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For Child Drowning Prevention in Swimming Pools using Face Recognition

Mr.P. Manivannan¹, M. Hemavathi², R. Muskan³, J. Praharshida⁴, K. Preethi⁵

Associate Professor, Department of Electronics and Communication Engineering, Adhiyamaan College of Engineering,
Krishnagiri, Tamil Nadu, India¹

U.G Scholars, Department of Electronics and Communication Engineering, Adhiyamaan College of Engineering,
Krishnagiri, Tamil Nadu, India^{2, 3, 4, 5}

ABSTRACT: Every year, many individuals, including kids under the age of 5 drown in the depths of the swimming pool, and the lifeguards are not well trained enough to handle these situations. Due to their technical aspects, like cameras, and methodological characteristics, such the requirement for human engagement in the rescue effort, the present systems designed to address the issue of guaranteeing safety at swimming pools have serious issues. Thus, arises the requirement for having a system that will consequently detect the drowning individuals. Swimming pool surveillance systems plays an essential role in safeguarding the premises. The use of an automated visual-based monitoring system can help to reduce drowning and assure pool safety effectively. This study presents a ground-breaking technique for quickly identifying drowning victims. It can identify a drowning individual using convolution neural network (CNN) models. Drowning is not like what we see in movies; the genuine symptoms don't involve yelling for help. Instead, the true symptoms of drowning involve an upright body moving up and down on the water's surface. In this project the children's details are recorded in the system prior to swimming. The recorded details are saved in the databases. The facial recognition of the kids in the swimming pool are continuously monitored. Using Open cv, threshold values for water depth level are defined in the system and any person detected beyond this depth are considered drowning and the image is captured instantly. The captured image is compared with the details in database and the kid drowned is identified. The details of the kid drowning are sent to the rescuer immediately through SMTP to used send the email alert. This helps in quick rescue of drowning kids.

KEYWORDS: Drowning Detection, facial recognition, CNN, database, OpenCV, SMTP, mail alert.

I. INTRODUCTION

The swimming pool is one significant area where the need for monitoring systems is acutely felt. In the depths of swimming pools, many individuals, including children, drown or come dangerously near to doing so every year, and the lifeguards are not adequately equipped to deal with these issues. This highlights the necessity for a technology that can recognise a drowning victim and alert lifeguards to the situation. In this project the children's details are recorded in the system prior to swimming. The recorded details are saved in the databases. Using CNN, the facial recognition of the kids in the swimming pool are continuously monitored. Using Open CV, threshold values for water depth level are defined in the system and any person detected beyond this depth are considered drowning and the image is captured instantly. The image of the drowning kid is compared with the images in database and the kid is identified. Using SMTP alert message is sent to the rescuer. Using speech synthesizer, the drowning kid's name will be announced. Thus, immediate action will be done to save the kid.

II. RELATED WORK

- 1) Fei, Lei, Wang Xueli, and Chen Dongsheng. Background subtraction-based drowning detection. Software and systems embedded. Several strategies have been put out for intelligent systems that monitor swimming pools. The majority of techniques process the input video frames in the background. Some use image denoising and backdrop subtraction to find the drowning individual.
- 2) Kharrat, Mohamed, using a neural network and pressure data collected at the swimmer's head level, near drowning pattern detection. A Gaussian Mixture Model is utilised to describe the pixels in this case, and the EM technique is used to update the model's parameters. Moreover, neural networks can be trained to distinguish between typical swimming patterns and patterns that indicate a close call with drowning.
- 3) Wang, Hua, and Sing KiongNguang. "Complete and Intelligent Pool Monitoring System." To identify the water polo players, the brightness is divided, and the Cb and Cr components are looked at in the YCbCr colour model. Together with an underwater video detection device that locates and finds the victims, underwater ultrasonic sensors can identify drowning victims in the swimming pool up to 70 metres beneath the surface of the water.
- 4) Kam, Alvin H., Wenmiao Lu, and Wei-Yun Yau. "A drowning detection system based on video." Algorithms for pattern recognition are also highly helpful for swimmer detection. A background model is used here that is familiar with swimming pools. The conduct of practically all disturbed swimmers serves as the basis for this hierarchical model's operation.
- 5) Chan, Kwok Leung. Swimmer detection utilising dense optical flow motion maps and intensity data. But, to do this we need a sizable dataset of both behavioural groups. The **dataset** is obtained by fastening a pressure sensor to a swimmer and having them swim normally and while faking drowning.
- 6) E. Menoud, "Alarm and monitoring device for the presumption of bodies in danger in as wimmingpool," In this paper, an outdoor surveillance problem, which involves human behavior monitoring within hostile aquatic environment, is considered. On top of some new insights into problems faced for common outdoor environments, problems unique to human detection within dynamic aquatic environment are also detailed. Such system is highly useful for lifeguard and potentially be applied at unattended pool to enhance the safety at swimming pool.

III. METHODOLOGY

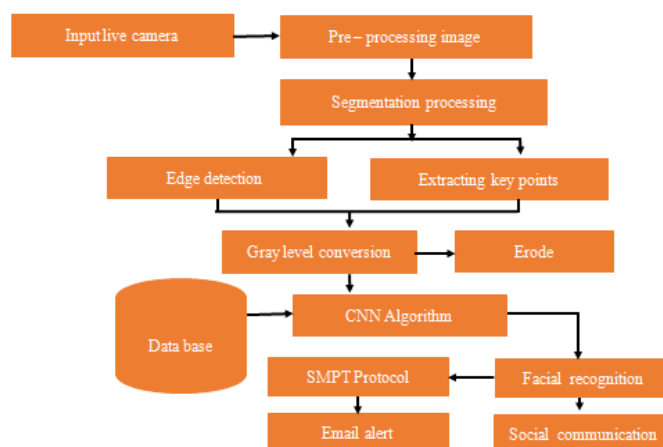


Figure 1 Block Diagram

1 Input module:

A pre-installed camera in the entrance of swimming pools helps to take better photos by intelligently identifying persons and scenes and optimizing the camera settings accordingly. Along with the captured image the person's details are noted down and saved in the database.

2 Open CV module:

Cameras are installed around the swimming pools with pertained threshold depth values. These values are given so that any person beyond this would be considered drowning.

3 Drowning detection modules

Any person who crosses the threshold limit and satisfies the condition of drowning which has been pertained in the system using CNN is considered drowning. This whole process takes place immediately and the image of person drowning is captured.

4 Database module

A database is, in the broadest sense, a carefully arranged collection of data. A database is a particular kind of electronic system that makes data access, modification, and updating straightforward. In other words, a database is used by a company as a digital method of managing, storing, and retrieving data.

5 Alert module

A monitoring system is a collection of software elements used for data gathering, processing, and presentation. A monitoring system's ability to detect and inform the operators of significant events that indicate a serious change in state is known as alerting.

CNN algorithm

Convolutional neural networks, sometimes known as CNNs, are a kind of deep learning neural networks. Simply defined, consider CNN to be a machine learning system that can take in an input image, give relevance (learnable weights and biases) to various characteristics and objects in the image, and be able to distinguish between them.

CNN works by extracting features from the images. Any CNN consists of the following:

1. The input layer, which is an image in grayscale
2. The binary or multi-class labels in the output layer
3. Hidden layers made up of a fully connected neural network, pooling layers, convolution layers, and ReLU (rectified linear unit) layers.

It is crucial to realise that Artificial Neural Networks (ANNs), which are composed of several neurons, are unable to extract characteristics from an image. Here is when a convolutional layer and a pooling layer combination come into play. Similarly, classification cannot be performed by the convolution or pooling layers, hence a fully connected neural network is required. Let's try to understand each of these portions on its own before diving deeper into the principles.

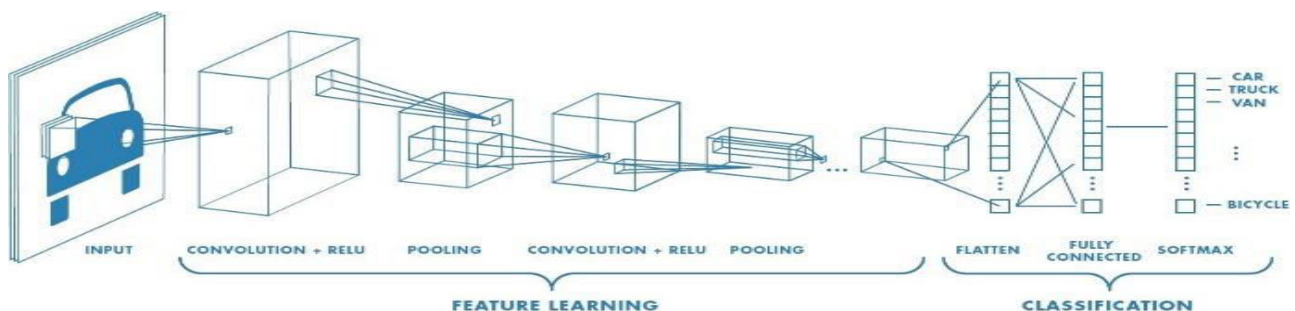


Figure 2 illustrates the CNN process from input to Output Data.

Consider that we have access to numerous pictures of various vehicles, each of which is identified as a truck, automobile, van, bicycle, etc. The goal is to create a machine learning system that can receive a new vehicle image and categories it

into the appropriate category or label using these pre-labeled or classified images. Now, it's important to realize that the majority of photographs are transformed into a grayscale format prior to processing before we begin developing a neural network.

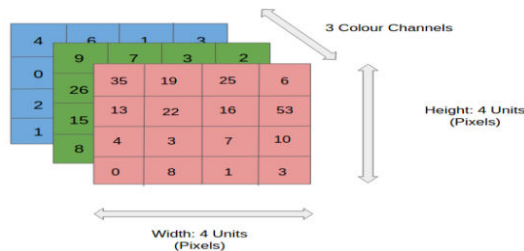


Figure 3 RGB color channels of an image

The convolved feature, which is also known as the activation maps, is subjected to a non-linear downsampling by the pooling layer. The major goal of this is to lessen the computing complexity needed to process the enormous amount of data associated with each image. Pooling is optional and frequently ignored. There are typically two forms of pooling: Max Pooling, which returns the highest value from the area of the picture that the pooling kernel covers, and Average Pooling, which averages the values that the pooling kernel covers. A functional illustration of the operation of various pooling strategies is shown in Figure 12 below.

1 Image flattening

Once the pooling is complete, the output must be transformed into a tabular format so that an artificial neural network can use it to carry out the classification. Notice that depending on the problem statement, both the number of the thick layer and the number of neurons can change. A drop out layer is frequently included to stop the algorithm from being overfit. Dropouts use all of the activation maps during testing but only a handful of them when training the data. By lessening the correlation between neurons, it minimizes overfitting.

2 Pre-Processing image

Data pre-processing, also known as data purification, is an important phase in the machine learning process, and most ML engineers devote a significant amount of time to it before developing a model. Outlier detection, missing value treatments, and removing undesired or noisy data are a few examples of data pre-processing. Similarly, Image pre-processing is the name for actions on images at the lowest level of abstraction. If entropy is a measure of information, then these actions diminish rather than increase the information content of the image. Pre-processing aims to improve the picture data by reducing unwanted distortions or enhancing specific visual properties that are important for subsequent processing and analysis tasks.



Figure 4 Imagepreprocessing

The following is a list of the four different categories of image pre-processing techniques:

- 1.Pixel brightness transformations/ Brightness corrections
- 2.Geometric Transformations
- 3.Image Filtering and Segmentation
- 4.Fourier transform and Image restauration

Segmentation process

1 Segmentation

A divide an image into distinct sections, each of which contains pixels with similar characteristics. The regions should have a close relationship to the portrayed items or interesting aspects in order to be meaningful and useful for picture analysis and interpretation. The accuracy of segmentation is crucial to the success of image analysis, however proper image partitioning is typically a very difficult challenge.

2 Thresholding

With this technique, the threshold is determined, and the pixels are then sorted into groups according to that standard. Thresholding method includes Histogram and Adaptive thresholding.

3 Color-Based segmentation

Algorithms segmentation based on the perception of colour. Incorporate the spherical coordinate transform and the principle component transform.

4 Discontinuity-Based segmentation

Active contours, radial search methods, and zero crossing of the Laplacian of the Gaussian are used to find lesion edges (LoG). It covers Active contours, Radial search &LoG 3.2.4 Region-based segmentation. It is a technique that divides the image into smaller parts before merging nearby and somewhat comparable sub images. It comprises morphological flooding, multi scale region growth, and statistical region merger.

5 Edge detection

An image processing technique called edge detection is used to find regions in a digital image that have abrupt brightness changes, or, to put it another way, discontinuities. The areas where the brightness of the image varies considerably are called the edges (or boundaries) of the image. Convolution algorithms help us process digital images with extremely high resolution.



Figure 5 segmentation process

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IV. EXPERIMENTAL RESULTS**1 Composition of mail:**

By creating an electronic mail message with a Mail User Agent, a user sends an email (MUA). Mail User Agent is a programme which is used to send and receive mail. The two parts of the communication are the body and the header. The message's primary component is its body, while the header contains details like the sender and recipient addresses. Also, the header contains descriptive details like the message's subject. In this instance, the message content resembles a letter, and the header resembles an envelope containing the address of the recipient.

2 Submission of mail:

The mail client then sends the finished email to the SMTP server using SMTP on TCP port 25 after composing it.

3 Delivery of mail:

An email address is made up of two parts: the domain name and the username of the recipient. As an example, consider the email address vivek@gmail.com, where "vivek" is the user's name of the recipient and "gmail.com" is the domain name. If the recipient's email address's domain name is different from the sender's domain name, messages will be routed to the Mail Transfer Agent (MTA). The email will be sent to the destination domain by the MTA. It consults the Domain Name System's MX record to locate the destination domain. The MX record contains the IP address and domain name of the recipient's domain. After discovering the record, MTA creates a connection with the exchange server to transport the message.

4 Receipt and processing of mail:

The incoming server receives the message from the exchange server, which then passes it along to the mail delivery agent (incoming server), which stores the email and makes it accessible to users.

5 Access and retrieval of mail:

With MUA, one can retrieve the emails that were saved in MDA (Mail User Agent). MUA is accessible with a login and password.

6 Sending Email:

To transmit mail, the client and server exchange a number of request and response messages. There is a header and a body to the message that is transmitted. The mail header is terminated by a null line, and everything that follows is regarded as the message's body, which consists of a string of ASCII characters.

7 Receiving Email:

The user agent on the server checks the mails at predefined intervals. It notifies the user if any information is received. A list of emails is shown when a user tries to view their email, along with a brief summary of each item.

this figure detects the emotion of the applicant is effective reaction of skills in CV

V. CONCLUSION

As part of this project, we offered a technique for reliable human tracking and semantic event recognition in the context of a video surveillance system that can detect drowning accidents in a swimming pool automatically. In the current study, swimmers can be successfully spotted and tracked despite the large presence of water ripples thanks to an efficient backdrop detection that includes prior information using HSV colour space and contour recognition. Our CNN algorithm had an average detection delay of 1.53 seconds, which is reasonably short compared to the required rescue time for a lifeguard operation, and was able to identify all drowning symptoms as well as the precise location of the drowning person in the swimming pool. Our findings demonstrate that the suggested approach can be employed as a dependable surveillance system using video in several media.

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BIOGRAPHY

Mr.P. Manivannan,
Associate Professor,
Department of Electronics
Communication Engineering,
Adhiyamaan college
Engineering(Autonomous),
Hosur.



M.Hemavathi, UG Student,
B.E. Electronics and
Communication Engineering,
Adhiyamaan college of
Engineering(Autonomous),
Hosur.



R. MUSKAN, UG Student,
B.E. Electronics and
Communication Engineering,
Adhiyamaan college of
Engineering(Autonomous),
Hosur.

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J.PRAHARSHIDA,UGStudent,
B.E. Electronics and
Communication Engineering,
Adhiyamaan college of
Engineering(Autonomous),
Hosur.



K. PREETHI, UG Student,
B.E. Electronics and
Communication Engineering,
Adhiyamaan college of
Engineering(Autonomous),
Hosur.



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