HOME SECURITY BY USING COMPUTER VISION

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Abstract **— Nowadays, to secure a home became a very important topic to discuss on because now many people used to keep all their valuable belonging inside the home so it is very important to develop a system that can secure our home in a cost-efficient manner so for that this project has develop a system that can secure our hose more efficiently. This project uses the method of computer vision to identify the face of the person so whenever a person come it will detect his/her face if its match with its data base then he/she will be allowed to enter into the house in case any unknown person come then by identifying his/her gesture the model can determine whether the person come unknowingly or he/she come to enter into house forcefully without the permission of house owner. So here in this project, model can successfully recognise the faces that are present in its data base and open the lock to allow that person to enter into the house. This home security system also alerts the house owner by sending a Gmail notification if any unknown person is trying to enter into the house by identifying his/her gesture. This helps the user to keep his/her house secure from robbery.**

Keywords— **home security, facial recognition, gesture recognition, object detection.**

I. INTRODUCTION

Computer vision is the technique where computer understand the pixels of the images through these pixel of images it detect the vertical and horizontal edges that are present in the image as shown in figure 1 .It detects vertical and horizontal images by performing convolution between m X n matrix which act as a filter to the pixel of image the matrix that we get after performing the convolution is called the filtered matrix this filtered matrix is shown in figure 2 The image that is shown in the figure 2 is the edge detected after performing convolution. After detecting vertical and horizontal edges that is a filtered matrix This process is repeated four to five time so that dimension of image gets reduce. After getting our desire matrix it will converted into fully connected layer then it will pass into inception network as an input then this inception network performs some mathematical operation on these filtered matrices to do the image processing task. The inception network is a connection of block that is formed by the stacking of different layer that we get after the convolution operation between the pixel of image and different filter as shown in figure 3. this inception block gives an output that is fully connected layer which is used to match the face between the unknown people photo with the photos that are present in the data base.

Human gesture recognition is another deep learning model that has been used in this project to detect the gesture of the person to detect the unwanted activity near the house by the unknown person. Basically, in gesture recognition this project uses the concept of localizing the point of the human joints in images or video. To achieve this Media pipe pose has been used in this project to detect the pose of the human body. Media pose is another machine learning solution for body pose tracking by implanting 33 3d landmark on the whole body from the RGB image or video.

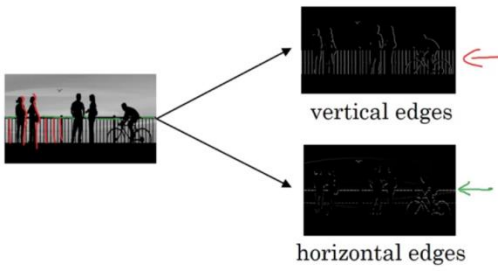

Figure 1-vertical and horizontal edges in image

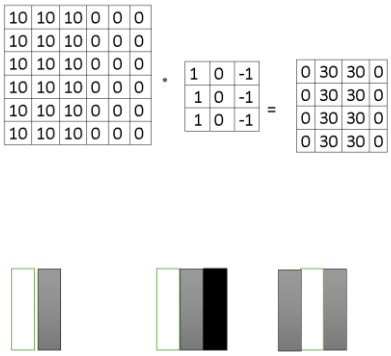

Figure 2- Filtered matrix

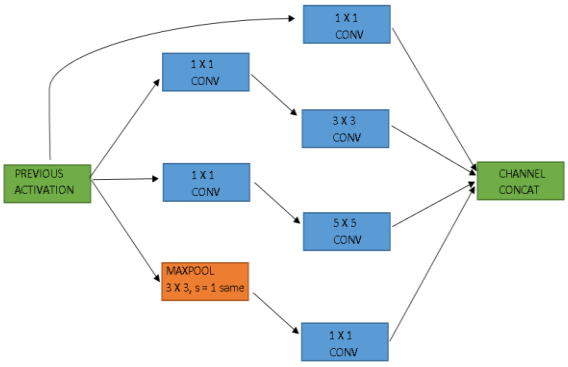

Figure 3-Inception Block

II. LITERATURE REVIEW

As there is an utmost important to save our valuable belonging inside our house lots of work has been done in this field of home security and among all of these work one of the most important work is done by Jae-Young Pyun all.[1] in this paper, they connect all the appliances with the connected with the home server which are getting a data from different ZigBee device this home server is connected with different home appliances and the lock so before going out user can check all these appliances whether it is in of /on mode. Akansha Singh all.[2]in their project they show how to open a lock by voice recognition and face recognition they also make the system that can open the lock by identifying the gesture of the human body this is basically for physically disabled people Ilkyu Ha [3] in his paper they develop a project that can detect the activity of breakage of lock in the absence of user through a alarm in the mobile device in this way it alerts the user if someone attempt to break the lock. Ibshar Ishrat all.[4]in their research paper they develop a model that can detect unwanted activity near the door bell and knock remotely with the help of different sensor and raspberry pi. if any unwanted activity detected it will notify the user. For the notification system, Google Cloud Messaging Service has been used. Yordan Hasan all.[5] in their research work they develop a system that can open or close the door lock of the class room by using RFID as the security key with the Arduino. Mohammad Amanullah [6]in his project they demonstrate they develop a system that used a mobile number for verification in this model person have to enter the correct password if password is correct then it will open the door otherwise show a red signal. and if it received a call-in mobile through which system is connected and if it is a valid phone number then it will open the door Chu Chong Teoh all.[7]in their research work they have added an intelligent algorithm to the existing home security system with the help of neural network basically the system analyses the information gather by the sensor and detector used to learn and predict the respond based on the analysis that it makes. In the above all the work they have not use gesture recognition to identify the intruder to secure the house from bugler in the absence of house owner and this way of detecting intruder is more cost efficient than using sensor to detect the presence of human being.

III. METHODOLOGY

A. Facial Recognition

Here in this project, we have use facial recognition technique to unlock the door. To implement facial recognition Convolution neural network technique has been used. First the pixel of image is filtered by using convolution operation between mxn matrix with the pixel of images through this we can detect the vertical edges and horizontal edges then this filtered image is pass into forward propagation function. We can use as many filtered as we want and after getting the filtered output these are stack on each other so that it become 3d matrix .This filtered output pass into forward propagation function before passing it into forward propagation function initialize the parameter W and b to compute $Z^{(i)}=WX^{(i)}+b$ that is required to compute the cost of the model. In forward propagation function our model gets trained with different images that are present in the data base and then compute the cost function this cost function tell how much error we have done in order to predict the image of the person so we have to minimize this cost function through backward propagation and updating the trained parameter W and b so after reducing the cost function and updating the parameter when we are satisfying with our result this Z is passed into activation function the activation function that we have used in our model is $g(z)=1/1+e^{-z}$ the output that we get from this activation layer is passed into inception block then this inception block gives the output of fully connected layer of mX1 dimension matrix this matrix is called encoding matrix .Now When unknown person come the then it will pass into inception block compute the SoftMax and then produces the fully connected output of m1X1 now the distance between these two-encoding matrix and compared and if it is less than the threshold value then our output will predict it as 1 that is an match condition otherwise it will give output 0 that is miss match condition .During the training of the

model we have to make sure that triplet loss is less. Training will use triplet of images that is (A, P, N) where A is anchor image of a person P is the picture of the same person as the anchor image. N is the picture of the person different from anchor image lets denote the encoded image as f(x) we have to make sure that $A^{(i)}$ is closer positive $P^{(i)}$ than negative $N^{(i)}$ we have to reduce the value of the following equation $J = \sum_{i=0}^{m} [||f(A^{(i)}) - f(P^{(i)})||_2^2 - ||f(A^{(i)}) - f(N^{(i)})||_2^2 + \alpha]$

B. Gesture Recognition

To identify the intruder in the absence of house owner gesture recognition algorithm have been used in this algorithm we have use media pose library in which by using detector the pipeline first locates the region of interest (ROI) with the frame then the tracker continuously predicts the landmark within this ROI using a ROI cropped image as an input. It explicitly detects two virtual point that are human body centre, rotation, scale as a circle. Now it will predict the midpoint of the person hip, radius of the circle that cover the entire person body and the incline angel that contain the line that connecting the shoulder and the hip. Now landmark model in media pose detect 33 landmarks on human body as shown in the figure 4

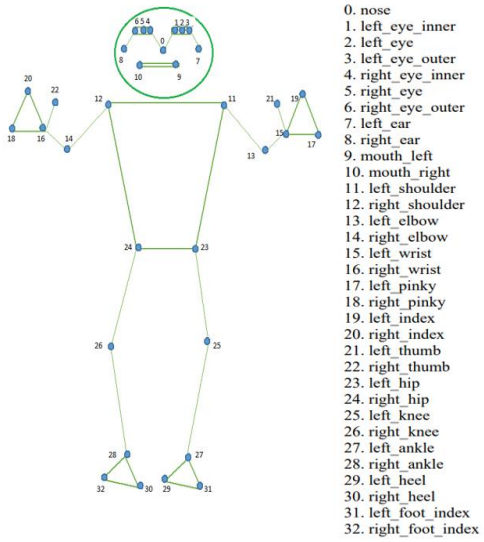

Figure 4- Different landmark of body part on the body

Now after successfully predicting the landmarks on the body of the person now we have to track the x and y coordinate of landmark 13,14,15,16 and if it crosses the threshold value that is if the x and y value of land mark 13 greater than 0.6 but less than the 0.98 then check the landmark 14 x and y coordinate if its x and y coordinate greater than 0.6 but less than 1 then check for land mark 15 if its x and y coordinate come in between the range of 0.7 to 0.92 then check the final landmark that is 16 if this x and y coordinate come in between 0.7 to 0.92 then sent an email notification to the user that "Your house is in danger "basically it keep track of the x and y coordinate of the left wrist and right wrist and left elbow and right elbow and if it's come near the lock of my house then it will crosses the threshold value and sent an email notification.

C. Object Detection

Now to make sure that if any unknown person with the photo of the house owner in his phone try to enter into house, then also our model will send a Gmail notification to the house owner. So, to achieve this we have to implement object detection, if face is detected along with it also detect the mobile phone that's mean someone trying to enter into house by showing the image of the house owner so to restrict this type of activity object detection YOLO (you only look once) algorithm has also used to detect another object such as mobile phone with the image of the person.

D. Raspberry pi

Raspberry pi have been used to compute all the image processing task .raspberry pi connected with the servo motor that will open and close the door .Pi camera has also been used to recognised the face of the person .When a raspberry pi detect any intruder in its camera in the absence of house owner in the house then it will start to analyse the gesture of that person if from the gesture recognition it get confirm that someone try to move inside the house force fully then then Raspberry pi will send an Gmail notification to the user .So here Raspberry pi work as an heart of the home security

E. Design of the Home security system

In this Home security system Raspberry pi is connected with a motor and camera. Camera will detect the face of the human and then it will match this unknown face with all other faces that are present in the database and if any match found then raspberry pi will set the pin of the servo motor high through which the lock is connected so that servo motor will turn 180 degree and open the lock .The camera that is connected with raspberry pi also detect an unknown intruder and then if it start to recognised its gesture if from its gesture raspberry pi come to sure that person is trying to enter into house forcefully then it will send an alert notification to the house owner .The complete system design is shown in figure 5

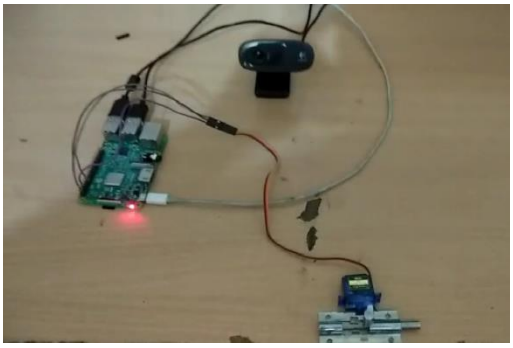

Figure 5-Complete set up for home security

IV. RESULT

The model is successfully recognised the face of the person with the accuracy of 71 percent as shown in figure 6 after recognising the face it will open the lock of the door

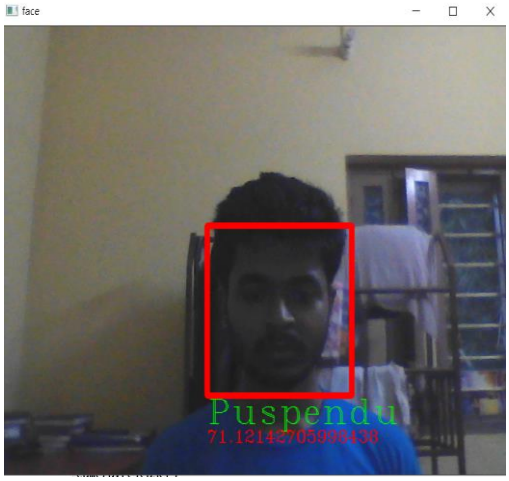

Figure 6-The model recognised the face that is present in database with an accuracy of 71

The model also success fully recognise the gesture of the intruder and after recognising its gesture if it gets confirm that intruder want to forcefully enter into house then it will send a Gmail notification to the house owner that “Your house is in danger”

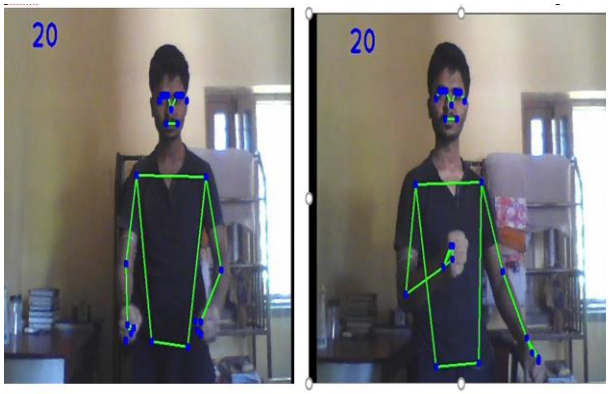

Figure 7-Model successfully recognised the pose of the human body

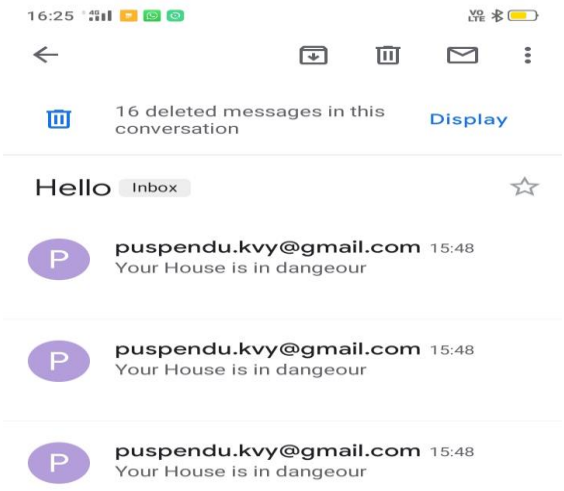

Figure 8- Sent an alert mail to the user after recognising the gesture of the body

V. CONCLUSION

The model successfully recognised the face of the person that is present in the database with an accuracy of 70 percent the database can store as many as images the user want so that in case if any relatives of user want to enter into his/her house in his/her absence he can enter into the house by taking permission from the user as soon as person enter into the user house Gmail notification will be sent to the user.

In case if anyone without the permission of user want to enter into house then the model will recognise its gesture and if it confirms that he/she want to enter into hose forcefully then alert mail will send to the user.

VI. REFERENCES

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