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Shop Weatherly – A Weather based Smart E-Commerce System Using CNN

Jawaria Sallar[1]; Sallar Khan[2]; Shariq Ahmed[3]; Parshan Kumar[4]; Hasham Faridy[5]; Mahaveer Rathi[6]

[1]Sir Syed University of Engineering and Technology, Karachi, Pakistan.
[1]h.jawaria@yahoo.com

[2]Sir Syed University of Engineering and Technology, Karachi, Pakistan.
[2]sallarkhan_92@yahoo.com

[3]Sir Syed University of Engineering and Technology, Karachi, Pakistan.
[3]shariqahmedssuet@gmail.com

[4]Sir Syed University of Engineering and Technology, Karachi, Pakistan.
[4]parshankumarssuet@gmail.com

[5]Sir Syed University of Engineering and Technology, Karachi, Pakistan.
[5]hasham_faridy@hotmail.com

[6]Sir Syed University of Engineering and Technology, Karachi, Pakistan.
[6]mahaveerrathi95@gmail.com

Abstract

In this current era of modern online shopping, people want to spend as little time as possible when it comes to buying products, therefore they prefer online shopping. People go shopping when the weather gets changed. For travelers, there is no such E-commerce platform that can recommend clothes according to any city weather. Even when people want to gift clothes to someone living in another country there is no such platform that gives recommendation of clothes according to that city's weather. They usually face problems when they want to buy weather-based products from various E-commerce platforms where they see mixed clothes of all types of weather which is very time-consuming, they become so confused most of the time that they think about whether they should buy or not. In this paper, we proposed a novel idea by using Convolutional Neural Network Algorithm of deep learning for developing an e-commerce platform that is unique in a way that it recommends clothes according to the city weather which provides hassle-free environment eventually saves customer's time thereby increasing customer satisfaction.

Keywords: Shop Weatherly, Deep Learning, Artificial Intelligence, Convolutional Neural Networks, Ecommerce, Online Shopping, Weather based Smart Shopping.

1. Introduction

1.1. AI and Ecommerce

Along with the rapid advancement in technology, AI is growing very fast and changing the lives of people. AI is progressing and becoming strong means of improving growth in sales, quality of service, in addition, enhance the E-commerce industry [1]. The trend of online shopping has given buyers more choice but overloaded information as well. To find desired items from multiple resources, customers are keen for technology by which websites can automatically recommend items of their interest [2]. Artificial Intelligence is also being used these days for recognition of browsing and purchasing history patterns, then the data accumulated is used for personalized recommendations. Microsoft and Google are already investing in new AI initiatives. AI is being implemented in many e-commerce businesses for better understanding customers and to provide a better customer experience [3]. Nowadays, online shopping is very popular. A customer always looks for the product of their interest whenever he wants to shop online. If the customer is not confident about his choices, he may face difficulties due to overloaded information. The customer often faces a problem where he is unable to decide what to purchase. When a customer visits an e-commerce website like Amazon or Wall-Mart and selects a product to purchase, the website recommends a lot of different products [4]. Amazon uses AI for Recommendation system to show the product in demand that is based on user searches. Through the recommendation engine, Amazon's total sales improve up to 35 percent. Alibaba has Ali Assistant, chatbot and Tmall Genie. Customer inquiries, both spoken and written, processes 95 percent through its chatbot. Alibaba believes that AI-based algorithms are very efficient in obtaining the finest delivery route that helps them in a 30% reduction in travel distances and a 10% reduction in the motor vehicle [5].

1.2. The Impact of Weather on Sales

The impact of weather not only on human behavior but also in business events has been explored in several fields and some research also found related to weather and retail sales. When temperature changes occur, sales in seasonal garments increase but total garments retailed for the whole season were not dependent on the daily or weekly changes in temperature. Every product category is different in terms of fabric and design and seasonal garments are expected to sell during the same season. The sale of seasonal products is important for the merchants because they publicize as well as sell these goods and it is an important factor of many purchaser goods. Forecast service

providers provide weather data that has become more correct, therefore, to make use of information for merchandise planning, merchants need to find out about the impact of weather on sales of their products. The recent research on the costumes and retail distribution field provided proof of a substantial relationship between sales and the temperature of seasonal clothes. In this study, the relationships between temperature changes and sales patterns of each seasonal garment consisting of unique fabric and retailing intervals of each seasonal garment determined by temperature ranges and typical dates lie in recent temperature changes and sales of seasonal garments. From wide work experience in the garments business, the researchers accept that temperature often affects customers buying behavior for seasonal garments and many merchants will say that a sudden drop down in temperature will help winter garment sales and in Spring will have an impact on the sales of light dresses [6]. Sellers provide many products through shopping websites that take customer's valuable time to find the desired product. However, a lot of inappropriate information will make buyers runoff because of overloaded information. In this modern era of Online Shopping, people need digital platforms like E-commerce, which can recommend possible products according to their interests [7].

1.3. Related Work

1.3.1. Recommendation Engine

A recommendation engine is a machine learning-based recommendation system. Customer behavior can be analyzed using Artificial Intelligence, using an Artificial Intelligence algorithm can achieve deep learning, prediction, statistical programming, and analysis of consumer behavior, of large data sets, and predict which products are expected to attract buyers. First, the machine learning algorithm in the recommendation engine will record key information of the searched product based on the measurement outcomes based on recent searches by potential customers, then the recommendation engine produces relevant browser recommendations and lists them on a personal page, effectively helping customers quickly locate the product. By creating the time dimension, the dynamic dimension of the system and the user can be achieved and there are many e-commerce platforms that use recommendation engines to detect the target audience for their products such as Alibaba, Amazon, Taobao, and jd.com [8]. Personalized recommendation system gathers and forms information resources according to potential demands, interests, hobby, and history behaviors of customers, and then recommend the user to purchase specific goods or services. A personalization recommendation system is made up of three modules: Behavior record, 2) Model analysis, and 3)

Recommendation algorithm module. In the Behavior record module, user behaviors like browsing and rating are saved. In the Model analysis module, analysis of potential customer interest and its degree based on customer behavior records is performed. Subsequently, the recommendation algorithm module can find the products that customers are interested in and then recommend them to the target customer [9].

1.3.2. Collaborative Filtering

In Collaborative Filtering (CF) methods, the user-item rating matrix can perform rating prediction with item-based or user-based collaborative filtering methods. User-based Collaborative Filtering assumes that users with similar choices for prior products would have similar inclinations for new products. Therefore, the model recommends the highly rated products by those users like the current user. Item-based Collaborative Filtering, or content-based Collaborative Filtering, uses the features of the products to build the user profile, and suggest new items like previous items the user gave good feedback. With the improvement of dimension reduction methods (DRM), Latent Factor Models are commonly implemented in recommendation systems later, not limited but including singular value decomposition, probabilistic matrix factorization, localized matrix factorization, non-negative matrix factorization, etc. Many e-commerce platforms include the evaluation of producers by customers through ratings. For example, on platforms like Amazon, customers can give a star rating of 1-5 to the items. The star rating discloses the satisfaction that customers obtain. The collaborative Filtering (CF) method predicts the customer-item rating with the customer/item bias and latent factors [8].

1.3.3. Content based Filtering

In content-based filtering, user's behavior on products is defined by the features that are based on assumption. Recommendation of products generally based on previous likes or dislikes by the user. The fundamental study concentrates on assessing a customer's profile from explicit feedback on whether they liked or disliked previous products. To solve this binary classification task, Text-classification algorithms, for instance, Support Vector Machine (SVM), logistic regression, neural networks, K nearest neighbors (K-NN) have been used [5].

1.3.4. Hybrid Recommendation Algorithms

Hybrid recommendation algorithms merge content-based filtering with collaborative filtering and normally work well as compared to the filtering method. Most of the present research in recommender systems disregards a factor that is very valuable in customer decision-making the product price. One noteworthy exception is, who shows that price is a factor that is transferable across different categories to improve recommendation system projections. Another exception uncovers price's marginal net utility role in E-commerce recommendation. Though, these works still assume price is given and are focusing on enhancing recommendation prediction performance with price as extra information they do not treat prices as manageable factors to manipulate user decisions [5].

1.3.5. Web Mining

The overall mining process for the web can be split into three interconnected stages i.e., Pre-processing, which usually involves removing ineffective and unnecessary data from a raw data set, and recycling data related to the structure of the site and webpages, and coordination of raw study data. Pattern Discovery, at this stage, the data from the earlier stage is analyzed and their behavior pattern is detected. The discovery of rules, conditions, and statistical relations between data are the outputs of this stage. Usually, in pattern analysis, certain patterns and rules are analyzed from the earlier stage, and their application is checked to solve problems. These patterns help analyze customer activities inside the website, recognize their needs, and make proper changes by enhancing the interaction between client and website [10].

1.3.6. Association Rules

Association rules are used for products recommendation based on their existence along with other products. When two items are bought together, the existence of one item in a transaction can be used to determine the second item also being in the same transaction. This technique is useful when making product recommendations to new customers. Association rules are not efficient when a lot of mining rules are used to make product recommendations, therefore it is slow [11]. The product-related recommendation allows companies to respond to a customer's existing preferences and allow organic links between different products to guide customers to make the right purchases. These recommendations bring together the effectiveness of an expert vendor who can recommend products

to match ones of interest with the layout of a good quality store where additional items are effortlessly stowed close together, even if that means they are stacked in multiple locations. When sales suggestions lead them to products they may have made not including or later bought at another retailer [12].

1.3.7. Customer Behavior Pattern Analysis

The most considerable features of online retail sales are the absence of physical interaction between the customer and the product. Customer approaches about online shopping are normally determined by the recognized utilities while customers give binary or multi-scale ratings to products to clearly express their utilities earned. For individual customers, historical data of the product is vital for the purchase decision. In this work, we presume that a customer makes estimations of the item utility by its historical ratings, and when making purchase decisions, the customer will rank the nominees according to the expected utilities of these products and choose among the highest ones [8].

1.3.8. Knowledge-Based Recommender Systems

Knowledge-based Recommender (KBS) systems are frequently used where user describes their requirements explicitly or where availability of rated data is inadequate like apartments and financial services. Two main methodologies are used to implement knowledge-based recommender systems, i.e., case-based recommendation and constraint-based recommendation. An alternative to a case-based system is critiquing-based recommender systems which are commonly used to make a recommendation of specific items. It also produces the view of users in terms of reviews that help to enhance the accuracy of the system [13].

1.3.9. AI Assistant

The key role of any AI assistant or chatbot is to automatically answer the customer queries and analyze further with sample voice commands and provide product recommendations using Natural Language Processing (NLP) systems. AI chatbot dialogs on e-commerce platforms are mostly based on machine learning Algorithms to communicate with customers in a personalized manner. Chatbots help customer finds the product of their choice and compares with various products. Customers can talk to the robot through text, pictures, and voice. Alibaba launched Shop Xiaomi, an AI services robot, a chatbot for Taobao merchants in March 2017. Once authorized and debugged by

merchants, chatbots can replace some customer support services, efficiently decrease labor costs, enhance the user experience, enhance service quality, and increase night traffic recovery, and helps customer service resolve recurring consulting issues [1].

1.3.10. Weather Forecasting with Deep Learning

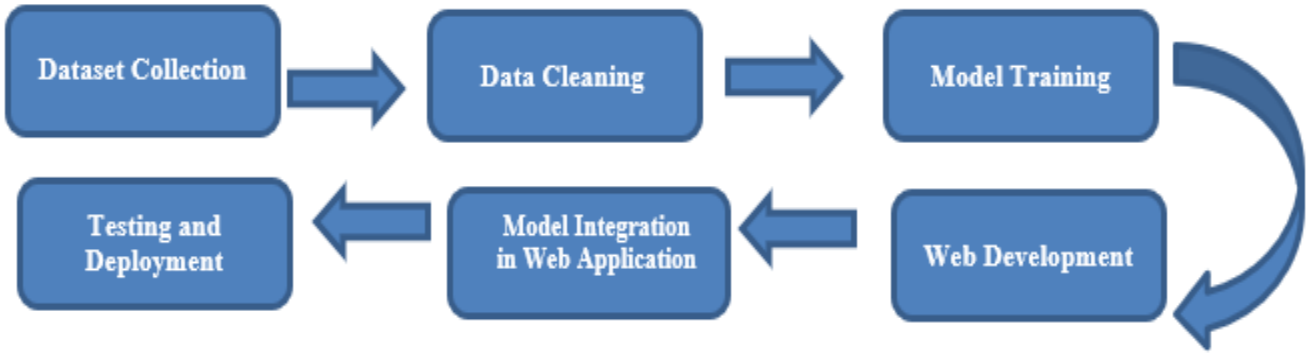
Several deep learning models for weather forecasting Convolutional Neural Network (CNN) and Conditional Restricted Boltzmann Machine (CRBM) and such models are explored and compared with the prominent time series forecasting models such as Recurrent Neural Network (RNN) [14].

In previous research, many techniques introduced for recommender systems as discussed above in the Related Work section, but none of the recommender systems are developed by using image classification techniques for recommending clothes products based on weather. In our research, Image classification will be used to predict two classes i.e., Summer and Winter by applying a binary classification technique using Convolutional Neural Networks (CNN) Algorithm in deep learning.

Moreover, this paper is arranged as follows: Research Methodology is described in Section 2. In section 3, Experimental Results are discussed. In section 4, Future Work is discussed. Lastly, the Conclusions are discussed in section 5.

2. Research Methodology

Figure 1 - Block Diagram of Steps of Research Methodology



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2.1. Data Collection

For training, we required image data of all types of men, women, and kid's clothes mainly summer and winter season. To achieve this, we performed web scraping. For scraping, we developed a scraper GUI Application in JAVA that can scrap images from multiple websites. The scraper uses Java's JSOUP library which is very famous for scraping. We scraped around 50,000 images from various renowned e-commerce platforms.

2.2. Data Cleaning

There was a lot of irrelevant data scraped during the scraping process. Irrelevant data like imperfect images, duplicate images, and format differences. It took plenty of manual effort to clean this data and make it appropriate for training.

2.3. Model Training

We used the Convolutional Neural Network Algorithm of Deep Learning for the training of images dataset. For Model Training, we divided our dataset into three subsets, Training, Validation, and Testing. In training, we used 22,000 images out of which in training we used 18000 images in which 9000 for Summer and 9000 for Winter. We used 2000 images out of which 1000 for winter and 1000 for Summer in Validation and Testing, respectively. We initially worked on two convolutional layers and then finally moved to the third and the last convolutional layer. We began our training with 10 epochs and increased the number of epochs gradually till the model was fully trained to provide desired results and accuracy.

2.4. Web Development

We developed an E-commerce Web Application using Django which is a Python web development framework. For implementing the database, we used PostgreSQL which is very suitable for Ecommerce platforms. It provides scalability and reliability that is much needed for large Ecommerce Platforms. The website has all the common features that any e-commerce platform should have which will help both Online Customers as well as Ecommerce Store. We have used Open

Weather Map API for fetching weather and IP STACK API for fetching geographical location. We also used services like Chaport for implementing Customer Admin Chat Service, Stripe Payment Platform for implementing payment method, Google Analytics for implementing Real-Time Analytics feature in our web application.

2.5. Model Integration in Web Application

We Integrated the trained model in our web application using API. We developed an API using FAST API. FastAPI is a modern, fast, web framework of python which is ideal for developing RESTful APIs.

2.6. Testing and Deployment

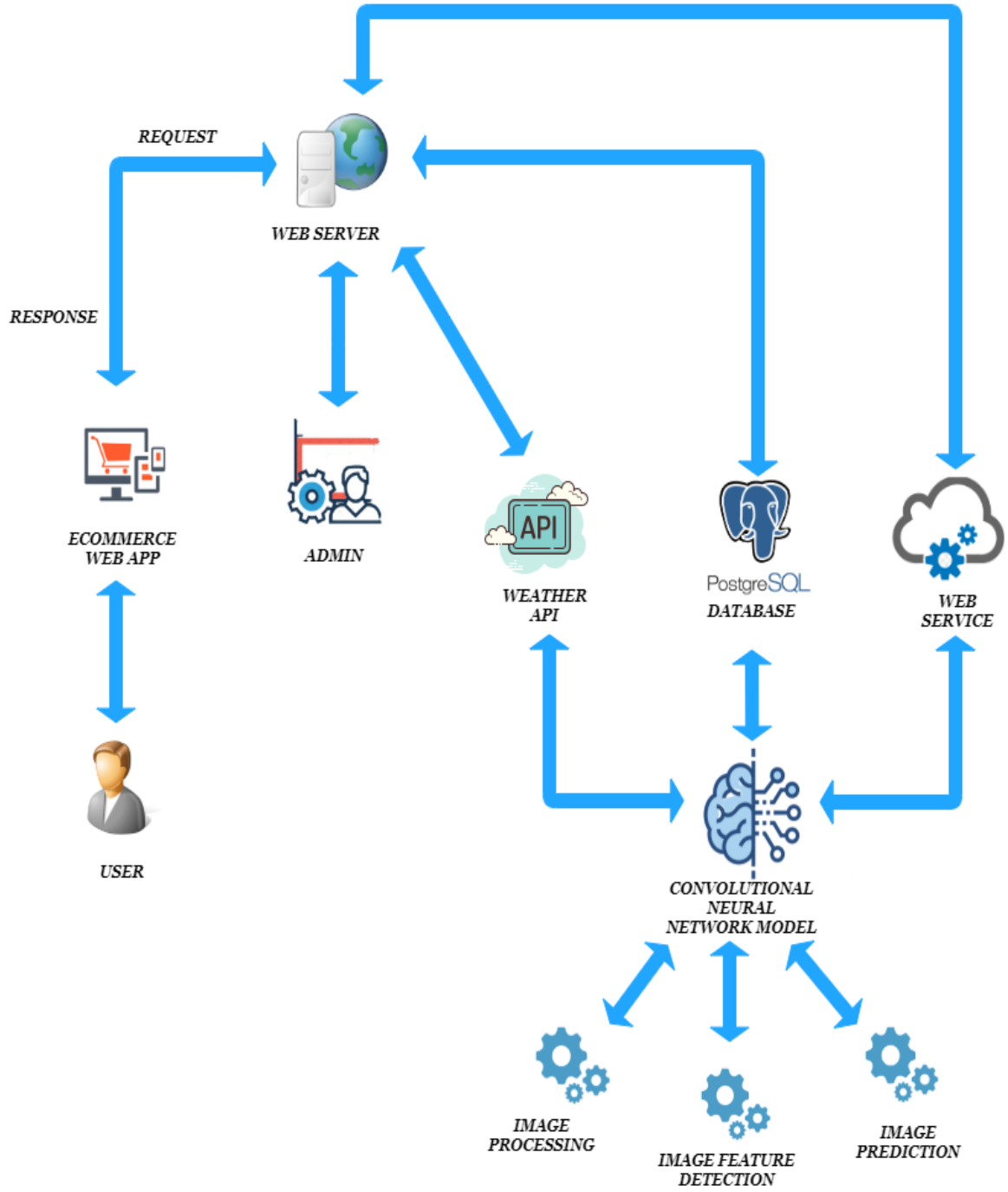
After the Implementation of the website and integrating Trained model API in the web application, functional testing like System Testing and Acceptance Testing was performed for bug reporting. This process continued until the web application is bug-free, stable, and working according to the business needs of that system.

- For Web Application Testing, we used commonly used browsers i.e., Mozilla Firefox, Google Chrome, Safari, Microsoft Edge, and Opera on both Desktop and Mobile Devices.
- For Trained Model Testing, we have created a separate web application developed in Django with Model Integrated. There we provided different clothes images randomly so that model can predict summer and winter clothes.

After successful testing, the web application is deployed to the Azure Cloud to access it from anywhere.

When a user first visits the website, weather API is called and fetches the current location, and then the images of weather-based products from a database are predicted in the recommendation engine then the predicted result of the model is displayed according to the temperature of that location.

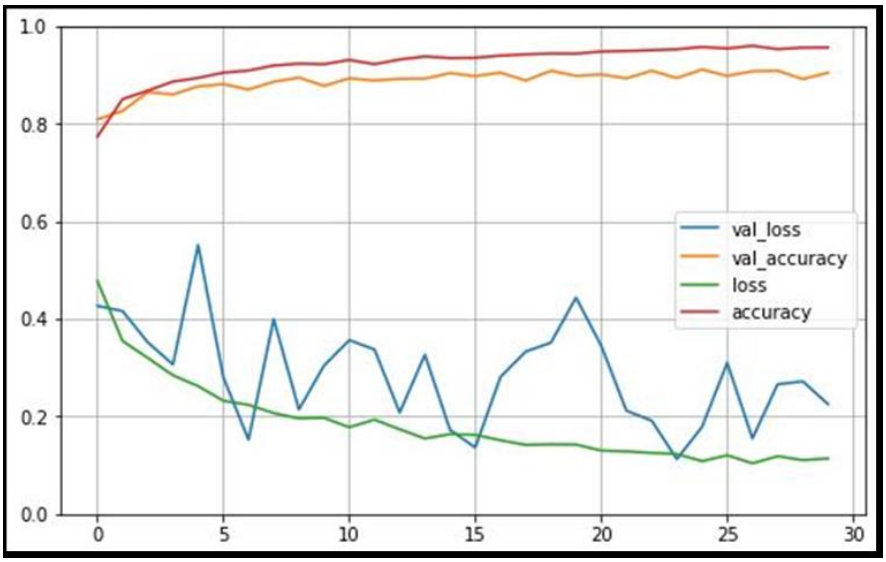
Figure 2 - System Architecture Diagram



3. Experimental Results and Discussion

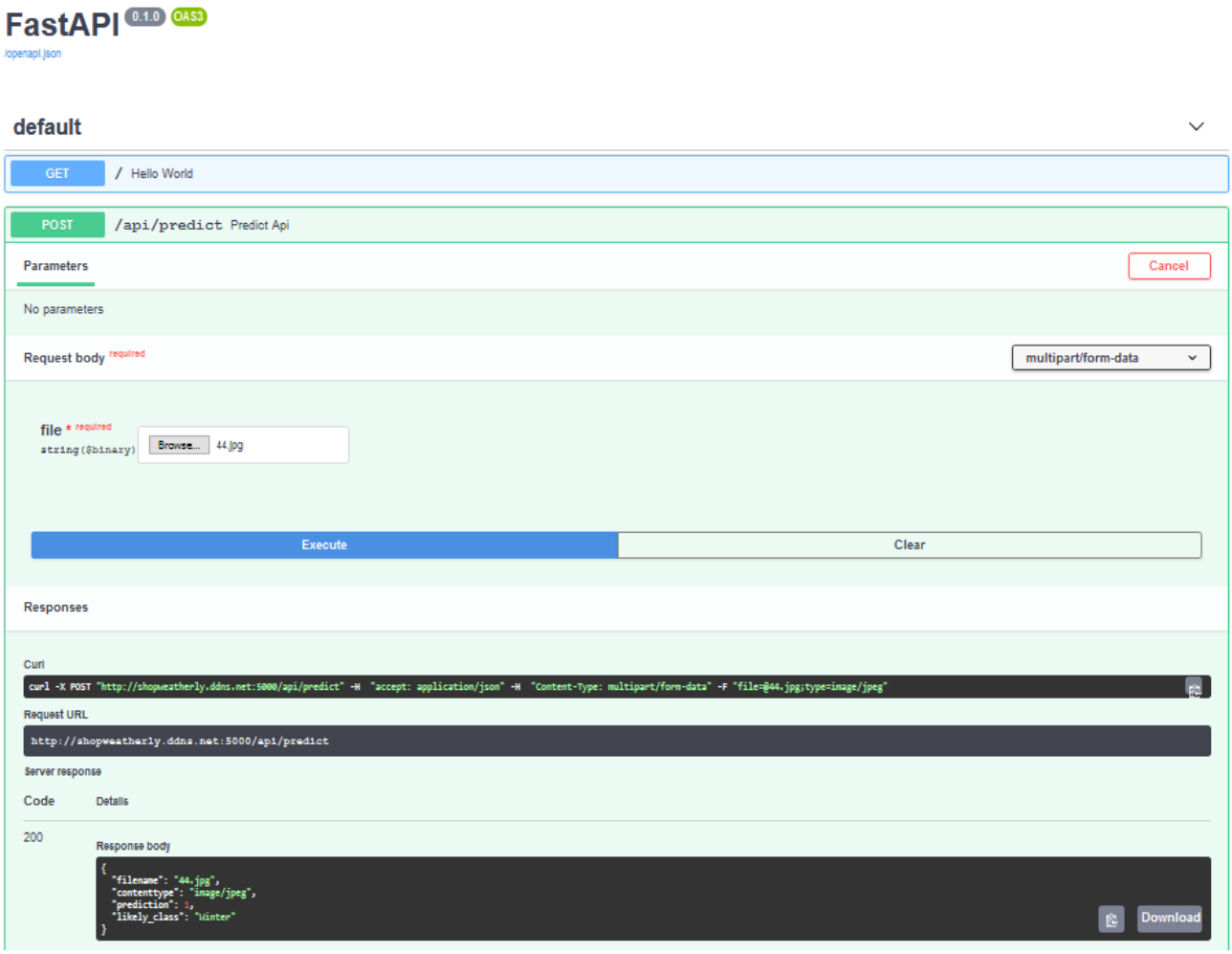
After the Model Training process, we have achieved an accuracy of up to 94%. In the graph below we can see that validation accuracy is around 90% which indicates that overfitting is significantly reduced.

Figure 3 - Training Graph



We provided a random winter cloth image to the model it predicted the result as expected:

Figure 4 - Winter Prediction Result



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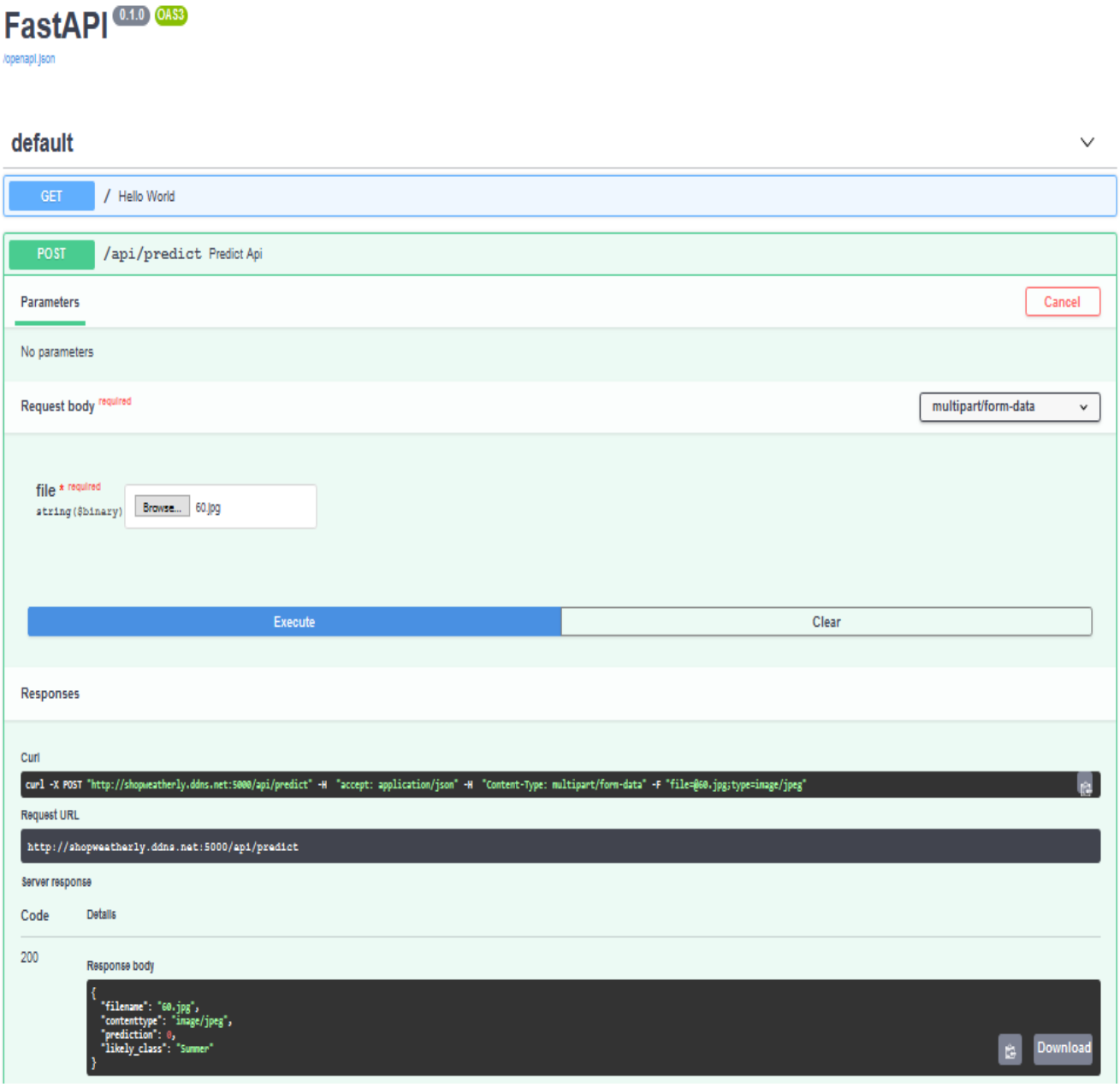
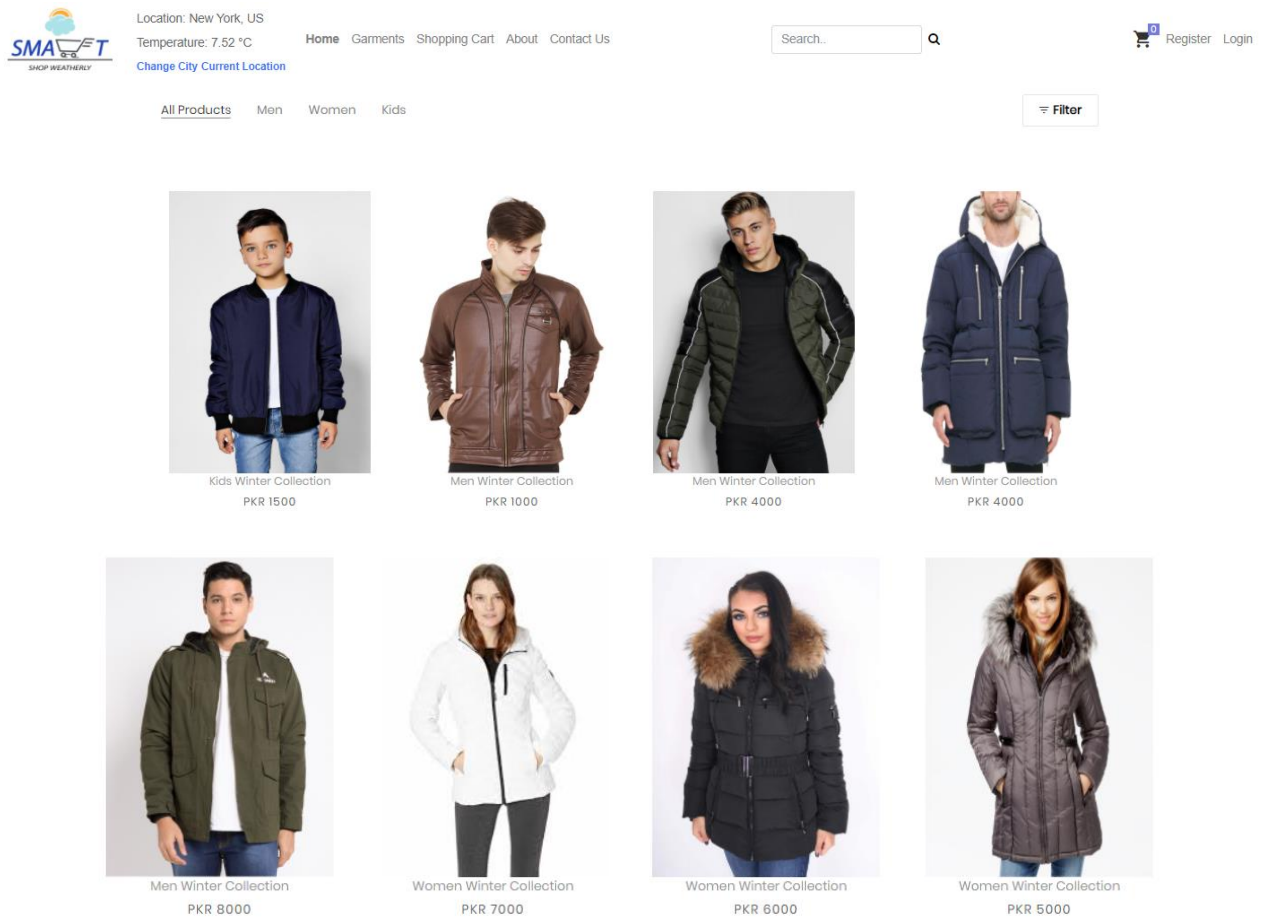
We provided a random summer cloth image to the model it predicted the result as expected:

Figure 5 - Summer Prediction Result



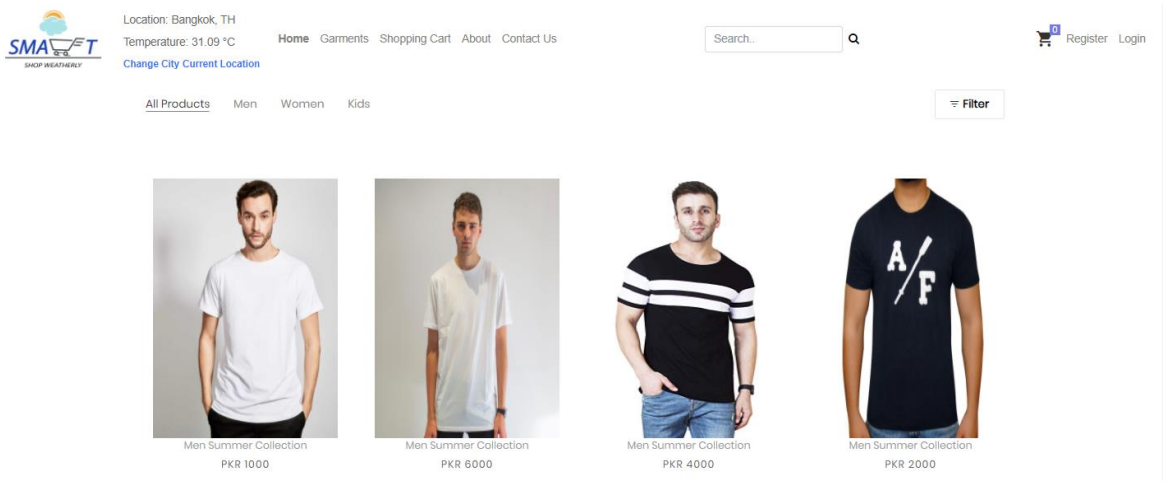
In our E-Commerce web application, we can see that when we access the website from the location of New York, Weather API fetches the temperature of New York where the temperature was 7.52 °C which is cold. Therefore, our web application is recommending Winter Garments.

Figure 6 - Recommendations for Cold Weather in Ecommerce Website



In our E-commerce web application, we can see that when we access the website from the location of Bangkok, Weather API fetches the temperature of Bangkok where the temperature was 31.08°C which is hot. Therefore, our web application is recommending Summer Garments.

Figure 7 - Recommendations for Hot Weather in Ecommerce Website



4. Conclusion

The trend of online shopping is growing rapidly. AI in the e-commerce industry has played a great role over the past few years. Therefore, we introduced the novel idea in Ecommerce Platforms that Recommendations of products will be according to the weather of your current location as well as the desired location. In this paper, image classification is performed using the Convolutional Neural Network (CNN) of Deep Learning. Initial work is carried out for two classes of Summer and Winter season clothes dataset which is scraped from various e-commerce platforms. Experimental results are evidence that accuracy of up to 94% is achieved and then the model is tested and integrated on e-commerce web application through API. Once the website is accessed, our proposed model can recommend garments according to the weather. Through this innovation, customer time will be saved during shopping and they do not need to search manually when they desire to shop weatherly.

5. Future Work

In the future, we will scale this idea by introducing more classes in Convolutional Neural Network (CNN). We plan to work on the Rainy, Sunny and Snowy products like raincoats, umbrellas, shoes, hats, sunglasses, woolen shawls, and jackets. We can achieve this by multi-class classification techniques in machine learning. For the dataset, we need to do more scraping and more effort required in data cleaning. We will also work on a cross-platform mobile application for this e-commerce platform. We will accomplish our goal of making online shopping more convenient for online customers by providing a hassle-free environment and introducing more techniques that can enhance e-commerce business.

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