, a meticulous system is to be implemented along the swimming pools to save human life. By studying body movement patterns and connecting cameras to artificial intelligence (AI) systems we can devise an underwater pool safety system that reduces the risk of drowning. Usually, such systems can be developed by installing more than 16 cameras underwater and ceiling and analyzing the video feeds to detect any anomalies. But AS a POC we make use of one camera that streams the video underwater and analyses the position of swimmers to assess the probability of drowning, if it is higher than an alert will be generated to attract lifeguards' attention.

1.2 Purpose

The system is not designed to replace a lifeguard or other human monitor, but to act as an additional tool. “It helps the lifeguard to detect the underwater situation where they can’t easily observe. Life Guard is a drowning detection system that detects every dangerous situation and accident. The software works in close integration with the cameras installed in the pool to continuously scan the pool. Thanks to this combination of hardware, software and profound innovations, today Life Guard represents excellence in drowning detection.



>> Establish and outline what is known on Drowning Detection Systems. >> Evaluate the current literature on Drowning Detection Systems, including their use in indoor pool environments along with interaction withtraditional lifeguarding.

>> 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.

2 LITERATURE SURVEY

Of the differing definitions of DDS, most outline three defining elements:

1) surveillance,

2) detection of a pool user in difficulty

3) raising an alarm

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 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 includeCCTV 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 alltimes, making the staff experience with this very different to the experienceof using a DDS falling under the first definition. It is important to distinguishwhat 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.

2.1 Existing problem

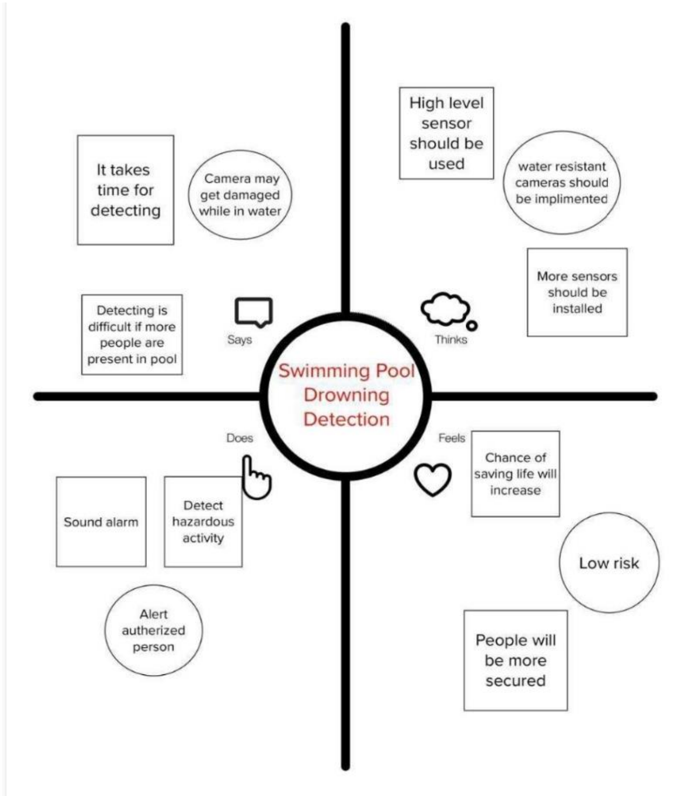
Whilst literature on DDS mostly agrees on areas such as the risks and issues associated with DDS performance, there are other areas where sources offer differing points of view, for example, DDS and their co- existence with lifeguards. There is debate around whether DDS can be helpful or harmful towards lifeguarding practices and how DDS may changethe landscape of traditional lifeguarding, as well as some disagreement on whether they serve as justification for reducing lifeguard numbers. The term ‘blended lifeguarding’ or ‘modern lifeguarding’ has been newly coined to describe the concept of traditional lifeguarding practices being blended withtechnology for drowning detection (Swimming Pool Scene, 2017). Currently, there is little qualitative or quantitative research analysing the experiences of lifeguards themselves relating to this concept.

2.2 Proposed solution

S.No.	Parameter	Description
1.	**Problem Statement (Problem to be solved)**	VirtualEye - LifeGuard for Swimming Pools To Detect Active Drowning.
2.	**Idea / Solution description**	Swimming is one of the best exercises that helps people to reduce stress in this urban lifestyle. Swimming pools are found larger in number in hotels, and weekend tourist spots and barely people have them in their house backyard. Beginners, especially, often feel it difficult to breathe underwater which causes breathing trouble which in turn causes a drowning accident so In This is project a Accurate Pulse Rate of every individual swimmer is also detected and sended as signal to the LifeGuard through alert message so it help LifeGuard to do earlier prediction of a swimmer pulse rate is reduced or increased By doing this they can get alert in advance and can save more then one person from Drowning.
3.	**Novelty / Uniqueness**	Accurate pulse rate detection using Deep learning.
4.	**Social Impact / Customer Satisfaction**	In case of an incident it is possible to extract and store not only the videos but also Pulse rate of a victim so it will be usefull to indentify the reason behind his/her drowness.
5.	**Business Model (Revenue Model)**	Can generate revenue from direct customers,like Lifeguard and collaborate with maritime sector and other swimming pool authorities.
6.	**Scalability of the Solution**	Deep learning Algorithm for the Pulse rate detection : It helps the LifeGuard for earlier prediction of drowning along with the Reason behind his/herdrowning.

3 THEORITICAL ANALYSIS

3.1 Block diagram



3.2 Hardware / Software designing

Hardware requirements:

1. Camera : You will need a camera system to capture real-time video footage of the swimming pool area. The camera system should provide a clear and high-resolution video feed.
2. Storage: Sufficient storage space is necessary to store the video footage for future analysis, if required.
3. GPU (optional): While YOLOv5 can run on a CPU, using a GPU can significantly accelerate the inference speed. If you choose to utilize GPU acceleration, ensure that your computer has a compatible GPU with sufficient VRAM (Video Random Access Memory) for your specific model size.

Software requirements:

1. Operating System: Choose an operating system that is compatible with the software tools and libraries you plan to use. Popular options include Windows, Linux, or macOS.

2.Python: YOLOv5 is implemented in Python, so you will need to have Python installed on your computer.

3. YOLOv5: Clone or download the YOLOv5 repository from the official GitHub page (https://github.com/ultralytics/yolov5). This repository contains the necessary code and scripts for training and deploying YOLOv5 models.

4.Deep Learning Libraries: Install the required deep learning libraries such as PyTorch and torchvision. These libraries provide the backbone for YOLOv5 and enable training and inference with custom datasets.

5.Annotation Tool: Use an annotation tool like LabelImg, RectLabel, or VGG Image Annotator (VIA) to label your swimming pool images and annotate the active drowning regions. This step is crucial for training a custom YOLOv5 model.

4 EXPERIMENTAL INVESTIGATIONS

While working on the solution for a YOLOv5 custom trained model for VirtualEye-Lifeguard to detect active drowning in swimming pools, several important analysis and investigations need to be conducted. Here are some key aspects to consider during the development process:

1. **Data Collection and Annotation:** The first step is to collect a diverse and representative dataset of swimming pool images or videos that encompass different lighting conditions, pool layouts, and potential active drowning scenarios. The dataset should be carefully annotated, marking the regions of active drowning within the pool. The accuracy and quality of the annotations significantly impact the performance of the model.
2. **Dataset Size and Quality:** Analyze the size of your dataset to ensure it is sufficient for training a robust and accurate model. Larger datasets generally yield better results, but it's important to strike a balance between dataset size and the available computing resources. Additionally, evaluate the quality of annotations to minimize errors or inconsistencies.
3. **Model Architecture Selection**: YOLOv5 provides different model architectures (e.g., YOLOv5s, YOLOv5m, YOLOv5l, and YOLOv5x) that vary in terms of model size, accuracy, and computational requirements. Analyze the trade-offs between model size and accuracy to determine the most suitable architecture for your application.

4. **Hyperparameter Tuning:** Experiment with various hyperparameters such as learning rate, batch size, optimizer settings, and augmentation techniques to optimize the training process. Conduct systematic evaluations by training multiple models with different hyperparameter configurations to identify the best performing model.

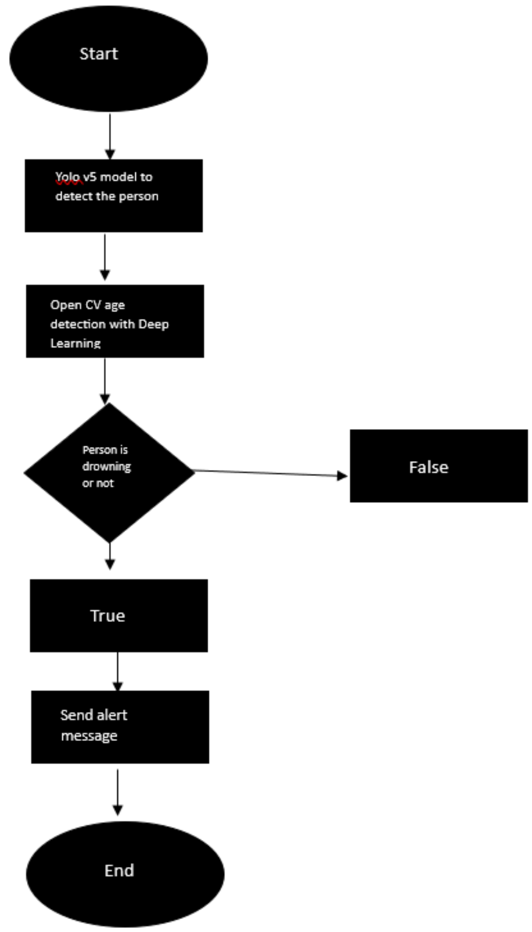
5. **Training and Validation Metrics:** During the training phase, monitor training and validation metrics such as loss, precision, recall, and mean average precision (mAP). Analyze these metrics to assess the model's progress and detect any potential issues like overfitting or underfitting.

6. **Model Evaluation:** After training, evaluate the performance of the trained YOLOv5 model on a separate validation or test set. Calculate evaluation metrics such as precision, recall, and mAP to measure the model's ability to accurately detect active drowning instances in swimming pools.

7. **System Integration and User Interface:** Evaluate the integration of the YOLOv5 model into the VirtualEye-Lifeguard system. Design and develop a user-friendly interface that allows users to view the video feed, receive alerts, and interact with the system seamlessly.

8. **Continuous Improvement:** Regularly analyze and evaluate the performance of the deployed system, gather user feedback, and identify areas for improvement. Monitor the system's performance over time and consider retraining the model with new data to adapt to changing conditions or improve accuracy.

5 FLOWCHART



6 RESULT

The results of a custom trained YOLOv5 model for VirtualEye-Lifeguard for Swimming Pools to detect active drowning would depend on various factors such as the quality of the training data, model architecture, training methodology, and the specific characteristics of the swimming pool environment. Here are some potential outcomes or results:

1. **Drowning Detection:** The YOLOv5 model can accurately detect instances of active drowning in real-time video feeds from swimming pools. It can identify individuals in distress, monitor their movements, and provide alerts or notifications to lifeguards or pool operators.

2. **False Positives and False Negatives**: Depending on the model's performance and the complexity of the swimming pool environment, there may be instances of false positives (detecting drowning when there isn't one) or false negatives (failing to detect a drowning incident). These errors can occur due to challenging environmental conditions, occlusions, unusual body movements,

or limitations of the model's training.

3 **Timely Intervention:** The model can enable lifeguards or automated systems to intervene promptly when a potential drowning incident is detected. This can help reduce response times and improve the chances of successful rescue operations.

4 **Reduction in Drowning Incidents:** By continuously monitoring swimming pool areas and providing early detection of drowning incidents, the YOLOv5 model can contribute to a reduction in drowning incidents. This can significantly enhance pool safety and save lives.

5 **Assistive Tool for Lifeguards:** The YOLOv5 model can act as an assistive tool for lifeguards, providing them with additional situational awareness and aiding in their decision-making processes. It can help lifeguards focus their attention on critical areas, allowing them to allocate their resources effectively.

It's important to evaluate and validate the performance of the custom trained YOLOv5 model in the specific swimming pool environment where it will be deployed. Regular monitoring, performance analysis, and model updates can help improve the accuracy and effectiveness of the system over time.

7 ADVANTAGES & DISADVANTAGES

ADVANTAGES:

1. user feel comfortable and more secure
2. Children, adult, pet animal , old age people are used
3. spending more time for family, freedom for safety guards near the Swimming pool
4. Swimmers, resort are gain in the financal
5. drowning should be monitored

DISADVANTAGE:

1.For uneducated people will suffer from this technology

2.Electricity will be required

3.Software and hardware requirement will need

8 APPLICATIONS

1 **Real-time Drowning Detection:** The YOLOv5 model can be deployed in a real-time surveillance system to monitor swimming pool areas. It can detect instances of active drowning by analyzing video feeds and identifying individuals in distress. This enables lifeguards or automated systems to quickly respond to potential drowning incidents.

2 **Early Warning System**: By continuously analyzing video streams from pool cameras, the YOLOv5 model can act as an early warning system. It can detect suspicious movements or behaviors that indicate potential drowning situations, such as extended periods underwater or irregular swimming patterns. This allows lifeguards to intervene proactively and prevent accidents.

3 **Automated Pool Monitoring:** The YOLOv5 model can be integrated with an automated pool monitoring system that alerts lifeguards or pool operators when instances of active drowning are detected. This reduces reliance on manual surveillance and enhances overall safety by providing timely notifications to respond to emergencies.

4 **Assistive Technology for Lifeguards**: Lifeguards can benefit from the YOLOv5 model as an assistive tool. By analyzing video feeds and highlighting instances of active drowning, the model can help lifeguards focus their attention on critical areas or individuals who require immediate assistance. This enhances their situational awareness and response capabilities.

5 **Training and Education:** The YOLOv5 model can be used as a training tool for lifeguards and pool staff. By analyzing historical video data, the model can identify common patterns and behaviors associated with active drowning incidents. This information can be used to develop training programs and educational materials to improve drowning prevention strategies.

9 CONCLUSION

This section will draw from three core documents: ISO_20380, HSG179, and the recently published German guideline, DGfdB R 94.15. A summary of each is given, outlining the key messages they disseminate and what this means for those involved with DDS.

ISO_20380 This document focuses on the requirements for the installation, operation, maintenance and performance of DDS, the testing methods, and the information required from the supplier in the operating manual. These international standards do not apply to systems used in domestic pools or pools smaller than 150m2 .

Prior to the installation of any DDS, ‘a technical study shall be carried out by the supplier in consultation with or based on information provided by the swimming pool’s owner/operator’. This is to establish the quantity and positioning of the equipment making up the system such as cameras, central processing unit, alarm tools, and other related equipment. The technical study must also provide a technical drawing of the pool basin, showing areas of ‘coverage’ and ‘noncoverage', as well as the minimum lighting levels required above and below the water surface for the DDS to operate within performance requirements. To carry out the study, a list of factors toconsider are given, outlining the variables that make each pool unique suchas the architecture, and alarm reception coverage area of mobile devices to be used with the system. With this information all in one document, the technical study can be used to help optimise performance of the system, andforms part of the contract between the supplier and the pool operator. The next area of the standard is the performance requirements. This outlines therequirements needed to pass the regular maintenance testing and performance requirements for normal operation. This section covers the alarm set off time for operational performance, which is to be 15 seconds orless and displayed on the system interface. It also states that the alarm set off time must be built- in and shall not be changeable by staff. The section also discusses the areas covered by the DDS and highlights that each trainedstaff member must be aware of these areas. Another coverage-related requirement is that the DDS must be able to temporarily create areas wheredetection is disabled, to manage specific activities such as rescue drills.

10 FUTURE SCOPE

This lifeguard system consists of three main components, i.e., the drowning detection, the rescuing drone, and the hazardous activity detection. All three components combined will create a system capable of detecting drowning victims, dispatching an inflatable tube using a drone (as depicted in Fig.9) and detecting hazardous activities—eventually becoming an entity that could assist a lifeguard. The system is accessible to its primary user, presumably a pool owner or a lifeguard, in the form of an interface with a sound alarm and an android mobile service that holds the capabilities of receiving Firebase notifications. Confined with a few of the hardware limitations, such as the use of a single camera and the Jetson Nano at the presence of better-quality hardware, could affect the speed and accuracy of the overall system is becoming a state-of-theart.
This limitation could be omitted with the use of multiple cameras that could be placed over the premises in several ground coordinates, increasing the accuracy of the computer vision algorithms. Moreover, due to the inability to fly a drone in extreme weather conditions such as rain, strong winds or lightning, the systemis limited to be used under few specifications. As swimming in extreme weather conditions is not preferred either, the system could be further improved to emit a warning signal if a person was to swim in any of the above weather conditions, bypassing the need to fly the drone. Additionally, all the processing is done on the clientside of the applications on the Jetson Nano board, preventing any security and privacy issues that might arise due to the sensitive information inputted through the cameras. For future developments convenience wise, the system could benefit by having an additional set of cameras to identify and verify a drowning or a hazardous activity on the

premises. Accessibility could also be improved by extending the Android service to be an application both in Android and iOS platforms that could hold the details of each premise individually, making a centralized system that watches over the decentralized pool premises. Both drown and hazardous activity detection could be improved by gathering a night time dataset that increases the accuracy of the data in low light.

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Alexey Bochkovskiy, Chien-Yao Wang, and Hong-Yuan Mark Liao. "YOLOv5: Unified, Real-Time Object Detection." arXiv preprint arXiv:2104.02143 (2021).

APPENDIX

https://github.com/YatharthSingh31/Virtual-Eye