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Finding Lost Child by Face Detection Using Machine Learning Algorithm

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Abstract—The technological developments in recent days have made people's life more convenient. A wild proliferation of face detection techniques is been exercised for various media applications where the people's facial contour has distinguished a system of cameras. Facial contours concepts are seemed to be in a fictional world, but the evolution of technology makes us to slowly realize them as reality. The paper explains about spotting the lost child in crowded places by comparing their faces with several surveillance systems implemented in the surrounding using a Convolution Neural Networks (CNN) appended with Viola-Jones Algorithm. CNN patterns the connectivity between the neurons that coincide the organization of a person's facial muscle. Thus, the paper aims to find the missing persons in a quicker-way than the usual scenario.

Keywords— Convolutional Neural Networks (CNN), Feature E, LBPH, face recognition, Machine learning algorithms

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I. INTRODUCTION

As technology advances regularly, it is seen that their advancements have its effect over different levels of society and has become an essential part of every business organizations to overcome their challenges in digital marketing areas. With futuristic technologies that are being developed, it has changed the lifestyle of the people that their executive routine in the workplace is changed and postulates their everyday lives. One of such technological trends in the facial recognition and detection that has some superior expertise [1] over the security system and has also become a commercial tool for identification and marketing. This technology evolvement has led to many giant

business organizations to go with selfie-payments methodology and tagging people by identifying their features that are known. Also, the current trend of adding filters in photos involves technology to detect facial contour and have respective filters over them. Face recognition [2] and detection is the process of making a computer learn to recognize a known face [3] similarly the way humans identify their family ones. Any development [4] or the creation of technology should not be complicated for the end-users. Facial contour recognition [5], [6] has two stages generally, the first stage is the detection where the image is in a frame. The second stage is the recognition [7], [8] where the various features were been extracted to make the system learn such that identify the person. The paper deals with implementing the application through various steps. Firstly, the input sets of images are corrected for their brightness via various standard algorithms [9, 10]. Then by applying the images, the neural network is classified. The images with faces are further trained to search for the face in videos or in images. The issue addressed in this paper is unconstrained face detection like occlusions and pose variations in arbitrary value. Deep quadratic tree with Normalized Pixel Difference (NPD) feature is used for scaling the invariant pixels, reconstructing the original image and to detect the complex face [11]. Plastic surgery made in the face is difficult to recognize the identity of the person because of local Regions Of Interest (ROI) altered. Multiple Projective Dictionary Learning (MPDL) framework produces an improvement in finding plastic surgery faces [12].

Deep Convolutional Neural Networks (CNN) proposed a method called HyperFace to detect the face, to recognize the gender, to estimate the pose and to localize the landmarks. This method increases the speed of the algorithm to capture global and local information about faces [13]. The Facial Pose Pre-Recognition (FPPR) model with the Dual-Dictionary Sparse Representation Classification (DD-SRC) to find the most similar one from both profile and full-face dictionary [14]. Recognizing the sample face using sensors is explained in this paper [15]. Support Vector Machines (SVMs) and Kohonen's self-organizing maps were used for training to detect the body movement while laughing as well as non-laughing [16]. The author in this paper describes the concept on how to design and develop a face recognition system through deep learning using OpenCV in python [17]. A new face detection scheme with a deep learning algorithm to achieve the performance on Face Detection DataBase (FDDB) and ranked best on ROC curves method [18].

II. Materials and Methods

Machine learning is a derivative of artificial intelligence focused on pattern and inference learning rather than being programmed. This enables machine learning programs to be self-reliant and self-sustaining [19]. Apparently, it empowers the programs to predict precisely and fetch the most recent results from its experience database. Further, the self-learning enables them to learn faster and respond spontaneously [20]. Multiple algorithms were created and analyzed so far to validate the performance of the machine learning abilities. These algorithms were applied in marketing and business intelligence to learn and understand the buying interests of the customers. It was also used in industries by the HR team to gauge the ethical behavior and periodic performance of the employees. Recently the algorithms are used to understand the likes and dislikes of individuals browsing in websites and push desired feeds based on predictive behaviors of the browsing pattern. Machine learning algorithms were used for identifying lost children, detecting and capturing the terrorist who

would otherwise be the reason for socio-economic damages. The algorithms were either supervised or unsupervised [21].

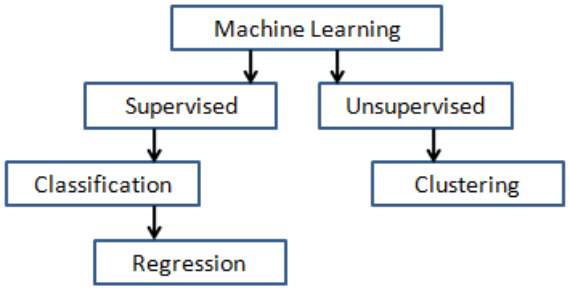

Fig 1. Machine learning types

Supervised algorithms often need experts to monitor and provide the required information for the algorithm to execute. Unsupervised algorithms are self-sustainable and don't need inputs and monitoring leads [22]. Deep learning methods were used in unsupervised algorithms to perform iterative approach to arrive at the desired results [23]. Fig 1 explains the machine learning types and common techniques adapted for various applications. This work focuses on realizing a perfect machine learning algorithm suitable for finding a lost child in a crowded platform

The **Viola-Jones** algorithm works down by the following steps: where initially, haar-like features are obtained from the images, then the results are converted to an integral image, further Adaboost training is provided and finally cascading of images are performed. The haar-like features are obtained from a digital image, where a rectangular box or frame is considered that breaks the image at various location and identifies the positive (images with faces) images and negative (images without faces) images. The haar-like features are said to be single-valued that is obtained by the average of pixels in the white rectangle from the average of pixels from the black rectangle. Fig.2 shows the edge feature extraction, while Fig 3 shows the line feature extraction.

Fig 2. Edge features extraction

Fig 3. Line features

Generally, a 24*24 window is considered to obtain haar features. Considering such window frame results in about nearly 1,60,000 features which are not possessed with the required features. To choose

the “Best” features among them **Adaboost** training is passed through. Finally, the features obtained from images containing the faces are alone considered as the Final Classifier which is the weighted sum of weak classifiers(images with lower weight). Fig 4 shows the flowchart of the proposed system.

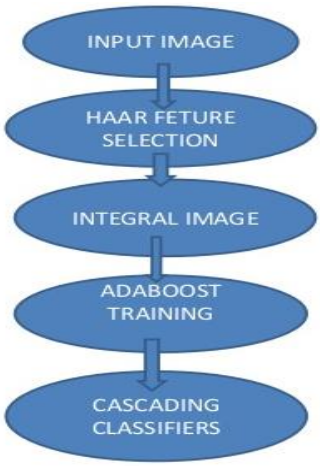

Fig 4. Flowchart of the Algorithm

The **Convolutional Neural Network (CNN)** is similar to that of viola-jones but set to have less structured and are capable of running various steps concurrently. It seems to be like a step-wise procedure but we could see that multiple pass-throughs different steps ensure only correct information is carried upon for execution. The CNN follows steps that include: convolution, pooling and Rectified Linear Units(ReLu) which is explained in Fig 5.

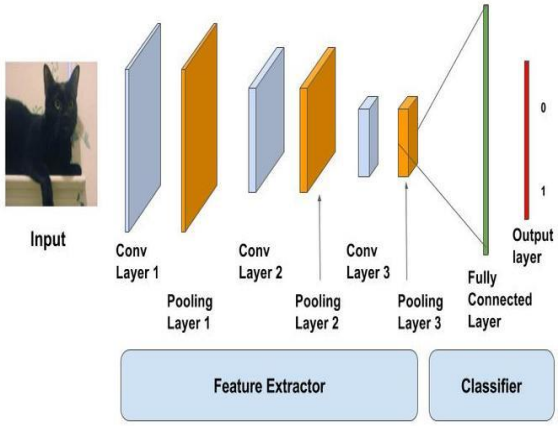

Fig 5 CNN workflow-The Fig explains the flow through various layers: Convolutional, pooling, ReLu, and Fully-connected layers.

Initially, the system (Program) finds it difficult to locate the face in an image. Convolution involves mathematical computations where it is trained to recognize where the faces might be from previous knowledge it has obtained. The mathematical computations involve multiplying each pixel in the feature by the respective pixel in the image that either RESULT IN THE VALUE OF 1 OR -1. THE PROCESS IS REPEATED UNTIL the feature spot is found in the inputted image. Followed by the pooling face where

the image window is narrowed to possibly locate the features in them. Finally, in the ReLu phase, all negative features obtained from the images are converted to zero. Finally, the fully-connected layer shows whether the selected features are correct.

The Local Binary Patterns Haarcascades (LBPH) is one of the face recognition algorithms. It is an efficient contour operator where it labels each pixel by thresholding with neighborhood each pixel and results in a binary value. LBPH classifiers are found to recognize faces faster and it is more convenient to use since computational values involve integers but not floats. LBPH provides robust results when used against grayscale image transformations.

III. Existing System

In the current system, when a child gets separated from their parents in a public event or public place, the parents first try to search with the help of people around them in nearby areas like parks or any rooms nearby in the location. After searching for an hour or so, still not able to find the child, then they approach the Police station in the jurisdiction area where the child is lost. In the Police station, we need to complain about the lost child details like name, age, any valuable ornaments worn by him, dress color of what he was wearing, any identification mark prominently seen and the latest picture of the child, which is useful to circulate with the other Police station through the control room. We need to give other details like with whom the child was there at the time of missing, appropriate time of lost, any calls received on the child lost, etc.

During the public gatherings in meetings, amusement parks or beaches, each child is given a tag with their parent's name and contact number. If the child is lost in any of these public events, with the help of the information in tags and through public addressing system, Police announce the lost child and people in the area, whoever finds the child that is lost, will inform the police with the available details in the child’s tag. In some extreme cases, through the media advertisement, we might be able to track the lost child.

IV. Proposed System

The system is used to locate the lost child by face detection methodology which is implemented using CNN appended with Viola-Jones Algorithm. The system initially accepts the lost child image and performs the affinity of trained images to extract the personal facial contour. The dataset of each lost child is created with a unique id in order to identify each lost child without any chaos. The extracted facial contour is compared to the live images obtained from the surveillance camera. Once when the image is matched the system returns the id of the person along with their name, date and time which is used to locate the child more accurately.

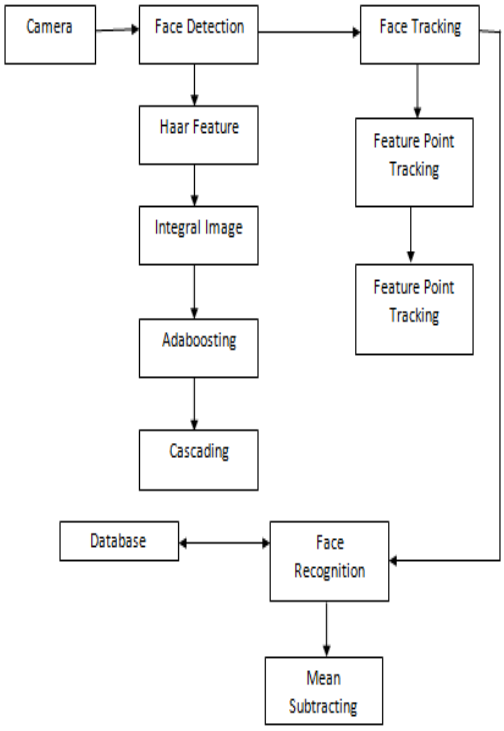

Fig 6. System Architecture

The system involves in three main phases namely, (1) creating data set (2) training data set (3) detecting phase which is explained in Fig 6. The main advantage of the proposed approach is the identification faces with high accuracy and the use of id improves the time efficiency to a greater extent.

In the training stage, to speed up the face detection a multistage or Haar-cascade classifier is utilized. The classifier involves extracting haar-like features from each image in the training dataset. This process is followed by collecting weak classifiers and producing strong classifiers by AdaBoost-machine learning algorithm. During the evaluation stage, the strong classifier is utilized to enact the face detection process using the Viola-Jones Face detection algorithm is shown in Fig 7. By using the classifier cascade process, the speed and accuracy are immense increases as depicted in Fig 8 that shows the open CV classifier.

Algorithm: Viola-Jones Face Detection Algorithm

1. **Input**: Captured image
2. **Output**: Image with face indicators as rectangles
3. **for** $i \leftarrow 1$ to capture images as grey scale images **do**
4. Down sample image to create $dataset\_image_i$
5. Compute integral image, $dataset\_image_{ii}$
6. **for** $j \leftarrow 1$ to num of shift steps of sub-window **do**
7. **for** $k \leftarrow 1$ to num of stages in cascade classifier **do**
8. **for** $l \leftarrow 1$ to num of filters of stage k **do**
9. Filter detection sub-window
10. Accumulate filter outputs
11. **end for**
12. **if** accumulation fails per-stage threshold **then**
13. Reject sub-window as face
14. Break this k for loop
15. **end if**
16. **end for**
17. **if** sub-window passed all stage checks **then**
18. Accept this sub-window as a face
19. **end if**
20. **end for**
21. **end for**

Fig 7. Proposed Algorithm

A. Haar cascade detection with Open Cv

An open CV (haarcascade_frontalface_default.py) already consists of many predefined classifiers for detecting the face, eyes, etc. Initially, the entail .xml classifiers were laden for detecting facial contour. More than fifty images of a person are stored to increase the efficiency of the system. When open-cv (trainer.py) cascade completes its work, the images are stored in the dataset folder; each image has the name in the format user.id and image_number. Each stored image is saved in greyscale mode which is depicted in Fig 9.

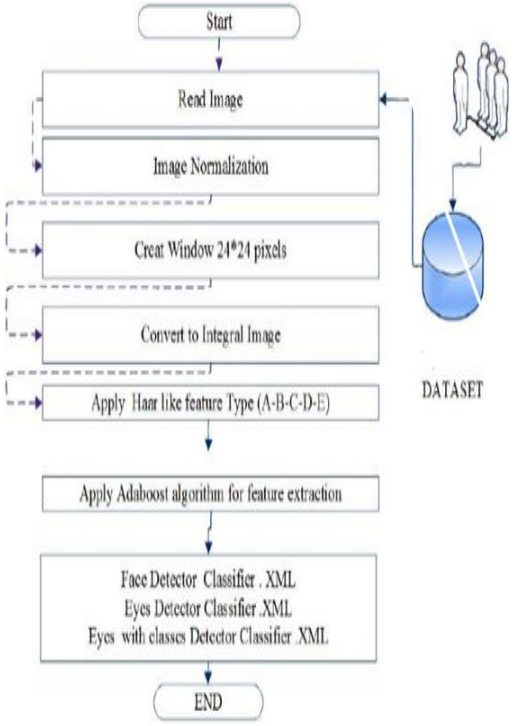

Fig 8. Flowchart for Open CV Classifier

To test the stored images, test.py is executed which displays the grey scaled images in the form of the gif. Once and when all the stages are successfully completed newdetector.py is used to compare the detected facial contour with the live images. Finally, when the image is matched and when found the system returns the name of the person, date and time when it's matched.

Fig 9. A dataset containing images stored as grayscale.

V. CONCLUSION

Facial recognition and detection systems work well nowadays even in constrained scenarios. These identification systems are found to be robust in almost every environment. The technological developments must not constrain the users and allow them to act freely in their comfort zone. Video-based person recognition and detection have more advantages in the current world and is used for various applications. Both the Viola-Jones and Convolutional Neural Network algorithm has its own strength and weakness over the face detection. Thus, our paper aims to identify the missing persons in a crowded environment much quicker than the traditional way by implementing the above algorithms. By implementing this application, the images of the missing person are trained in a few minutes and the system starts comparing with the faces to detect them. Their movements over all the cameras are recorded with date and time that we could find them in a zone and locate them faster. Though, the technology deals with various other detection issues it is found to produce about 90% better results than the manual searching process.

REFERENCES

1. Bobak, A. K., Pampoulov, P., Bate, S. Detecting superior face recognition skills in a large sample of young British adults. Frontiers in Psychology, 7, Article 1378. DOI:10.3389/fpsyg.2016.01378 (2016).
2. Croydon, A., Pimperton, H., Ewing, L., Duchaine, B. C., Pellicano, E.. The Cambridge Face Memory Test for Children (CFMT-C): A new tool for measuring face recognition skills in childhood. Neuropsychologia, 62, 60–67(2014).
3. Dantcheva, Antitza, Petros Elia, and Arun Ross What else does your biometric data reveal? A survey on soft biometrics. IEEE Transactions on Information Forensics and Security, vol 11, no. 3, pp. 441-467(2016).
4. DeGutis, J. M., Chiu, C., Grosso, M. E., Cohan, S. Face processing improvements in prosopagnosia: Successes and failures over the last 50 years. Frontiers in Human Neuroscience, 8, Article 561. DOI:10.3389/fnhum.2014.00561, (2014).
5. Duchaine, B. Individual differences in face recognition ability: Impacts on law enforcement, criminal justice, and national security. Psychological Science Agenda. Retrieved from http://www.apa.org/science/about/psa/2015/06/face-recognition.aspx (2015).
6. Jin, Jing, Bin Xu, Xiaoliang Liu, Yuanqing Wang ,Liqun Cao, Lei Han, Biye Zhou, and Minggao Li. A face detection and location method based on Feature Binding. Signal Processing: Image Communication, vol. 36, pp. 179-189(2015).
7. Papakostas, George A, Over 50 Years of Image Moments and Moment Invariants. Moments and Moment Invariants-Theory and Applications, pp. 3-32. (2014).
8. Tolba, A. S., A. H. El-Baz, and A. A. El-Harby Face recognition: A literature review. International Journal of Signal Processing, vol 2, no. 2, pp. 88-103. (2006).
9. Zafeiriou, Stefanos, Cha Zhang, and Zhengyou Zhang.,A survey on face detection in the wild: past, present and future." Computer Vision and Image Understanding, vol. 138 pp. 1-24. (2015)
10. Zhang, Xiaozheng, and Yongsheng Gao, Face recognition across pose: A review, Pattern Recognition, vol 42, no. 11, pp. 2876-2896. (2009).
11. Liao, S., Jain, A. K., & Li, S. Z. A fast and accurate unconstrained face detector, IEEE transactions on pattern analysis and machine intelligence, 38(2), 211-223. (2015).
12. Kohli, N., Yadav, D., & Noore, A. Multiple projective dictionary learning to detect plastic surgery for face verification, IEEE Access, 3, 2572-2580. (2015).

13. Ranjan, R., Patel, V. M., & Chellappa, R. Hyperface: A deep multi-task learning framework for face detection, landmark localization, pose estimation, and gender recognition, IEEE Transactions on Pattern Analysis and Machine Intelligence, 41(1), 121-135. (2017).
14. Jian, Z. H. A. O., Chao, Z. H. A. N. G., Shunli, Z. H. A. N. G., Tingting, L. U., Weiwen, S. U., & Jian, J. I. A.. Pre-detection and dual-dictionary sparse representation based face recognition algorithm in non-sufficient training samples, Journal of Systems Engineering and Electronics, 29(1), 196-202. (2018)
15. Di Lu and Limin Yan: Face Detection and Recognition Algorithm in Digital Image Based on Computer Vision Sensor, Journal of Image Analysis of Vision Sensors, Article ID 4796768, (2021)
16. Niewiadomski, R., Mancini, M., Varni, G., Volpe, G., & Camurri, A. Automated laughter detection from full-body movements IEEE Transactions on Human-Machine Systems, 46(1), 113-123. (2015).
17. KH Teoh et al : Face Recognition and Identification using Deep Learning Approach, J. Phys.: Conf. Ser. 1755 012006, (2021)
18. Sun, X., Wu, P., & Hoi, S. C. Face detection using deep learning: An improved faster RCNN approach. Neurocomputing, 299, 42-50. (2018).
19. V. Sharma, S. Rai, A. Dev, A Comprehensive Study of Artificial Neural Networks, International Journal of Advanced Research in Computer Science and Software Engineering, ISSN 2277128X, Volume 2, Issue 10. (2012)

[1] Loganathan, Jayakumar, S. Janakiraman, and T. P. Latchoumi. A Novel Architecture for Next Generation Cellular Network Using Opportunistic Spectrum Access Scheme. Journal of Advanced Research in Dynamical and Control Systems,(12): 1388-1400.(2017)

[2] James Cussens ,Machine Learning, IEEE Journal of Computing and Control, Vol. 7, No. 4, pp 164-168. (1996).

[3] Hugo Jair Escalante, A Comparison of Outlier Detection Algorithms for Machine Learning, CIC-Congreso Internacional en Computacion- IPN. (2005).

[4] Pierre Geurts, Alexandre Irrthum, Louis Wehenkel Supervised learning with decision tree- based methods in computational and systems biology,Molecular BioSystems, Vol.5, No. 12, pp.1593-1605. (2009).

[5] Ajitha, P.Sivasangari, A.Gomathi, R.M.Indira, K."Prediction of customer plan using churn analysis for telecom industry",Recent Advances in Computer Science and Communications,Volume 13, Issue 5, 2020, Pages 926-929.

[6] "Sivasangari A, Ajitha P, Rajkumar and Poonguzhali," Emotion recognition system for autism disordered people", Journal of Ambient Intelligence and Humanized Computing (2019)."

[7] Ajitha, P., Lavanya Chowdary, J., Joshika, K., Sivasangari, A., Gomathi, R.M., "Third Vision for Women Using Deep Learning Techniques", 4th International Conference on Computer, Communication and Signal Processing, ICCCSP 2020, 2020, 9315196

[8] Sivasangari, A., Gomathi, R.M., Ajitha, P., Anandhi (2020), Data fusion in smart transport using convolutional neural network", Journal of Green Engineering, 2020, 10(10), pp. 8512–8523.

[9] A Sivasangari, P Ajitha, RM Gomathi, "Light weight security scheme in wireless body area sensor network using logistic chaotic scheme", International Journal of Networking and Virtual Organisations, 22(4), PP.433-444, 2020

[10] Sivasangari A, Bhowal S, Subhashini R "Secure encryption in wireless body sensor networks",Advances in Intelligent Systems and Computing, 2019, 814, pp. 679–686

[11] Sindhu K, Subhashini R, Gowri S, Vimali JS, "A Women Safety Portable Hidden camera detector and jammer", Proceedings of the 3rd International Conference on Communication and Electronics Systems, ICCES 2018, 2018, pp. 1187–1189, 8724066.

[12] Gowri, S., and J. Jabez. "Novel Methodology of Data Management in Ad Hoc Network Formulated Using Nanosensors for Detection of Industrial Pollutants." In International Conference on Computational Intelligence, Communications, and Business Analytics, pp. 206-216. Springer, Singapore, 2017.

[13] Gowri, S. and Divya, G., 2015, February. Automation of garden tools monitored using mobile application. In International Confernce on Innovation Information in Computing Technologies (pp. 1-6). IEEE.