International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 04 | Apr 2021 www.irjet.net p-ISSN: 2395-0072

AUTOMATIC DOOR UNLOCK USING AI FACE RECOGNITION

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Abstract - *This article proposes Smart Door Unlock System primarily based totally on Face Recognition to beautify the safety. In this device digital digicam sensor is used to seize the face and photograph matching set of rules can be used to discover the authenticated faces. Only the individual whose face is matched may be capable of release the door So, drawback of dealing with keys can be resolved. The safety device is additionally made through keeping into the attention of vintage age human beings for whom it's tough to open the door manually. This device will now no longer most effective but the safety however additionally make the device keyless.*

1.INTRODUCTION

Facial detection is a famous pc imaginative and prescient application, widely recognized in today's technology which may be solved the use of AI (Artificial Intelligence). AI is a era which replicates neurons within side the human mind and attempts to imitate its getting to know method of figuring out and fixing real international issues including facial detection, item detection, facial recognition, etc. The AI wishes to gain knowledge of to carry out such responsibilities in a manner wherein a infant wishes to be knowledgeable on a selected topic. Recognizing a face the use of diverse factors including pores and skin colour, mouth, eyes, and nostril calls for steering that's supplied through schooling instances, additionally referred to as supervised getting to know.

2. PROJECT DESCRIPTION

Convolutional Neural Network:

A neural community additionally called ANN (Artificial Neural Network) is a computational mastering device that makes use of a community of capabilities to apprehend and translate statistics enter of a shape to the favoured output of any other shape. Since a facial detection challenge includes images/video feeds, a neural community may be a capability candidate for fixing the trouble at hand. There is a significantly large distinction among a human's and a computer's belief of an picture. The human mind is educated to extract capabilities from an picture and distinguish them, whereas, computer systems view an picture within side the shape of numbers, i.e., pixels. These numbers variety from zero to 255, describing the pixel depth at each point.

The Essential Components of CNN:

Feature Learning: In reference to stand detection, the characteristic mastering challenge of CNN could contain mastering how exclusive components of the face appearance relying on height, width, and different capabilities.

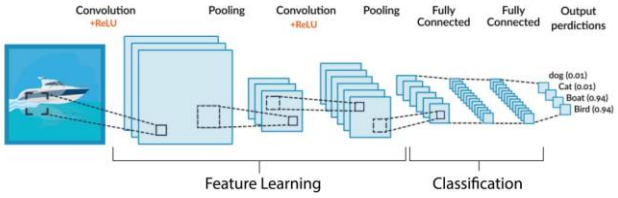


Fig:1(Layers of CNN Model)

MTCNN:

MTCNN (Multi-Task Cascaded Neural Network) detects faces and facial landmarks on images/videos. This technique changed into proposed through of their paper[8] in the reference. The complete idea of MTCNN may be defined in 3 ranges out of which, withinside the 1/3 stage, facial detection and facial landmarks are finished simultaneously. These ranges includes diverse CNN's with various complexities. A less complicated rationalization of the 3 levels of MTCNN may be as follows In the primary degree the MTCNN creates more than one frames which scans through the complete picture beginning from the pinnacle left nook and ultimately progressing in the direction of the lowest proper nook. The facts retrieval system is known as P-Net(Proposal Net) that's a shallow, completely related CNN. In the second one degree all of the facts from P-Net is used as an enter for the following layer of CNN known as R-Net(Refinement Network), a totally related, complicated

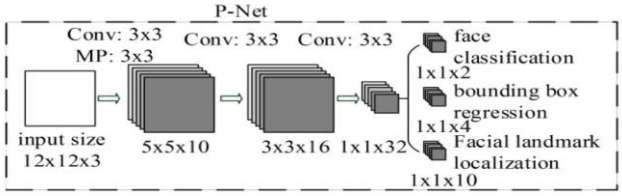
CNN which rejects a majority of the frames which do now no longer comprise faces. In the 1/3 and very last degree, a greater effective and complicated CNN, called O-Net(Output Network), which because the call suggests, outputs the facial landmark role detecting a face from the given picture/video.

3. METHODOLOGY

The Three Stages of MTCNN: The first step is to take the photo and resize it to distinctive scales as a way to construct aphoto pyramid, that's the enter of the subsequent three-staged cascaded network.

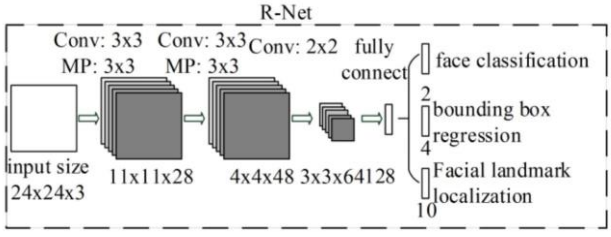
Stage 1: The Proposal Network (P-Net)

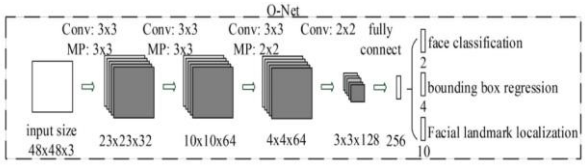
This first level is a completely convolutional community (FCN). The distinction among a CNN and an FCN is that a completely convolutional community does now no longer use a dense layer as a part of the architecture. This Proposal Network is used to achieve candidate home windows and their bounding container regression vectors. Bounding container regression is a famous method to expect the localization of containers whilst the purpose is detecting an item of a few pre-described class, in this situation faces.



Stage 2: The Refine Network (R-Net)

All applicants from the P-Net are fed into the Refine Network. Notice that this community is a CNN, now no longer an FCN just like the one earlier than in view that there's a dense layer on the final level of the community architecture. The R-Net similarly reduces the quantity of applicants, plays calibration with bounding container regression and employs non-most suppression (NMS) to merge overlapping applicants. The R-Net outputs whether the enter is a face or now no longer, a four-detail vector that is the bounding container for the face, and a ten-detail vector for facial landmark localization.





Stage 3: The Output Network (O-Net)

This stage is similar to the R-Net, but this Output Network aims to describe the face in more detail and output the five facial landmarks' positions for eyes, nose and mouth.

MODEL EVALUATION CRITERIA

The Three Tasks of MTCNN

The Network's task is to output three things: 1.Face/non-face classification, bounding box regression, and facial landmark localization.

$L_i^{det} = -(y_i^{det} \log(pi) + (1 - y_i^{det})(1-\log(pi)))$

Where y_i^{det}—Ground truth table $Y_i^{det} \in \{0,1\}$

Log(pi)—Probability produced by the network

Cross-Entropy Loss

Face classification: this is a binary classification problem that uses cross-entropy loss.

2.Bounding box regression: the learning objective is a regression problem. For each candidate window, the offset between the candidate and the nearest ground truth is calculated. Euclidean loss is employed for this task.

$L_i^{box} = \|\hat{y}_i^{box} - y_i^{box}\|_2^2$

Where $\hat{y}_i^{box}$—Target obtained from network

y_i^{box}—Ground truth coordinate

Euclidean Loss

Facial Landmark localization: the localization of facial landmarks is formulated as a regression problem, in which the loss function is Euclidean distance.

$L_i^{landmark} = \|\hat{y}_i^{landmark} - y_i^{landmark}\|_2^2$

Euclidean Distance

There are five landmarks: left eye, right eye, nose, left mouth corner and right mouth corner.

4. IMPLEMENTATION RESULT

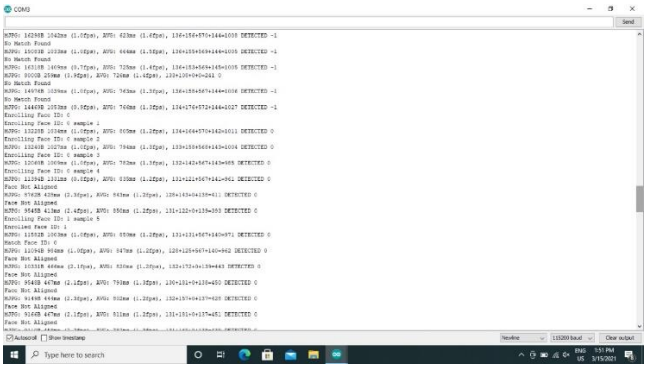


Fig:2(Output)

Thus the face detection and recognition has been sucessfully performed and it has been shown in the output Fig(2) . If a face is shown in front of the camera it will detect the face and check for the match.If any match is found it will give the message as “Match Found” and the detected value will be equals to zero. If no match is found it will give the message as “No Match Found” and the detected value will be in negative.

5. CONCLUSION

In this proposed door access system by using face detection and recognition the images are stored and recognized. This system is used as a door lock access for Residential and Commercial Purposes. Here we have designed a highly secured door locking system by using Arduino ESP32-cam.

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