2021 International Conference on Design Innovations for 3Cs Compute Communicate Control (ICDI3C) | 978-1-6654-2569-8/21/$31.00 ©2021 IEEE | DOI: 10.1109/ICDI3C53598.2021.00048

Video Based Drowning Detection System

PAVITHRA P
Department of Electronics and Communication,
MVJ College of Engineering
Bangalore, India
pavithra.p@mvjce.edu.in

NANDINI S
Department of Electronics and Communication
MVJ College of Engineering
Bangalore, India
nandinis812@gmail.com

NANTHANA A
Department of Electronics and Communication
MVJ College of Engineering
Bangalore, India
nanthanaa012@gmail.com

NOOR TABREEN ASLAM
Department of Electronics and Communication
MVJ College of Engineering
Bangalore, India
noortabreenaslam@gmail.com

PRAVEEN KUMAR P
Department of Electronics and Communication
MVJ College of Engineering
Bangalore, India
praveenprakash@gmail.com

***Abstract*—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.**

Keywords—Faster RCNN, open CV, Image Processing, Person Detection

I. INTRODUCTION

We always want our loved ones to be safe and enjoy their life to the fullest. To have knowledge on how to prevent injuries, like drowning, is a step toward this objective. When most of us enjoy our family time at the water places like pools and beaches, injuries are not the first thing we think about .Due to which, drowning accidents have become the leading cause of death. As most of the kids love water and plus their eagerness to explore the surroundings around them attract them towards water. The reason for their attraction is that water ripples, shines, and can also make the objects float. Due to this they do not understand that this water which attracts them so much can be dangerous at times and can be life threatening too and due to their age they are also unaware of the measures to be taken to prevent them from incidents such as drowning. So it is very important to protect them from these unseen and unpredicted incidents. Safety is an important criteria for all ages. Drowning has become the leading cause of death in kids aged between 1 to 4years. Young children drown in water very quickly and without anyone noticing. This is one of the frequently occurring injuries but the plus point is that this injury is preventable by using proper preventive techniques and methods. However, evidence-based interventions which describe drowning in adults are much needed to reduce the deaths on a global scale. Drowning happens because the water prevents breathing. First aid should be given as soon as the individual is removed from the water. Drowning happens in water resources such as lakes, rivers, beaches and swimming pools. However, the leading cause of death which is drowning cannot be underestimated. Keeping all this in mind here we are analysing a useful drowning prevention method keeping all the circumstances in mind.

II. PROPOSED APPROACH

Proposed system consists of the swimmer detection system and alert system. Camera is attached to the Raspberry pi module which work as the central unit of the entire system. The system is trained with lot of data to find out swimmers in pool. The trained model is used to find swimmers from the video captured by camera attached to it. When a swimmer goes down to the water at that time the system starts the process. The system starts a counter and when that counter reaches its threshold value which set according to time a human being can be survive in under water. When the timer goes beyond limit it will activate the alert system near to the rescue management room. It will help the rescuer team to reach as soon as possible.

III. DESCRIPTION OF THE PROPOSED SYSTEM

As shown in figure1, the proposed system consists of the following: Pi camera, Raspberry Pi, Buzzer, Adapter for power supply and Python IDLE Software. The system consists of the drowning detection system and alert system. Camera is attached to the Raspberry pi module which works as the central unit of the entire system. The system is trained with sufficient data to find out about swimmers in the pool. The trained model is used to find swimmers from the video captured by a camera attached to it. Whenever a swimmer goes down to the water at that time the system starts a counter and when that counter reaches its threshold value which is set according to time a human being can survive underwater. When the timer goes beyond limit it will activate the alert system near to the rescue management room. It will help the rescuer team to reach as soon as possible.

978-1-6654-2569-8/21/$31.00 ©2021 IEEE
DOI 10.1109/ICDI3C53598.2021.00048

The project starts with the video to image frame conversion with the help of the open computer vision library. The video camera object created on the user side will provide the image frame (60 frame per second). The video feed is converted into an image frame with the help of the open cv-python read method. The read image frame is subjected for pre-processing. In pre-processing, the loaded image is resized into universal size for the future person detection process using the R-CNN algorithm. The resized images are then transformed to Gray scale, and hue saturation images for the comparison of the RGB image based detection over other colour channels. The collected images are then subjected to the action recognition module. In the action recognition module, a fully trained RCNN network is created using the darknet module of the open cv library.

The RCNN network is trained and loaded with the pre-trained weights for the detection of the person in the image frame. If any person is detected on the continuous image frame, the centre position of the person will be calculated based on the pixel x and y value which aids in the centroid calculation. The centroid point is assumed as the region of interest of the person. If the ROI moves below the water, the counter will start and it initiates the triggering mechanism for the drowning detection. If the person's ROI is below the threshold value. It will be considered as drowning. The obtained drowning data must be processed by the raspberry (single board computer). Upon detection of drowning in the environment, the buzzer connecting the general purpose GPIO pins of the raspberry pi will be activated. In addition to that, a short message service will be sent to the rescue person with the help of the SMS API.

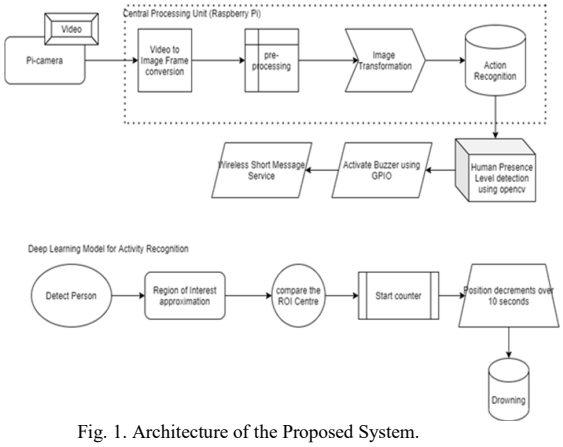

Fig. 1. Architecture of the Proposed System.

Specifications for figure 3 are 1.4GHz 64-bit quad-core processor, dual-band wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and Power-over-Ethernet support (with separate POHAT). Broadcom BCM2837B0 64-bit ARM Cortex-A53 Quad Core Processor SoC running at 1.4GHz, 1GB RAM LPDDR2 SDRAM, 4x USB2.0 Ports with up to 1.2A output, Extended 40-pin GPIO Header, and Video/Audio Out via 4-pole 3.5mm connector, HDMI, CSI camera, or Raw LCD (DSI).

Storage: Micro SD, Gigabit Ethernet USB 2.0 (maximum 300Mbps), 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE, H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30); OpenGL ES 1.1, 2.0 graphics and Low-Level Peripherals: are 27x GPIO, UART, I2C bus, +3.3V, +5V,12C bus where SPI bus has two chip that selects and Ground.

Power Requirements: 5V @ 2.5A via Micro USB power source and Supports Raspbian, Windows 10 IoT Core, Open ELEC, OSMC, Pidora, Arch Linux, RISC OS and More! 85mm x 56mm x 17mm.

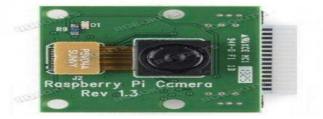

Fig.2. Pi camera

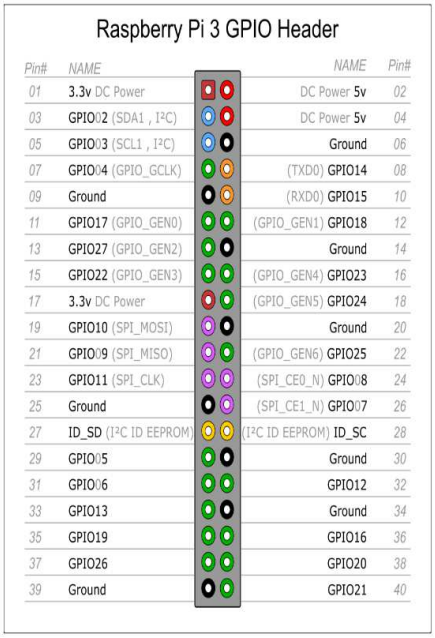

Fig. 3. Raspberry Pi 3 GPIO Header.

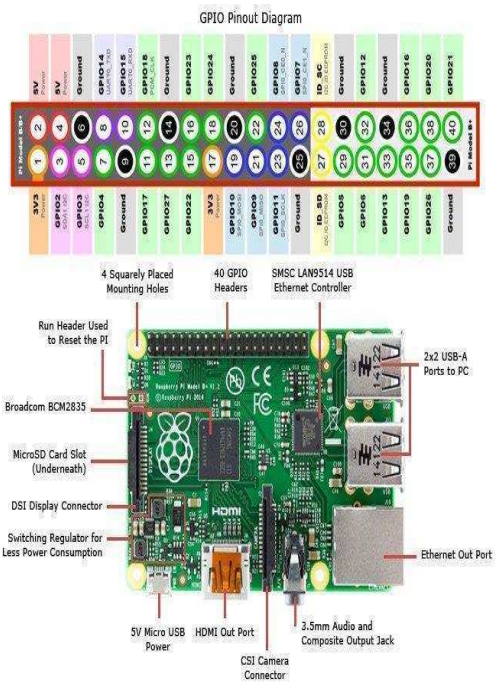

Fig. 4. Raspbery pi GPIO pinout diagram.

IV. ALGORITHM

In order to detect the person, we are following the method called Faster R-CNN algorithm. In this process it first extracts the features from the captured image. Feature Extraction is an initial set where the raw data is divided and reduced to more manageable groups to make the process easier. Next is the feature map which is the output of feature extraction. The image is then passed to RPN followed by convolution. The Basic idea of RPN is to find out whether there is a possibility of object presence. The RPN performs its function by using anchor boxes. The output of the RPN will be the anchor boxes with the foreground class and it will be in terms of feature maps. After this, the ROI pooling will produce the fixed size feature maps using match pools. Then, it produces the fully connected layers followed by the operation of the Regressor and Classifier.

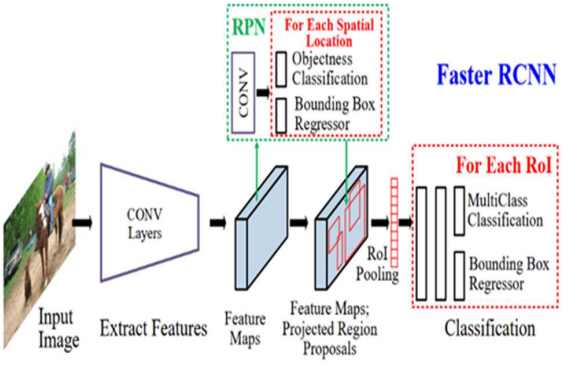

Fig. 5. Flow of Faster RCNN Algorithm.

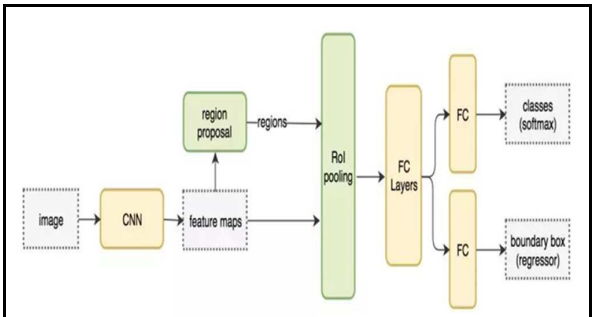

Fig. 6. Building Block of RCNN

V. RESULTS

In this paper, we have analysed and discussed the result of drowning detection based on the following three important factors which include cost efficiency, reliability and least system complexity. The system which we have proposed possesses the ability to automatically recognise and capture a drowning person and perform the extraction of the underlying and complex features from a single image. The system proposed consistently yields better outcomes compared to the existing deep learning algorithm. The feature which makes our proposed system reliable is because of its accuracy of about 99%.Secondly, the requirements used to design and setup the proposed system are only a camera, buzzer, GSM module and raspberry pi computer station, which are cost effective than existing other systems which requires video cameras and other computer resources which are used to process image frames to detect drowning objects in the expected time. The system makes use of only a single captured image, which implies that its requirement is of less computational time when compared to other existing systems making use of video sequences. The existing proposed system makes use of various transfer learning algorithms that are implemented by using the Raspbian operating system. The python modules used are open computer vision, numpy, raspberry pi io, and matplotlib. The computational models which are implemented in this project were chosen after extensive research and successful testing results confirm that the choices made were reliable. The result samples are depicted in the figure 6 and 7 respectively.

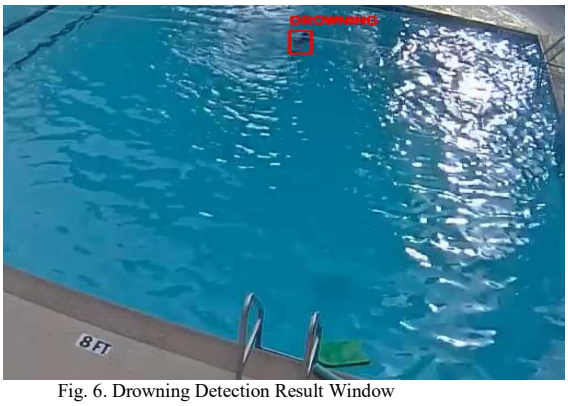

Fig. 6. Drowning Detection Result Window

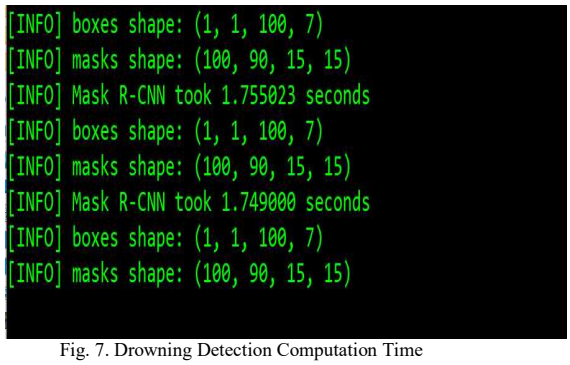

Fig. 7. Drowning Detection Computation Time

VI. CONCLUSION

This research is an automated vision-based surveillance system to detect drowning Incidents in swimming pools. The swimmers in the pool are detected and tracked using a Pi camera. As soon as the swimmer remains under a certain level for more that a determined period of time, Raspberry Pi will calculate the swimmer's position, velocity, path of movement. Meanwhile, a warning message will signal the lifeguard of an imminent danger with such a system, the number of drownings would be reduced.

REFERENCES

[1] Alshbatat, Abdel Ilah N., et al. "Automated Vision-based Surveillance System to Detect Drowning Incidents in Swimming Pools." *2020 Advances in Science and Engineering Technology International Conferences (ASET)*. IEEE.

[2] Jose, Arun, and Ganesha Udupa. "Gantry robot system for preventing drowning accidents in swimming pools." *Materials Today: Proceedings* (2020).

[3] Eng, How-Lung, et al. "DEWS: A live visual surveillance system for early drowning detection at pools." *IEEE transactions on circuits and systems for video technology* 18.2 (2008): 196-210.

[4] Hayat, Muhammad Aftab, et al. "Comprehensive and Comparative Study of Drowning Person Detection and Rescue Systems." *2019 8th International Conference on Information and Communication Technologies (ICICT)*. IEEE, 2019.

[5] Hou, Jianbin, and Baoguo Li. "Swimming target detection and tracking technology in video image processing." *Microprocessors and Microsystems* 80: 103535.