**Title: Identifying lost children using Deep learning**

**Rationale and Gap analysis:**

**Rationale:**

* Children are an important factor in our society as they are the future we look up to. But many children get reported missing every year which creates a big issue as most of them remain untraced. This is due to the difficulties faced in recognition of the missing child.
* So the proposed system is developed to make the process of finding a missing child less painful and faster. As compared to the existing system we are solving the problem of face variations caused due to the age gap.
* Using methodology like Facenet and C-Gan the process of recognition gets easier which will help the authorities to find the missing children quickly and solve many cases which have been untraceable because of the above issues.

**Gap analysis:**

* It is been noted that the Existing systems do not contain an Age-progression module that helps recognize any child with an age gap of 3-5 years. So if any missing child is found after 3-5 years the child cannot be recognized by the face recognition algorithm correctly.
* The existing system does not give high accuracy for images clicked in uncontrolled environment containing low light, blur images, images which are taken from a distance, changes of the pose, illumination, and expression, etc.
* Existing system uses complex algorithms which makes the system more complex and the system slower.

**Objectives:**

* To find and recognize a missing child using photograph to the child using face recognition algorithm making the process much easier.
* Overcome the challenge of face aging which makes the area of face recognition less accurate by age progressing the images of the children to recognize children from photos with an age gap.
* Take care of small and blurred faces clicked in an uncontrolled environment.
* To help police and higher authorities track down missing children quickly.

**Hypothesis:**

**Research Design and Methods/ Research Methodology:**

The proposed system consists of a portal where the public can store the details with a photograph of the missing child. By using the photograph the public can search for matching children from the missing child data. The system will prompt the most matching cases after applying a face recognition algorithm to the uploaded image. Once the matching is done the concerned person can get the details of the child.

The proposed model is divided into various phases. First, whenever the public finds any missing or suspicious child they can upload the photograph of the child with the details like name of the child, age, place where the child was found, date and time when the child was found and remarks like what clothes the child was wearing when he was spotted or any information the child might have told to the person which can be helpful to find the child.

This uploaded image goes through an image pre-processing phase. The input to this is the raw image that is uploaded by the public and the output of this phase is an aligned frontal face image. The main purpose of this step is to align all the face images based on eye coordinates such that all the images are aligned with the same standard size.

The next stage is to extract the required face features. This stage uses a Multi-task Cascaded Convolutional Networks (MTCNN) model which is a framework used for face alignment and face detection that can detect landmark locations such as eyes, nose, and mouth. The pre-processing step includes removing noise from the image, straighten the image, and detecting and cropping the face from the whole image. The extracted face features will be stored in the database for further processing.

To search for a missing child parent of the child need to upload a photograph of the child then this image will go through the age C-GAN algorithm after the pre-processing and feature extraction step. The GAN algorithm is used to generate a new age-progressed image with the same statistics as the training images. As the child may be spotted after many years, the face of the child changes from the last known photograph taken before the child had gone missing. So this model will be used to synthesis the child's face to produce an age-progressed facial image of the child. This face synthesized and age-progressed image goes through the FaceNet algorithm for feature extraction and face recognition. The FaceNet is used to automatically compare the age-progressed photo of the missing child with the already present images in the database and if the photo matches with any of the photos present in the database then an alert message will be sent to the parent of the missing child along with details like name and location where the child was found.

**Preliminary Work/ survey:**

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| **NAME OF THE PAPER** | **NAME OF THE TECHNOLOGY** | **INTRODUCTION/**  **USES** | **ADVANTAGES** | **DISADVANTAGES** |
| 1) Missing ChildIdentification System Using Deep Learning and Multiclass SVM[1] | Convolutional neural networks (CNN) & VGG-face CNN descriptor **.** | In deep learning methods, CNN are important tools that works appropriately with image data. Blocks of convolutional, ReLU pooling layers and fully connected layers are composed in CNNs or ConvNets. In this paper, For face recognition VGG- Face network is used. | CNN and VGG-Face  network applied on  photos of children. These  photos are taken in  uneasy environment. It  gives higher accuracy of  99.41 % for classification. | CNN and VGG-Face networks slower the process of classification and extraction of faces from images. |
| **2) Double-Blinded**  **Finder: A Two- Side Privacy- Preserving Approach for Finding Missing Children [2]** | Multitask Facenet (Mt- Facenet)model and IPE method for blind face matching | This Face-to-face matching method is based on IPE- based blind computing which is used to restrict access to photos | Using these technologies, the system can safely run and provides the privacy for both the unsure and missing children parts. | To provide more effective face recognition module, the output of images with threshold encryption schemes should be improved. |
| **3) Child Face**  **Recognition with**  **Deep Learning. [3]** | VGG16, ResNet50, MobileFacenet | In this paper, VGG16,ResNet50 and MobileFaceNet these three Convolutional neural networks algorithms were used. | MobileFaceNet provides higher accuracy than VGG16 and ResNet50 and also it is lightweight model | MobileFaceNet has a smallest model size and VGG16 has largest model in size. |
| **4) Optimizing deep neural network structure for face Recognition [4]** | DeepId Modules with Wide Module. | In this paper, DeepId, FaceNet networks are used by acquiring modified Inception structures which contains different typesuch as DeepId2,DeepId3. | A deep face network gives the best performance with higher accuracy when there is very less difference between wide module and deep module. | At the beginning as the width increases, The mutual information of a single image in the same layer of different designed module also increases. However, the mutual information goes down with  additional branches such as DeepId3 in wide module. |
| **5)** **Face Aging with Conditional Generative Adversarial Networks [5]** | Age-cGAN (Age Conditional Generative  Adversarial Network) | This system used Age-cGAN to generate artificial images within different age categories. And apply latent vector optimization approach which protect the original photo’s identity while recreating images using Age-cGAN. | This system used Age-cGAN to generate artificial images within different age categories. And apply latent vector optimization approach which protect the original photo’s identity while recreating images using Age-cGAN. | The face recognition method which is being used by this system can be improved by combining Pixelwize and Identity-Preserving methods into one singular method. |

**Expected Outcomes:**

* The proposed project uses Deep learning methods for Age progression and for face recognition. From the Age progression, Images are recreated while protecting child’s identity feature and it will be useful to recognize child who goes missing for 3-4 years.
* Our system is based on maintaining a database, such that at the time of the reporting recent photograph of a missing child which is given by parents will get stored and provision will be given to the public to voluntarily take the photographs of the children so they can add the photograph to the system, so the automatic searching will take place by using Face recognition.
* Missing children cases are gradually increasing and with the help of our system these cases can be solved quickly.

**Benefits to Society:**

According To the National Crime Record Bureau 2019 report, the number of missing children has increased by 8.9% since 2019 giving a total of 73,137 children reported missing last year. Face recognition is thus the most promising biometric technology for recognizing missing children. But as the time difference between a probe image and a true mate image gets larger, the performance of the face recognition algorithm decrease, and thus the search gets harder. Thus the primary goal is to generate age-progressed image of the child rather than enhancing the face recognition performance. Thus this system enhances the ability of face matches to identify and locate children who are lost at a young age by aging face features to reunite them back with their families. Our system will be helpful to the police and higher authorities for tracking down missing children quickly.

**Cost Benefit Analysis:**

**Future Scope:**

* As face aging depends on various other factors other than aging, it is required to consider all the other factors like having a single face aging database with correct demographic details and a lot of images of the child of various age groups is need of the hour for better accuracy of the face aging model.
* The model age progresses the images of the child to just one age group, this can further be improved in the future by using a bigger dataset and categorizing the images in the dataset in various required age groups.
* The system can be further extended by connecting it to public cameras to detect real-time faces which can be continuously monitored by the system.

**SWOC analysis/ Limitations:**

* Complete training of the deep learning model which requires a large dataset remains a challenge when training with a small dataset hence accuracy is compromised.
* The age-progressed images get blurred which eventually affects the performance of the model.
* The performance of the face recognition model heavily depends on the accuracy of age-progressed images which are obtained.

**References:**

[ 1 ] S. Chandran, Pournami Balakrishnan, Byju Rajasekharan, Deepak N Nishakumari, K Devanand, P M Sasi, P. (2018). “Missing Child Identification System Using Deep Learning and Multiclass SVM”.

[ 2 ] Xin Jin, Shiming Ge, Chenggen Song, Xiaodong Li, Jicheng Lei, Chuanqiang Wu, and Haoyang Yu “Double-Blinded Finder: A Two-SidePrivacy-Preserving Approach for Finding Missing Children”(2020).

[ 3 ] Shun Lei Myat Oo, Aung Nway Oo University of Information Technology, Yangon, Myanmar “ Child Face Recognition with Deep Learning”(2019).

[ 4 ] Chang Shu School of Communication and Information Engineering,University of Elec- tronic Science and Technology of China Chengdu,China “Optimizing deep neural network structure for face recognition” (2017).

[ 5 ] Grigory Antipov, Moez Baccouche, Jean-Luc Dugelay ”Face Aging with Conditional Generative Adversarial Networks” (2017) arXiv:1702.01983v2