Swimming Alert and Monitoring Platform

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Motivation

Drowning often occurs when there is no one around to help the victim or there are too many occupants in the pool for the victim to be recognized in time. The purpose of the Swimming Alert and Monitoring Platform (SALMON) is to reduce the possibility of drowning related casualties by monitoring and notifying the nearest responder of potential emergencies as soon as possible.

Introduction

- 55% of drownings happen in a private or public swimming pool, with 53% of cases being children 4 years old or younger [1]
- Reducing response times is critical for preventing serious damage or even casualties
- Our solution to this problem is the Swimming Alert and Monitoring Platform
- The platform utilizes a combination of person detection, classification, and tracking algorithms to identify potential emergency cases
- When a potential drowning is detected, an electronic notification is sent to the pool supervisor
- The system can be deployed in private pools as well, where more drownings happen unnoticed
- Its purpose is not to replace lifeguards, but to provide peace of mind for all pool goers
- Au-Zone Technologies' eIQ Portal was used to build the machine learning models

Dataset Curation

- Images used for the training dataset were collected by ourselves in the Vecova swimming pool
- Videos were recorded underwater in the pool
- Images were extracted from video frames
- Images were labelled for creating both the detection and classification models
- For detection, 4206 images were used
- For classification, 527 images contained fully submerged swimmers and 1240 images contained swimmers above water

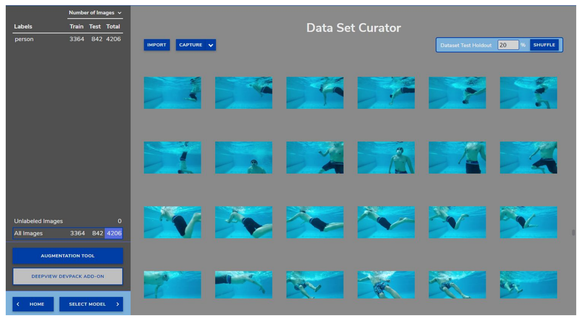

Figure 1: Collected dataset within eIQ Portal.

Machine Learning Model

Person Detection

Using the collected dataset, a machine learning model was trained to find swimmers on the camera.

Underwater Classification

A separate machine learning model was trained to classify the identified swimmers as being submerged or not submerged.

Tracking

Positions of detected swimmers are tracked in the camera feeds and used to determine how long individuals have been underwater. Tracking is based on the direction and speed swimmers are travelling, allowing for the tracking of swimmers even when they are close or overlap.

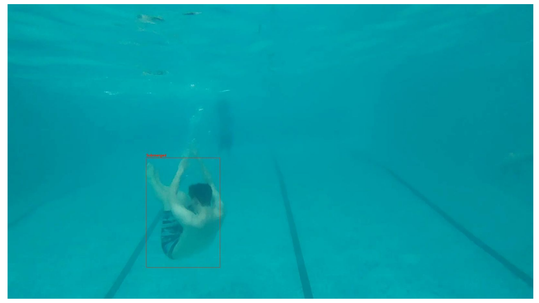

Figure 2: Single swimmer tracked and classified as submerged by the model.

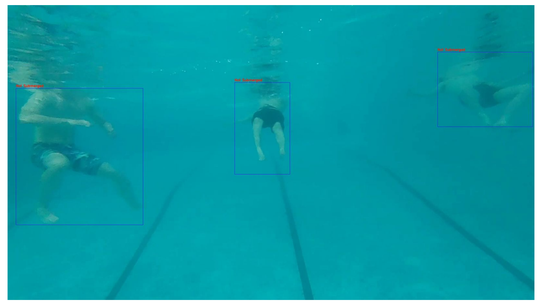

Figure 3: Three swimmers tracked and classified by the model as not submerged.

User Program

Central Server

- Receives the video feed and tracked swimmers from each camera set up in the pool
- Services the user interface, providing users with the ability to see tracked swimmers in real time
- Sends mobile notifications for swimmers that are potentially drowning

Graphical User Interface

- Displays all video footage feeds from each camera
- Shows camera name, location, and number of people detected
- Each person detected has a box drawn around them
- There are four colors representing four stages of potential drowning:
  - **Blue** - person is above water and safe
  - **Green** - person underwater for a short time, no concern
  - **Yellow** - person underwater a little while, some concern
  - **Red** - person underwater for a long time, potential drowning
- Specific time intervals for each stage are configurable by the user

Results

Our solution offers an innovative approach to a common problem by utilizing machine learning and providing an interface for users to monitor swimmers. SALMON improves pool safety by providing lifeguards or other nearby responders with an effective tool and improves response times in situations where every second counts.

[1] Government of Canada, "Drowning related deaths and injuries," 20-Dec-2021. [Online]. Available: https://health-infobase.canada.ca/datalab/drowning-blog.html.

Sponsor: Au-Zone Technologies
Academic Advisor: Dr. Yani Ioannou
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Special thanks to Mackenzie Garbe and Vecova for allowing us to use their facility for data collection.

Au-Zone Technologies