**Shoe classification using deep learning**

**Reenie Christudass**

# **I. Introduction**

Shoe classification using deep learning is a rapidly growing field that has shown tremendous potential in automating the process of categorizing different types of shoes. With the increasing number of shoe designs and brands, it has become challenging for humans to classify them manually into different categories. However, with the help of deep learning techniques, it has become possible to automate this process, thereby reducing the manual effort and time required. This paper uses deep learning to discuss the background, data, methods, analysis, limitations, challenges, recommendations, ethical assessment, and conclusion of shoe classification.

# **II. Business Problem**

The shoe industry is multi-billion-dollar, with consumers purchasing shoes for various reasons, such as fashion, functionality, and athletics. With the increasing popularity of online shopping, customers have access to a wide range of shoes, making it difficult to choose the right pair. Shoe classification using deep learning can assist customers in identifying shoes that match their preferences, reducing the time and effort required to find the perfect pair.

Additionally, for companies in the shoe industry, this technology can help optimize inventory management and reduce the costs associated with manual shoe categorization. It can also assist in targeted marketing and sales efforts based on customers’ preferences.

# **III. Background/History**

Deep learning is a subset of machine learning that uses artificial neural networks to mimic the functioning of the human brain. This technique has been applied to various applications, including image classification, natural language processing, and speech recognition. In the field of computer vision, deep learning has shown tremendous potential in automating the process of object recognition and classification. Shoe classification using deep learning is one such application of computer vision that has gained attention recently.

# **IV. Data Explanation**

The data used in this study consists of images of shoes from the UT Zappos50k dataset. The dataset contains over 50,000 images of shoes in categories such as boots, sandals, sneakers, and dress shoes. The photos are labeled according to the type of shoe and the brand. The dataset was split into training, Chart, pie chart

Description automatically generatedvalidation, and testing. The training set was used to train the deep learning model, while the validation set was used to tune the model's hyperparameters. Finally, the testing set was used to evaluate the Chart, histogram

Description automatically generatedmodel's performance.

# **V. Methods**

This study used a convolutional neural network (CNN) to classify the shoes. The CNN consisted of multiple layers, including convolutional, pooling, and fully connected layers. The input to the model was an image of a shoe, and the output was the predicted category of the shoe. The Adam optimizer trained the model with a categorical cross-entropy loss function. The hyperparameters of the model were tuned using the validation set.

# **VI. Analysis**

After training the model, we evaluated its performance on the test set, achieving an accuracy of 85.93%. The confusion matrix showed that the model performed well for most shoe categories, with the lowest performance for the sandal and slipper categories.

# **VII. Limitations**

The model may have limitations in classifying shoes that are similar in appearances, such as different types of sneakers or sandals. The model may also be affected by variations in lighting, background, and camera angles in the images.

# **VIII. Challenges**

One of the challenges faced in this project is the need for a large and diverse dataset of shoe images. Another challenge is the need for a powerful computing system to train and test the deep learning model.

# **X. Recommendations and Implementation Plan**

To improve the performance of our model, we recommend collecting a more extensive and diverse dataset of shoes that includes images with different backgrounds and angles. Additionally, using an ensemble of models and incorporating domain-specific knowledge such as shoe construction and design could improve performance.

For implementation, we recommend integrating our shoe classification model into an e-commerce platform, enabling customers to search for shoes based on their visual features. Additionally, shoe companies can use this technology to optimize their inventory management, reduce costs, and improve marketing efforts.

# **XI. Ethical Assessment**

One primary ethical concern related to using a shoe classification system based on deep learning is the risk of introducing bias into the algorithm. One big worry about using a computer system to classify shoes based on style and quality is that it might not treat everyone fairly. This could happen if the computer is trained only on data from a particular group of people, like rich people, and then ends up unfairly judging shoes more commonly worn by people with less money. This could create more problems and make things worse for people who are already struggling. To avoid this, it's essential to ensure the computer is taught using information from many different types of people.

Another ethical consideration is privacy. To train the model, large datasets of shoe images must be collected and stored. Suppose these images contain personally identifiable information, such as images of people wearing the shoes. In that case, there is a risk that this information could be used for nefarious purposes, such as identity theft. Additionally, there is a risk that these images could be misused in ways that violate people's privacy rights, such as being sold to third parties without consent.

A third ethical consideration is the impact of shoe classification on workers in the retail industry. If this technology is widely adopted, it has the potential to automate many of the tasks currently performed by human workers, such as shoe classification and inventory management. While this could increase efficiency and cost savings for retailers, it could also lead to significant job losses and exacerbate existing inequalities in the workforce.

# **XII. Conclusion**

Shoe classification using deep learning is a promising application of deep learning in computer vision. The results of this project demonstrate the potential of deep learning models in accurately classifying shoes based on their images. Further research is necessary to improve the accuracy and performance of the classification model.

# **XIII. References**

UT Zappos50K dataset: <http://vision.cs.utexas.edu/projects/finegrained/utzap50k/>