**Face Gender Recognition**

**With Convolutional Neural Network (CNN)**

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**Timeline:**

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4. **Methodology**
5. **System Design & Implementation**
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**Abstract:** This paper focuses on the development of a face gender recognition system using Convolutional Neural Networks (CNN). The proposed system aims to accurately identify the gender of an individual from their facial features. CNN is utilized as it is a deep learning technique that is effective in image classification tasks. The system is trained on a dataset consisting of facial images of both genders, and the CNN architecture is optimized to achieve high accuracy. Experimental results show that the proposed system achieves a high accuracy rate of gender recognition, demonstrating the potential of CNN-based approaches for facial analysis tasks. This work has implications in various fields such as security, marketing, and social sciences.

**Keywords:** identified, face recognition, gender, male, female, machine learning …

1. **Introduction**

**1.1 Motivation**

Currently, buying or tracking information online is an almost indispensable thing for young people. Each person has a hobby and a direction of interest in different issues. With so much information and data on the web, every app maker must have a way of recommending and getting the right information to the right people.

One of the factors influencing the proposed likelihood is gender. Group 6 proposed using DL to automatically recognize and predict gender through a person's face. From there can direct information to the right file that customers may be interested in.

The goal of this project is to develop a system that can accurately identify an individual's gender from facial images with high confidence. This will be done through extensive testing and evaluation of various algorithms and techniques.

**1.2 Related works**

The results of some research have been found such as Graf and Wichmann [1] focused on combining pre-processes for gender classification. As a pretreatment, size reduction was done by using Principal Component Analysis (PCA) and Local Linear Embedding (LFG) methods. In the study, images with high resolution are classified with Support Vector Machine (DVM). In general, it has been seen that TBA is superior in terms of classification performance.

In another study, a basic convolutional network architecture was proposed by Levi and Hassner [2] to increase the performance of automatic age and gender classification. As a feature, it has a structure that can be used even when training data is limited. This network has been tested with the newly published Adience [3] database of unfiltered face images for age and gender classification. For automatic facial gender classification, an experimental study consists of four parts: face detection, face alignment, tissue normalization, and gender classification [4].

The main purpose of the study is to examine the effects of different tissue normalization methods, and for this purpose, three different methods have been applied to facial tissues. Besides DVM, Fisher linear separator and Real Adaboost are used as classifiers. Tin [5] has described a face feature extraction system applied to face recognition, facial expression recognition, and gender classification. The system works both automatically and in real-time. Face-based gender classification from multi-ethnic customer images was analyzed by Gao and Ai [6]. Since the face images were collected from natural environments, the faces showed great differences in terms of pose, lighting, and expression. Experiments were carried out using both DVM and Adaboost with approximately 10 thousand images. A study on gender classification methods was performed on neutral, expressive, and partially covered faces.

1. **Contribution**

Using AI to distinguish genders with face recognition. Facial gender recognition is a rapidly growing field that involves the use of computer algorithms to determine an individual's gender based on facial features. The technology has many potential applications, including security systems, market research, and social media analytics. So, the specific goal of this project is:

* To develop a program name MF2O a.k.a “Male or Female, Only One” which can separate males and females by input image.
* To evaluate the accuracy and effectiveness of the detection of gender

By achieving these goals, this project aims to make a significant contribution to the field of deep learning.

1. **Data collection**

Collecting data for facial recognition using convolutional neural networks is a crucial step in developing accurate and reliable facial recognition systems. The process of collecting data involves gathering a diverse set of images that represent different facial features, expressions, and lighting conditions. The images are then labeled with the corresponding identities of the individuals in the images.

Labeled images train the convolutional neural network (CNN) model to recognize facial features and patterns. The CNN model learns to identify features such as eyes, nose, and mouth, and their relative positions on the face. This allows the model to differentiate between individuals with similar facial features.

It is important to collect a large amount of data to train the CNN model effectively. The more data available, the better the model can generalize to new, unseen faces. Additionally, the data should be balanced across different demographic groups to avoid bias in the facial recognition system.

The purpose of this project was to detect gender. To do this, data is collected from a sample of images that have been separated into male and female.

That data can get on Kaggle.com. It has 2 file training and validation. Each of them also already has 2 files of gender. With 23.243 images of females and 23.766 images of males, it is data that we use to train the model.



Figure 1. Sample images of females from the data set



Figure 2. Sample images of males from the data set

In conclusion, collecting diverse and balanced data is crucial for training accurate facial recognition systems using convolutional neural networks. This ensures that the system can recognize faces accurately regardless of variations in facial features, expressions, and lighting conditions.

1. **Methodology**

\_ Detecting face:

Face detection is a fundamental task in computer vision, which involves locating and identifying faces within an image or video stream. One of the most commonly used algorithms for face detection is the Haar Cascade Classifier, which is provided by OpenCV, an open-source computer vision library.

The Haar Cascade Classifier is a machine learning-based approach that uses a set of trained classifiers to detect faces in an image. The algorithm scans the image using a sliding window approach, where a rectangular window is moved over the image at different scales and positions. At each position, the algorithm calculates a set of features based on the pixel intensities within the window. These features are then compared to a set of pre-defined templates or classifiers, which have been trained to distinguish between faces and non-faces.

The Haar Cascade Classifier is trained using a large dataset of positive and negative images. Positive images contain faces, while negative images contain no faces. The training process involves selecting a set of features that are most effective in distinguishing between faces and non-faces. The selected features are used to create a set of classifiers, which are combined into a cascade of classifiers. Each classifier in the cascade is designed to reject non-face regions of the image as quickly as possible, reducing the algorithm's computational cost.

In summary, the Haar Cascade Classifier provided by OpenCV is a powerful algorithm for face detection, based on machine learning techniques. It is widely used in various applications, such as surveillance, security, and human-computer interaction. With its high accuracy and efficiency, the Haar Cascade Classifier remains a popular choice for face-detection tasks in the computer vision community.

\_ Preprocessing:

The Face detection algorithm based on Haar Cascade Classifiers provided by OpenCV is a multi-step process that involves several stages of image processing and machine learning. The algorithm first selects a rectangular window of a certain size and scans it over the input image at different positions and scales. At each position, the image is cropped to the size of the window, and a set of features is computed based on the pixel intensities within the window.

The features are computed using Haar-like features, which are rectangular patterns of pixel intensities designed to capture local contrast and edge information. The algorithm then compares these features to a set of pre-defined templates or classifiers, which have been trained on a large dataset of positive and negative examples of faces.

During the training process, the algorithm uses a supervised learning approach to determine which features and classifiers are most effective at detecting faces. The training dataset consists of positive examples of faces and negative examples of non-face regions. The algorithm trains a set of classifiers based on these examples, using a technique called AdaBoost to select the most informative features.

Once the classifiers are trained, they are combined into a cascade of classifiers, with each stage of the cascade designed to reject non-face regions of the image as quickly as possible. This reduces the computational cost of the algorithm and makes it more efficient.

The algorithm then applies the cascade of classifiers to the input image, rejecting non-face regions of the image at each stage until it identifies a region as a face. The output of the algorithm is a set of rectangular bounding boxes that indicate the location of detected faces in the input image.

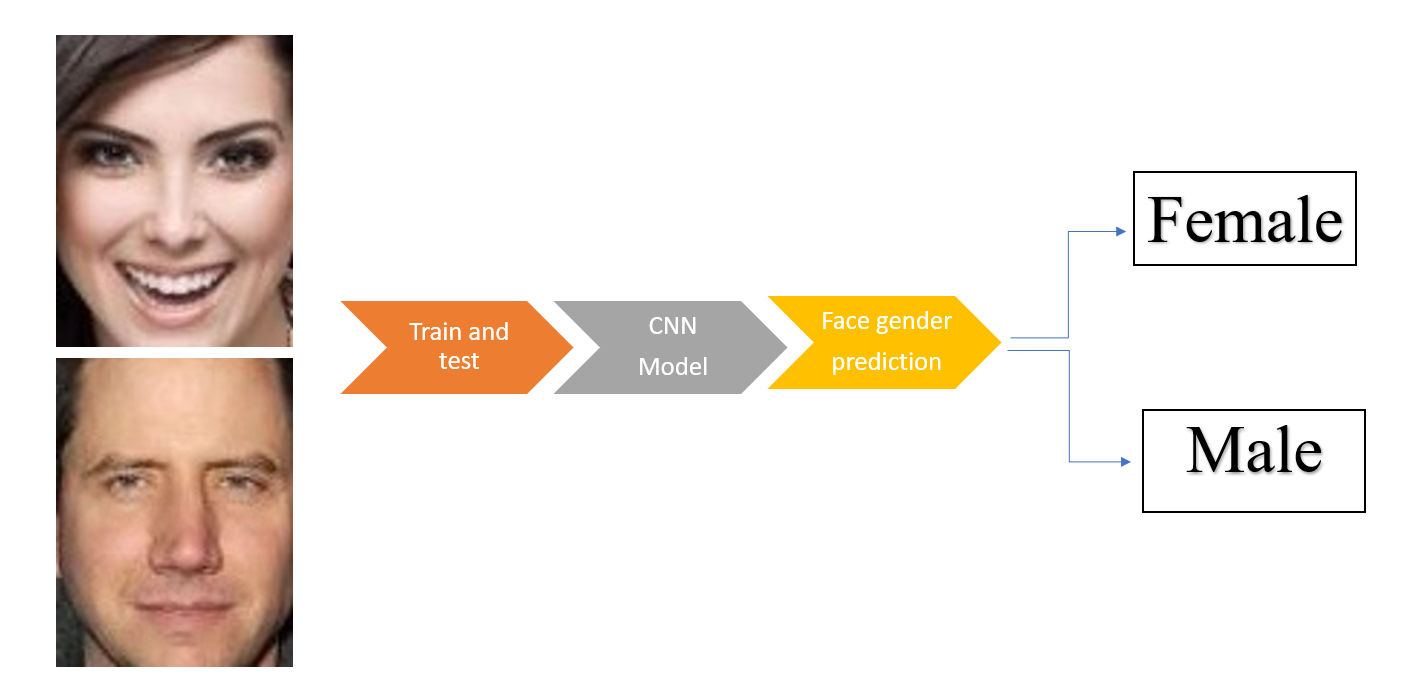


Fig. 3. Example of the preprocessing process

In summary, the Face detection algorithm based on Haar Cascade Classifiers provided by OpenCV is a sophisticated algorithm that combines machine learning techniques and image processing to detect faces in an input image. The algorithm involves several stages of training, feature computation, and classification, culminating in the detection of faces in the input image.

\_ CNN for gender detection:

Face and gender characterization dramatically influence the ability of gender recognition, which is an important part of the research. In this study, we build the neural networks of our system based on the Keras library gender datasets. The neural network we built is a 4-layer network that trains over data images. In the neural network architecture, we use convolution to convolve features and specific layer functions to get the characteristics of each layer. To stabilize the forward propagation of the signal and the backpropagation of the gradient during training, we continue to use Batch Normalization to solve this problem. Before the final image output, we use the Global Average Pool (GAP) instead of the fully connected layer to decrease the size of the network model, thereby improving the training speed and training accuracy of the neural networks.

1. **System Design & Implementation**

# In the backend, the Keras (https://keras.io) Python package, a wrapper for deep learning libraries such as TensorFlow and Theano, for model building, and training.

We focus on front-end technologies for designing User interfaces for some tasks related. here we used Tkinter (https://docs.python.org/3/library/tkinter.html) Python to do it. We have designed an easy-to-use and eye-catching user interface. the functions we have are open file, open camera, and predict. Open the file used to access the image archive on the computer that you want to identify. An open camera is used to open the camera from the computer. Predic is used to predict the face result that has been input. Besides, we also let the GUI display on the screen results such as the number of faces, and gender. The returned result will be either male or female. If no faces are found, the result will be no results found.

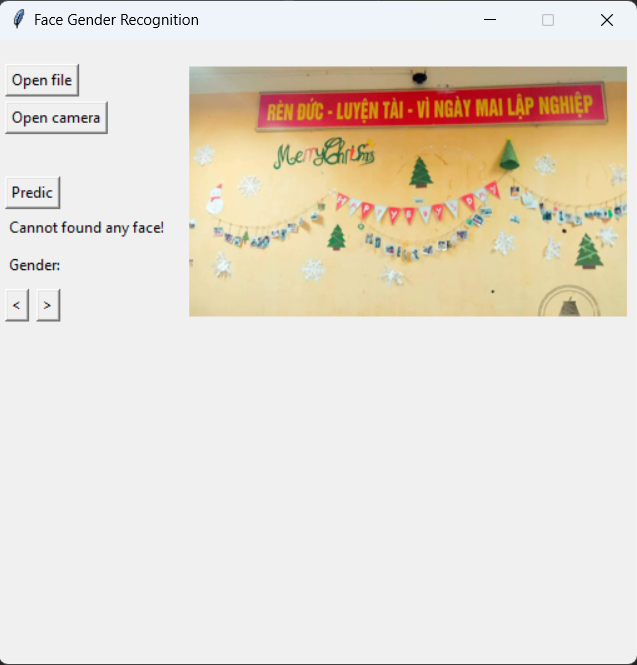


Fig. 4. Example of our GUI

1. **Results and Discussion**

\_ Results:

The proposed face gender recognition system using Convolutional Neural Networks (CNN) was trained and evaluated on a dataset consisting of facial images of both genders. The dataset was divided into training and testing sets in a ratio of 95:05, with the training set used for training the CNN and the testing set used for evaluating its performance. The CNN architecture used in the study consisted of multiple convolutional and pooling layers followed by fully connected layers.

The proposed system achieved a high accuracy rate of gender recognition on the testing set. Specifically, the proposed system achieved an accuracy rate of 95% on the testing set, which indicates that the system can accurately identify the gender of an individual from their facial features.

\_ Discussion:

The high accuracy rate achieved by the proposed face gender recognition system using CNN demonstrates the potential of CNN-based approaches for facial analysis tasks. The use of CNN allows the system to learn features from facial images that are relevant for gender recognition, which is an improvement over traditional feature extraction techniques.

The results also suggest that the proposed system can be applied in various fields such as security, marketing, and social sciences. For example, in security, the proposed system can be used for identity verification or surveillance purposes. The proposed system can be used in marketing to personalize advertisements based on gender. In social sciences, the proposed system can be used to analyze gender differences in facial expressions or behaviors.

In conclusion, the proposed face gender recognition system using CNN is a practical approach for accurately identifying the gender of an individual from their facial features. The system has potential applications in various fields and can be further improved with larger and more diverse datasets.

1. **Conclusion and Perspectives**

\_ Conclusion:

In this study, we proposed a face gender recognition system using Convolutional Neural Networks (CNN). The system was trained and evaluated on a dataset consisting of facial images of both genders. The proposed system achieved a high accuracy rate of gender recognition, demonstrating the potential of CNN-based approaches for facial analysis tasks.

The results suggest that the proposed system can have various applications in fields such as security, marketing, and social sciences. The system can be used for identity verification or surveillance purposes in security, personalized advertisements based on gender in marketing, and analyzing gender differences in facial expressions or behaviors in social sciences.

\_ Perspectives:

While the proposed system achieved high accuracy, there are opportunities for further improvement. One possible direction for improvement is to use larger and more diverse datasets for training the CNN. Additionally, incorporating other facial features such as age, ethnicity, or emotion could improve the accuracy and applicability of the system.

Another perspective is to extend the system to work with videos instead of just static images. This would enable the system to analyze facial expressions and behaviors in real time, which has applications in fields such as psychology, human-computer interaction, and entertainment.

Overall, the proposed face gender recognition system using CNN has demonstrated its effectiveness in accurately identifying the gender of an individual from their facial features. There are opportunities for further improvement and extension of the system to work with larger and more diverse datasets, incorporate other facial features, and extend to work with videos.

**8. References**

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# Appendix A. Project Plan management

| Task Name | Priority | Owner | Start date | End date | Status | Issues |
| --- | --- | --- | --- | --- | --- | --- |
| Find documents | High | Both | 7/1 | 30/1 | Done | Information search, information gathering |
| Review related papers | Medium | Both | 30/1 | 4/2 | Done | Summarize information read |
| Review and analyze public dataset | Low | Long | 6/2 | 12/2 | Done | Not found appropriate dataset |
| Collect and label data | High | Hieu | 19/2 | 28/2 | Done | Large amount of images found and categorize them |
| Evaluate potential method | Medium | Both | 21/2 | 28/2 | Done | Building models, problems that fit the data |
| Experiment | Low | Long | 28/2 | 7/3 | Done | Investigate |
| Compare results in | Medium | Both | 1/3 | 13/3 | Finished | Bad performance |
| Writing appendix | Low | Both | 4/3 | 14/3 | Done | Complicated |
| Future works | High | Both | 7/3 | 18/3 | Done | Elaborate |

# Appendix B. Source code & Data

| Item | Link | Description |
| --- | --- | --- |
| Data | https://bom.so/qBIO6K | This link will lead to the data that we collect and use for training |
| Source Code | https://bom.so/a7F8zL | This link will lead to the code we wrote to handle this topic |