IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, July 2024

Intruder Detection Recognition Alert System for Fencing Defence using Image Processing Techniques

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Abstract: *Nowadays it is observed that the significance of surveillance and security is increasing. In buildings, industrial areas, schools, and college security has become an essential aspect. Therefore, it becomes necessary to design and implement a system that presents a comprehensive solution that will be used for real-time detection of abnormal human activities. An interactive full stack full-fledge system can be developed to detect abnormal activities at fencing or country borders. The system development involves various frontend technologies like HTML, CSS and backend technologies like Python, OpenCV, Flask, etc. The system altogether acquires a success rate of about 90 percent, making it a reliable system to detect abnormal activities. The system captures video streams and collects detailed facial and full-body landmarks along with the proper timestamps for each activity—the sound alert mechanism implemented in the system which provides security along with timely notifications to the user. The main goal of conducting this research is to bring surveillance and security systems to a greater level which makes a significant contribution to the field.*

Keywords: Image Processing, Object Detection, Survillence, OpenCV, MediaPipe

I. INTRODUCTION

In the era of the growing importance of surveillance and security, the significance of real-time detection to unusual behaviours has reached extraordinary levels. This research showcases this need by integrating a system which identifiers and captures abnormal activities which includes: running, jumping, crawling and integrating facial recognition for clear understanding of observed behaviour. The project directs the increasing security challenges by providing a detailed approach. It improves the security by detecting unusual activities though different environments, which contributes to the safety of individuals and assets. By involving facial recognition and alerts, it changes the security protocols which offers immediate insights and fast responses to threats. The implementation of this surveillance system guarantees to revolutionize some security protocols. It also enables threat mitigation through identification of unusual behaviour and immediate notifications.

A basic surveillance system detects various activities by providing information for gathering, marketing or directing purposes. With that it also includes two types of observation which are: distance observation using electronic equipment and internet traffic. Human intelligence gathering are also a crucial part of surveillance.

This project uses computer vision and image processing algorithms to detect and segregate human activities. An alarm is triggered when the activity is detected which gives an alert. In the era of growing importance of surveillance, the importance of real time detection and unusual behaviours has reached great levels. This research meets the development of a system that can not only identify and capture unusual activities but also integrates facial recognition.

II. LITERATURE SURVEY

M. Vashisht and B. Kumar have provided a study of various methods for object detection. The author discusses the various object detection techniques like Single Deep Neural Networks; Deep CNN based models, Viola Jones Algorithm, Convolution Neural Network, Face Recognition Vendor Test, and Machine Learning Based Approach

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along with the precise results (1). K. Thakur, P. Banerjee et al discussed the simplest way of object detection. The paper discussed two techniques for implementation and used various libraries of OpenCV and YOLO (2).

M. R. Islam et al have implemented human face recognition along with tracking; counting and time spent calculating using tools like OpenCV. The author used a pilot method for implementation using different libraries which show the exact outcome for the different implementations done in the project (3). S. Saranya et al, give a very easy approach to detecting face masks using TensorFlow, Keras, and OpenCV. It can detect faces correctly and identify whether the person has worn a mask or not (4).

S. Yi et al has proposed some optimization techniques for Local Binary Pattern which is based on some face detection algorithms. The author has presented the acceleration of the face detection on embedded Graphical Processing Units (GPUs) and also represents the performance of Tegra K1 GPU (5).

R. Thangaraj et al show a technique in which CCTV cameras can record data only when there is a motion being detected. It shows a reduction in the cost of the data storage device in the CCTV and can be implemented in places like home, office, etc. It uses Haar Cascades to detect the human face from real-time images and then after the face is detected, it is cropped and then fed into gender classification. The results gave an accuracy of 97 percent (6).

III. PROPOSED SYSTEM

Fig 1, showcases the proposed system architecture of the project. The home page consists of the login page which allows the user to log in to the website with their credentials, the contact us page which contains links to different social media pages like Facebook, GitHub, Instagram, and LinkedIn and the dashboard which serves as the main functionality of the website. The dashboard allows users to conduct surveillance with precision enabling the detection of human activities like running, crawling, and jumping. It is developed using some powerful tools which include OpenCV, YOLO, MediaPipe, and Flask. When the camera detects the presence of a human in front of it, it immediately captures the live footage of it and in the meantime, this live footage is uploaded to the server. When the live footage is captured by the system, it analyses the movement of the human and along with that, we can see the timestamp of the human's interactions when it is in front of the camera. Whether the human is running, crawling, or jumping, the system categorizes these activities and then saves this movement in the console to analyse later on. In the event of any movement detected by the camera, the system immediately sends an alarm to the dashboard to show that an activity is detected.

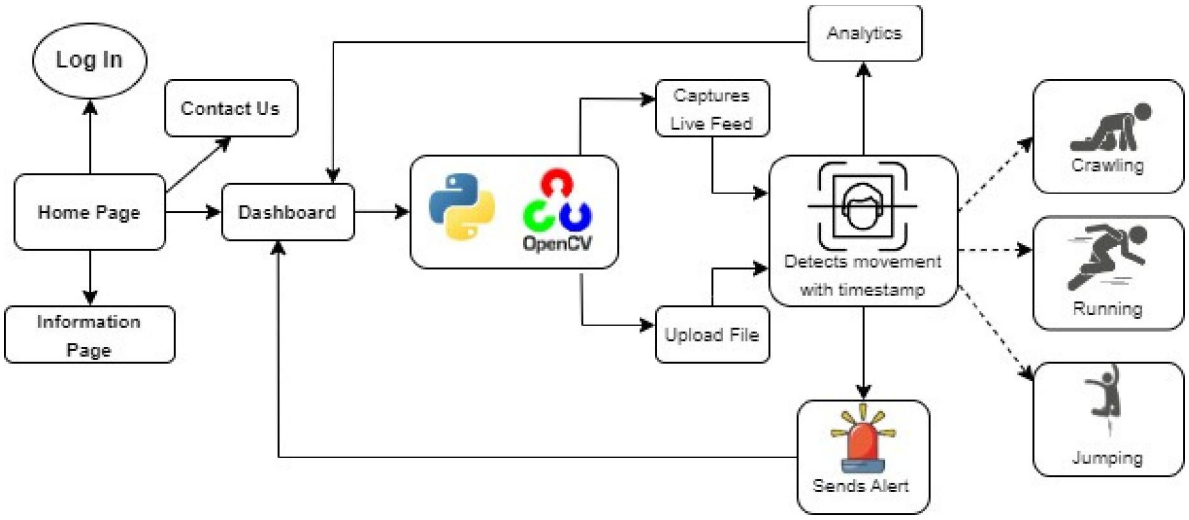

Fig. 1 System Architecture

Fig. 2 shows an example of a low-resolution image which would not be acceptable, whereas Fig. 3 shows an example of an image with adequate resolution. Check that the resolution is adequate to reveal the important detail in the figure.

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IV. METHODOLOGY

The proposed system aims to detect human and non-human entities by leveraging distinctive features between human and non-human. Features are the Nose, left ear, right ear, left eye, right eye, wrist, knee, etc. These distinctive features (body parts) play a vital role in classifying humans and non-humans through the recognition and analysis of thefeatures. The proposed system detects the jumping activity by analyzing the changes in vertical position. By monitoringfeatures such as ears and shoulders, the system checks for predefined thresholds and indicates that the person is jumping. When the person is jumping, the landmarks such as thighs and calves come together at the same level which aids the system to detect the person jumping more precisely. The system identifies all landmarks across the human body. Then system performs a comparative study between the landmarks of the ankle and the knees. It compares the levels of feet and the level of calves, if the levels coincide then the system detects the running.

To detect crawling, the system checks the proximity of the hand and knee landmarks to the ground. The system calculates the vertical distance between these landmarks and the defined ground plane to determine crawling. The system can detect multiple objects based on separating each object either human or non-human. This feature is very essential to detect multiple intrusions through the defense. The process of analyzing abnormal movements is done by first marking the landmarks on the body of the human and calculating the distance of landmarks to determine the initial position of the human and proving them an ID through face recognition.

The distance can be calculated using the formula:

$$\text{Distance} = \frac{\text{width} * \text{focal length}}{\text{pixel width} * 39.37}$$

Face recognition software is used to detect the person with abnormal movements and to help in post-accident investigation after saving the person's activities into the database. It is also used to keep track of the same person and give them the same ID even if they leave the frame and re-enter it.

To detect a face and mark it:

To detect eyes:

rects={(w,x,y,h) | H(w,x,y,h)> Threshold}

detect(roi.copy(),nested)

The system then tries to detect any abnormal movement and if some it immediately sends the user an alarm regarding some abnormal behavior.

Jumping Detection:

Step 1: Initialize Variables

Step 2: Calculate Differences for left and right shoulder and eardxl_Ear | Xl_Ear - Xprev_L_Ear | dxr_Ear | Yprev_L_Ear | dyr_Ear | Yr_Ear - Yprev_R_Ear | dxr_Shoulder | Xr_Shoulder - Xprev_R_Shoulder |dyr_Shoulder | Yr_Shoulder - Yprev_R_Shoulder |dxl_Shoulder | Xl_Shoulder - Xprev_l_Shoulder | dyl_Shoulder | Yl_Shoulder - Yprev_l_Shoulder |

Step 3: Updating Previous Coordinates

If the right and left - ear and shoulder are greater than jump then the alarm will be triggered for jumping.

Running Detection:

A comparison of knees and ankles is used to determine if the person is running. If the level of landmarks offeet and calves are on the same level the user is assumed to be running in the frame.

Step 1: Mark the knees and ankles Plk and Pla = left_knee left_ankle Prk and Pra = right_knee right_ankle

Step 2: Calculate the angles

Θlk = atanl and Θrk = atanl

Step 3: Check for runningPose = Θlk > RunT h

P ose = Θrk > RunT h

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Crawling Detection

Crawling is determined by the close proximity of hand and feet to the ground and a distance is calculated todetermine if the person in frame is crawling or not.

Step 1: Calculate distance from the groundpose_landmarks = result

mean position = [mean(landmarks array)]

$$\text{distance} = \frac{}{\sqrt{(x1\ \text{mean\_position}[0])^2 \mid (y1\ \text{mean\_position}[1])^2}}$$

V. RESULTS AND DISCUSSION

The proposed system provides the significant result in detection of human and non-human entities by leveraging distinctive features such as the nose, left ear, right ear, left eye, right eye, wrist, knee, etc. with an accuracy of 93 percent (as shown in figure 2), also the results are robust to the environment and background of the image.

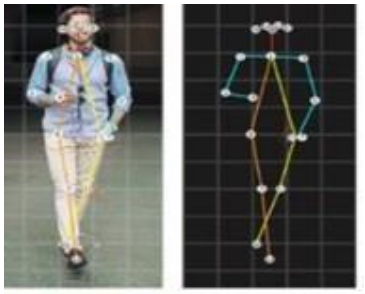

Fig 2: Landmark Detection On Human

The system detects the jumping accurately by 91 percent (as shown in Figure 3). It also detects running with 89 percent accuracy (as shown in Figure 4) detection of crawling is 90 percent (as shown in Figure 5). The system can detect multiple objects (as shown in Figure 8). Uniquely, the frames do not overlap or get confused if two people are standing close to each other. This feature increases the reliability of the system, providing a strong solution for dynamic environments such as crowded places. It can detect multiple objects with 93 percent accuracy, and also it detects the object name with 90 percent accuracy. Figure 7 Shows, the detection of a teddy bear. The results obtained accurately identify and classify objects within the monitored environment. For instance, the system can differentiate between a person engaged in dynamic movements, a dog exhibiting distinctive behavior, and a stationary soft toy. The system provides an accuracy of about 90 percent with varying around different objects and environments.

Fig 3: Running Detection

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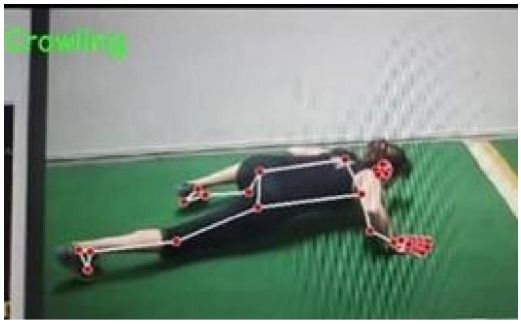

Fig 4: Crawling Detection


Fig 5: Detecting Multiple Objects

Fig 6: Detecting Object Name

Fig 7: Detecting Humans at Night

The system can detect humans or objects in low-light conduction (Night). It includes the ability to discern activities, identify specific objects, and categorize them accurately even when ambient light is limited. The accuracy of detecting 69 percent which is relatively low as it is difficult to identify body landmarks in the dark (as shown in Figure 7).

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VI. CONCLUSION

The proposed system has the ability the recognize objects and body landmarks with any movement in the real-time identification and analysis of human behaviors. The implementation of these technologies has led to a broad understanding of observed activities. The software is reliable because of the accuracy of the system. This system also showcases the potential for advancements in surveillance systems and emphasizing the importance of privacy in the real of evolving technologies. Hence, the system can classify the human and statue of human based on human body temperature and the result can be improvised by considering rhythmic heartbeat.

REFERENCES

[1]. M. Vashisht and B. Kumar, "A Survey Paper on Object Detection Methods in Image Processing," 2020 International Conference on Computer Science, Engineering and Applications (ICCSEA), Gunupur, India, 2020, pp. 1-4, doi: 10.1109/ICCSEA49143.2020.9132871.

[2]. K. Thakur, P. Banerjee, F. Naaz and P. Banerjee, "Real Time Object Detection and Classification Using Small and Similar Figures in Image Processing," 2023 3rd Asian Conference on Innovation in Technology (ASIANCON), Ravet IN, India, 2023, pp. 1-5, doi: 10.1109/ASIANCON58793.2023.10270219

[3]. M. R. Islam and K. Horio, "Real Time-Based Face Recognition, Tracking, Counting, and Calculation of Spent Time of Person Using OpenCV and Centroid Tracker Algorithms," 2023 5th International Conference on Computer Communication and the Internet (ICCCI), Fujisawa, Japan, 2023, pp. 210-216, doi: 10.1109/ICCCI59363.2023.10210102.

[4]. S. Saranya, V. Surendar and P. V. Paul, "Machine Learning based Real-Time Face Mask Detection System," 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), Erode, India, 2022, pp. 1479-1483, doi: 10.1109/ICSCDS53736.2022.9760919.

[5]. S. Yi, I. Yoon, C. Oh and Y. Yi, "Real-time integrated face detection and recognition on embedded GPGPUs," 2014 IEEE 12th Symposium on Embedded Systems for Real-time Multimedia (ESTIMedia), Greater Noida, India, 2014, pp. 98- 107, doi: 10.1109/ESTIMedia.2014.6962350.

[6]. R. Thangaraj, P. Pandiyan, T. Pavithra, V. K. Manavalasundaram, R. Sivaramakrishnan and V. K. Kaliappan, "Deep Learning based Real-Time Face Detection and Gender Classification using OpenCV and Inception v3," 2021 International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA), Coimbatore, India, 2021, pp. 1-5, doi: 10.1109/ICAECA52838.2021.9675635.

[7]. Ibrahim, Sutrisno. (2016). A comprehensive review on intelligent surveillance systems. Communications in Science and Technology. 1. 10.21924/cst.1.1.2016.7.

[8]. Paul, M., Haque, S.M.E. And Chakraborty, S. Human detection in surveillance videos and its applications - a review. EURASIP J. Adv. Signal Process. 2013, 176 (2013).

[9]. Prema, DR And Jahnavi, V.Sri And Reddy, S.Vinoothna. (2023). Smart Surveillance System using Python and OpenCV. INTERANTIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT. 07. 10.55041/IJSREM18936.

[10]. Perwej, Dr. Yusuf And Akhtar, Nikhat And Verma, Mrs And Chaturvedi, Shivam And Mishra, Shubham. (2022). An Intelligent Motion Detection Using OpenCV. International Journal of Scientific Research in Science, Engineering and Technology. Volume 9. Pages 51-63. 10.32628/IJSRSET22925.

[11]. V. S. P. Bhamidipati, I. Saxena, D. Saisanthiya and M. Retnadhas, "Robust Intelligent Posture Estimation for an AI Gym Trainer using Mediapipe and OpenCV," 2023 International Conference on Networking and Communications (ICNWC), Chennai, India, 2023, pp. 1-7, doi: 10.1109/ICNWC57852.2023.10127264.

[12]. P. Sharmila, V. B. Devi, R. Jegatha, A. R. S and H. NK, "IoT-Oriented Gesture Automation with Mesh Detection Through OpenCV and Pyfirmata Protocol Using ResNet-Mediapipe," 2023 Innovations in Power and Advanced Computing Technologies (i-PACT), Kuala Lumpur, Malaysia, 2023, pp. 1-5, doi: 10.1109/i-PACT58649.2023.10434872.

[13]. R. S. Deepthi and S. Sankaraiah, "Implementation of mobile platform using Qt and OpenCV for image processing applications," 2011 IEEE Conference on Open Systems, Langkawi, Malaysia, 2011, pp. 284-289, doi: 10.1109/ICOS.2011.6079235.

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[14]. T. Otsuyama, J. Honda, K. Shiomi, G. Minorikawa and Y. Hamanaka, "Performance evaluation of passive secondary surveillance radar for small aircraft surveillance," 2015 European Microwave Conference (EuMC), Paris, France, 2015, pp. 1527-1530, doi: 10.1109/EuMC.2015.7346066.
[15]. Z. Chuansheng, L. Yingchun, W. Zhenxing, Z. Yang, W. Chenxu and Z. Zhiquan, "A Novel FPGA- Based Moving Object Detection and Tracking Using Image Processing Technique," 2023 IEEE 6th International Conference on Electronic Information and Communication Technology (ICEICT), Qingdao, China, 2023, pp. 1218-1221, doi: 10.1109/ICEICT57916.2023.10245301.