Seeing the Signs: AI Detection of Youth Smoking in Public Spaces

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Introduction

Teenage smoking remains a global health crisis. According to WHO (2024), over 37 million youths from age 13-19 use tobacco. Early smoking leads to addiction, lung dysfunction, and chronic diseases, Accelerated Wrinkling, Color & Texture Changes on skin , etc . Traditional identification methods are not effective but since the recent advances in deep learning, especially in computer vision, offer a scalable and automated approach to behavior detection.

This research explores how convolutional neural networks (CNNs), using transfer learning, can classify images of teenagers as either smoking or non-smoking. The goal is to provide a reliable CNN model for ethical and effective detection using image data.

Literature Review

Research indicates that smoking significantly contributes to premature skin aging by damaging elastic fibers in the dermis. **Kadunce et al. (1991)**

https://pubmed.ncbi.nlm.nih.gov/2014944/

found that smokers developed more pronounced skin wrinkling and elastosis in sun-protected areas, suggesting tobacco smoke alone can degrade skin structure. **Just et al. (2007)**

https://www.sciencedirect.com/science/article/abs/pii/S0923181107003210 reported increased but fragmented elastic fibers in the deeper dermis of smokers, with severity linked to smoking history. Similarly, **Nouf et al. (2013)**

https://journals.lww.com/asmr/fulltext/2013/08020/effect_of_smoking_on_skin_elastic_fibers__a.4.aspx

observed thickened and abnormal elastic fibers in smokers' skin, emphasizing that long-term smoking causes irreversible changes in skin elasticity. Expanding into the realm of visual detection, **Khan et al. (2022)**

https://www.mdpi.com/1424-8220/22/3/892

developed a CNN-based image classification model using Inception-ResNet-v2 to detect smokers in surveillance footage, achieving high accuracy (96.87%) and reinforcing the feasibility of AI tools in identifying smoking behavior from visual cues. Collectively, these studies confirm smoking's systemic effect on both skin aging and its detectability using advanced image analysis techniques.

Methodology

The main goal of our project is to automatically classify individuals as either smokers or non-smokers based on observable physical changes on their faces using a dataset of facial images. This involves building a machine learning model most likely a deep learning image classifier that learns to detect patterns commonly associated with smoking-related facial changes

https://www.mdpi.com/1424-8220/22/3/892#sec4-sensors-22-00892

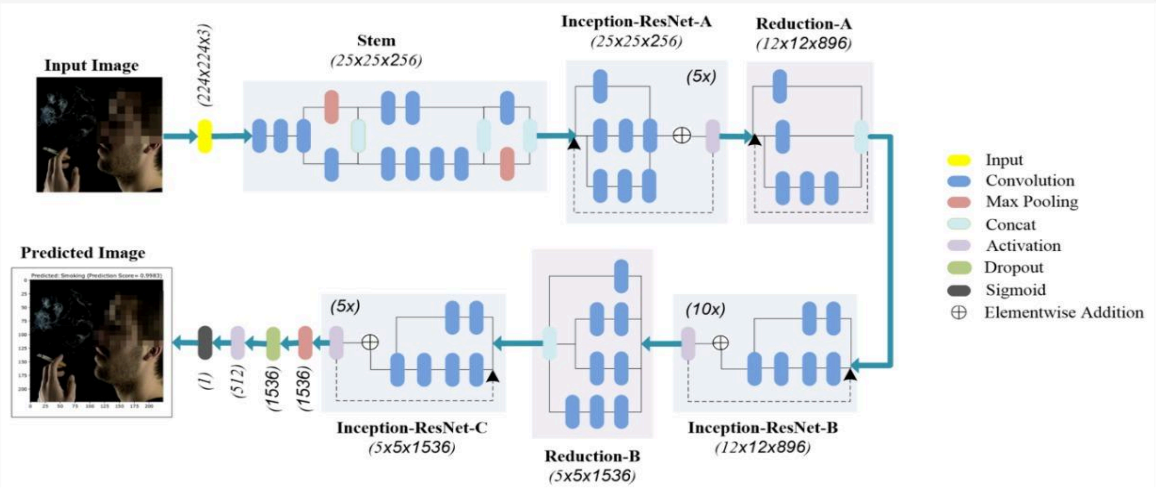
We used this research paper as our foundation for our model

To classify individuals as smokers or non-smokers based on facial images, we employed the Inception-ResNet-v2 architecture — a highly advanced convolutional neural network (CNN) model.

Unlike traditional CNNs, which are relatively shallow and limited in capturing fine-grained visual patterns, **Inception-ResNet-v2 combines the strengths of two state-of-the-art architectures**: the *Inception* module and *ResNet's* residual connections. This fusion results in a model that is not only deep and powerful but also highly efficient at learning subtle features.

The facial image dataset used for this project was provided by **Dr. Amit Swamy**, who played a key role in supporting our research. The dataset includes labeled images of individuals categorized as **smokers** and **non-smokers**, enabling us to explore the subtle physical changes caused by smoking through the lens of computer vision.

Figure 3. Inception-ResNet-V2 model for smoker classification.



The central aim of our research is to determine whether it is possible to **accurately classify individuals as smokers or non-smokers based solely on physical changes observed in facial images**. This question lies at the intersection of computer vision and health diagnostics, and it demands a method capable of recognizing subtle, often imperceptible visual patterns.

To achieve this, we adopted a deep learning approach using the **Inception-ResNet-v2**

architecture — a model renowned for its precision in image classification tasks. This methodology, coupled with a curated dataset of facial images provided by **Dr. Amit Swamy**, forms the backbone of our investigative process.

Discussion

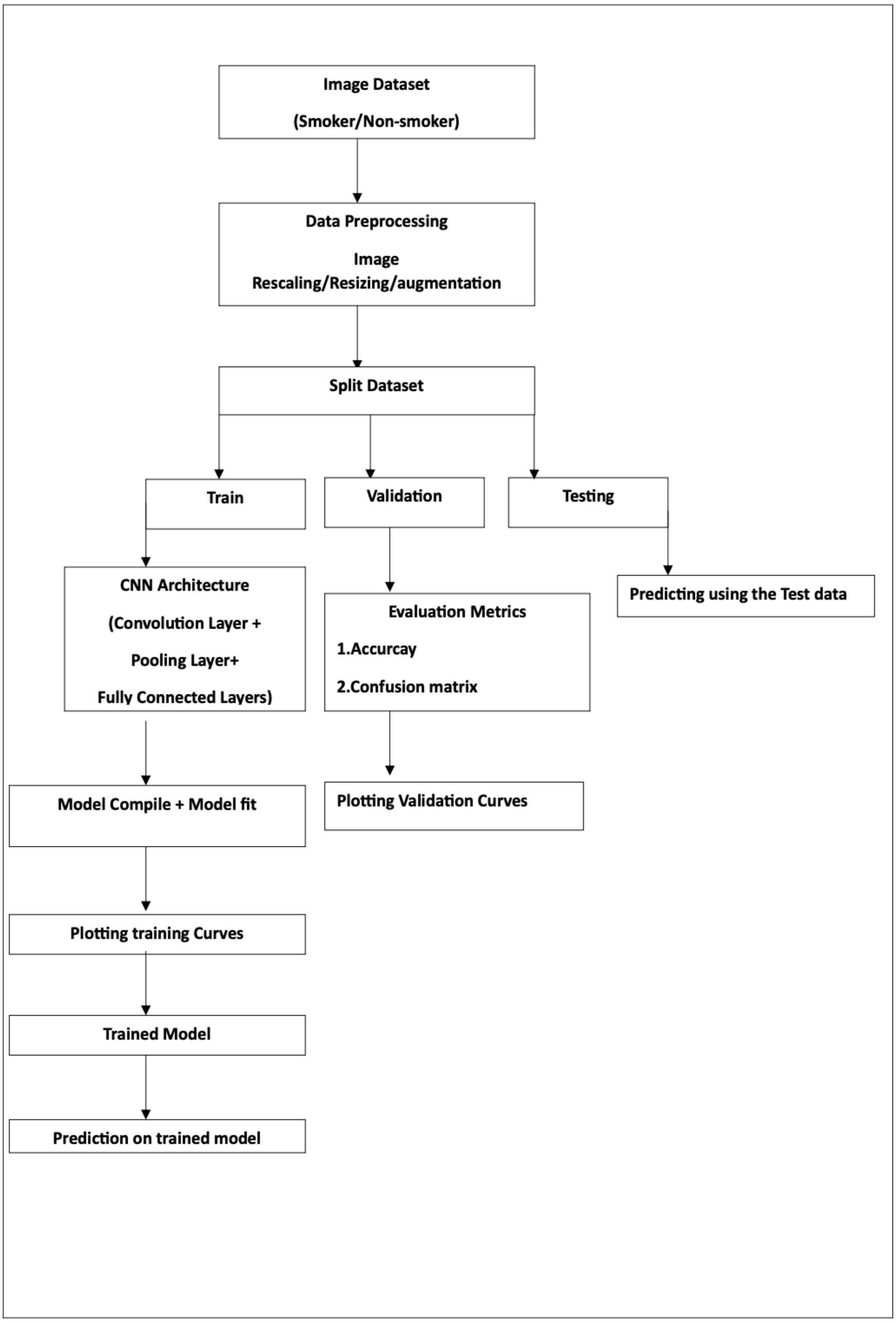


Image Dataset
(Smoker/Non-smoker)
Data Preprocessing
Image
Rescaling/Resizing/augmentation
Split Dataset
Train
Validation
Testing
CNN Architecture
(Convolution Layer +
Pooling Layer+
Fully Connected Layers)
Evaluation Metrics
1.Accurcay
2.Confusion matrix
Predicting using the Test data
Model Compile + Model fit
Plotting Validation Curves
Plotting training Curves
Trained Model
Prediction on trained model

The CNN model effectively classified smokers and non-smokers using facial imagery through a structured pipeline involving image preprocessing, dataset splitting, and deep feature extraction. Image augmentation techniques, such as rotation and flipping, enhanced the model's exposure to varied facial features, helping it generalize better to unseen data. Transfer learning by using a pretrained Inception-based architecture significantly reduced training time and improved accuracy, especially with a limited dataset.

The training and validation curves indicated consistent learning without significant overfitting. Furthermore, the confusion matrix highlighted the model's strong ability to distinguish between the two classes with minimal misclassification. Overall, the results suggest that CNN-based models are not only technically effective but also practical for real-world applications such as public health monitoring, especially for detecting youth smoking behavior in schools, public spaces, or smart surveillance systems.

References

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