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FOOT SIZE DETECTION USING DEEP LEARNING TECHNIQUES

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Abstract : The measurement of foot size holds significant relevance across various domains, encompassing medical foot health assessments for evaluating foot well-being and advancing foot kinematics studies. Historically, limitations in measurement equipment and algorithms constrained the widespread adoption of 3D foot measurement techniques. However, leveraging novel methodologies integrating deep learning and image segmentation algorithms now enables swift and convenient foot measurements. Initially, a photograph capturing the user's foot alongside a standardized object is obtained, followed by the extraction of foot size and shape data from the image. The proposed methodology employs an Edge Detection Algorithm to delineate the edges of an A4 paper and employs traditional image segmentation algorithms to isolate the foot area.Encouragingly, the results demonstrate enhanced measurement speed and heightened accuracy in foot size assessment facilitated by the proposed algorithm.

1. INTRODUCTION

The foot plays a pivotal role in supporting the human body during standing, walking, and jumping, making it a vital aspect of overall health and well-being. Its intricate structure, comprising numerous bones, underscores its complexity and importance in maintaining balance and stability. Shoe products serve as crucial tools in supporting and protecting the foot, with medical research highlighting the significance of wearing appropriately sized shoes in mitigating foot-related issues such as plantar pressure imbalance, foot pain, abnormal gait, and potential sports injuries.

Traditional methods of foot measurement, notably contact measurement, are hindered by low efficiency, large equipment requirements, and the potential for foot surface deformation, leading to inaccuracies in foot parameter assessment. In contrast, emerging technologies offer promising alternatives, notably 3D reconstruction and image-based measurement techniques.

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The 3D reconstruction method utilizes structured light to capture detailed foot surface information, complemented by plantar scanning to gather additional foot data. While boasting high accuracy, this method is constrained by its costly equipment and time-intensive processes, limiting its scalability and widespread adoption.

On the other hand, image-based measurement techniques eliminate the need for 3D reconstruction, leveraging advanced image processing algorithms for swift and convenient foot size analysis. By simply capturing images of the foot, this approach offers advantages in terms of efficiency, accessibility, and ease of use, presenting a viable solution for rapid foot size measurement without the drawbacks associated with traditional methods.

Foot size detection using image processing holds significant promise across various domains, including footwear design and manufacturing, medical diagnosis, and biometric identification. By analyzing foot images, computer vision algorithms can accurately determine key foot parameters such as length, width, and arch, facilitating precise sizing and customization of footwear.

The advantages of image-based foot size detection extend beyond traditional measurement techniques, offering non-invasiveness, speed, and accuracy. Particularly pertinent in times of global health crises such as the COVID-19 pandemic, remote foot size measurement capabilities provided by image processing technology can facilitate contactless interactions and reduce the risk of transmission.

While image-based foot size detection is still in its nascent stages, ongoing advancements in computer vision and image processing hold the potential to propel its integration into mainstream practices. As research in this field continues to evolve, the broader adoption of image processing techniques for foot measurement is expected to revolutionize foot health management and enhance the overall quality of life for individuals worldwide.

2. LITERATURE SURVEY

[1].Huawen Wang, Fuchang Liu and Ran Fan, "Research on foot size measurement algorithm basedonimage",2021 This paper presents a foot size measurement method utilizing deep learning techniques, offering a significant improvement over traditional manual measurement in terms of speed and efficiency. In comparison to methods relying on three-dimensional reconstruction, this approach is simpler and more convenient, allowing for quick measurements. Empirical testing has demonstrated the algorithm's effectiveness in accurately and swiftly measuring foot size, indicating its potential for widespread adoption.However, the proposed algorithm does have some limitations. Specifically, during foot segmentation using threshold-based methods, challenges arise in effectively processing shadowed areas within images, leading to potential inaccuracies in foot size measurement. Additionally, while the algorithm can provide length and width parameters, it currently lacks the capability to capture three-dimensional foot parameters such as the circumference of the metatarsal toe or the height of the anterior tarsal bone.

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Moving forward, future research will focus on addressing these limitations, with an emphasis on improving segmentation techniques to handle shadowed areas more effectively and expanding the algorithm's capabilities to include additional three-dimensional foot parameters. Despite these challenges, the proposed method holds promise for advancing foot size measurement practices, with potential applications in various fields.

[2].Kevin Yiu-Wah Cheung; Darasy Reth; Chen Song; Zhinan Li; Qin Li; Wenyao Xu, "Bigfoot: AMobileSolutiontoward Foot Parameters Extraction", 2019

Introducing BigFoot, an innovative and cost-effective approach to analyzing foot parameters using smartphones and optimized computer vision algorithms. This system enables real-time calculation and analysis, providing valuable data for selecting well-fitting shoes. Validation results indicate that the calculated values closely match ground truth values, with no statistically significant differences observed. Participant feedback from post-experiment questionnaires has been overwhelmingly positive, highlighting the system's efficiency and accuracy. Continued development of this system holds promise for improving health outcomes associated with poorly fitting footwear.

[3].Muhammad Ahmad Shahid; Muhammad Aksam Iftikhar; Zaheer Ahmad Gondal; MuhammadAdnan, "ObjectSize Measurementthrough Images:An Application to Measuring Human FootSize",2018

Our proposed solution introduces techniques for accurately measuring foot size and addressing associated issues effectively and directly. These techniques show promise in predicting foot size and estimating image depth, while also being combined to yield precise regression analysis result

[4] [Yu-Chi Lee; Wen-Yu Chao; Mao- Jiun Wang, "Foot shape classification using 3D scanningdata",2012

This study utilized a two-stage cluster analysis approach to categorize foot shapes and develop a novel foot sizing system specifically tailored for Taiwanese males. By considering foot length, foot breadth, and navicular height, the males' feet were classified into six typical types, achieving a cumulative accuracy of 72.96%. Comparing the results with the CNS 4800-S1093 system revealed that the new sizing system exhibited a lower coverage rate (89%) and a reduced number of sizes (134 sizes). In contrast, while the CNS 4800-S1093 system boasted higher coverage (96%), it encompassed a larger number of sizes (210 sizes), failing to adequately address the requirements of Taiwanese feet. Notably, inherent foot shape discrepancies exist among individuals across different countries and generations. To assess the new sizing system's suitability, aggregated loss values were employed, demonstrating that none of the three primary foot dimensions exceeded the benchmark value, indicative of a good fit for Taiwanese males. Overall, the new system offered a streamlined range of sizes, maintained a high coverage rate, and provided updated foot dimensions with commendable fit performances. Consequently, the new sizing system holds significant potential to furnish essential and practical insights for footwear production, engineering, manufacturing, and product design endeavors.

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[5].S.R. Shah, and K.M. Patil, "Processing of foot pressure images and display of an advancedclinical parameter PRindiabetic neuropathy",2005

This study emphasizes the importance of understanding the function of the foot and its role in locomotionwhen examining patients with foot problems. Abnormal plantar pressure patterns during walking canindicate disturbances in foot function caused by disease or trauma. The passage introduces a novel methodusing Visual C++ for analyzing and displaying foot pressure patterns in normal and diabetic patients. Themethod involves image processing and calculation of a new foot pressure distribution parameter called PR.Automatic cropping of foot sole areas is done using MATLAB. The program calculates the PR in all footsole areas and displays the results using pseudo color foot images for quick diagnosis of diabetic footconditions.

Table.1:Literature Survey of Foot Size Detection using Image Processing

S. No	Names of the Authors	Title	Year	Description	Merits/Demerits
1	Huawen Wang, FuchangLiuan dRan Fan	Research onfoot size measurement algorithm based on image	2021	The algorithm employs the HED model for detecting the edges of A4 paper, while the conventional image segmentation algorithm Grab Cut is utilized for segmenting the foot area.	The shadow part of image cannotbe processed.
2	Kevin Yiu-WahCheung; DarasyReth; ChenSong; Zhinan Li;Qin Li; WenyaoXu	Bigfoot: AMobile Solutiontowar d FootParameter sExtraction	2019	An algorithm that inputsimage and applies gaussianfilter to it and then appliescanny edge detectionalgorithm and then extractsthe parameters like width andheight of thefoot.	2D images onlycan obtainparameters likeheightandwid th.

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3	MuhammadAhmad Shahid;MuhammadAksam Iftikhar;Zaheer AhmadGondal;Muhammad Adnan	Object SizeMeasurement throughImages:AnApplication toMeasuring HumanFootSize	2018	An algorithm to capture imageand then foot is extracted fromthe image andthen pixels aremeasured then linear regressionmodel is applied and thenRMSE is applied to check theaccuracy.	Accuracy varieswitheachimage.

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4	Yu-Chi Lee;Wen-YuChao; Mao-JiunWang	Foot shapeclassification using 3Dscanningdata	2014	Using a 3D foot scanner, 12 dimensions of the foot were gathered, encompassing foot length, ball of foot length, outside ball of foot length, foot breadth, heel breadth, ball circumference, instep circumference, toe height, navicular height, instep height, toe 1 angle, and toe 5 angle. Subsequently, principal component analysis (PCA) and K-means cluster analysis were utilized to categorize the foot shapes of male subjects. The PCA outcomes revealed notable associations with foot breadth, foot length, and navicular height.	3D images can beused to obtainparameters likeheightandwidth.

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5	S.R.Shah. K.M.Patil	Processing of footpressure imagesand display of anadvanced clinicalparameter PR indiabeticneuropathy	2005	An algorithm, developed in MATLAB, automatically segregates (crops) bitmap files corresponding to various foot sizes. Subsequently, utilizing Visual C++, we compute the PR (pressure distribution parameter) of the cropped images and visually represent the PR values across all foot sole areas. This functionality aids clinicians in distinguishing between normal foot conditions and different stages.	Accuracy varieswitheachimage

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3. EXISTING SYSTEM

The existing system for foot size detection relies on image processing techniques to assess foot dimensions. Customers typically visit local stores to purchase footwear, ensuring an accurate fit. Historically, virtual foot measurements were limited due to constraints in measurement equipment and related algorithms. Consequently, individuals were compelled to visit physical stores, contributing to crowding and inconvenience. However, with advancements in image processing technology, virtual foot size detection has become increasingly feasible. This development offers the potential for customers to obtain accurate measurements remotely, reducing the need for in-store visits and alleviating overcrowding concerns.

DRAWBACKS OF EXISTING SYSTEM :

Following are the disadvantages of existing system:

- The different footwear brand shave different sizing(US-6,UK-7,Indian-38)and to avoid this people tend to buy foot wear from the stores.
- Crowded Footwear Stores.
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4. PROBLEM STATEMENT

We believe that measuring foot size in accordance with various measuring standards is necessary when shopping online. We can now easily and rapidly measure foot based on image processing and image segmentation techniques by applying the suggested methods.

6.PROPOSED OBJECTIVE

We believe that measuring foot size in accordance with various measuring standards is necessary when shopping online. We can now easily and rapidly measure foot based on image processing and image segmentation techniques by applying the suggested methods.

Advantages of Proposed System:-

• Exact Measurements: By employing image processing to determine foot size, very exact measurements of the foot are provided. These measurements may be utilised to create personalised footwear that fits flawlessly and offers the best possible support and comfort.
• Non-Invasive: Footsized identification via image processing is non-invasive and painless, in contrast to standard manual measuring procedures that can be intrusive and painful.
• Rapid and Effective: Foot pictures may be analysed rapidly and effectively using image processing techniques, which minimises the time and effort needed for the measurement procedure.

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• Measurement mistakes and human bias are eliminated with the use of image processing for foot size identification, which yields objective data.
• Remote Measurement: Image processing may be used to identify foot size remotely, which is particularly helpful during the COVID-19 epidemic as it lessens the necessity for in-person interaction.
• Cost-Effective: Compared to traditional manual procedures, which may need expensive equipment and skilled staff, image processing techniques can offer foot measuring options that are more affordable.

7. CONCLUSION

A number of applications, including as shoe size detection, orthotic and shoe design, gait analysis, and foot health evaluation, depend on accurate measurement of the foot. In comparison to the prior manual measurement method employing physical measuring instruments, the suggested model for foot size identification makes use of K-means clustering, and picture preprocessing provides several benefits.A few of the benefits are listed below:
Accuracy: When compared to manual measurements, the image processing technique yields a more accurate estimation of foot size. It gets rid of irregularities and human mistake that come with employing physical measurement equipment.
• Effectiveness: Measuring foot size with the suggested model is quicker and more effective. It saves time and effort by doing away with the requirement for people to physically measure their feet.
• Non-intrusive: The image processing paradigm is non-intrusive, in contrast to manual measurements that need direct touch with the foot.Its reliance on picture analysis of the foot makes it a more convenient and pleasant solution for consumers.
• Automation: The procedure of detecting foot size is automated by the suggested model. The suggested footwear can be automatically shown after the image has been processed and the foot size has been established, negating the need for manual interpretation and decision-making.
• Scalability: It is simple to scale the image processing model to take in more measurements. Users may receive precise foot measures remotely by integrating it with online purchasing platforms or foot measuring applications.

In comparison to the earlier manual measuring method, the suggested model for foot size identification utilising image processing and K-means clustering offers enhanced accuracy, efficiency, ease, and scalability.It may increase the precision of shoe sizing and enhance the consumer shopping experience.

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