

# Deep Learning Methods for Selecting Appropriate Cosmetic Products for Various Skin Types: A Survey

Swati Solanki<sup>1</sup>, Gayatri Jain (Pandi)<sup>2</sup>

<sup>1</sup>Student of Masters of Engineering, Ahmedabad, Dept. of Computer Engineering, L. J. Institute of Engineering & Technology, Gujarat, India

<sup>2</sup>Head of Department, Ahmedabad, Dept. of Computer Engineering, L. J. Institute of Engineering & Technology, Gujarat, India

\*\*\*

**Abstract** - Now days, cosmetic product plays major role in personality appearance. With online shopping and E-commerce websites customers are given number of products. Selecting best product for our skin is difficult for us. Therefore we propose a predictive system which gives exact idea about which product is best for our skin type. The composition is based on the skin types which can be oily, dry or neutral. In our proposed system we will implement the best composition of cosmetic product using deep learning architectures like Deep Neural Network. The proposed method takes input features like product ingredients, product suitability for skin type etc which are passed to the input layer and then to the hidden layers for automatic feature learning. Finally we get composition of cosmetic product on the output layer. The suggestion for the composition will be better than the traditional system. By using deep learning methods we will ease the challenging task of IT industry in cosmetic and beauty care.

**Key Words:** Deep Learning, Deep Neural Network, Cosmetic Product Composition.

## 1. INTRODUCTION

Over the years beauty industry becomes more and more vast, and so the products offered by this industry and the customers are also increased. So based on this expansion of products and consumers, the selection of appropriate cosmetic product becomes very important. As cosmetic products play an important role in personal appearance there is a need for selecting the best product for one's according to personal factors (i.e. skin type). Finding the perfect cosmetic for user's skin type is notoriously tricky-as every individual has a unique skin texture. Even if we find a product for a customer it can lead to skin trouble, which is a very complex issue. For solving this problem of the beauty industry we can use machine learning's framework- deep learning, as it works fine with unstructured and large amount of data with promising results.

In addition, a consumer may want to select a beauty product based on several personal factors. Beauty consultants are often very helpful in making product recommendations, a number of modern techniques for marketing and sales of beauty products are unable to provide such a personal advisor. For example, discount stores, on-line purchase arrangements, telephone ordering, and mail-in product purchases often lack any significant communication

exchange other than that absolutely necessary to consummate a product sale. So it is needed to automatically recommend the products. This could be generated by selecting product information in a database based on the personal information.

### 1.1. Cosmetic Product Composition

Cosmetic product refers to the products that one is using for betterment of their appearance. It can include various types of cosmetic items-Lipsticks, Kajal, Eyeliner, Foundation, Eye shadow, Mascara, Compact, Face wash, Body lotion etc. Cosmetic product composition comprises of so many steps and tasks to find the harmony between each of the items it possesses. As everyone is not so good at choosing the right product for them, so this solution will definitely help them out.



**Fig-1:** Composition of cosmetic products based on dry and normal skin

### 1.2. Need for Deep Learning

In recent years, Deep Learning has provided many researches in fields such as computer vision, natural language processing, machine translation, chat bots and many others. They provide stable performance and deprived the property of learning feature representation from the scratch. This influence also applied to recommendation area, where deep learning methods give significant results in comparison to traditional methods. Deep Neural networks are composite in the manner that multiple neural building blocks composed into a single differentiable function and trained end-to-end. Contrary to linear models, deep neural

networks is capable of modeling the non-linearity in data with nonlinear activations such as relu, sigmoid, tanh, etc. makes it possible to capture the complex and intricate user item interaction patterns.

Deep learning techniques possess high flexibility, especially with the advent of many popular deep learning frameworks such as TensorFlow<sup>a</sup>, Keras<sup>b</sup>, PyTorch<sup>c</sup>. Most of these tools are developed in a modular way and have active community and professional support. The good modularization makes development and engineering a lot more efficient.

## 2. DEEP LEARNING (DL)

Deep Learning is a field of Machine Learning that allows computational models that are composed of multiple processing layers of representation and abstraction that help to make sense of data such as images, sound and text.

Deep learning is a part of a broader family of machine learning based on algorithms inspired by ANN [1]. Deep learning algorithms such as Deep Neural Networks (DNN), Deep Belief Networks (DBN) have been applied to fields including computer vision, speech recognition, natural language processing, audio-video recognition, bio-informatics, medical image analysis, where they have produced comparable and in some case better result to human experts.

Basically Deep Neural Network is composed of number of hidden layers it can be any number. The input layer takes the inputs.

a. <https://www.tensorflow.org/>

b. <https://keras.io/>

c. <https://pytorch.org/>

The input cell is known as neuron and each neuron are connected with some weight. The weight decides which input is more important. Then the inputs are passed to hidden layer. Each neuron has activation function, which transfers non-linear relationships between inputs of each cell before the finalized output.

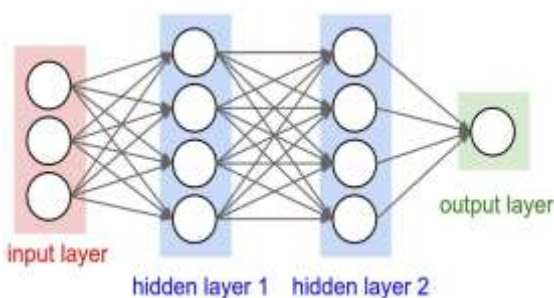


Fig-2: Deep Learning Architecture with Two hidden layers

## 2.1. Deep Learning for Cosmetic Item Composition

Cosmetic Item composition is a sequence of task which harmonizes the decision of which product is best for the given skin types. As everyone is not good enough to make decision about what to choose, the problem of cosmetic product composition arises. The solution of this problem will be given by Deep Learning Technique as provides better accuracy. The deep learning techniques are Deep Neural Network (DNN), Recurrent Neural Network (RNN), Convolution Neural Network (CNN) and Deep Belief Network (DBN). These methods provide better result in recommendation with regard to traditional recommendation methods. While working with Deep Learning there is benefit of better results for new problems.

### Various Deep Learning Techniques:

DNN: Deep Neural Network (DNN) is an Artificial Neural Network (ANN) with multiple layers between the input and output layers. The DNN finds the correct mathematical manipulation between the input and output, whether it be a linear or non-linear relationship [3].

CNN: Convolutional Neural Network (CNN) is a special kind of feedforward neural network with convolution layers and pooling operations. It can capture the global and local features and significantly enhancing the efficiency and accuracy. It performs well in processing data with grid-like topology [2].

RNN: Recurrent Neural Network (RNN) is suitable for modeling sequential data. For remembering the former computation there are loops and memories [2].

DBN: In machine learning, a deep belief network (DBN) is a generative graphical model, or alternatively a class of deep neural network, composed of multiple layers of latent variables ("hidden units"), with connections between the layers but not between units within each layer [4].

AE: Autoencoder (AE) is an unsupervised model attempting to reconstruct its input data in the output layer. In general, the bottleneck layer (the middle-most layer) is used as a salient feature representation of the input data. Variants of autoencoders such as denoising autoencoder, sparse autoencoder, contractive autoencoder and variational autoencoder (VAE) [2].

## 4. RELATED WORK

Deep Learning is successful in Natural Language Processing (NLP), computer vision, Speech recognition and other fields. It is also applied on recommendation area. Notable recent application areas are music recommendation, news recommendation, and session-based recommendation [13]. Tingting Li, Ruihe Qian et al, have proposed a Deep Generative adversarial network for makeup transfer of makeup image to non-makeup image [16].

Rio Iwabuchi, Yoko Nakajima et al., proposed the Recommender system based on User Evaluation and Cosmetic Ingredients. The focus of their research is recommending the cosmetic item in which the ingredients have high cosmetic effect using user ratings. So basically, they have defined user categories with similar skin and extract the user attributes (i.e. skin quality and age) which are set by users at the time of registration. For each cosmetic product, they derive a skin lotion with high ratio of cosmetic effect tags. For determining this threshold they have used a natural classification method. For ingredient extraction they have applied TF-IDF concept, which is used to find a word that characterizes a sentence. They have calculated IF-IPF value and sort them. Recommendation will be based on the top ingredient of the sorted IF-IPF value [5].

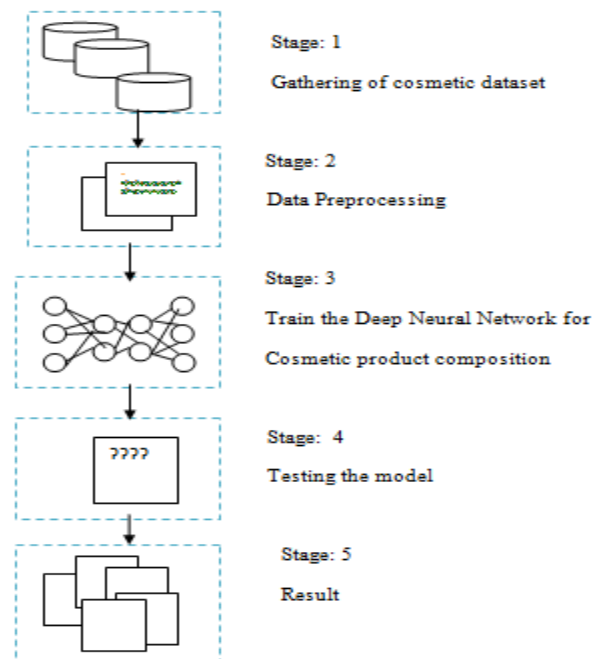
In 2017, Yuki Matsunami et al., have proposed a Tag recommendation method for Cosmetic review in recommender system. The aim of this research is assign a tag to review text. To evaluate the review text they have used automatic scoring method. System reads a text and judges the sentences and then extracts the k unit from that review text and finally sums all the aspect by analyzing sentence and calculates the score for a target review. Then system recommends a tag for evaluation expression that has a high score [6].

Asami Okuda et al., have proposed method of Finding similar users based on their preferences against cosmetic Item clusters. They proposed a method for creating clusters of similar cosmetic items based on calculating the average score for each aspect and making the cluster based on the similarity of the scores. Based on similar user that was found by clustering method the system then recommend the suitable review [7].

In 2019, Christopher J. Holder et al., have defined a Visual Siamese clustering for cosmetic product recommendation. The focus of this work is to create a model capable of matching images of new subjects based on visual similarity. The solution is based on visual similarity of customer's feature and a set of people whose preference are already known. Siamese network learn to cluster together images of eyes belonging to the same person based on similarity of visual features [8].

Yuncheng Li et al., have proposed mining fashion outfit composition using an end-to-end deep learning an approach on set data. Authors have proposed a generic algorithm for automated outfit generation with the help of Outfit Scoring Function. Outfit scoring function works by four tasks, Feature Extraction followed by Fusion Model, Pooling Model and Classification Model [9].

### 5. PROPOSED WORK



**Fig-2:** Workflow of proposed method for cosmetic product composition

As shown above the proposed model is divided in to five stages:

Stage 1: Gathering of Cosmetic Dataset.

The cosmetic data from various websites @cosme and @Nykaa gathered for this model evaluation.

Stage 2: Data Preprocessing

In Deep Learning models if you feed the garbage data, then you should expect garbage result with high probability. So data preprocessing step is necessary for cleansing of data which is required for the given model. Data preprocessing can be done by normalization, dealing with the missing data.

Stage 3: Training of Deep Neural Network for Cosmetic products composition

In this stage the training data will feed to the input layer of DNN and then using the input layer cells it then forwarded to the hidden layer, which process some steps for cosmetic product composition and the output of that will forwarded to the output layer, where we get the cosmetic product composition.

Stage 4: Testing of Model

After training the model it is required to test the model for whether the output given by it is accurate or not

## Stage 5: Result

The cosmetic product composition will be given based on skin types; dry, natural or oily.

The proposed model will use Deep Learning Technique for cosmetic product composition for various skin types, which will improve the composition quality. Deep Neural Network will help in better performance in composition task. This will lead to better and reliable cosmetic product composition.

## 6. CONCLUSION

Decision making in today's world is more complex than the past, as for consumers who are now confronted by various kind of choice for each type of products and brands. This approach provides the composition based on skin types (i.e. dry, oily or natural). Our main aim is to serve better composition of cosmetic products. By using Deep Learning technique the proposed system will definitely help in better composition of cosmetic products.

## REFERENCES

- [1] Jason Brownlee. "What is Deep Learning?" accessed on 29 November 2019, <https://machinelearningmastery.com/what-is-deep-learning/>.
- [2] Ian Goodfellow, Yoshua Bengio, and Aaron Courville. 2016. *Deep Learning*. MIT Press. <http://www.deeplearningbook.org>, pp-800.
- [3] Wikipedia. "Deep Neural Network", accessed on 30 November, 2019. [https://en.wikipedia.org/wiki/Deep\\_learning#Deep\\_neural\\_networks](https://en.wikipedia.org/wiki/Deep_learning#Deep_neural_networks).
- [4] Wikipedia. "Deep Belief network", accessed on 30 November, 2019. [https://en.wikipedia.org/wiki/Deep\\_belief\\_network](https://en.wikipedia.org/wiki/Deep_belief_network).
- [5] Rio Iwabuchi et al, "Proposal of Recommender System Based on User Evaluation and Cosmetic Ingredients", IEEE 2017.
- [6] Yuki Matsunami et al, "Tag Recommendation Method for a Cosmetics Review Recommender System", iiWAS'17, ACM 2017
- [7] Asami Okuda et al, "Finding Similar Users Based on Their Preferences against Cosmetic Item Clusters", iiWAS'17, ACM 2017.
- [8] Christopher J. Holder et al, "Visual Siamese Clustering for Cosmetic Product Recommendation", ACCV 2018, Springer, 2017, 510-522.
- [9] Yuncheng Li et al, "Mining Fashion Outfit composition using an End-to-End deep learning approach for set data", IEEE transaction on multimedia 2017, IEEE, 2017.
- [10] Jiwon Jiong, "For Your Skin Beauty: Mapping Cosmetic Items with Bokeh", accessed on 23 June 2019, <https://towardsdatascience.com/for-your-skin-beauty-mapping-cosmetic-items-with-bokeh-af7523ca68e5>.
- [11] Yun Fu, Shuyang Wang. "System for the beauty, cosmetics and fashion". United States Patents US 20170076474A1, 2017.
- [12] Sid Salvi, Meghan Maupin, Nava Haghighi. System and methods for formulizing personalized skin care product. United States Patents US 20190237194A1, 2019.
- [13] Alexandros Karatzoglou and Balázs Hidasi. "Deep Learning for Recommender Systems", RecSys'17, August 27-31, 2017.
- [14] Weiwei Guo, Huiji Gao, et al, "Deep Natural Language Processing for Search and Recommender Systems". KDD '19, ACM, 2019.
- [15] Taleb Alashkar, Songyao Jiang et al, "Examples-Rules Guided Deep Neural Network for Makeup Recommendation" Association for the Advancement of Artificial Intelligence, AAAI, 2017.
- [16] Tingting Li, Ruihe Qian et al, "BeautyGAN: Instance-level Facial Makeup Transfer with Deep Generative Adversarial Network", Multimedia (MM, 2018), ACM, 2018.
- [17] Songsri Tangsripairoj, Kwanchanok Khongson et al, "SkinProf: An Android Application for Smart Cosmetic and Skincare Users", International Joint Conference on Computer Science and Software Engineering, JCCSE, 2018.
- [18] Florian Strub, Romaric Gaudel et al, "Hybrid Recommender System based on Autoencoders", DLRS '16, September 15 2016, Boston, MA, USA, ACM, 2016.
- [19] Valeriy Gavrishchaka, Zhenyi Yang, Rebecca Miao, and Olga Senyukova. "Advantages of Hybrid Deep Learning Frameworks in Applications with Limited Data", International Journal of Machine Learning and Computing IJMLC, 2018.
- [20] Gediminas Adomavicius and Alexander Tuzhilin. "Toward the next generation of recommender systems: A survey of the state-of-the-art and possible extensions". IEEE transactions on knowledge and data engineering 17, 6 (2005), 734-749.
- [21] Basiliyos Tilahun Betru, Charles Awono Onana, and Bernabe Batchakui. 2017. "Deep Learning Methods on Recommender System: A Survey of State-of-the-art". International Journal of Computer Applications 162, 10 (Mar 2017).
- [22] Xiangnan He, Lizi Liao, Hanwang Zhang, Liqiang Nie, Xia Hu, and Tat-Seng Chua. 2017. Neural collaborative Filtering. In WWW. 173-182.
- [23] Chenyi Lei, Dong Liu, Weiping Li, Zheng-Jun Zha, and Houqiang Li. 2016. "Comparative Deep Learning of Hybrid Representations for Image Recommendations". In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. 2545-2553.
- [24] Isshu Munemasa et al, "Deep Reinforcement Learning for Recommender Systems", International Conference on Information and Communications Technology (ICOIACT), IEEE, 2018.