Virtual Eye - Lifeguard for swimming pools to detect active drowning

Domain: Artificial Intelligence

Team Members:

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Paper 1: The Swimmers Motion Detection Using Improved VIBE Algorithm

Authors: Muhammad Aftab Hayat, Goutian Yang, Atif Iqbal, Adeel Saleem, Adil hussain, Muhammad Mateen.

This paper proposed a novel method for drowning person detection in the swimming pool using video images. For background extraction and to update the exact motion area from the whole video using frame by frame difference vibe algorithm is used. Static and dynamic features are detected to recognize the normal swimmer and drowning person. The present invention discloses video based swimming pools drowning event detection method. In the detection process Time of map(Tom), the method is used to improve the traditional VIBE result. The sequence of video images of the swimming pool is collected in real-time by using a camera installed above the water surface, which mainly includes three steps of swimmers detection, swimmers tracking and drowning person behavior analysis. In the aspect of swimmer detection, an improved VIBE swimmer detection algorithm is proposed, and the algorithm is used to determine the swimmer's position. The swimmer tracking and particle filter based on the color distribution model which is combined with the nearest neighbor data association algorithm to achieve tracking of multiple swimmers. In the analysis of drowning behavior, three characteristics of drowning behavior are proposed to determine whether the swimmer is drowning. The invention can monitor the swimming pool in real-time through the camera installed above the water surface in a real public swimming place, and automatically detect the drowning person, which has great engineering application value.

Paper 2: An Automatic Video-Based Drowning Detection System for Swimming Pools using Active Contours

Authors: Nasrin Salehi and Maryam Keyvanara,Seyed Amirhassan Monadjemmi.

Safety in swimming pools is a crucial issue. In this paper, a real time drowning detection method based on HSV color space analysis is presented which uses prior knowledge of the video sequences to set the best values for the color channels. Our method uses a HSV thresholding mechanism along with Contour detection to detect the region of interest in each

frame of video sequences. The presented software can detect drowning person in indoor swimming pools and sends an alarm to the lifeguard rescues if the previously detected person is missing for a specific amount of time. The presented algorithm for this system is tested on several video sequences recorded in swimming pools in real conditions and the results are of high accuracy with a high capability of tracking individuals in real time. According to the evaluation results, the number of false alarms generated by the system is minimal and the maximum alarm delay reported by the system is 2.6 sec which can relatively be reliable compared to the acceptable time for rescue and resuscitation.

Paper 3: Design of a drowning rescue alert system

Authors: Samuel Ndueso John, Ukpabio Imelda Godswill, Omoruyi Osemwegie, Godfrey Onyiagha, Etinosa Noma-Osaghae, and Kennedy Okokpujie.

Dating back in time, drowning has been a significant ground for death worldwide; it accounts for the third cause of unplanned death globally, with about 1.2 million cases yearly. Characteristically it affects swimmers, accident victims, children and recreational seeking individuals. Although there have been various provisions put in place from drowning in some countries, it still accounts for the primary cause of unplanned death. Eradication rather than cure has been able to minimize the number of individuals who drown generally, except in developing nations, who lack adequate educational facilities and enforcement of safety measures on the dangers of drowning, thereby making the burden of drowning to escalate. The proposed drowning rescue system aims to curb deaths from drowning by observing the rise and fall of the heart rate and blood pressure of a swimmer or non-swimmer in water and if endangered, sends signals from the wearable device attached to the wrist of the victim who maybe undergoing a near drowning experience to the receiver or rescuer who could be a lifeguard, parent or neighbour, in order to enable the rescuer render immediate help.

Paper 4: Automated and Intelligent System for Monitoring Swimming Pool Safety Based on the IoT and Transfer Learning

Authors: Aziz Alotaibi.

Recently, integrating the Internet of Things (IoT) and computer vision has been utilized in swimming pool automated surveillance systems. Several studies have been proposed to overcome off-time surveillance drowning incidents based on using a sequence of videos to track human motion and position. This paper proposes an efficient and reliable detection system that utilizes a single image to detect and classify drowning objects, to prevent drowning incidents. The proposed system utilizes the IoT and transfer learning to provide an intelligent and automated solution for off-time monitoring swimming pool safety. In addition, a specialized transfer-learning-based model utilizing a model pretrained on "ImageNet", which can extract the most useful and complex features of the captured image to differentiate between humans, animals, and other objects, has been proposed. The proposed system aims to reduce human intervention by processing and sending the classification results to the owner's mobile device. The performance of the specialized model is evaluated by using a prototype experiment that achieves higher accuracy, sensitivity, and precision, as compared to other deep learning algorithms.

Paper 5: Computer Vision Enabled Drowning Detection System

Authors: Upulie Handalage, Nisansali Nikapotha, Chanaka Subasinghe, Tereen Prasanga, Thusithanjana Thilakarthna, Dharshana Kasthurirathna.

Safety is paramount in all swimming pools. The current systems expected to address the problem of ensuring safety at swimming pools have significant problems due to their technical aspects, such as underwater cameras and methodological aspects such as the need for human intervention in the rescue mission. The use of an automated visual-based monitoring system can help to reduce drownings and assure pool safety effectively. This study introduces a revolutionary technology that identifies drowning victims in a minimum amount of time and dispatches an automated drone to save them. Using convolutional neural network (CNN) models, it can detect a drowning person in three stages. Whenever such a situation like this is detected, the inflatable tube-mounted self-driven drone will go on a rescue mission, sounding an alarm to inform the nearby lifeguards. The system also keeps an eye out for potentially dangerous actions that could result in drowning. This system's ability to save a drowning victim in under a minute has been demonstrated in prototype experiments' performance evaluations.

Paper 6: Video Based Drowning Detection System

Authors: *Praveen Kumar P, Noor Tabreen Aslam, Nanthana A,Nandini S, Pavithra P.*

At present, there are swimming pools in every part of the world. Most of the swimming pool accidents or incidents occur due to improper security. Therefore, Accidental deaths in swimming pools are actually increasing. So, Video based drowning detection system is designed in this article. The proposed system structure comprises raspberry pi (Single Board Computer) equipped with a USB camera for taking the live feed from the pool area. The system also covers the alerting phenomena using a buzzer so that necessary actions are taken intermittently without any delay. The working structure starts from the raspberry pi with image processing for video feed intake, deep learning for activity recognition and finally GPIO system for alerting and short message service.

Paper 7: A Survey of Drowning Detection Techniques

Authors: *Abdelaziz M. Shehata, Eslam M. Mohamed, Khaled L. Salem, Ahmed M. Mohamed, Mustafa Abdul Salam, Mennatullah M. Gamil.*

Drowning is one cause of unintentional injury death worldwide, which made it a public health problem. It gained the interest of many engineers to create drowning detection systems by applying different technologies. This paper reviews different methods used for drowning detection in swimming pools, that applied the concepts of image processing, accelerometer, pulse and pressure sensing and LASER-LDR techniques. The reviews discussed the process, reliability and goals of each system. By surveying this we represented a comparison between the provided systems. A further discussion of the future challenges facing these systems is also mentioned with ideas to overcome them.

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Paper 9: An Underwater Sonar-Based Drowning Detection System

Authors: *Guoliang Xing, Zhenvu Yan, Haozheng Hou, Lixing He.*

Drowning is a major cause of unintentional deaths in swimming pools. Most swimming pools hire lifeguards for continuous surveillance, which is labor-intensive and hence unfeasible for small private pools. The existing unmanned surveillance solutions like camera array requires non-trivial installations, only work in certain conditions (e.g., with adequate ambient lighting), or raise privacy concerns. This demo presents SwimSonar, the first practical drowning detection system based on underwater sonar. SwimSonar employs an active ultrasonic sonar and features a novel sonar scanning strategy that balances the time and accuracy. Lastly, SwimSonar leverages a deep neural network for accurate drowning detection. Our experiments in real swimming pools show that the system achieves 88 % classification accuracy with a scan time of 1.5 seconds.

Paper 10: Drowning Detection Based on Background Subtraction

Authors: *Chen Dongsheng, Wang Xueli, Lei Fei.*

The main research subject in this paper is swimmer detection for visual surveillance of pool. A drowning detection method based on background subtraction is presented in this paper. The consecutive sequence of visual surveillance was obtained by the fixed camera installed in the pool wall. Each pixel is described by Gaussian mixed model, set up self-adapted background model and updating timely. When the foreground objects was separated, for getting good results, the shadows and noises must be removed. The experiments results show that this method is effective to detect the drowners and eliminate the shadows.