Journal of Innovations in Data Science and Big Data Management

e-ISSN: 2583-9845, Vol. 3, Issue 1 (January – April, 2024) pp: (14-20)

Categorizing Attire through the Fashion MNIST Dataset

Koushik Kambham[1], K. Sreekala[2*]
[1]Undergraduate Student, [2]Assistant Professor, Department of Computer Science & Engineering, Mahatma Gandhi Institute of Technology, Hyderabad, Telangana, India
[*]Corresponding Author: ksrikala_cse@gmail.com

Received Date: January 09, 2024; Published Date: February 12, 2024

Abstract
The ongoing expansion of the online fashion market is leading fashion websites to accumulate increasing volumes of data from diverse brands. Consequently, the task of classifying various garments has become challenging for numerous websites. Addressing this challenge necessitates the implementation of a highly accurate algorithm capable of identifying garments. Such an algorithm can prove instrumental for companies in the clothing sales sector, aiding in comprehending the profiles of potential buyers. It enables businesses to tailor their sales strategies to specific niches, develop targeted campaigns aligned with customer preferences, and enhance overall user experience. This project is aimed to find the best model with the highest accuracy and precision results. Models like Logistic Regression, Decision Tree Classifier, Random Forest Classifier and some other models are used in this project to classify the garments. To train and test these models, the Fashion MNIST dataset is used. Among all the models that are used here, the model that shows the best performance is suggested to the fashion website.

Keywords- Fashion MNIST dataset, Garment classification, Logistic regression, Online fashion market, Sales strategies

INTRODUCTION

Over the past three decades, the fashion market has undergone significant changes, leading to a transformation within the industry. Increasing profits hinges on a profound understanding of customer preferences and more effective sales strategies. The advent of e-commerce has facilitated quicker and easier clothing purchases through online platforms. Enhancing the user experience during product searches on these platforms is crucial. Clothing classification is an integral aspect of the broader task of categorizing scenes. Automatic generation of image labels describing products can alleviate the workload for human annotators. Such information not only aids in labelling scenes but also contributes to a deeper understanding of users' tastes, culture, and financial status. Classification of garments has become a very tough task for many websites due to large data and many different images. Even though there are many methods in classifying clothes there is some misclassification and the output is not as expected i.e., when you search for a shirt on any website then the website will suggest some extra outfits like pants, shoes which are not required for us and irritate us sometimes. To solve this problem different models are used The Fashion MNIST dataset is derived from images on Zalando, Europe's largest online fashion platform. Comprising 60,000 products, the dataset features 28x28 pixel grayscale images categorized into ten classes: t-shirts, trousers, pullovers, dresses, coats, sandals, shirts, sneakers, bags, and ankle boots. The evaluated implementations (from scikit-learn) in this paper were: Decision Tree, Logistic Regression, Random Forest, Stochastic Gradient Descent, XGBoost and sequential model. These models [1] are trained using the Fashion MNIST dataset and performance measures are calculated for each of the models. The model which gives the best performance measures is tested with the testing dataset. Among all the models sequential model has the best performance measures when compared to the remaining models.

LITERATURE SURVEY

The following literature review discusses various methods for the prediction of the disease.

“Cloth Classifying from Fashion-MNIST Dataset” by Anita Maria Rocha, V.Q. Leithardt, L. Rodrigo, and S. Correia proposed SVM, Random Forest Classifier and drop-out technique for Cloth Classification. The primary objective is to assess these findings against the original outcomes, offering guidance for prospective research to readily identify the most appropriate classification method. The model exhibited commendable performance measures and accuracy ranging from 89.7% to 99.1%. However, a notable limitation of this study is the classification challenge, attributed to the intricate nature of clothing properties and the extensive depth of cloth categorization [2, 3].

“Classification of Garments Using CNN LeNet-5 Model” by Mohammed Kayed, A. Anter, and H. Mohamed proposed that LeNet-5 outperforms both classical CNN and state-of-the-art models. The demerit of this model is it cannot deal with challenges in training a Convolutional Neural Network and overfitting also cannot be handled [4].

“Fashion-MNIST Classification Based on HOG Feature Descriptor Using SVM” by Greeshma KV, Sreekumar K classified the dataset based on the HOG feature descriptor. They used a Support Vector Machine (SVM) classifier algorithm. Min's reason for using SVM is it is the best method to train the images. Accuracy is not clear for each class of classification [5].

“Image Classification of Fashion-MNIST Dataset Using Long Short-Term Memory Networks” by Shuning Shen in 2018 discusses the LSTMs model, Network pruning and Training Pattern Reduction. The computational cost of this model is low. The disadvantage of this paper is Performance of training pattern sets is worse when the number of training patterns is reduced [6].

“ImageNet Classification with Deep Convolutional Neural Networks” by Alex Krizhevsky, Ilya Sutskever, and Geoffrey E. Hinton described Local response normalization and also about training pattern reduction. In this paper Non-saturating neurons of conventional operation are used, so that training is done faster. The disadvantage is the models used in this paper achieve an error rate of more than 35% [7].

DESIGN METHODOLOGY

The Objective is to design a system that classifies the data into required items and different classes; this consists of using the Fashion MNIST dataset and various algorithms. The approach comprises a sequence of steps for loading the dataset and classifying the dataset into 10 different classes and also standardizing the dataset to ensure that all the values for each feature (pixel) are within a narrow range, determined by the standard deviation value. To get good predictions for some models we should consider a large dataset. The general workflow of the program can be seen in Fig. 1.

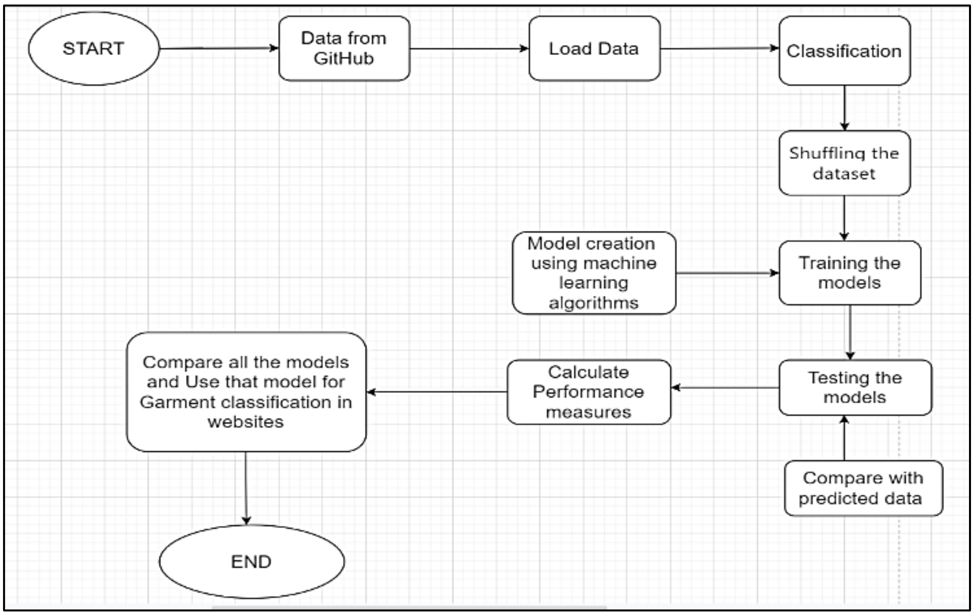
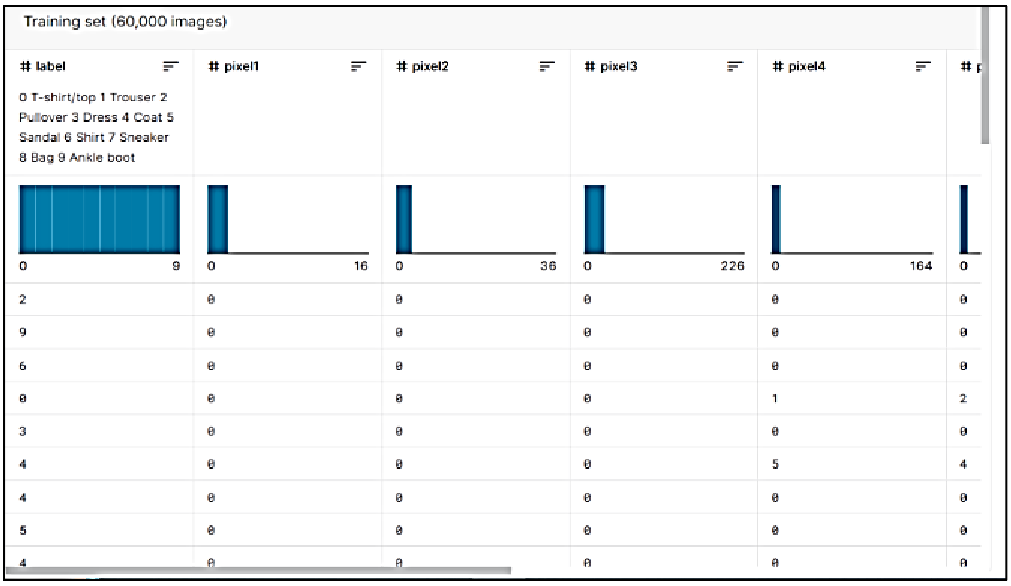


Figure 1: *Architecture diagram.*

As shown in the Figure above the data is retrieved from GitHub and then it is loaded into the program. Then the data is classified into different classes. Dataset is the shuffled to make sure there is no bias in the dataset. Models like Random Forest, XGBoost, and sequential models are used. By using the dataset we train these models and performance measures are calculated for these models then the best testing is performed on the model that has the best accuracy.

The most important criterion for good classification is to have an accurate dataset. The fashion MNIST dataset is considered for the classification of garments.

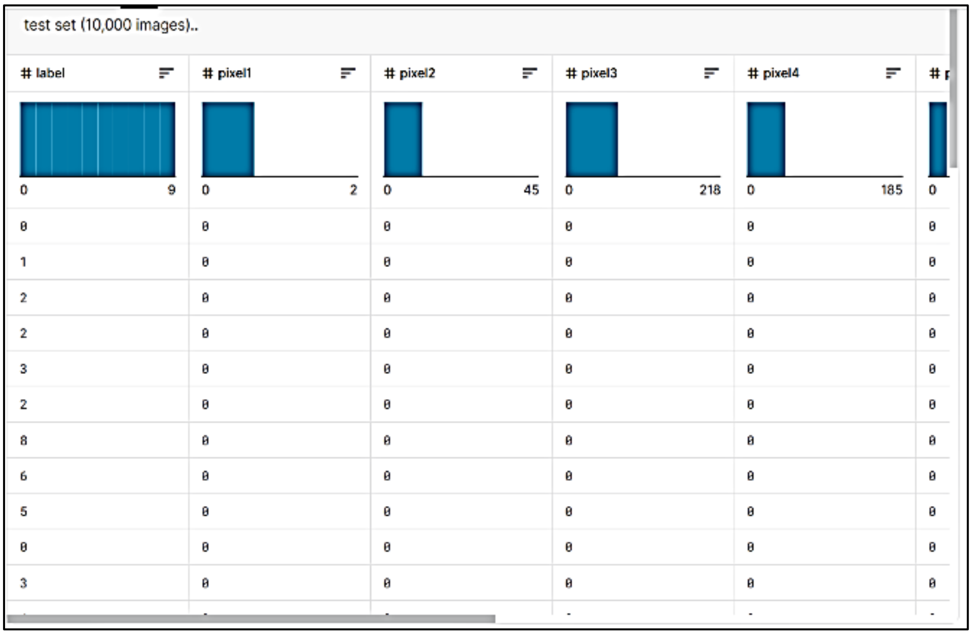
The dataset sourced from GitHub comprises a training set containing 60,000 examples and a test set with 10,000 examples. Each instance is a 28x28 grayscale image paired with a corresponding label. Notably, the dataset is devoid of noisy and missing values. Additionally, all essential attributes for optimal results are present in this dataset. Consequently, classification is accomplished by directly training the models with the available data. Some pixel values out of 785 are shown in the below Fig. 2 and 3.



Training set (60,000 images)

# label	# pixel1	# pixel2	# pixel3	# pixel4	# p
0 T-shirt/top 1 Trouser 2 Pullover 3 Dress 4 Coat 5 Sandal 6 Shirt 7 Sneaker 8 Bag 9 Ankle boot					
0 – 9	0 – 16	0 – 36	0 – 226	0 – 164	0
2	0	0	0	0	0
9	0	0	0	0	0
6	0	0	0	0	0
0	0	0	0	1	2
3	0	0	0	0	0
4	0	0	0	5	4
4	0	0	0	0	0
5	0	0	0	0	0
4	0	0	0	0	0

Figure 2: *Training dataset of 60,000 images.*



test set (10,000 images)..

# label	# pixel1	# pixel2	# pixel3	# pixel4	# p
0 – 9	0 – 2	0 – 45	0 – 218	0 – 185	0
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
2	0	0	0	0	0
8	0	0	0	0	0
6	0	0	0	0	0
5	0	0	0	0	0
0	0	0	0	0	0
3	0	0	0	0	0

Figure 3: *Testing dataset of 10,000 images.*

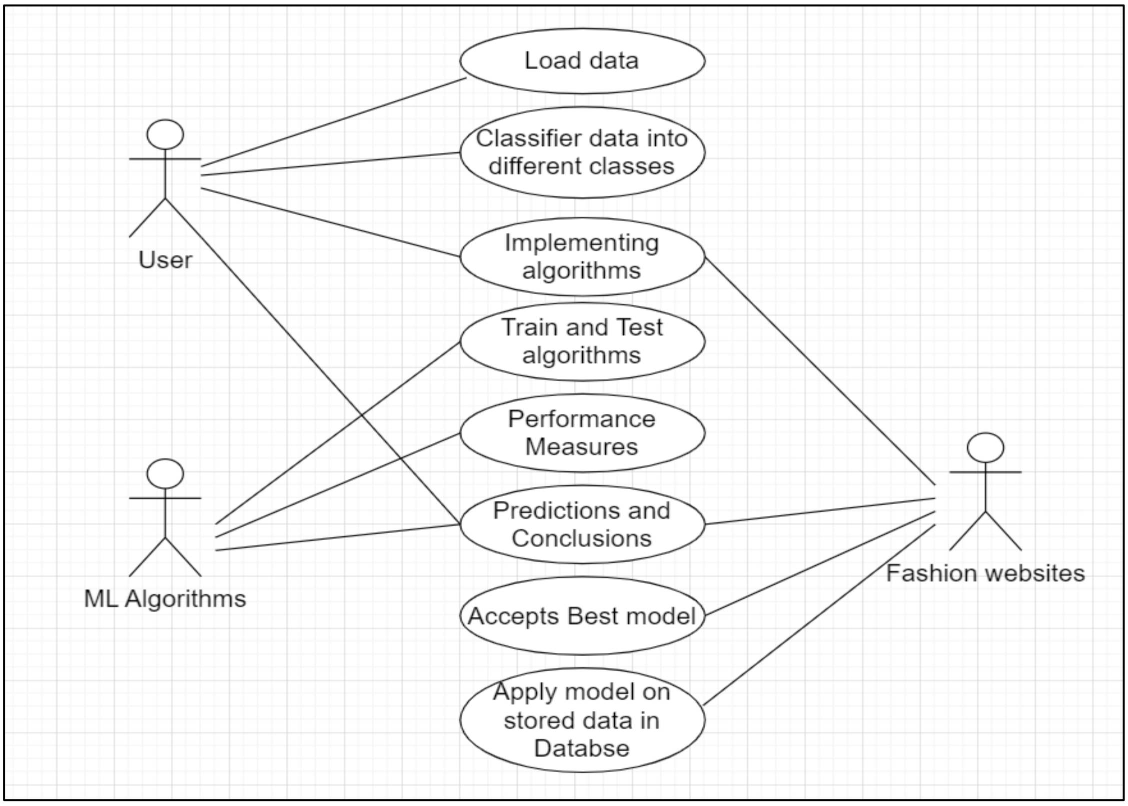


Figure 4: *Use case diagram.*

In Fig. 4, the user loads data and classifies the data into different classes. Subsequently, diverse algorithms are employed to train the model using the provided data and compute performance metrics. Fashion websites use the model which has the best performance measure i.e., accuracy and precision.

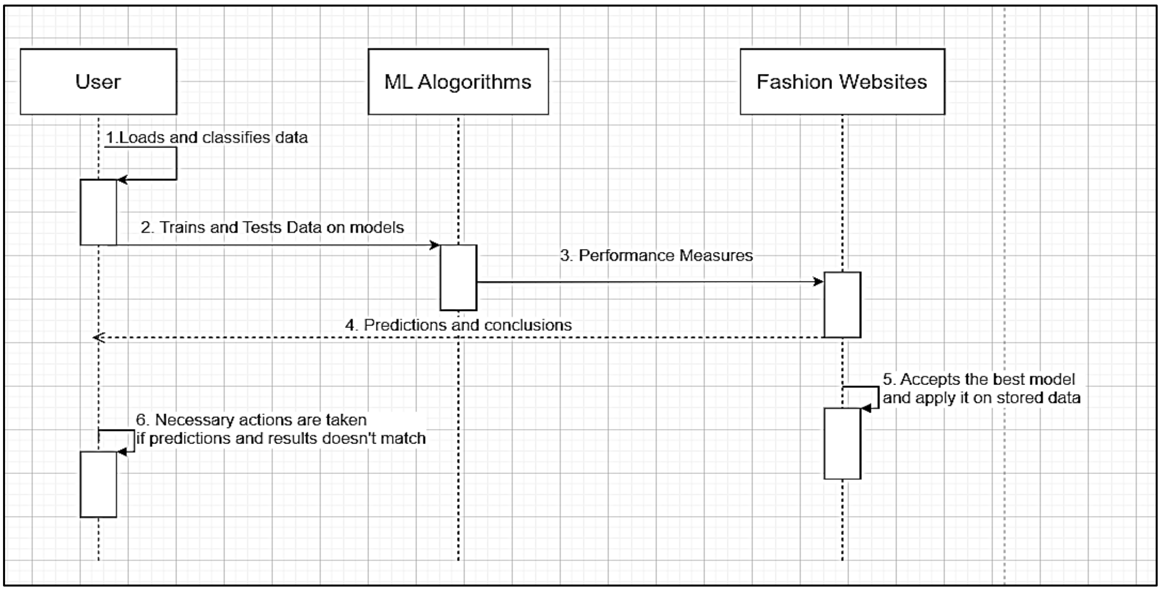


Figure 5: *Sequence diagram.*

Fig. 5 shows the sequence followed in the project, where the user loads data and classifies the data into different classes. Subsequently, diverse algorithms are employed to train the model using the provided data and compute performance metrics. Fashion websites use the model which has the best performance measure i.e., accuracy and precision.

TESTING AND RESULTS

Fig. 6 below shows the view of images based on the pixel values ranging from 0 to 255. Labels are classified into 10 different classes T-shirt, trousers, Pullover, Dress, Coat, Sandal, Shirt, Sneaker, Bag, and Ankle boot.

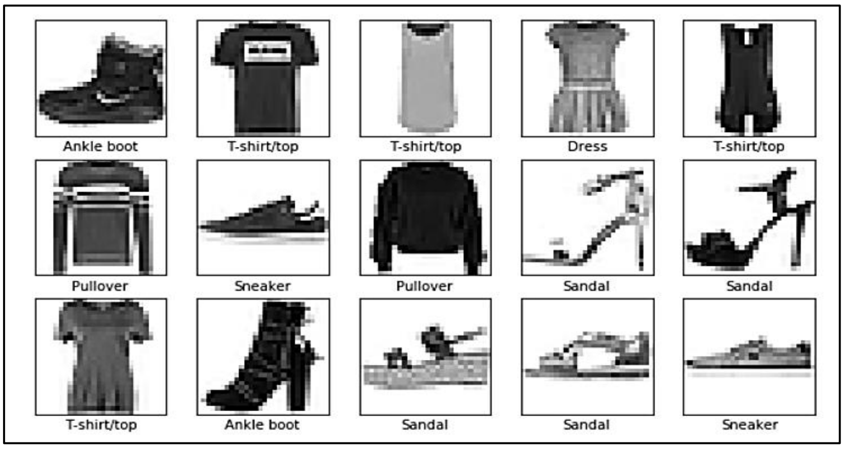


Figure 6: *Image view.*

Performance measures are calculated for various models used here. Cross-validation is employed in this context to determine the appropriate score for each model and to ensure that the model neither overfits nor underfits. If the cross-validation score values for a given performance measure, such as accuracy, exhibit minimal variation across different folds (k-folds), it indicates that the model is not overfitting. Conversely, if the cross-validation score values for a performance measure like accuracy are not excessively low across various folds (k-folds), it suggests that the model is not underfitting. The approach involves conducting k-fold cross-validation, where the training set is randomly divided into three distinct subsets, or folds (cv=3). To manage the computational intensity and time consumption associated with cross-validation, we have limited the number of folds ('cv') to 3 instead of the conventional 10 folds. Subsequently, each model is trained and evaluated three times, selecting a different fold for evaluation each time and training on the remaining two folds. The outcome is an array containing the three evaluation scores for each performance measure, including accuracy, precision, and F1 score, with the cross_val_score() function used to calculate accuracy. From Fig. 7, the accuracy of all the models is above 80 except for the Decision tree, where it has around 80. XGBoost has an accuracy of nearly 90 and the sequential model has over 90. Because epoch operation is performed on this model. So eventually the accuracy increases as the number of epochs increases. Hence, we can consider the sequential model as the best model because it has high accuracy.

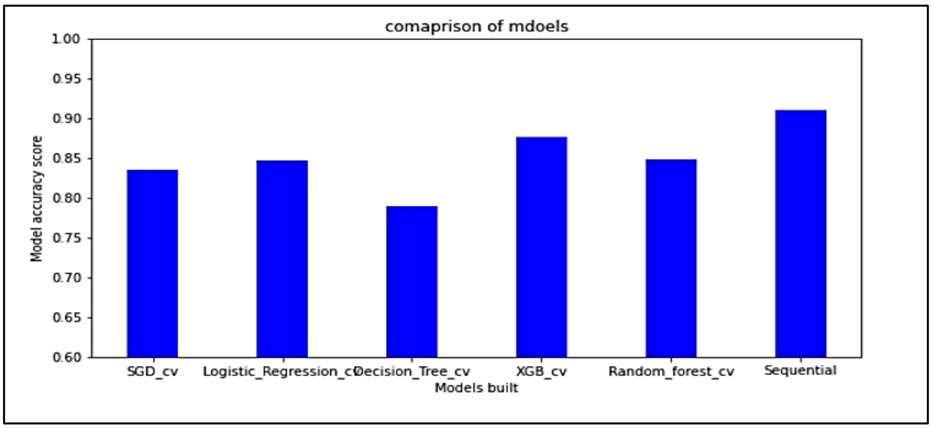


Figure 7: *Comparison of models.*

Fig. 8 describes the output for the first 15 labels and the predicted output. If the color of the bar in the graph represents blue then we can say the predicted output is right and classification is done well. If the bar color is red then the classification of the model is wrong. The grey colour represents some deviation from the output. If both pictures have a similar structure then there is a chance of wrong prediction. As from the figure, we can conclude that most of the class labels have the right outcome and classification of the model works accurately.

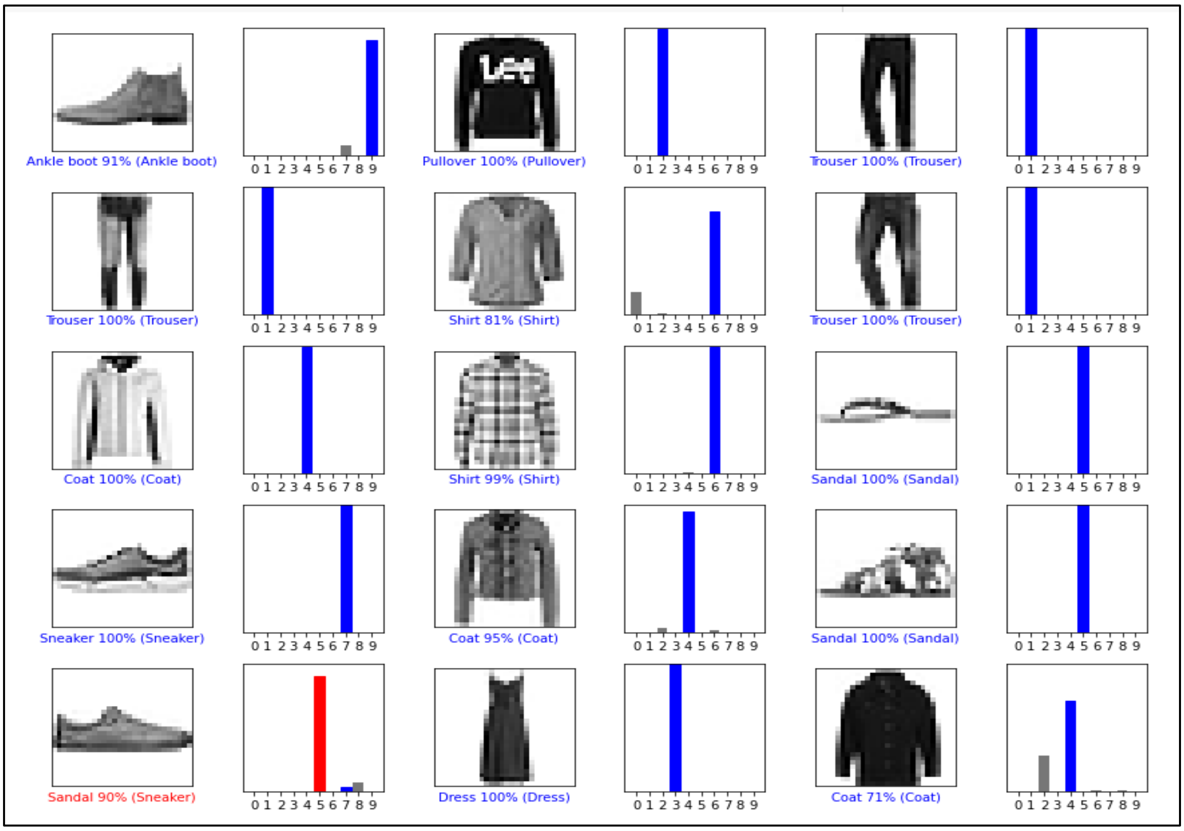


Figure 8: *Results of the sequential model after testing the model.*

CONCLUSION AND FUTURE WORK

Classification has become a severe problem for many companies and websites because of the huge data and different kinds of data. In this proposed system, garment classification is done using various models. The best model is a sequential model. The final accuracy of the sequential model is 91% and is the best model when compared to all other models. This algorithm is easy to implement and fast when compared to all other models used to classify the dataset. This machine learning model can be used by fashion websites to solve the classification problem. Thus, the proposed system provides accurate results and can easily classify the data. A similar classification system can be built to solve this problem with the help of many upcoming technologies and it is suggested to further improve this model using different kinds of machine learning models. Also, new algorithms can be proposed to achieve more accuracy and reliability. Some warnings had occurred while training some models. These can be eliminated by increasing the number of iterations or scaling the data. The time taken for the implementation of some models and cross-validation is very high. Even though the k-fold value is reduced, time consumption is high. There are some ways in which the performance of the system can be further improved and time consumption can be reduced.

REFERENCES

1. (2015, September 13). *Python 3.5.0*. Python.org. https://www.python.org/downloads/release/python-350/
2. LEITHARDT, V. (2021). Classifying

garments from fashion-MNIST dataset through CNNs. *Advances in Science, Technology and Engineering Systems Journal*, *6*(1), 989-994. https://comum.rcaap.pt/bitstream/10400.26/37237/1/ASTESJ_0601109.pdf

3. (n.d.). *Fashion-MNIST*. Github.com. https://github.com/zalandoresearch/fashion-mnist
4. Kayed, M., Anter, A., & Mohamed, H. (2020, February). Classification of garments from fashion MNIST dataset using CNN LeNet-5 architecture. In *2020 international conference on innovative trends in communication and computer engineering (ITCE)* (pp. 238-243). IEEE. https://doi.org/10.1109/ITCE48509.2020.9047776
5. Greeshma, K. V., & Sreekumar, K. (2019). Fashion-MNIST classification based on HOG feature descriptor using SVM. *International Journal of Innovative Technology and Exploring Engineering*, *8*(5), 960-962. https://www.researchgate.net/profile/Greeshma-K-V/publication/332035279_Fashion-MNIST_classification_based_on_HOG_feature_descriptor_using_SVM/links/5d1256c4458515c11cf880fe/Fashion-MNIST-classification-based-on-HOG-feature-descriptor-using-SVM.pdf
6. Shen, S. (2018). Image classification of Fashion-MNIST dataset using long short-term memory networks. *Research School of Computer Science*. http://users.cecs.anu.edu.au/~Tom.Gedeon/conf/ABCs2018/paper/ABCs2018_paper_38.pdf
7. Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2017). ImageNet classification with deep convolutional neural networks. *Communications of the ACM*, *60*(6), 84-90. https://doi.org/10.1145/3065386

CITE THIS ARTICLE

Koushik Kambham and K. Sreekala, (2024). Categorizing Attire through the Fashion MNIST Dataset, *Journal of Innovations in Data Science and Big Data Management*, 3(1), 14-20.