**VIRTUAL EYE – LIFE GUARD FOR SWIMMING POOLS TO DETECT ACTIVE DROWNING**

**ABSTRACT**

In modern metropolitan lifestyle, swimming is one of the best activities for stress reduction. Swimming pools are more prevalent at hotels and weekend tourist destinations, and hardly anyone has one in their backyard. Beginners, in particular, frequently find it challenging to breathe underwater, which leads to respiratory issues, which ultimately lead to a drowning disaster. In the world, children under the age of six are determined to have the highest rates of drowning fatality, with about 1.2 million cases occurring each year. A rigorous mechanism must be put in place beside the swimming pools to save human life in order to resolve this dispute. To tackle this issue, design an underwater pool safety system that lowers the chance of drowning by analysing body movement patterns and integrating cameras with artificial intelligence (AI). Employ a single camera that transmits underwater video while analysing swimmer positioning to determine the probability that they would drown. If the probability is higher than normal, an alarm will be sent to catch lifeguards' attention. The system is intended to be an additional tool rather than to take the place of a lifeguard or other human monitor. The lifeguard can use it to detect situations under water that are difficult for them to notice. Deep Learning Technology used for detecting object in a swimming pool using YOLO algorithm.

1. **INTRODUCTION**
   1. **PROJECT OVERVIEW**

Swimming pool safety is a critical concern. This research presents a real-time drowning detection approach based on HSV colour space analysis that employs past knowledge of video sequences to choose the appropriate colour channel values. Our approach detects the region of interest in each frame of video sequences by combining a mechanism and contour detection. The provided programme can identify drowning people in indoor swimming pools and sends an alert to lifeguard rescues if the previously recognised individual is gone for an extended period of time. The provided method for this system has been evaluated on various video sequences acquired in real-world swimming pools, and the results are of good accuracy with a high capacity of monitoring persons in real time. According to the assessment results, the system generates few false alarms, and the greatest alert delay provided by the system is 2.6 seconds, which is relatively dependable when compared to the permissible time for rescue and resuscitation.

* 1. **PURPOSE**

On the basis of an underwater camera, propose a deep learning method for swimmer behaviour detection. Through the real-time gathering of underwater-related picture and data, this technology can properly detect the swimmers' swimming behaviour and drowning behaviour and alert the drowning behaviour. Swimming pools are safe thanks to lifeguards' increased ability to perform rescues.

1. **LITERATURE REVIEW**
   1. **EXISTING PROBLEM**

**2.1.1 TITLE: Helping to detect legal swimming pools with Deep Learning and Data Visualization, 2021**

**AUTHOR NAME: Bruno Lima**

One of the major challenges they encounter is dealing with the territory's constant and rapid changes in order to authenticate or licence them. However, much manual intervention is required. This paper describes a prototype system for detecting swimming pools in aerial images. It investigates and integrates artificial intelligence (AI), systems integration, and geographic information systems (GIS), and data visualization. The AI increases objective detection, and middleware facilitates the integration of detection results with other municipal systems for geo-referencing and private property data licensing data crossing. Visualization libraries were investigated in relation to the novel interoperability services, and a sophisticated visualisation and analysis system was built. A dataset of aerial images of swimming pools was created, along with the corresponding classification metadata. To obtain and compare precision results, the model was trained with several convolutional neural networks. The model that is more accurate is described.

**2.1.2 TITLE: Construction Method of Swimming Pool Intelligent Assisted Drowning Detection Model Based on Computer Feature Pyramid Networks, 2021**

**AUTHOR NAME: Keshi Li**

Intelligent aided drowning detection in swimming pools is an important research topic in the field of drowning rescue. A significant number of researchers employ an underwater intelligent monitoring system to track drowning targets in real time and use it to develop a dependable swimming pool intelligent aided drowning detection model to lower the danger of drowning. The prior detection methodology was difficult to adapt to the actual need due to the complicated underwater environment of the swimming pool. In this regard, the feature stratification of the swimming pool intelligent assisted drowning detection image is completed based on the summary of the previous swimming pool intelligent assisted drowning detection models and the computer feature pyramid networks, and then the final swimming pool intelligent assisted drowning detection results are obtained using the YOLO principle. Following analysis, it is confirmed that the accuracy rate of this method's swimming pool intelligent assisted drowning detection is significantly improved, which can provide effective data theoretical guidance for swimming pool intelligent assisted drowning rescue and has significant practical benefits.

**2.1.3 TITLE: Framework for Intelligent Swimming Analytics with Wearable Sensors for Stroke Classification, 2021**

**AUTHOR NAME: Joana Costa**

An intelligent data analytics system for swimmer performance is suggested in this paper. The system contains I raw signal pre-processing; (ii) wearable sensor and biosensor feature representation; (iii) online detection of swimming style and turns; and (iv) performance post-analysis for coaching decision assistance, including stroke counts and average speed. Wearable inertial (AHRS) and biosensors (heart rate and pulse oximetry) are used to support the system. Radio-frequency connections are used to communicate with the heart rate sensor and the station near the swimming pool where analytics are performed. Experiments were conducted in a real-world training environment with 10 athletes aged 15 to 17 years. This scenario yielded around 8000 samples. Based on real-time data analysis, the experimental findings reveal that the suggested system for intelligent swimming analytics with wearable sensors efficiently provides instant feedback to coaches and athletes. The suggested framework's value was shown by efficiently assisting coaches while monitoring the training of many swimmers.

**2.1.4 TITLE: Computer Vision Enabled Drowning Detection System, 2021**

**AUTHOR NAME: Tereen Prasanga**

In all swimming pools, safety is of the utmost importance. Because of technological aspects such as underwater cameras and methodological features such as the requirement for human participation in the rescue operation, the present solutions supposed to handle the challenge of assuring safety at swimming pools have considerable problems. The implementation of an automatic visual-based monitoring system can successfully aid to decrease drowning and ensure pool safety. This study proposes a breakthrough technique that quickly recognises drowning victims and launches an unmanned drone to save them. It can identify a drowning person in three phases using convolutional neural network (CNN) models. When such a scenario is discovered, the inflatable tube-mounted self-driven drone will launch a rescue operation, blasting an alarm to alert surrounding lifeguards. The technology also monitors for potentially harmful acts that might lead to drowning. The capacity of this technology to save a drowning person in less than a minute has been established in prototype experiment performance assessments.

**2.1.5 TITILE: A Survey of Deep Learning Techniques for Underwater Image Classification, 2022**

**AUTHOR NAME: Sparsh Mittal**

In recent years, there has been a great deal of interest in utilising deep learning to categorise underwater photos in order to detect diverse items such as fish, plankton, coral reefs, sea grass, submarines, and sea-diver motions. This categorization is critical for monitoring the health and quality of water bodies as well as conserving endangered species. It is also used in oceanography, maritime economics and defence, environmental protection, undersea exploration, and human-robot collaboration work. This study provides an overview of deep learning algorithms for underwater picture categorization. We highlight the similarities and contrasts between various strategies. We believe that underwater image classification is one of the killer applications that will put deep learning techniques to the ultimate test. This survey aims to inform researchers about the state-of-the-art in deep learning on underwater images while also motivating them to push its frontiers forward.

* 1. **REFERENCES**

[1]. Bruno Lima, Helping to detect legal swimming pools with Deep Learning and Data Visualization, 2021

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[3]. Joana Costa, Framework for Intelligent Swimming Analytics with Wearable Sensors for Stroke Classification, 2021

[4]. Tereen Prasanga, Computer Vision Enabled Drowning Detection System, 2021

[5]. Sparsh Mittal, A Survey of Deep Learning Techniques for Underwater Image Classification, 2022

* 1. **PROBLEM STATEMENT DEFINITION**

In existing system, surveillance systems deliver valued information in monitoring of large areas. Applying intelligence in video surveillance systems allows real-time monitoring of places, people and their activities. The tracking approach can change with varying targets and can change from a single camera to multiple camera configurations. Various factors, including object motion, location, course of movement, and velocity, as well as biometrics like skin colour or clothing colour, are used in tracking techniques in video surveillance. The tracking must be robust and overcome occlusion and noise which are common problems in monitoring.

1. **IDEATION & PROPOSED SOLUTION**
   1. **EMPATHY MAP CANVAS**

* 1. **IDEATION & BRAINSTORMING**
  2. **PROPOSED SOLUTION**

The use of video surveillance as a monitoring and security tool is possible. Observing both public and private locations has grown to be a highly delicate subject. To make people's lives safer, the visual monitoring capabilities may be used in a variety of settings. There are built and deployed video-based security systems in areas like airports, train stations, and even dangerous surroundings. Real-time intelligent monitoring of the objects or events of interest may be accomplished effectively through the use of image processing, pattern recognition, and machine-vision based approaches. Proposed a method for automatic real-time detection of a person drowning in the swimming pools, 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.

* 1. **PROBLEM SOLUTION FIT**

There isn't a systematic approach to gather the condition of swimmers and not able to monitor all the surrounding for hours. Analyze the position of swimmers in the images, compute and send alert to the responsive team. This system's effectiveness and accuracy will also be increased by expanding the dataset to cover a larger variety.

1. **REQUIREMENT ANALYSIS**
   1. **FUNCTIONAL REQUIREMENT**

**Framework Creation**

The advancement of technologies for avoidance drowsiness at the wheel is a key dilemma in the field of accident prevention systems. Prevent drowsiness in a swimming pool and send alert to the life savers. Drowsy Detection System has been developed, using a non-intrusive machine vision based concepts. This system offers a method for detecting drowsy person in a pool which could be used for observing a level. In this module, we can detect the swimmers movements from real time camera and it will be registered in admin interface.

**Object Detection**

Object Detection is an advanced form of image classification where a neural network predicts objects in an image and points them out in the form of bounding boxes. Create an underwater pool safety system that lowers the danger of drowning by analysing body movement patterns and integrating cameras with artificial intelligence (AI) technologies. Object detection thus refers to the detection and localization of objects in an image that belong to a predefined set of classes.

**Drowsy Detection**

Such systems are often created by mounting a camera that transmits underwater footage while analysing swimmer positioning to determine the likelihood that they would drown; if this probability is high, an alarm will be sent to draw lifeguards' attention. To analyse drowning, the YOLO algorithm is used to find the swimmers' location underwater.

**Notification System**

In this module send notification to the life savers at the time of drowsy prediction. If the position of swimmers is lesser than 50% means, provide notification alert to the lifeguards.

* 1. **NON FUNCTIONAL REQUIREMENTS**

**Usability**

The system shall allow the users to access the system with pc using web application. The system uses a web application as an interface. The system is user friendly which makes the system easy

# Availability

The system is available 100% for the user and is used 24 hrs a day and 365 days a year. The system shall be operational 24 hours a day and 7 days a week.

# Scalability

Scalability is the measure of a system's ability to increase or decrease in performance and cost in response to changes in application and system processing demands.

# Security

A security requirement is a statement of needed security functionality that ensures one of many different security properties of software is being satisfied.

# Performance

The information is refreshed depending upon whether some updates have occurred or not in the application. The system shall respond to the member in not less than two seconds from the time of the request submittal. The system shall be allowed to take more time when doing large processing jobs. Responses to view information shall take no longer than 5 seconds to appear on the screen.

# Reliability

The system has to be 100% reliable due to the importance of data and the damages that can be caused by incorrect or incomplete data. The system will run 7 days a week. 24 hours a day.

1. **PROJECT DESIGN**
   1. **DATA FLOW DIAGRAMS**

A two-dimensional diagram explains how data is processed and transferred in a system. The graphical depiction identifies each source of data and how it interacts with other data sources to reach a common output. Individuals seeking to draft a data flow diagram must identify external inputs and outputs, determine how the inputs and outputs relate to each other, and explain with graphics how these connections relate and what they result in. This type of diagram helps business development and design teams visualize how data is processed and identify or improve certain aspects.

**Level 0**

The Level 0 DFD shows how the system is divided into 'sub-systems' (processes), each of which deals with one or more of the data flows to or from an external agent, and which together provide all of the functionality of the system as a whole. It also identifies internal data stores that must be present in order for the system to do its job, and shows the flow of data between the various parts of the system.

Training Data

Stored on Database

**Level 1**

The next stage is to create the Level 1 Data Flow Diagram. This highlights the main functions carried out by the system. As a rule, to describe the system was using between two and seven functions - two being a simple system and seven being a complicated system. This enables us to keep the model manageable on screen or paper.

Testing Data

Input Data

Pre-processing

Noise Filtering

Feature Extraction

Extract Shape, Colour

**Level 2**

A Data Flow Diagram (DFD) tracks processes and their data paths within the business or system boundary under investigation. A DFD defines each domain boundary and illustrates the logical movement and transformation of data within the defined boundary. The diagram shows 'what' input data enters the domain, 'what' logical processes the domain applies to that data, and 'what' output data leaves the domain. Essentially, a DFD is a tool for process modelling and one of the oldest.

Extracted Data

Matching with Training Data using YOLO algorithm

Give Result

* 1. **SOLUTION & TECHNICAL ARCHITECTURE**

A system architecture or systems architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g. the behavior) between them. It can provide a plan from which products can be procured, and systems developed, that will work together to implement the overall system. There have been efforts to formalize languages to describe system architecture, collectively these are called architecture description languages (ADLs).

Training Data

Testing Data

Input

Pre-Processing

Noise Filtering

Feature Extraction

Extracting Movements

Extracted Data

Classifying Using YOLO

Performance Evaluation

User

Stored on Database



* 1. **USER STORIES**

1. **PROJECT PLANNING & SCHEDULING**
   1. **SPRINT PLANNING & ESTIMATION**
   2. **SPRINT DELIVERY SCHEDULE**
   3. **REPORTS FROM JIRA**
2. **CODING & SOLUTIONING**
   1. **FEATURE 1**
   2. **FEATURE 2**
   3. **DATABASE SCHEMA**
3. **TESTING**
   1. **TEST CASES**

A test case has components that describe input, action and an expected response, in order to determine if a feature of an application is working correctly.A test case is a set of instructions on “HOW” to validate a particular test objective/target, which when followed will tell us if the expected behavior of the system is satisfied or not.

Characteristics of a good test case:

* Accurate: Exacts the purpose.
* Economical: No unnecessary steps or words.
* Traceable: Capable of being traced to requirements.
* Repeatable: Can be used to perform the test over and over.
* Reusable: Can be reused if necessary.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.NO** | **Scenario** | **Input** | **Excepted output** | **Actual output** |
| 1 | User login | User name and password | Login | Login success. |
| 2 | Upload Image | Upload input image | Detecting swimmers condition | Details are stored in a database. |

* 1. **USER ACCEPTANCE TESTING**

This sort of testing is carried out by users, clients, or other authorised bodies to identify the requirements and operational procedures of an application or piece of software. The most crucial stage of testing is acceptance testing since it determines whether or not the customer will accept the application or programme. It could entail the application's U.I., performance, usability, and usefulness. It is also referred to as end-user testing, operational acceptance testing, and user acceptance testing (UAT).

1. **RESULTS**
   1. **PERFORMANCE METRICS**
2. **ADVANTAGES & DISADVANTAGES**

**ADVANTAGE**

* Quickly help life savers
* Detecting the drowsy person accurately
* Provide technical support for reducing drowning accidents

**DISADVANTAGE**

* Hard for lifeguards to monitor all the surroundings for a long time
* Supervision model is not very reliable
* Consuming more man power

1. **CONCLUSION**

Provided a method to robust human tracking and semantic event detection within the context of video surveillance system capable of automatically detecting drowning incidents in a swimming pool. In the current work, an effective background detection that incorporates prior knowledge using deep learning algorithm enables swimmers to be reliably detected and tracked despite the significant presence of water ripples. The system has been tested on several instances of simulated water conditions such as water reflection, lightening condition and false alarms. Our algorithm was able to detect all the drowning conditions along with the exact position of the drowning person in the swimming pool and had an average detection delay of 1.53 seconds, which is relatively low compared to the needed rescue time for a lifeguard operation. Our results show that the proposed method can be used as a reliable multimedia video-based surveillance system.

1. **FUTURE SCOPE**

In the future, a generative adversarial network will be applied to generate synthesis data, in order to increase the size of the training dataset. In addition, more classes will be added to explore and to investigate the efficiency of the proposed system. Thus, the specialized model has outperformed other deep learning algorithms and can achieve impressive results in human drowning incident detection.

1. **APPENDIX**

**SOURCE CODE**

**GITHUB & PROJECT DEMO LINK**