VirtualEye - Life Guard for Swimming Pools to Detect Active Drowning

Sai Shridhar Balamurali ; Shashank Panda ; Aditya Pahad Singh ; Tushar Nair

Literature Survey

In [1], the authors separate the foreground -containing moving objects- from the background scene using a Gaussian Mixture Model. The parameters were selected using Expectation Maximization. It also deals with the problem of shadows using shadow removal as, sometimes, the moving shadows are detected as moving objects.

In [2], the authors prepare their own drowning detection dataset. They have 2 classes within drowning: arms above water and arms underwater and 6 classes within non drowning depicting different swimming strokes. They then use ALEXNET to classify if the person is drowning or not drowning. The model is then deployed to NVIDIA Jetson Nano an edge computing device which is can be combined with a camera. The model was then evaluated in real-time. It managed to classify drowning and not drowning successfully however there were many false positives. The reasons for the false positives were the use of single lens camera instead of Raspberry pi camera, different illumination and lack of spatiotemporal clues.

In [3], the authors use a 3-step water crisis detection strategy. First, they preprocess the image using background modelling. In order to deal with the change in location of the classes in the background image in each frame due to the ripples in the water they perform unsupervised segmentations and then morphologically dilate the boundaries of the class. They then determine if there is a water crisis based on professional knowledge of water crisis situations. There are universal behavioral traits exhibited by troubled swimmers, which they model into hierarchical swimmer descriptors. They then use these descriptors to determine if the swimmer is drowning or not. Finally, by combining expert domain knowledge and experimentation, they determine the appropriate duration for each modelled water crisis situation to be manifested continuously before an alarm is raised. This final step enables the timely detection of genuine water crises while minimizing the number of false alarms.

The authors of [4] proposes the BR-YOLOv4 model to solve the problem of misclassifying people swimming on the surface as drowning and people who are deep underwater as swimming. They use two underwater cameras to get a video feed of the entire pool. The frames are divided into two parts: one part is the swimming zone which is above a pool line and the other part is the drowning zone which is below the pool line. The pool line is found using statistical techniques of where swimmers are most likely to be in the pool. The swimmer is surrounded by a bound box. As long as this bound box is completely above the pool line the subject is swimming. If it is completely below, the subject is drowning. If the bound box intersects the pool line then the ratio of the bound box in the area of the swimming zone and the ratio of the bounding box in the area of the drowning zone is found. If the ratio in the drowning zone is above threshold 1 than one then the subject is swimming. If it is less than threshold 1 but greater than 2 the subject is drowning. Otherwise, the original detection result is kept. The thresholds were decided depending on the dimensions of the pool and the positioning of the camera.

References

1. L. Fei, W. Xueli and C. Dongsheng, "Drowning Detection Based on Background Subtraction," 2009 International Conference on Embedded Software and Systems, 2009, pp. 341-343, doi: 10.1109/ICESS.2009.35.

2. Chan, Y.T., Hou, T.W., Huang, Y.L., Lan, W.H., Wang, P.C. and Lai, C.T., 2020. Implementation of deep-learning-based edge computing for preventing drowning. *computing*, *8*, p.13.

3. Kam, A.H., Lu, W. and Yau, W.Y., 2002, May. A video-based drowning detection system. In *European Conference on Computer Vision* (pp. 297-311). Springer, Berlin, Heidelberg.

4. Lei, F., Zhu, H., Tang, F. and Wang, X., 2022. Drowning behavior detection in swimming pool based on deep learning. *Signal, Image and Video Processing*, pp.1-8.