



Under Supervision  
**Dr. Prithish Kumar Varadwaj**

# Biological Gender Estimation From OPG Images using Deep Learning

Presented By  
**MD AHMAD JAMI**

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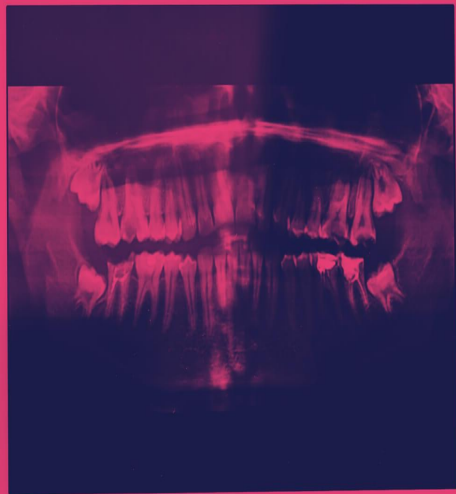
# Problem Definition

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- Age and sex estimation is an important factor in biological identification in forensic fields.
- Sex determination becomes the first priority in the process of identification of a person by a forensic investigator in the case of mishaps, chemical and nuclear bomb explosions, natural disasters crime investigations, and ethnic studies.

## GOAL:

**We will help in Forensic Investigation for Sex determination using Deep Learning on OPG Images**





# Introduction

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- Age determination of unknown human bodies is important in crime investigation or a mass disaster.
- Current age estimation methods rely on manual measurements and time consuming and human estimations which can introduce variability to the estimation results and a lack of transparency.
- This allows for human error to influence the results, especially in disaster situations where the workload for forensic experts far exceeds reasonable amounts.

- Estimating the age of minors is relatively straightforward due to a wide selection of developmental markers but the estimation in adults and seniors still poses a big problem in forensic odontology.
- We are trying to implement automated system based on deep learning to reduce the processing time, while at the same time offering consistent, reproducible results.

### Orthopantomogram (OPG)


An OPG is a panoramic X-ray of the upper and lower jaws, including the teeth. The OPG unit is specifically designed to rotate around the patient's head during the scan.

Cont...



# Why Dental data ?

- ❑ Tooth formation is the best choice for estimating the age as variations are less as compared to other development factors.
- ❑ The resistance of teeth to environmental influence makes them particularly valuable in the forensic setting. Teeth can remain intact for an appreciable time and allow for an odontologic identification of even very old skeletons.
- ❑ Age estimation by skeletal may be another approach. But age estimation by dental indicators might be more applicable than through skeletal structures because post-death changes are the slowest progressing on dental tissue, makes it a prime candidate for identification and age estimation

The background of the slide is a blurred photograph of a dental procedure. A dentist, wearing a white mask and a pink surgical cap, is using a dental mirror to examine a patient's teeth. The patient's face is also blurred. The entire image is overlaid with a semi-transparent pink color. On the right side of the image, there is a white curved shape that serves as a background for the title text.

# Literature Survey

A hand holding a dental mirror against a pink background with a blurred face.

# Background

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Edwin Saunders, a dentist, was the first to publish information regarding dental implications in age assessment by presenting a pamphlet entitled “Teeth A Test of Age” to the English parliament in 1837.

There are studies which set the foundation for the estimation of age in adults.

1. Kvaal, Kolltveit, Thomsen, and Solheim (1995) developed a method based on the discovery that the dental pulp cavity is reduced with advancing age due to secondary dentine deposit.
2. Drusini, Toso, and Ranzato (1997) bases their method on the correlation of reduction of the coronal pulp cavity and chronological age but uses it in conjunction with the tooth-coronal index.
3. Cameriere, Ferrante, and Cingolani (2004) estimate the age of adults from single-rooted teeth, specifically the single-rooted maxillary right canine. They use a set of ratios based on pulp and tooth length, width, and area to estimate the age.



# Literature Review

Sr No	Author	Title	Dataset	Findings
1.	Nicolás Vila Blanco et.al (2020) <a href="#">[1]</a>	Deep Neural Networks for Chronological Age Estimation From OPG Image	Collected from School of Medicine and Dentistry, University of Santiago de Compostela (Spain).	Used 2289 OPG images. DANet and DASNet architectures used. Model is not accurate for global data.
2.	Denis Milošević et.al <a href="#">[2]</a>	Automated estimation of chronological age from panoramic dental X-ray images using deep learning	Collected from Dept. of Dental Anthropology School of Dental Medicine University of Zagreb.	Used 4035 panoramic dental X-ray images. Model is only Estimating Age not considering Sex features and the data is of European people.



# Dataset

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- We are collecting data from [REDACTED] and collected around 3035 OPG Images data.
- After data cleaning, we have around 2335 images dataset.
- Images are in various format like .png, .jpg, .jpeg, .DCIM

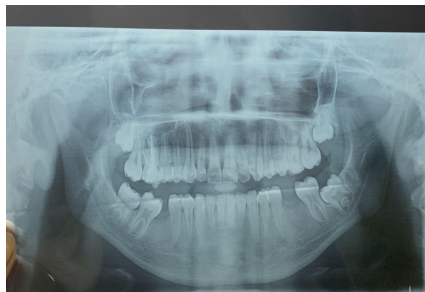
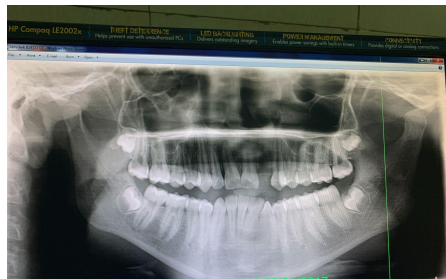
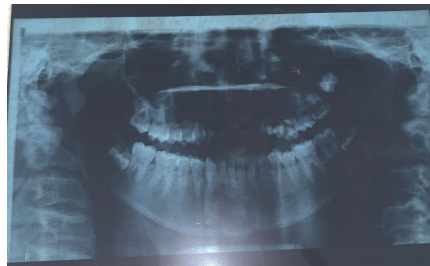
## ◆ Data Distribution

**Male - 1333**

**Female - 1002**



# Dataset





# Proposed Methodology

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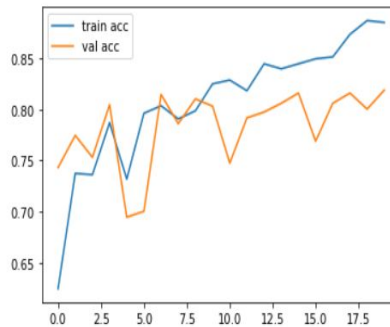
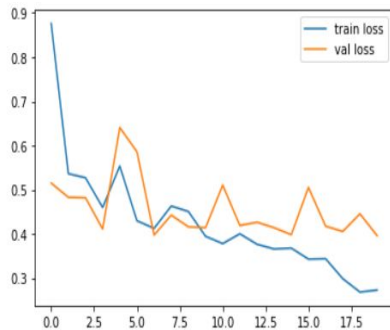
Our approach will make it entirely automatic to use raw OPG data.

- Data Extracted and make them all in same format.
- Data Cleaning, remove inefficacious data.
- Data Preprocessing like Resize, Grayscale, Normalization, Augmentation.
- Data Splitting, Stratified Sampling.
- Apply pre-trained models which is already built into keras library:
  - VGG16, VGG19
  - Inception
  - Xception
  - DenseNet201
  - ResNet50

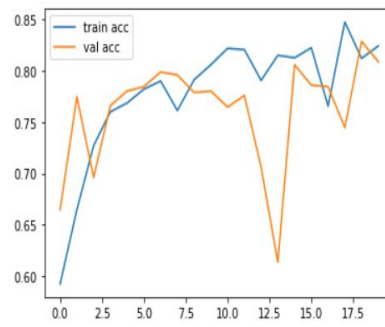
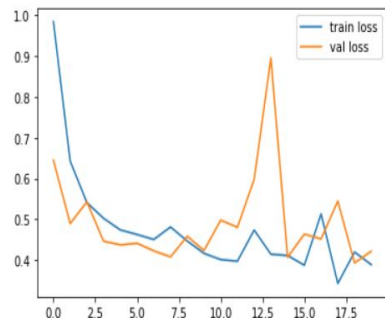
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The performance of our model on training and validation datasets visualized with the help of accuracy and loss graphs as follows:

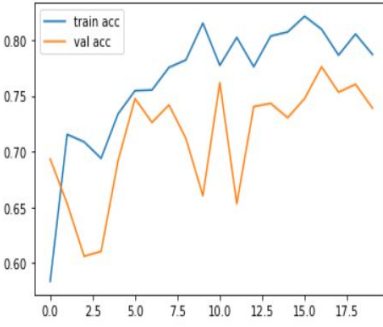
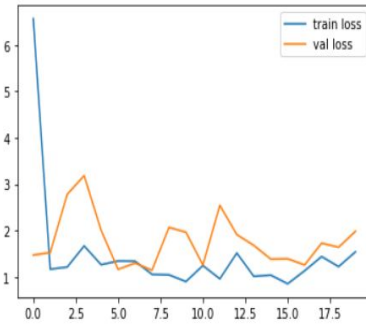
VGG16



VGG19



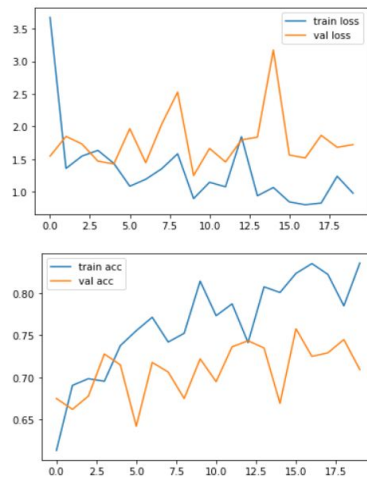
Inception



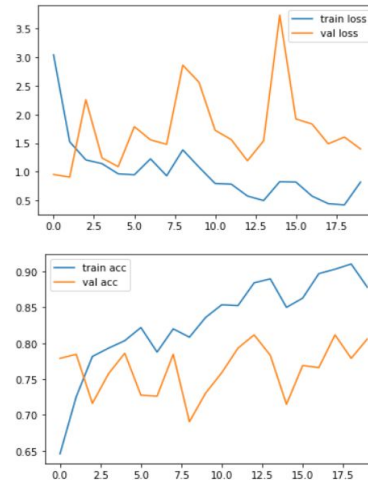


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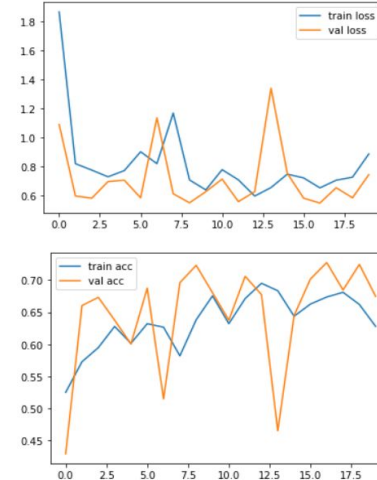
### Xception



### DenseNet201



### ResNet50



Model	Train Accuracy	Val Accuracy
VGG16	0.8795	0.81
VGG19	0.8478	0.80
Inception	0.8289	0.77
Xception	0.8495	0.72
DenseNet201	0.8982	0.81

# Results



- Accuracy of VGG16, VGG19 and DenseNet210 is better than Inception, Xception, ResNet50
- VGG19 outperform with less deviation in age (about 7 Months).

# References



1. Deep Neural Networks for Chronological Age Estimation From OPG Images Nicolás Vila-Blanco , María J. Carreira , Member, IEEE, Paulina Varas-Quintana, Carlos Balsa-Castro, and Inmaculada Tomás. IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 39, NO. 7, JULY 2020
2. Automated estimation of chronological age from panoramic dental X-ray images using deep learning Denis Milošević, Marin Vodanović, Ivan Galić, Marko Subašić, 2022



# Thanks

