Occlusion Detection and Gait Analysis

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Abstract Gait Analysis is a crucial utilization strategy that health organization / security organization can utilize to decide for the treatment or analyzing the walking style detect the wrong person. However, Gait Analysis under the presence of occlusion decreases the efforts when compared to the manual process and this process can be carried out by explainable ML algorithm.

The proposed solution based on real-world data on healthcare organization will significantly reduce the workload on staff and improve the efficiency of their walking process. It can also provide better insights into the factors that influence the decision-making process and help ensure patients get the care they need.

Overall, it has potential to revolutionize how healthcare/security organizations manage the gait process and lead to better outcomes for patients and in security domain as it can be used for comparing the sequence of gait of criminal and catch them.

(Note that the organization of the body of the paper is at the authors' discretion; the only required sections are Introduction, Methods and Procedures, Results, Conclusion, and References. Acknowledgements and Appendices are encouraged but optional.)

***Index Terms*—Gait Analysis, Occlusion Detection, Gait Sequence .**

I. Introduction

IN a world where we have 1.8 billion population and everyone has their own unique fingerprint, iris. Similarly, every person has a unique walking style and analysis is called Gait Analysis.Thus the field of human motion, which has potential applications in healthcare, sports and security industries. A persons walking pattern is one important aspect of human motion and office that has been widely studied in literature survey. However occlusion occurs when an object or person is partially or completely disturbed from a view can significantly affect the accuracy of gait analysis this can occur to various reasons such as the presence of other objects or blurriness in the scene or due to the limitation of the camera used to capture the visual data. Although gait analysis for human identification is not yet as mature as fingerprint, iris, or face, it can still be a useful tool. Almost all of the gait data sets that are currently available assume that there is just one person moving within the camera's field of vision Consequently, the gait cycles discovered from those recordings are pure. All of the suggested gait recognition methods have been created in the literature with such clear gait cycles in mind. However, in practical implementations, multiple people might be visible in the camera's range of view, and they virtually always block one another out.

Other factors, such as the existence of beams, pillars, and other inanimate objects, can also cause occlusion. This kind of circumstance is more likely to occur because the gait video sequence was recorded in an unrestricted environment without the subject's active participation or cooperation. An example sequence of video frames where the first person on the right in the first frame is occluded during his gait cycle is shown in

Fig. 1

Fig 1

For this subject, it might not be possible to extract clean gait cycles. Even though the classifier was initially trained on the same person, none of the approaches described in the literature can identify the subject from a video series using gait

The number of clean gait cycles that could be recorded in the video is the first step in human recognition utilising gait in the presence of occlusion. A sequence of key poses can be used to describe a gait cycle. If a gait has all the necessary positions,The gait cycle is regarded as a clean cycle.

The two main negative impacts that this procedure has Both occlusion detection and gait analysis have a chance of producing false positive results. A person's walk, for instance, may seem off because of an injury or disability, even if there is no malice intended.

II. LITERATURE SURVEY

There is little information about how often Occlusion and Gait Analysis is used and on what procedures. But it is used on procedures that are complex and costly to save costs and time and to make sure if the procedure is necessary.

In [1], Recently, there has been a lot of interest in the field of gait biometrics. Humans are tracked and modelled using Kinect and IMU sensors to create the walking trajectory for robots. The information gathered from the subject's walking cycles is used to create the gait pattern model. But in actual situations, the subject is frequently blocked by various static and moving objects, which causes the gait data to be lost.

[2] Using the correlation between the angles formed by the hip, knee, and ankle joints, gait symmetry can be used to assess how similarly leg swing motions are performed.

[3] was a study on A VGG-16 model was used specifically for occlusion detection, and a proposed occlusion reconstruction approach was assessed based on the Gait Energy Image (GEI) feature on the rebuilt sequence. similarly [7] The Gait Energy Image captures temporal motion over a gait cycle and is independent from any appearance-based criteria like colour, making it a real gait recognition approach

[4] was a critical review of the literature in relevance In particular, Azure Kinect DK Sensor, and CNN used Azure Kinect DK allows us to efficiently obtain camera-centric multi-person 3D poses and can simultaneously collect multimodal data to support various gait recognition algorithms. Multi-view is also better at dealing with occlusion than single view.

[5] also included and showed the trained model is known as the Bidirectional Gait Reconstruction Network (BGait-R-Net) and was developed utilising synthetically occluded CASIAB and OU-ISIR data. While concurrently retaining the body structure, that is, silhouette-level information at a high resolution, our LSTM-based model reconstructs occlusion and provides frames that are temporally consistent with a gait cycle.

[6] Through the use of the Balanced Gaussian Process Dynamical Model (BGPDM), occluded silhouette frames are recreated and used Pose detection · Dynamic programming · BGPDM model.

[13] This work proposes a scale-adaptive object-tracking technique with occlusion detection. To extract more reliable characteristics, ResNet was utilized. The response maps produced from the various layers are weighted and fused throughout the tracking process.

[15] This paper is majorly focus on the occlusion and finding it in a properly way but couldn’t able to success properly it has given an insights about how other models are lagging back as it only used Navie Bayes classifier

[8] this paper deals with the movement of the human body so detection of human body when there are many people around is a difficult task. So for this kind of situation occlusion will be taking place and this process further can be done with the help of

[8] This paper deals with the movement of the humanbody so detection of the human body when there are many people around is a difficult task. so for this kind of situation occlus -ion will be taking place and this process further can be done with help of gait to find the human movement. they have tried with three algorithms and found the conclusion that the cubic spline and Lagrange is working good.

[9] this paper focuses on the people who are disabled with neurology and orthopedic where the people can't able to walk. So using gate analysis system can able to find out whether the person is able to walk or not with the help of with the help of gate analysis it tries to find out the the leg movement in the presence of the obstacle and the system processes the video stream by means of tracking different markers placed in 5 anatomical landmarks of patient’s leg and applying Kalman filter in conjunction with a method that copes with occlusion.4

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[12] this paper was dealing the motion images like the group of images and most of the images are of single person images and this model is working good for single person images rath -er than multi person and they have compared it with tradition -al methodology and their model & used latent structural SVM

[14] Occlusion handling for gait detection is a difficult but crucial problem. In this study, they offer a conditional deep generative adversarial network-based method for reconstructing silhouette sequence from an obscured sequence (sVideo) (GAN). they have estimated the gait cycle from the rebuilt sequence and extract the gait features from a one gait cycle image sequence.

III. DATASET

The dataset that is walking videos of person and real time videos are recorded by the camera and few from the internet.it also includes the low- and high-resolution videos for better understanding of the code application.

The dataset Snapshots are displayed in the Fig 3.1

Fig 3.1

IV. PROPOSED METHOD

The proposed method in this research involved using various machine learning algorithms for predicting the output of the status of analyzing the gait of the person . The algorithms include Yolo algorithm , MobileNET SSD and COCO model for identification and other OpenCV algorithms.

Occlusion detection and Gait Analysis are mainly classified into two(2) different approaches 1.Detection of the occlusion 2. Finding the Gait of the person.

Part- I Detection of Occlusion

Step 1 **-** Initialize variables: Set the minimum contour area and kernel size for morphological operations.

Step – 2 Read the video: Open a video file using OpenCV's VideoCapture() function and read the first frame.

Step **-**3 Create a window: Create a window to display the output of occlusion detection.

Step – 4 Loop through the video frames: Read each frame of the video until there are no more frames. Convert the frames to grayscale and apply background subtraction to obtain the foreground mask.

Step**-** 5 Remove noise and fill holes: Apply morphological operations to remove noise and fill holes in the foreground mask.

Step-5 Find contours: Find contours in the foreground mask using OpenCV's findContours() function.

Step – 6 Detect occlusions: Check if the contour area is greater than the minimum threshold. If so, draw a bounding box around the contour and set a flag to indicate that occlusions have been detected.

Step **-**7 Display the output: Resize the output window and display the current frame with bounding boxes around detected occlusions.

Step **-**7 Exit the loop: Exit the loop when the 'q' key is pressed or when the end of the video is reached.

Step – 8 Release the video: Release the video object and destroy all windows.

----Part – II Gait Analysis

Step – 1 Imports necessary packages: time, cv2, imutils, numpy, and FileVideoStream from imutils.video.

Step – 2 Sets the path for the video file to be processed and initializes a FileVideoStream object.

Step **-** 3 Sets the parameters for the algorithm, including the kernel size, background history, and paths to the OpenPose and object detection models.

Step – 4 Defines some constants for the algorithm, including the number of keypoints, the mapping of keypoints to body parts, and the pairs of keypoints that should be connected to form poses.

Step – 5 Initializes the list of colors to use for drawing the keypoints and poses.

Step – 6 Defines a function getKeypoints that takes a probability map and a threshold as input and returns an array of keypoints that meet the threshold.

Step – 7 Defines a function getValidPairs that takes the output of the OpenPose model as input and returns a list of valid pairs of keypoints and a list of invalid pairs of keypoints.

Step – 8 Defines a function getPersonwiseKeypoints that takes the output of the OpenPose model as input and returns a list of poses, where each pose is represented as an array of keypoints.

Step – 9 Loops over the frames of the video file, reads each frame using the FileVideoStream object, and preprocesses the frame by resizing it and converting it to grayscale.

Step – 10 Runs the OpenPose model on the preprocessed frame and obtains the output.

Step – 11 Filters out the detections that are not people using the object detection model.

Step – 12 Generates the poses by linking the keypoints and drawing them on the frame.

Step – 13 After generating the keypoints it is processed with OpenPose prototxt and caffemodel files.

Step – 14 Drawing the sequence of the keypoints and Analyzing the Gait

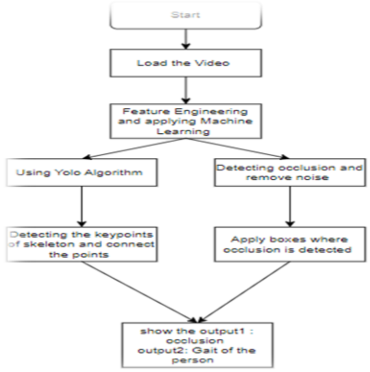


Fig 4.1 Proposed methodology

V. ALGORITHMS

A. COCO MODEL

Many cutting-edge object detection and segmentation models have been trained and evaluated using the COCO dataset, which is frequently utilized in computer vision research.

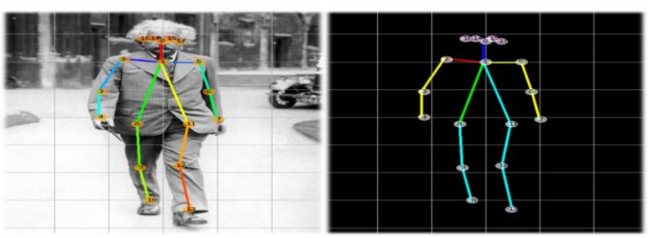


Fig 5.1 detection points of human

The computer vision problem of keypoint identification, also known as keypoint estimation, entails locating particular spots of interest in an image/video, such as an object's corners or a person's bodily joints. Usually, the image's object or subject is represented by these focal points. They are applicable to many different tasks, including object tracking, motion analysis, and human-computer interaction. Over 250,000 persons are annotated with keypoints in more than 200,000 photos in the COCO dataset. The x and y coordinates of 17 important body locations, including the right elbow, left knee, and right ankle.

B. Yolo

YOLO (You Only Look Once) is a real-time object detection algorithm that uses a single neural network to predict bounding boxes and class probabilities for objects in an image. YOLO achieves high accuracy and fast inference times by dividing the image into a grid and predicting objects within each grid cell. YOLO is commonly used in applications such as Human detection, self-driving cars, surveillance, and robotics.

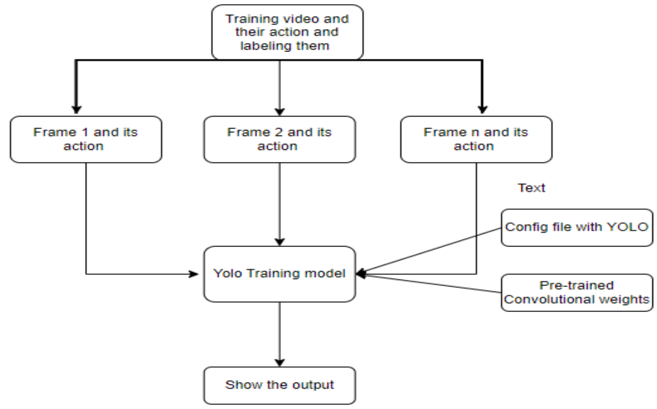


Fig5.1 Yolo Architecture

C. MobileNET SSD

MobileNetSSD is a real-time object detection algorithm that uses a deep convolutional neural network architecture optimized for mobile devices. It achieves high accuracy and fast inference times by using depth-wise separable convolutions and network pruning. MobileNetSSD is commonly used in applications such as self-driving cars, robotics, and augmented reality.

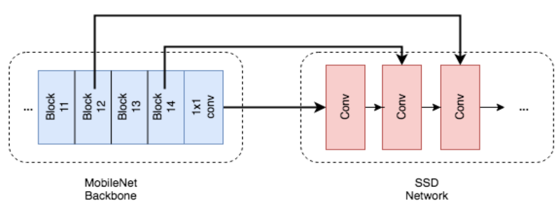


Fig 5.2 - MobileNet SSD

VI. Results and Discussion

Multiple machine learning algorithms were used for post processing the data to make sure it is void of any discrepancies. The implementation of the proposed model was performed in Python using Jupyter Notebook/Vscode. The models were trained using different methods to ensure that they have high accuracy. The results shown in fig 6.1 and accordingly key points detection (fig 6.2) , Human skeleton detection (fig 6.3), Sequence of human walking (fig 6.4) [GAIT ANALYSIS]

The results on the detection of occlusion Fig 6.1.

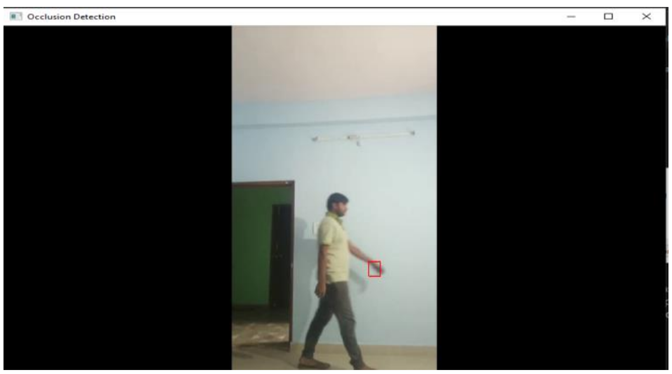


Figure 6.1 Results on Testing Data

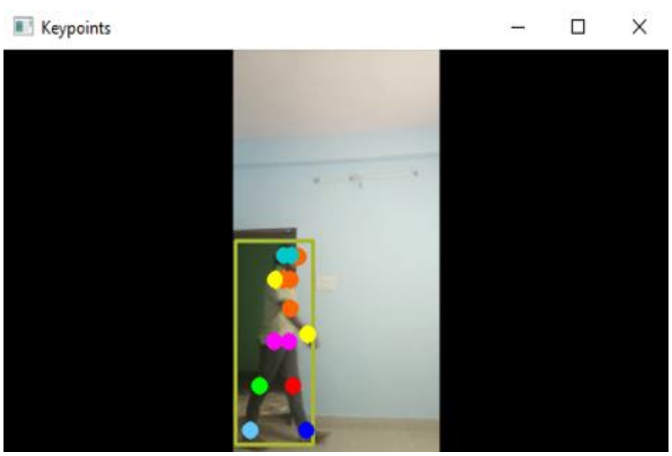
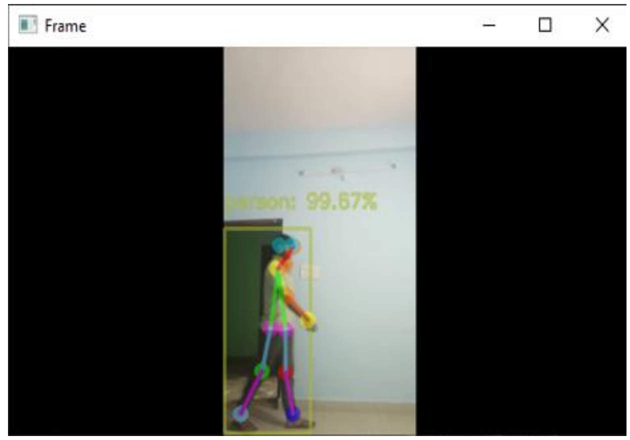
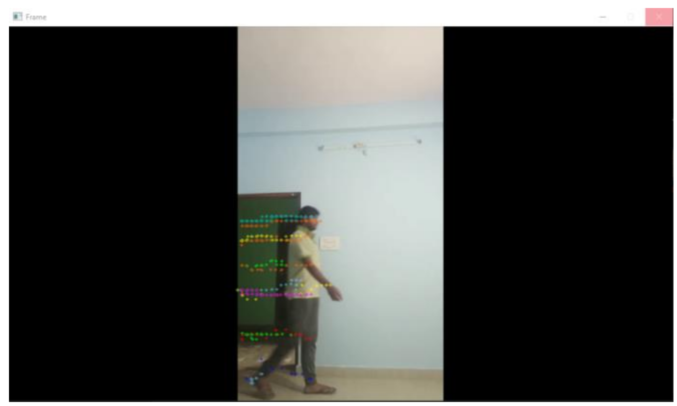


Fig 6.2 Key points detection

Here all the 18 points of body skeleton is detected and pointed the each point with different colors



All the key points are analyzed and linking each joint of the skeleton points of the human structure and checking the accuracy of detection



Analyzing the Gait by following the sequence of the key points and Thus GAIT ANALYSED

VII. Conclusion

Using the Yolo , Mobilenet SSD and OpenCV to tune the parameters, a high model accuracy is achieved during the human detection. This is further used to calculate the key points of the human structure and get the key points sequence frame and hence the Gait can be analyzed.

The use of Machine Learning Algorithms and Shapley Additive Explanations can create a huge positive impact in the Any Industry. It has potential to increase efficiency and cut down on unnecessary work performed by the manual labor.

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