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Face Recognition using Neural Network

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***Abstract*—2-D and 3-D models can be used for face recognition. The effect of light due surrounding factors can be reduced using 3-D model. But the issue with 3-D model method is that it takes large amount of time for fitting. This makes it difficult to meet real-time requirements. The algorithms usually use 2-D model for recognizing a face. These 2-D images are used for everything as the image captured can be of any distance using appropriate sensors and any illumination scenario. Whereas for capturing an image in 3-D, imaging technologies that currently work are able to do so at very short distances and also suffer from the inability to replicate complex patterns unless they get extremely close to the subject. 3-D imaging is a new technology when it comes to image capturing as its original purpose was to scan and measure objects accurately for aeronautical and scientific applications. Current commercial devices have cameras that can work well with low exposures and bad lighting situations using a combination of 2-D and 3-D imaging techniques that helps in creating incredibly detailed images. Our aim in this paper is to improve low-light camera performance using 2-D face recognition algorithms for extracting facial features captured using older security footage devices with no additional sensors. This paper is aimed to work with video streams as well as images so that plenty of learning and testing data is available to the paper.**

***Keywords*—Deep learning, Log-Gabor, LBP, LBPH, CLAHE, Open Face, Weiner, BM3D Filter, Neural Network**

I. INTRODUCTION

Our paper aims at improving low light performance using neural networks and algorithms that in order do so in a feasible amount of time. We can use these technologies to bring better low light performance to lower end devices. Since the solutions used by manufacturers is to add additional hardware to newer devices for optimizing their accuracy.

Face detection is used in multiple scenarios like human computer interface, surveillance systems, video conferencing, forensic applications, crossing pedestrian detection [3], government image databases, etc. However, the development of a reliable system for face detection in a complex scene is very difficult due to a wide range of possibilities in illumination, variability in scale and unevenness, location, orientation, and pose.

This paper helps in extracting the facial features of a person in lowly lit environment[1], this can be helpful in cases where the target person acts at night time or in dimly lit streets as such the paper will use CCTV footage in order to gather the information required to recognize the person in any lighting situations[1]. Also, if implemented this will help manufacturers to offer better performance to lower segment devices.

This paper performs these tasks using neural networks, histograms, and various filters. The main objective of this work is to propose a reliable method to detect human faces at different lighting conditions. We aim to distinctly identify different people using their faces from a video stream [4] regardless of the lighting scenarios by the end of this paper.

Existing systems: Current generation of low light imaging uses time of flight sensors to create a 3-D map of the target and use AI to merge and reconstruct the object. These are extremely accurate and require very less power so that it could be equipped on a low power device like a smartphone or those newer generation CCTV cameras that work on batteries but these are hardware solutions and cannot be ported back to older generation devices using software updates. As such the manufacturers use these sensors in addition with the camera sensors to create high fidelity image data using images available at their current low exposure environment. Some manufacturers have used techniques that involve merging multiple different exposure images to construct a new image but the quality of result varies.

II. LITERATURE SURVEY

Our paper will review the literature related to the area of study – Low light Face Recognition. The study may use existing research conducted in this area, what and how much has been studied in relation to the subject and what has yet to be addressed due to limitations in their research. This provides background to the research; it will provide the necessary foundation and support to the research. By referring to the past research conducted on the subject, the researcher will have an idea of how such a study has been done in the past. In this way, this research may be able to reflect, compare itself, learn from setbacks and produce a stronger and more efficient solution.

[1] Deep Learning for Face Recognition under Complex Illumination Conditions Based on Log-Gabor and LBP: This paper demonstrates a novel method for face recognition in harsh lighting conditions. Here they used Log-Gabor and LBP based algorithms for generating the Query image. This query image is given as input to the DBN to get the expected output.

[2] Real-Time Face Recognition Using Feature Combination: This paper demonstrates real time face recognition in a cluttered scene. Here images are recorded and facial detection algorithm is performed on that image and the result is stored in the database. At a future time, a person in

front of the camera is identified if their image was present in the database. In this paper the emphasis is to identify the person even with variation in poses and expressions.

[3] A novel approach of low-light image used for face recognition: This paper demonstrates that using homomorphic filtering and image multiplication process for the image pre-processing helps to enhance the human face recognition rate. Homomorphic filtering is a frequency domain approach to enhance the image contrast. The image multiplication operation is used to improve the brightness of the image and guarantee the image feature points without loss.

[4] A survey on comparison of face recognition algorithms: This paper demonstrates and compares various methods of face recognition and texture analysis. Various algorithms like Eigenfaces, Fisher faces, Local Binary Pattern Histograms (LBPH) methods are compared based on their performance and hit ratio. Their experiments results showed that the LBPH succeed in recognition with expanse of performance

[5] State-of-the-art Face Recognition Performance Using Publicly Available Software and Datasets: This paper exploits the Open Face open-source system to generate a deep convolutional neural network model using publicly available datasets.

III. PROPOSED SYSTEM

Facial recognition is a very important part of human society in this day and time as it is used everywhere from smartphones to security protocols in governments and huge corporations. Existing technology constantly replaces the camera and biometric systems so as to stay updated. These camera systems can still be used for properly identifying individuals in daylight but night time performance is what suffers the most in such hardware. To optimize the performance of such hardware is our main aim of this paper. We are using a software-based solution to make up for the hardware shortcoming in the target hardware. We are using Neural networks [1], histograms, Gabor filters [1][4], Open Face [5], etc to extract the necessary information from the source files obtained using this hardware.

In this solution:

1. The data source is given as input to the software.
2. Illumination threshold is applied.
3. Pre-processing is done to remove noise and increase image quality.
4. Face(s) from the source are detected
5. Feature extraction from the detected face(s).
6. Detect the closest match for the target face from the existing faces database.
7. Output.

Use Cases:

- Better face detection for older devices in any lighting conditions.
- Can be used for better feature extraction in CCTV footages of crime scenes so as to obtain better detailed facial structure of the criminals.
- Can be used in finding kidnapped/lost children if they are captured in CCTV footage.
- Can be used for cost deduction in smart devices/automation systems/security devices by using a software-based approach.

IV. DESIGNING

Our idea is to allow the user to feed data in one of the two ways into the paper:

1. Import video source to the paper.
2. Import an image on which these operations are to be performed.

Now after taking the input, pre-processing is done to remove noise and contrast boosting is done. Pre-processing techniques like Weiner, BM3D are used for noise removal, Homomorphic filter and CLAHE are used to adjust contrast image multiplication operation is used to improve the brightness of the image and guarantee the image feature points without loss.

Once the pre-processing is done, the face is detected and extracted using MTCNN. After this, the Log Gabor, LBP [1][4] and Open face [5] are applied to extract the facial features from that frame. The output of all three algorithms are used for analysis and face matching with the existing faces in the database.

In a video source the program uses an open face-based model to detect the target face from the video source. The video face detection has an alternative having more manual intervention by selecting frames from the video sources and then extracting faces from each and every individual that was making an appearance in that video source. This is a more time-consuming method but ensures that all the faces are properly being extracted and then once all the faces are extracted, it then passes it to the recognition phase where the closest match to the target is identified and generated at output.

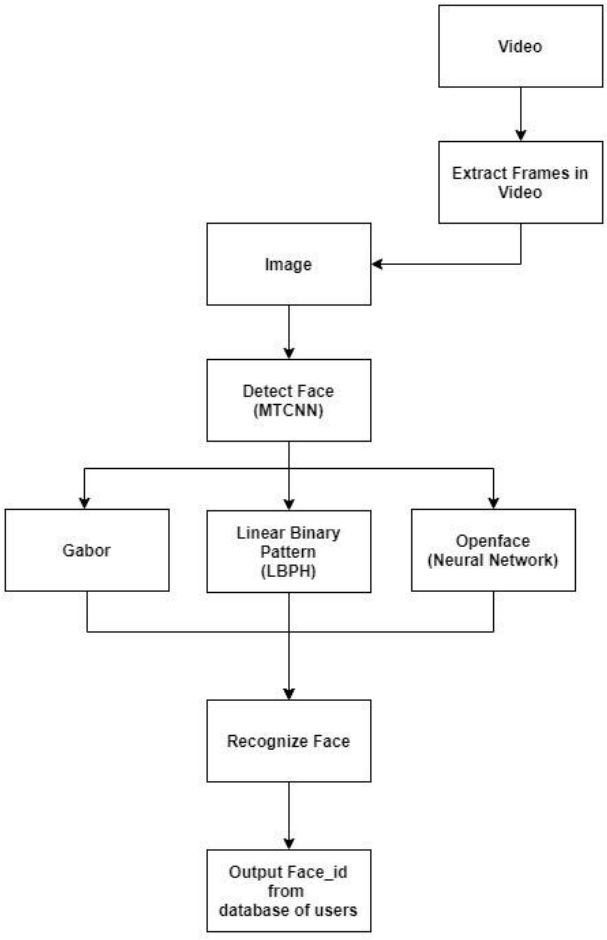

Fig. 1. Design Flowchart

V. METHODOLOGY

Algorithms:

- Pre-Processing:
  a. Noise Removal Filter (Weiner, BM3D Filter)
  b. Homomorphic Filter
  c. Image Multiplication
  d. Contrast Limited Adaptive Histogram Equalization
- Feature Extraction:
  a. Log Gabor
  b. Linear Binary Pattern
  c. Open face
- Technologies Used:
  a. TensorFlow-GPU 1.12.0
  b. Multi-task Cascaded Neural Networks
  c. Opencv2
  d. Open Face

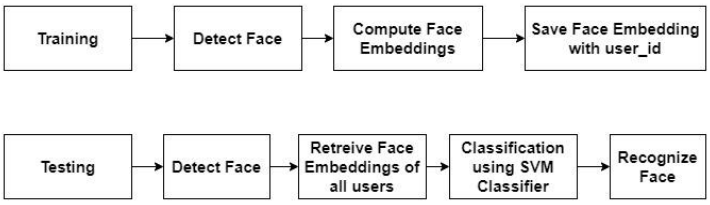

Fig. 2. Method Flowchart

- Wiener Filter: Wiener Filter is an adaptive filter based on Fourier - iteration. That is Wiener performs better smoothing if variance is small enough else performs little smoothing. The adaptive filter is more selective than a linear filter as it does not blur edges and other high-frequency regions of an image.
- BM3D filter (Block-matching and 3D filtering): It is a denoising strategy that is based on enhanced sparse representations in the transform-domain. Different 2D object fragments (e.g. blocks) are clustered into 3D data arrays to improve the sparsity.
- Homomorphic filter: Homomorphic filtering is the frequency domain approach that enhances image contrast. Mostly it is used to enhance the useful information for low illumination images without any loss of image features [3].
- Image Multiplication: The brightness of the image would be reduced when it is passed through a homomorphic filter. Reduced image brightness may lead to loss of important feature points, local information cannot be recognized. So, we enhance the brightness of an image by multiplying images with a multiplication factor [3].
- CLAHE (Contrast Limited Adaptive Histogram Equalisation): CLAHE is different from other Histogram Equalization in a way that it is an adaptive method computes several histograms, each corresponding to a different section of the image and uses them to redistribute contrast values of the image. It is the best suitable method for improving contrast and enhancing the definition of edges. It can also be used to improve the visibility level of foggy image or video.
- MTCNN (Multi-task Cascaded Neural Networks): Multi-task Cascaded Neural Network is a facial detection model based on TensorFlow which gives high accuracy keeping real-time performance. It is too good that it detects faces with side poses. The model is a multi-task network because it makes three types of predictions: face classification, bounding box regression, and facial landmark localization.
- Log Gabor: The effect of lighting conditions on image processing is relatively small because Log Gabor has no DC component. Therefore it helps in minimizing the effects of light while recognizing a face. The transfer function of the log Gabor supports the high-frequency feature. Because of this additional feature Log-Gabor can encode natural images more capably than normal Gabor functions. The low-frequency components were overrepresented by normal Gabor filter and the high-frequency components were under-represented in any encoding. [1]
- LBPH (Local Binary Patterns Histogram): It is a simple texture operator which labels the pixels of an image by thresholding the neighbourhood of each pixel. This process considers the result as a binary number. This process allows to find patterns in image using matrix constructions and is very efficient [1]
- Open face: Open face is a deep learning based facial recognition model which provides accuracy similar to the State-of-the-art system such as Deep face and Face net. But Open face is open-source when compared to the others. Open face is trained in a neural network pipeline passing around 500,000 images for training [5]

V. IMPLEMENTATION

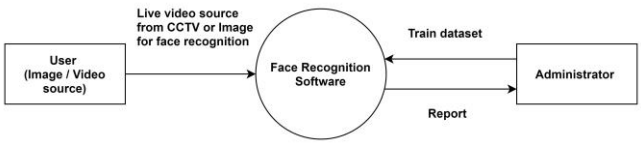

Fig. 3. Implementation DFD

Our paper's user model is planned such that an administrator could just update the dataset of individuals on demand so that the user could check for his target individual using his source footage. The software acts as an intermediary between the admin and user, the admin is notified when the

results cannot be determined from this dataset as a clear image of the intended target is not present or the appearance of the target differs from the one in the dataset. The admin then accordingly updates the dataset.

The program is to be periodically updated with newe datasets by the administrator so as to work with differen sources provided by users. The user is required to input th video or image where his target is visible on screen. Th program does its processing and compares it to its database and provides its output to the user.

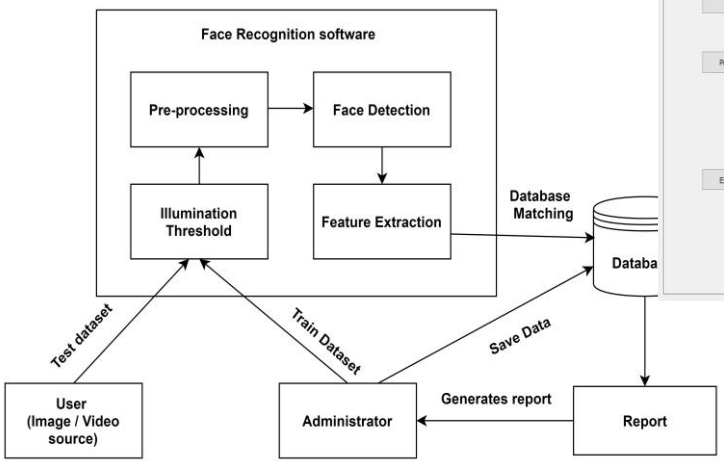

Fig. 4. Working of the system

The design of this paper is such that the user has no interaction or idea of what the program is processing apart from feeding the data. This is done so that the paper could be focused solely on the processing and face recognition parts. The admin is left with only updating the dataset to keep the paper updated when no entries of a particular target is available or when newer targets are to be added for a particular situation.

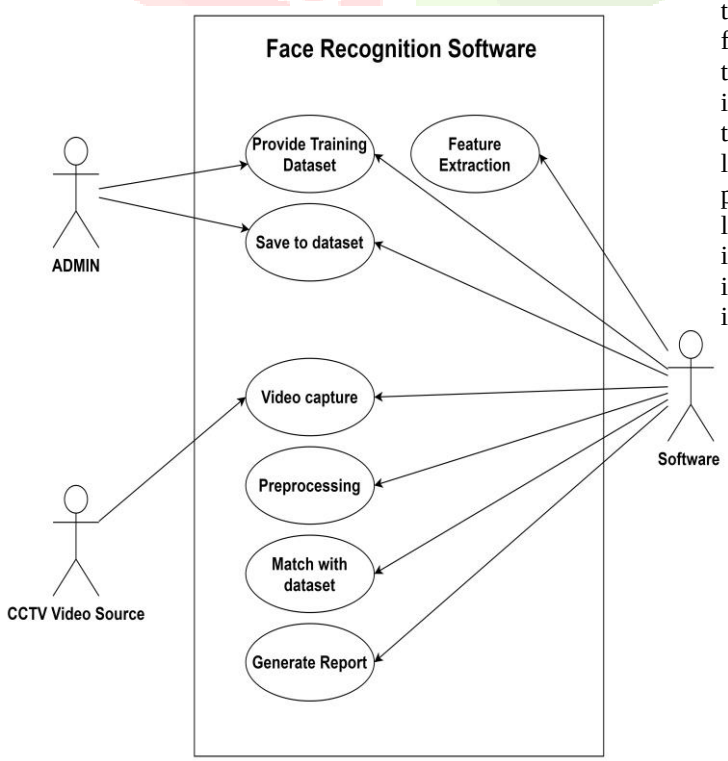

Fig. 5. UML diagram

VI. RESULTS

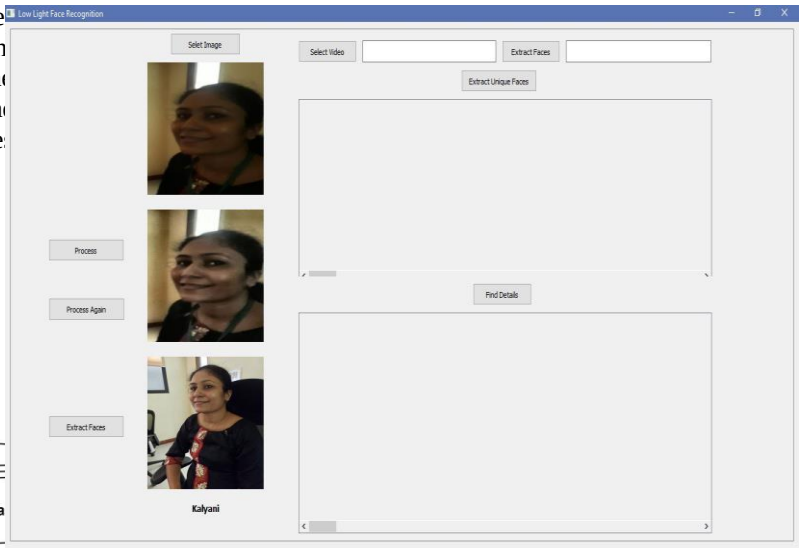

Fig. 6. The GUI

This above image is the main GUI interface that we designed in order to display the data provided by the user and the one that the program managed to detect using its processing algorithms. As shown above the UI is simple and is divided into two parts, the image recognition side shows the input data provided by the user, the image after is the preprocessed image then at the bottom this image is the one from the database, this image is the closest match to the target image provided by the user. Now as for the video part, it has an input box where the user is expected to send his video source data. This source file's name is displayed at the top box and the extracted unique faces are displayed below.

The Fig. 7. chart is a comparison of the images used by the program. The one on the left is the image that the user had fed into the program, this image has very little exposure and the image is grainy. The image obtained after pre-processing is having more contrast and the exposure is adjusted so that the face is visible. The difference in between the images in the left and image in the middle is very noticeable, this pre-processed image is smoothened so as to keep the noise level lower, the image is also quite grainy due to the original image's lack of exposure and details. This pre-processed image is then used to find the closest match to the target image.

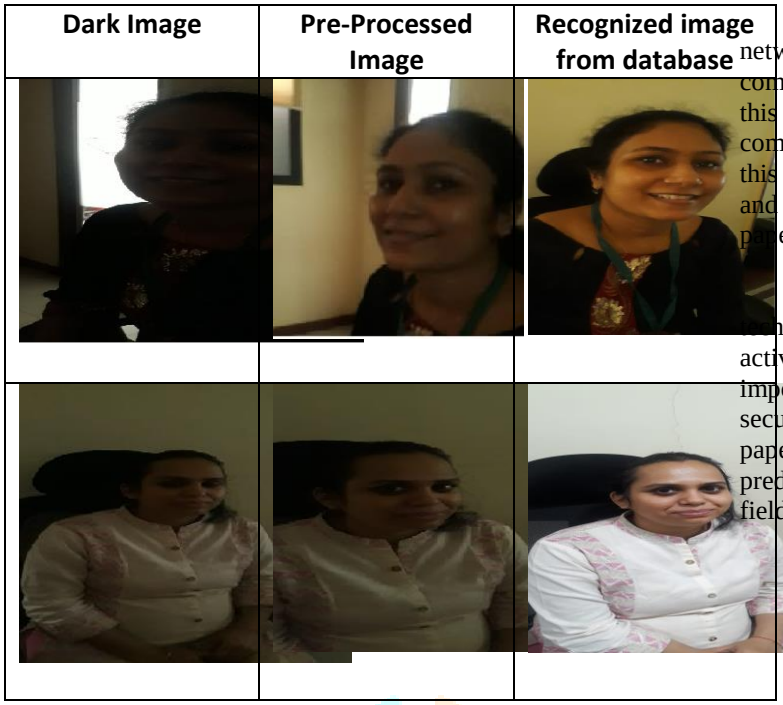

Fig. 7. Comparison chart

This paper is one where we have used neural networks in order to train our models, this requires lots of computing power and as such, in future the papers based on this would benefit highly by using more advanced and less computationally expensive training methods. This will enable this paper to be feasible to be implemented on low end devices and as such smartphones in the future will be able to use this paper if possible.

As the world is moving towards a future where technology is used in more and more aspects of society. Every activity will be monitored and as such face recognition is an important field where organizations not only related to security but other fields will take interest in. As such this paper will serve as a marginal improvement over its predecessors and can be used by people having interest in this field to improvise or research on this topic

VII. CONCLUSION

REFERENCES

[1] L. Zhuang and Y. Guan, "Deep Learning for Face Recognition under Complex IlluminationConditions Based on Log-Gabor and LBP," 2019 IEEE 3rd Information Technology, Networking, Electronic and Automation Control Conference (ITNEC), Chengdu, China, 2019, pp. 1926-1930.doi: 10.1109/ITNEC.2019.872902

[2] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.

[3] Dafeng Ren, Hui Ma, Laijun Sun and Tingchun Yan, "A novel approach of low-light image used for face recognition," 2015 4th International Conference on Computer Science and Network Technology (ICCSNT), Harbin, 2015, pp. 790-793. doi: 10.1109/ICCSNT. 2015.7490860

[4] A. Özdil and M. M. Özbilen, "A survey on comparison of face recognition algorithms," 2014 IEEE 8th International Conference on Application of Information and Communication Technologies (AICT), Astana, 2014, pp. 1-3. doi: 10.1109/ICAICT.2014.7035956

[5] M. A. Hmani and D. Petrovska-Delacrétaz, "State-of-the-art face recognition performance using publicly available software and datasets," 2018 4th International Conference on Advanced Technologies for Signal and Image Processing (ATSIP), Sousse, 2018, pp. 1-6.