FIND YOUR FIT: Footwear-size Detection and Recommendation System

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ABSTRACT

Fashion is a means of expressing oneself, emotions, and attitude. Clothing and footwear being highly involved products in fashion industry, it is very difficult to make sales online as size and fit are the most important criteria which influences customer satisfaction. Many of the customers prefer online shopping as it saves a lot of time. But in the case of footwear selection, many people go wrong because the foot size of a person varies from brand to brand. Hence this project proposes a Footwear Size Detection and Recommendation system which uses OpenCV (Open-Source Computer Vision Library) based logic for calculation of foot size and will help people to find their perfect fit that allows a smooth transaction from both ends.
The user can upload their foot image and the logic will calculate the foot size and display the size in Euro, UK, US, and centimeters. This will serve as an advantage for users to know their foot size in different scales. Recommendation system is also developed in which the user can select footwear from different brands according to their preference. Based on the user selection, the page will be directed to that exact brand and type of footwear. The end users for this system will be customers who shop for footwear online because it enables them to choose their perfect match without any hassle.

Keywords: Footwear, Foot Size, Open CV, Detection, Recommendation.

1. INTRODUCTION

Fashion is a form of self-expression which mostly defines one's identity, moods, and opinions, which might be in any form such as clothing, footwear, accessories etc. Recent studies show that size and fitness are the factors which are most influential that drives e-commerce for customer satisfaction.

When compared to traditional methods of shopping where we purchase the product in person, one major disadvantage of using online platforms is that we cannot give immediate feedback about how a product fits and feels. According to a study, many people might be comfortable purchasing online products but most of them were not satisfied with the product because of many factors like quality, fit etc., and this is a major drawback against fashion e-commerce.

In the fashion industry there is factor called 'vanity sizing' (also be termed as size inflation) which is a phenomenon of using a ready to wear product of a nominal size, but it increases in physical size as time passes. This requires the brands to change the standardized size specifications to target a particular set of customers. Due to the availability of so many products that overlap size systems in the fashion industry, there is no longer a standard size for any given product. When a product is compared with different brands and especially when the product is related to fashion such as clothing or footwear there is no exact method of conversion logic which is implemented to convert sizes from one to another. To help customers find the right size, it is possible to guide them by providing size conversion charts. Customers can convert their body measurements to the sizes of the product. Additionally, size charts within a brand will always suffer from high variation, even if the consumer provides their correct measurements.

There are many other factors that make size detection essential for fashion e-commerce platforms. To develop data-driven systems and in order to provide fit and size advice to their customers, we propose a computer vision-based content-collaborative methodology to get personalized size and fit detection and also recommend the product of the same resulting foot size of a desired brand. We hereby propose a logic that calculates the size of foot and filters the footwear of a desired brand which only relies on interaction data to model customer behavior. The method used for this kind of measurement is based on 3D construction which uses some materials like structured light and plantar scanner to get the information about foot.

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And the foot information is obtained by splicing and measuring the common parameters. Though this technique gives high accuracy, it is not suitable to implement on a large scale as this involves working with expensive equipment and takes a long-time consumption. So, the idea of measuring the foot based on pictures came to light so that this process does not need any method of reconstructing the 3D shape of foot and this process is also more convenient than that 3D measuring. The whole measuring can be done by only clicking pictures. Logic detects edges, with more accurate and efficient foot measurement methods. And by a particular algorithm we process the edge information of the image and use the traditional OpenCV algorithm to separate the foot from the background of image to calculate the size.

2. RELATED WORK

A relative analysis by Abdul-Saboor Sheikh [4] and his team shows in their article that, by using a deep learning methodology they were able to combine collaborative and content-based modeling techniques by which we could learn some useful representations of customers for size and fit detection. The advantage of using this method is, that it is highly scalable and works end to end for which we do not require any knowledge in prior. The team also proposed that by using an architecture called SFnet which gives both flexibility and carries a good capacity to capture higher abstractions of fit, size which gives related information of customers random choices. In order to overcome the problem of inaccurate measurements Sungkuk chun [5] and team by applying Markov Random Fields and image segmentation methods showed how to detect the foot surface which is in contact with the footplate and also in their work they proved that by using an autonomous geometric foot-arch analysis platform it is much more suitable to capture the sole of the foot and produce three parameters like AI (arch index), AW (arch width), AH (arch height). For this we need an RGB-D (Red Green Blue-Depth) camera to capture a foot in a static standing pose. Sagar Arora [6] and team proposed a footwear size recommendation with an aim to provide customers an enhanced shopping experience. The challenge encountered here was to provide recommendations for those who do not have a history of any previous purchases on an online platform. A probabilistic graph was constructed which shows the brand-to-brand relationship which addresses challenges like sparse signal for some new products in the system and gives a solution for new users and the recommendation precision and coverage was improved. Emily Yim Lee Au and Ravindra S. Goonetilleke [7] in their study say that by using two models they were able to predict footwear fit by considering foot-shoe dimension difference in toe. Also, a polynomial relation was built to predict preference rating from this footwear fit where the quality of fit will also be evaluated. Damir Omrcen and Ales Jurca [8] share their innovative shoe size recommendation system which is based on foot measurements that significantly increase accuracy of recommendation. Later they did work on further development of this recommendation system where instead of using foot scanners a self-foot measurement would provide a good solution.

3. METHODOLOGY

A. System Overview

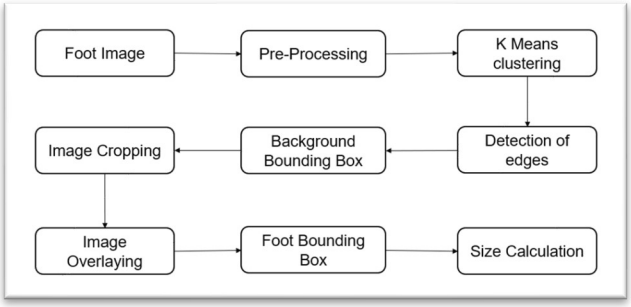

Figure 1. Process Flow Diagram

B. Process

INPUT: Input is taken in the form of static/real time images.

PRE-PROCESSING: Converts the color space of the image from RGB (red, green, blue) to HSV (hue, saturation, value). This is often used in image processing for various purposes, such as simplifying color manipulation. Gaussian blur is also applied to reduce noise and detail in an image. This enhances certain features in the image.

K-MEANS CLUSTERING: Image is first converted to 2-dimentinal array. Tweak the cluster size and observe changes in output. Here we have used 2 clusters. This assigns each pixel of the 2D array to its nearest cluster centre. Obtained from k-means clustering. Thus, it effectively assigns each pixel a new colour based on the cluster it belongs to. Reshape back the image from 2D to 3D (clustered image)

EDGE DETECTION: Applies canny edge detection algorithm. Uses lower and upper thresholds for Edge detection. Dilation is done. It expands the boundaries

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of detected edges and helps in connecting broken edges. Erosion also is done here.

BOUND-BOX, CONTOURS AND CROP IMAGE: The image is designed to find bounding boxes around the contours of an image after edge detection. Mainly used to get height/width of paper and feet. The contours in the image processing are curves/ outlines that represent the boundaries of objects in the image. The cropped image is obtained by cropping the Region of Interest (ROI) from the original image based on bound box.

OVERLAY IMAGE: Here it takes the cropped image from previous step and creates a new black image with a blue background and overlays the cropped image onto the blue background at a specific location. The resulting image is then returned.

FOOT SIZE DETECTION: Calculates the size of the foot relative to a standard paper size (A4) and returns an offset value. It is later converted into various other measurements.

4. EXPERIMENTAL RESULT

The use of printer paper serves as a reference for the height and width of the foot in the image. This reference is important for accurately calculating the foot size. Additionally, the white background of the paper helps in preprocessing the image, making it easier to detect and analyse the foot.
The foot in the image should be positioned in the centre of the paper and should be touching the bottom edge of the paper. This ensures that the foot is properly aligned for accurate measurements.
The floor colour should be different from white to provide contrast in the image. This helps in distinguishing the foot from the background, making it easier to detect and analyse.
The image should be clicked from a top angle to capture the entire foot and paper in the frame. This angle provides a clear view of the foot and its dimensions, ensuring accurate measurement.
The paper used as a reference should be completely visible in the clicked image. This ensures that the entire reference area is captured, enabling accurate calculation of the foot size.

5. CONCLUSION

In conclusion, the study offers significant advantages by converting detected foot sizes into Euro, UK, and US measurements, securely storing user-uploaded foot and profile pictures, and incorporating a Recommendation system based on user feedback. However, limitations such as specific image capture requirements and longer processing times exist. Future improvements could focus on enhancing processing speed, implementing a QR code system for image upload, generalizing image capture requirements, providing multilingual support, and refining the Recommendation system for a more intuitive user experience. These enhancements aim to make the study more efficient, accessible, and user-friendly for a broader audience.

6. REFERENCES:

[1] A.-S. Sheikh et al., "A Deep Learning System for Predicting Size and Fit in Fashion E-Commerce," Proceedings of the 13th ACM Conference on Recommender Systems, pp. 110–118, Sep. 2019, doi:10.1145/3298689.3347006.

[2] Gunseli Yalcinkaya, "Nike app uses AR and AI to scan feet for perfect fit," Dezeen, May 09, 2019. https://www.dezeen.com/2019/05/09/nike-fit-app-ar-ai-trainers/

[3] Wevolver, "Computer vision for virtual footwear fitting and shoe size suggestion," 1651. https://www.wevolver.com/article/computer-vision-for-virtual-footwear-fitting-and-shoe-size-suggestion (accessed Jul. 29, 2022).

[4] A.-S. Sheikh et al., "A deep learning system for predicting size and fit in fashion e-commerce," in Proceedings of the 13th ACM Conference on Recommender Systems, 2019.

[1] Corresponding author: Aishwarya H R
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[5] Chun, S. *et al.* (2017) "A foot-arch parameter measurement system using a RGB-D camera," *Sensors*, 17(8), p. 1796. Available at: https://doi.org/10.3390/s17081796.

[6] S. Singh, G. M. Abdulla, S. Borar, and S. Arora, "Footwear size recommendation system," arXiv [cs.IR], 2018.

[7] E. Y. L. Au and R. S. Goonetilleke, "A psychophysical model for predicting footwear fit," in 2009 IEEE International Conference on Virtual Environments, Human-Computer Interfaces and Measurements Systems, 2009, pp. 202–205.

[8] D. Omrcen and A. Jurca, "Shoe size recommendation system based on shoe inner dimension measurement," in Proceedings of the 2nd International Conference on 3D Body Scanning Technologies, Lugano, Switzerland, 25-26 October 2011, 2011.

[9] G. M. Abdulla and S. Borar, "Size recommendation system for fashion e-commerce.".

[10] V. Sembium, R. Rastogi, A. Saroop, and S. Merugu, "Recommending product sizes to customers," in Proceedings of the Eleventh ACM Conference on Recommender Systems. ACM, 2017, pp. 243–250.

[11] G Mohammed Abdulla and Sumit Borar. 2017. Size recommendation system for fashion e-commerce. In Workshop on Machine Learning Meets Fashion, KDD.

[12] Kolsek, T., Jurca, A., Vidic, T. (2010): "Recommendation System For Sizing of Children's Footwear", In Proc. 3D Body Scanning Techniques, Switzerland.

[13] Y. Hu, X. Yi, and L. S. Davis, "Collaborative fashion recommendation: a functional tensor factorization approach," in Proceedings of the 23rd ACM international conference on Multimedia. ACM, 2015, pp. 129–138.

[14] V. Sembium, R. Rastogi, A. Saroop, and S. Merugu, "Recommending product sizes to customers," in Proceedings of the Eleventh ACM Conference on Recommender Systems. ACM, 2017, pp. 243–250.

[15] G. Adomavicius and A. 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, vol. 17, no. 6, pp. 734–749, 2005

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