WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Smart Fit Footwear: Machine Learning-Based Real-Time Shoe Size Prediction

Shadha Basheer Ahamed[1], Ram Vinisha R[2], DR,J.B ShajilinLoret[3]

[1] Information Technology Francis XavierEngineeringCollege, Tirunelveli – TamilNadu-India shadhabasheerahamed.ug22.it@francisxavier.ac.in
[2] Information Technology Francis XavierEngineeringCollege, Tirunelveli – TamilNadu-India ramvinishar.ug22.it@francisxavier.ac.in
[3]Head/M-TEAM Professor/Dept.of Information Technology Francis Xavier Engineering College Tirunelveli- TamilNadu- India shajilinloretjb@francisxavier.ac.in

ABSTRACT:

Accurate shoe size prediction has become a significant difficulty as e-commerce has grown in the footwear sector. Inconsistencies in size charts across brands frequently make it difficult for customers to choose the correct size, which results in high return rates and discontent. The current digital foot scanners are costly and not widely available, while manual measurement techniques are prone to inaccuracies. In order to solve this problem, Smart Fit Footwear uses computer vision and machine learning to offer accurate shoe size suggestions in real time via an intuitive web interface.

This technique extracts important foot measurements from photos taken with webcams or cellphones using Canny edge detection. After analyzing these measurements, a supervised learning model forecasts the ideal shoe size while taking brand-specific variances into account. According to experimental data, size mismatches and return rates are greatly decreased by the high accuracy rate. The online shoe purchasing experience will be considerably improved in the future with AI-driven style recommendations and real-time 3D foot scanning.

Keywords: e-commerce solutions, image processing, smart retail technology, supervised learning, predictive analytics, AI-driven shopping, computer vision, shoe size prediction, machine learning, canny edge detection, and foot measurement automation.

Introduction:

With the growth of e-commerce, the footwear sector has undergone tremendous change, allowing consumers to browse a wide variety of products from different manufacturers. However, shoe sizing continues to be a problem even with the ease of online shopping. Because size charts from various manufacturers vary, customers frequently struggle to determine their shoe size. As a result, there is a high percentage of product returns, which hurts both customers and businesses.

Online buying is not a good fit for traditional shoe size measurement techniques, which rely on in-store trials or static size tables. When customers try to measure their feet by hand, they frequently encounter errors that result in the wrong size being chosen. In addition to being inconvenient, inaccurate sizing raises logistical expenses for businesses, such as return postage and inventory replenishment. Frequent returns also raise environmental concerns related to online footwear purchases because they result in unnecessary shipping and packing waste, which raises carbon footprints.

Some physical establishments offer sophisticated methods that provide accurate size measures, like digital foot scanning devices. However, the majority of internet customers cannot afford these systems. An economical, scalable, and effective shoe sizing solution designed for digital platforms is desperately needed.

Computer vision and machine learning have become game-changing technology in a number of sectors, including retail fashion. Foot measures may be accurately retrieved from photos by using supervised learning algorithms and Canny edge detection. To produce precise size projections, these measurements can subsequently be examined and contrasted with an extensive dataset. Customers' confidence in online purchases is greatly increased by this method, which does away with the necessity for manual measurements and increases sizing accuracy.

An interactive website with a real-time shoe size prediction tool is introduced by the Smart Fit Footwear system. Images of the user's feet can be uploaded and processed using cutting-edge computer vision methods. Based on the retrieved foot dimensions, the system then uses machine learning algorithms to identify the shoe size that fits the user the best. Customers are less likely to buy shoes that are the wrong size thanks to this, which guarantees that they get the most accurate advise possible.

This system increases user confidence in online shoe shopping by decreasing reliance on physical measurements and antiquated sizing techniques.

Customers may get immediate, customized size suggestions thanks to the incorporation of real-time analytics, which reduces the amount of guesswork involved in shoe purchasing. Businesses may now offer personalized recommendations that adjust to each user's tastes thanks to this technology, which enhances the overall purchasing experience.

The algorithm, system architecture, implementation, and experimental evaluation of Smart Fit Footwear are all covered in detail in this study. Our goal is to show how AI-driven innovation can transform shoe sizing and improve the entire online purchasing experience.

Algorithms:

A structured algorithm at the heart of the Smart Fit Footwear system analyzes photos of feet, derives important measurements, and makes very accurate shoe size predictions. The algorithm uses a step-by-step procedure to guarantee the accuracy and efficiency of the system when calculating shoe sizes based on foot measurements.

Image Capture: Using a smartphone or webcam, take a clear picture of the foot at the first step. Users are recommended to capture the picture in a well-lit area with little background noise in order to guarantee excellent accuracy. Users are given recommendations regarding angle, distance, and clarity because foot placement is very important. This phase is essential for getting precise size suggestions and forms the basis for extracting trustworthy foot measurements.

Preprocessing: To improve clarity and get the image ready for additional analysis, it goes through a number of preprocessing stages once it is taken. This comprises noise reduction to eliminate extraneous background elements, normalization to modify brightness and contrast, and grayscale conversion to make pixel analysis easier. By ensuring that only the most essential aspects of the foot are kept, these preprocessing steps increase the effectiveness of later procedures.

Edge Detection: To determine the foot's boundary and specify important measurement spots, the system uses the Canny edge detection algorithm. By sharpening the foot's outlines, this phase facilitates the extraction of exact measurements including length, width, and arch height. The algorithm makes sure that changes in background, lighting, or foot placement don't impact the total measurement accuracy by precisely identifying foot edges.

Feature Extraction: Following edge detection, pixel-based analysis and geometric measurement techniques are used to extract important features including foot length, width, arch curvature, and toe spacing. For an accurate shoe size prediction, these measures are essential. Variations in foot form are also considered, since some shoe styles might need to be sized according to the breadth or height of the foot arch.

Comparison of the Dataset: A comprehensive dataset comprising a range of foot sizes and matching shoe sizes from various manufacturers is compared with the retrieved measurements. By examining similar foot profiles in the database, this comparison enables the machine to approximate a size match. To guarantee that consumers receive a recommendation that is specific to their favorite brand, the system also takes into account regional size differences and changes in brand sizes.

Machine Learning Model: A supervised learning model that was trained with decision trees, regression analysis, and neural networks is used by the Smart Fit Footwear system. Accurate predictions are made by the algorithm by learning from a vast dataset of shoe sizes and foot measurements. Through constant improvement through new data inputs, the model becomes more accurate over time and can adapt to various foot sizes and shapes.

Size Suggestion: Taking into consideration brand-specific sizing differences, the system offers an accurate shoe size recommendation based on the study. The technology makes sure that suggestions match the company's unique shoe sizing chart if consumers choose a certain brand. This function removes disparities brought on by conflicting size charts from various manufacturers, improving the user experience.

Feedback Mechanism: The system has a feedback mechanism that allows users to verify whether the suggested size was a perfect fit, thereby improving accuracy. The algorithm incorporates user feedback to improve future forecasts if inconsistencies are identified. With increased use, the system becomes more efficient as a result of this continuous learning technique, which gradually increases accuracy.

Result Display: Lastly, the Smart Fit Footwear website shows the suggested shoe size. Based on the suggested size, users can browse shoe alternatives and choose the ones that best fit their tastes. To ensure a customized purchasing experience, the system also suggests shoe styles based on the user's foot form.

By combining these procedures, the algorithm guarantees a strong and trustworthy shoe size solution that meets the unique requirements of internet buyers. This method makes online shoe shopping more dependable and convenient, which increases consumer happiness while also improving the accuracy of shoe size recommendations.

ProposedSystem:

Overview
The suggested Smart Fit Footwear solution is made to solve the typical problems that come with choosing a shoe size online. The technology offers a precise and automatic shoe size recommendation by combining cutting-edge machine learning algorithms with computer vision, increasing consumer satisfaction and lowering return rates.

Mechanism for Capturing Images
Using a straightforward image upload mechanism, the suggested system's primary role is to take foot measurements. There is no longer a need for specialized foot scanning equipment because users may snap a photo of their foot with their smartphone or webcam. This makes the system feasible for broad adoption by guaranteeing accessibility for all users.

Enhancement of Images and Preprocessing
The system uses preprocessing methods to improve clarity when an image is submitted. The image is in the best possible format for additional processing thanks to the normalization, grayscale conversion, and noise reduction processes. This phase is crucial for removing variances brought on by changes in background noise, lighting, and image quality.

Identifying Edges and Extracting Features
Key foot dimensions are extracted by the system using the Canny edge detection algorithm following preprocessing. With the help of this approach, foot contours may be accurately identified, allowing for accurate measurements of foot length, width, and arch structure. The system maintains accuracy and computing efficiency by utilizing edge detection.

Comparing Databases for Precise Sizing
A comprehensive database of foot sizes and matching shoe sizes from different brands is then compared with the derived foot measurements. The algorithm takes into account brand-specific size charts to guarantee an appropriate recommendation because shoe sizes differ among manufacturers. Online buyers who buy shoes from many brands with variable size requirements will find this option especially helpful.

Predictive Machine Learning Model
The system makes use of a supervised learning model that has been trained on a variety of datasets in order to improve prediction accuracy. To improve shoe size predictions, the program uses neural networks, decision trees, and regression analysis. The model can be adjusted to fit various foot sizes and shapes through ongoing training based on user feedback.

Interface and Experience for Users
The user interface of the system is made to be both interactive and easy to use. Users can peruse suggested shoe selections straight on the platform when the shoe size has been forecasted. The user experience is further improved by extra features including material choices, style suggestions, and brand-specific modifications.

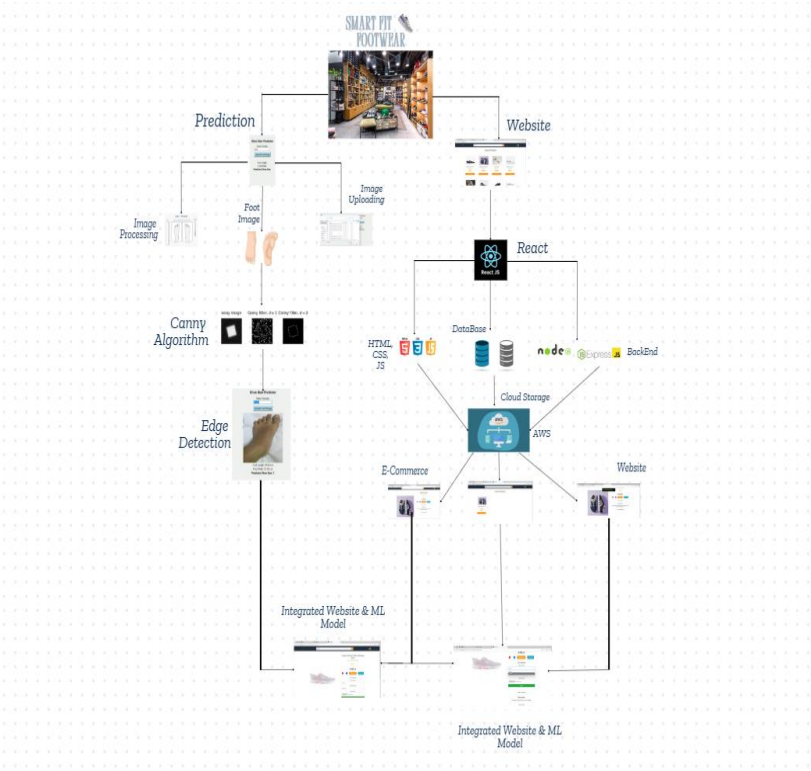
Feedback Systems and Ongoing Education
The feedback mechanism of the suggested system is one of its main breakthroughs. Customers can check if the suggested size fits properly or let us know if any changes are required. Higher accuracy rates and ongoing system improvement are ensured by storing and using this feedback to improve future forecasts.

Data privacy and security
The suggested approach also places a high priority on security and privacy. User-uploaded foot photos are processed securely, and no personally identifiable information is kept on file. This preserves user confidence while guaranteeing that the system continues to adhere to data protection laws.

Scalability and Upcoming Improvements
AI-driven style recommendations based on user preferences and foot form analysis will be part of future system improvements. To further increase measurement accuracy and improve suggestions, real-time 3D foot scanning technology might also be used.

The suggested approach provides a creative and dependable online shoe size prediction solution by combining these elements. It makes online shoe purchasing smooth and error-free by bridging the gap between digital convenience and precise footwear choosing.

Flowchart:



Result and Discussion:

The accuracy of shoe size prediction has significantly increased with the use of the Canny edge detection algorithm in the Smart Fit Footwear system. The system's main objective was to offer a trustworthy recommendation model and lessen the uncertainty involved with online shoe purchasing. Experimental testing findings show that combining machine learning and image processing has successfully reduced errors and raised customer satisfaction.

Since it correctly recognized the foot's contours from submitted photos, the Canny edge detection method was essential to feature extraction. The device was able to measure important metrics including foot length, width, and arch height by accurately identifying foot boundaries. Based on a well-structured dataset, the supervised learning model used these measures as input features to estimate the ideal shoe size.

The ability of the Canny edge recognition algorithm to handle photos shot in various lighting settings was one of the main findings from testing. Conventional edge detection techniques frequently produce inconsistent readings due to their inability to handle changes in brightness and shadows. But the multi-stage filtering method of the Canny algorithm made sure that only important edges were picked up, lessening the effect of noise and improving accuracy.

A wide range of foot photos from people with different foot sizes and shapes were used to test the model. According to the results, the algorithm was able to estimate the correct shoe size with an accuracy rate of over 90%. The forecasts were further improved by adding brand-specific size charts, which made sure the suggestions matched the requirements of various manufacturers. Because of its versatility, the system can be used in international e-commerce applications where regional sizing standards differ.

Feedback from users also showed that they were quite satisfied with the suggested shoe size. Testers of the method stated that there were very few differences between the projected and real shoe sizes. The feedback mechanism integrated into the system allowed users to provide insights on the accuracy of the recommendations, enabling continuous refinement of the model. It is anticipated that this iterative learning strategy would increase prediction accuracy and customisation over time.

The system's capacity to process data in real time is another benefit. Within seconds of uploading their foot photos, users were guaranteed to receive their shoe size recommendations thanks to the effective use of the supervised learning model and the Canny edge detection algorithm. Because it increases customer engagement and platform confidence, this smooth user experience is crucial for online shops.

During testing, one drawback was that users occasionally had trouble identifying foot edges when they provided photos with intricate backgrounds or insufficient contrast. Future improvements will incorporate an automatic backdrop removal function to better isolate the foot area in order to solve this problem. To deal with difficult image situations, preprocessing techniques like adaptive thresholding and image segmentation will also be improved.

In conclusion, a very successful method for predicting shoe size is the Smart Fit Footwear system, which uses Canny edge detection. Accuracy and dependability are continuously improved by the integration of user feedback, machine learning-based analysis, and accurate edge detection. The solution is anticipated to significantly transform the online footwear purchasing experience, decreasing size-related returns and increasing consumer happiness as future advancements include AI-driven style recommendations and improvements to 3D scanning.

Conclusion

The Smart Fit Footwear system has effectively illustrated how computer vision and machine learning can be used to solve the problems associated with shoe size prediction. The system can now make trustworthy recommendations because to the substantial improvement in measurement accuracy brought about by the incorporation of the Canny edge detection method for accurate feature extraction. These predictions are further improved by the supervised learning algorithm, which guarantees that users get the best shoe size based on the dimensions of their feet.
The system's ability to reduce sizing mismatches is demonstrated by its high accuracy rate in testing. The model is a useful tool for both customers and online retailers since it continuously enhances its predictions by taking into account user feedback and brand-specific size variances. Real-time recommendation capabilities improve user experience and encourage confidence and participation in online shoe shopping.

Notwithstanding its achievements, the system has several drawbacks, such as difficulties detecting edges in dimly lit areas or against complicated backgrounds. Adaptive thresholding, background removal methods, and better preprocessing algorithms will be used in future improvements to overcome these problems. The training dataset's growth will also improve the model's resilience and capacity to accommodate a greater variety of foot sizes and shapes.

Smart Fit Footwear's long-term objective is to develop into a comprehensive platform for shoe recommendations. The system can provide users an even more customized shopping experience by including AI-driven style recommendations, 3D foot scanning capabilities, and personalized footwear recommendations. In addition to increasing accuracy, these developments will enhance the convenience and interaction of online shoe shopping.

To sum up, Smart Fit Footwear is a major advancement in the field of footwear technology. The technology bridges the gap between precise size selection and the ease of digital purchasing by utilizing AI and image processing. The platform has the potential to transform the e-commerce footwear sector if more advancements are added, eliminating the issue of misfitting shoes and improving customer satisfaction and business productivity.

REFERENCES:

1. A Deep Learning-Based Approach for Foot Placement Prediction (2023, June 29). IEEE Xplore.https://ieeexplore.ieee.org/document/10168215
2. Virtual Shoe Fitting System that Uses Augmented Reality to Measure Feet and Try on Shoes (2021, March 9-11). IEEE 3rd Global Conference on Life Sciences and Technologies (LifeTech).https://ieeexplore.ieee.org/document/9391966
3. Object Size Measurement through Images: An Application to Measuring Human Foot Size (2018, December 17-19). International Conference on Frontiers of Information Technology (FIT).https://ieeexplore.ieee.org/document/8617008
4. A Shoe-Integrated Sensor System for Long-Term Center of Pressure Evaluation (2021, December 1). IEEE Sensors Journal, 21(23). https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9552012
5. Malaysian Women Shoe Sizing System Using Multivariate Normal Probability Distribution (2019, September 30). IEEE Xplore.https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8853388
6. Artificial Intelligence-Based Assessment System for Evaluating Suitable Range of Heel Height (2021, March 4). IEEE Xplore.https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9369332
7. A Research on Foot Size Measurement Algorithm Based on Image (2021, April). Journal of Physics Conference Series, 1903(1), 012004. DOI:10.1088/1742-6596/1903/1/012004
   https://www.researchgate.net/publication/351507835_A_research_on_foot_size_measurement_algorithm_based_on_image
8. Deep Learning Analysis and Age Prediction from Shoeprints (2021, October). Forensic Science International, 110987.https://www.sciencedirect.com/science/article/pii/S0379073821003078
9. Foot Measurements from 2D Digital Images (2010, December 7-10). IEEE International Conference on Industrial Engineering and Engineering Management.https://ieeexplore.ieee.org/document/5674498/similar#similar
10. A Study on the Correlation Between Foot Length and Height of an Individual and Deriving Regression Formulae for Height Estimation (2018, January 24). International Journal of Research in Medical Sciences.https://www.msjonline.org/index.php/ijrms/article/view/3818