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AI based Smart Mirror for enhancing selfie experience

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Abstract - *A smart mirror is an application that enhances the user-experience of taking pictures. It uses a Multi-Label Classification algorithm that classifies the natural beauty of humans which is not limited to fairness. Everyone has the belief that beauty is related to fairness. The idea presented in this paper helps categorize beauty with respect to the anatomy of the face and other attributes. For the system, our own custom Dataset was developed each for skin attributes and hair. The dataset for skin had over 830 images and 21 facial attributes and the dataset for hair had over 500 images and 11 attributes. The images were manually searched and downloaded from google.com and were manually mapped with their respective attributes.*

Key Words*: *smart mirror, Multi-Label Classification, custom Dataset , beauty, fairness.

1.INTRODUCTION

This paper aimed at designing a mobile application that can not only see the skin-deep reflection but also go beyond an ordinary mirror and can classify hair and skin type by just seeing the image. The application can be used to see the changes in a person like change in hair color, skin-tone, and so on. Knowing your skin and hair type is essential as proper measures can be taken to avoid any further damage to hair and skin. The type of skin a person has depends on the amount of water and oil in skin. If these are out of balance, a person may have to suffer.[9]Of total people studied, 27.9% of men and 36.7% of women declared having "sensitive" or "very sensitive" skin. The subjects complaining about "sensitive" or "very sensitive" skin were 2–4 times more probable to declare suffering from atopic dermatitis, acne, psoriasis, or vitiligo. They were 2- 3 times more reactive to climatic factors, cosmetics and food intake. In conclusion, although less frequently reported than in other countries, sensitive skin is a frequent condition in India. Understanding your hair texture is the most important rule in natural hair care, it is crucial to establishing a proper care routine. When the hair strand is thinner than the string of thread, your hair is fine. Hair strands with the same thickness as a thread are classified as medium, and thicker than the thread are coarse/thick .Nowadays, there are different products for different skin and hair types. Choosing an appropriate product is very difficult without knowing your skin and hair type. So , in order to know a type of skin and hair with a click , we have built an application which can classify hair as thick,thin,medium,long,straight,so on and skin as fair, acne breakout, oily ,sensitive, so on. The main features of Smart Mirror are: 1) extensible: many such modules can be integrated. 2) changes in skin and hair can be recorded with a click.In this paper we describe the design and implementation of mobile application and ml modules and compare it with other similar platforms.

1.1 LITERATURE SURVEY

There are already several spectacular open-source smart-mirror projects in the market however they have restricted functionality.

Ali Mollahosseini Et al.[1] projected a brand new deep neural network architecture for machine-driven facial features recognition. The projected network consists of 2 convolutional layers each followed by max pooling then four inception layers. Author has projected a picture based static facial expression recognition method for emotion Recognition. The projected technique contains a face detection module supporting the ensemble of 3 progressive face detectors, followed by a classification module with the ensemble of multiple deep convolutional neural networks (CNN).

The vision of ambient Intelligence (AmI) has brought a new twist to the decade previous analysis and industry initiatives in realizing sensible Environments. The AmI vision, as projected by the EU. association [12], promotes a paradigm wherever humans are enclosed by intelligent and natural interfaces offered by the interconnected heterogeneous computing devices embedded into everyday objects. Therefore, Aml are often seen as a propulsion toward a user friendly and user-empowered smart surroundings for providing effective support to human interactions.

The proposal [1],[2] focuses on facial and expression recognition. The proposed methodology is to determine various attributes of skin to further recognize skin disorders and suggest cures for the same. The smart mirror is a modification over a normal which uniquely classifies the given image of hair and skin over a wide range of attributes. The system also keeps a record of

previously uploaded images to compare the change of attributes of skin and hair and suggests the causes and cures if any. The system also has an image dataset varied over several races, age, groups and even gender to provide unbiased results for users all over the globe.

2. SYSTEM DESIGN

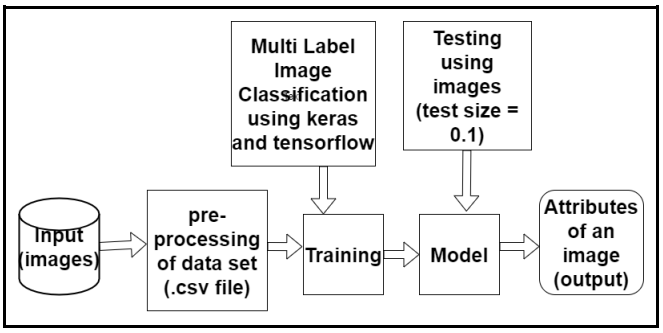

Fig -1: Block diagram of system

The different attributes of hair and skin were listed and corresponding images of different attributes were downloaded. A custom dataset was made by mapping images to corresponding attributes. This dataset was provided as an input for training a model. Skin and hair models used Multi Label image classification using keras and tensorflow. The 90% data is used for training wereas 10% data is used for testing a model.

3. IMPLEMENTATION DETAILS

The Smart Mirror is a web based application which uses deep neural networks and gives classification for over 21 facial and 11 hair attributes

3.1 Dataset Creation

A lot of datasets were searched but none of them had the attributes that met our proposed system's requirements.Hence a custom Dataset was developed each for skin attributes and hair.

The images were manually searched and downloaded from google.com and were manually mapped with their respective attributes.

3.1.1 Skin Dataset

The dataset for skin had over 850 custom images with 21 attributes each. These attributes were: Acne Breakouts, Dark skin tone, Dry skin, Earings, East Asian, Fair Skin Tone, Heart-shaped face, Left side face, Medium skin tone, Necklace, Oily, Oval-shaped face Resistive skin, Right side face, Sensitive skin, South East Asian, Tattoos,Visible pores, Glasses, Goggles, Western.

3.1.2 Hair Dataset:

The dataset for hair had over 500 custom images with 11 attributes each. These attributes were: Hair color: black , brown, blond Hair length: medium, long, short Hair quality: Thick, thin/fine Hair type: Straight, wavy, curly

3.2 Algorithm

Complex problems like Image Classification are solved by applying the concepts of AI.The machine's perception of an image is completely different from what we see. As a matter of fact, machines only see numbers in an image. A value between 0 and 255 is given to each pixel in an image.Therefore some preprocessing is required for finding patterns in an image so that the machine is able to classify the image and distinguish them

The following stages help machines to identify patterns in an image: **Convolution:** Convolution is performed on an image to identify certain features in an image. It helps in sharpening,blurring, edge detection and noise reduction .**Pooling:** A convoluted image can be too large and therefore needs to be reduced.In order to reduce the image without losing features or patterns, **Pooling** is applied. **Flattening:** Flattening transforms a two-dimensional matrix that can be fed to a neural network. **Full-Connection:** It refers to the process of feeding the flattened image into a neural network.We have used Keras and TensorFlow frameworks for building our Convolutional Neural Network.A lot of datasets were searched but none of them had the attributes that met our proposed system's requirements. Hence a custom Dataset was developed each for skin attributes and hair. The dataset for skin had over 850 images and 21 facial attributes and the dataset for hair had over 500 images and 11 attributes. The images were manually searched and downloaded from google.com and were manually mapped with their respective attributes.In the output layer for a multi-class image classification model, a softmax activation function is used . For each image, we want to maximize the probability of a single class so that the probability of other classes decreases. So, we can say that the probability of each class is dependent on the other classes.But in the case of multi-label image classification, we can have more than one label for a single image. Usage of the softmax activation function will not be appropriate as we want the probabilities to be independent of each other.In such a scenario the **sigmoid activation function** can be used**.** This will predict the probability of each class independently. It will internally create *n* models (n here is the total number of classes), one for each class and predict the probability for each class.Using a sigmoid activation function the multi-label problem will be turned to an n – binary classification problem. So for each image, we will get probabilities in the form defining whether the image belongs to class 1 or not, and so on. The *binary_crossentropy* loss will be used as we have converted the probel to an n - binary classification problem. **In order to improve the performance of the model, the aim shoub be to minimize this loss.**

For solving a multi-label image classification problem, this is the change we have to make while defining the model architecture. The training part will be similar to that of a multi-class problem.The training images, their corresponding true labels and the validation set will be

passed to validate our model's performance. Finally, a new image will be fed and the trained model will be used to predict the labels for this image..

3.3 Test Results

3.3.1 Mode: Hair

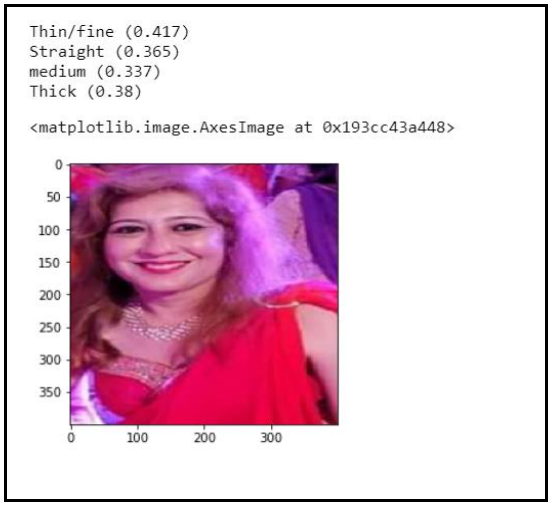

Fig -2 : Classification results for Hair

The following accuracies are obtained with multi label image classification using keras and tensorflow for Hair Classifier.:

Table -1: Results of Hair Classifier

Accuracy For Hair Classifier		
Epoch	Val_ Accuracy	Val_ loss
10	67.09%	65.90%
15	67.09%	65.18%
20	67.09%	64.23%

3.3.2 Mode: Skin

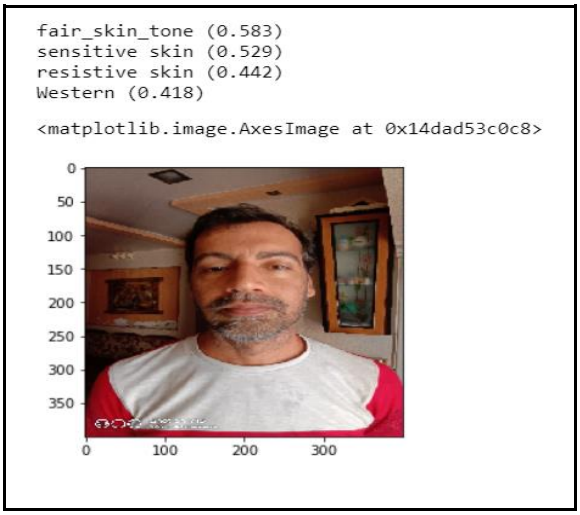

Fig -3 : Classification results for Skin

The following accuracies are obtained with multi label image classification using keras and tensorflow for Skin Classifier.:

Table -2: Results of Skin Classifier

Accuracy For Skin Classifier		
Epoch	Val_ Accuracy	Val_ Loss
10	77.22%	49.92%
15	78.00%	48.25%
20	76.03%	49.80%

4.END USER APPLICATION

The Custom trained ML models were then integrated with a flask web application which had an interface for user interaction.

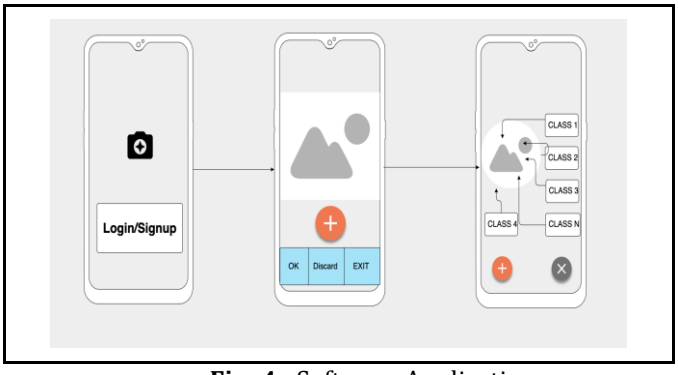

Fig -4 : Software Application

In order to use the application:

- The user needs to login the system
- Upload the image to the website.

- Select whether he wants the skin or hair classifier.
- Submit the image.
- System displays the top four facial attributes and hair attributes of the image uploaded.
- The uploaded image is saved into the database

5. CONCLUSIONS

Using multilabel image classification we were successful in implementing custom models of skin and hair attributes. The model implemented had over 21 attributes of skin and 11 attributes of hair.

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BIOGRAPHIES

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