Case Study: YouFit AI Size Suggestion Algorithm

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Abstract

Online fashion retail is experiencing a significant issue with returns, often resulting in loss of customers, damage to brand reputation, and increased customer acquisition costs, ultimately lowering customer lifetime value. Size mismatch is classified as the most likely return reason with 53%. To prevent and reduce the damage caused by high return rates many online fashion retails are looking in the direction of size suggestion algorithms, the solution on the market as of now are slow, inaccurate and highly priced.
Here we introduce YouFit, an AI based Size suggestion Algorithm that uses a single frontal User picture and their height to accurately calculate their measurements for any Bodypart, under 30 seconds with overall accuracy of 95%.

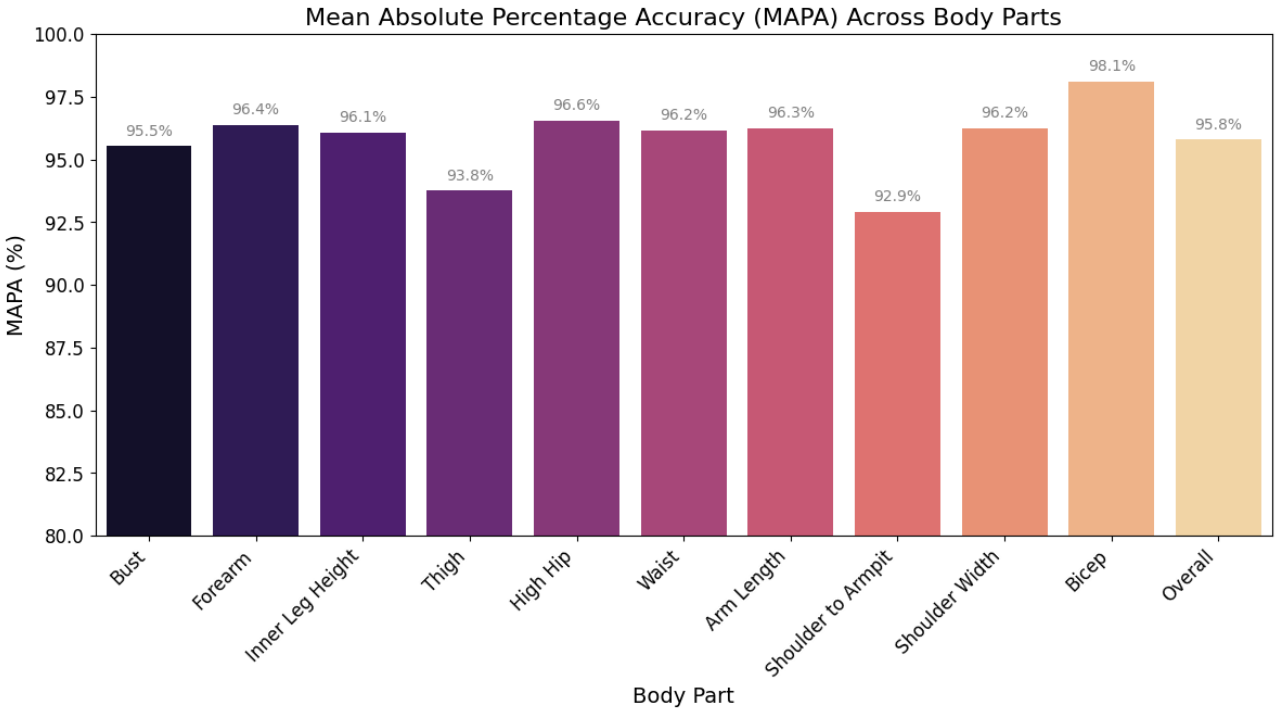

Figure 1: Accuracy results on all 10 measurements and Overall Accuracy

1 Introduction

- Issue: Returns are a considerable problem for online fashion retailers, leading to lost customers, damaged brand reputation, higher customer acquisition costs, and lower customer lifetime value.
- Data on the issue: Returns in the fashion e-commerce sector are costly, about 66% of the original item's price, with an average return rate for apparel at around 10%. In the US market, this rate is estimated at 24.4%, amounting to approximately $38 billion in 2023. The primary reasons for returns are size/fit, color, and damage. Brands are implementing technology such as virtual try-on tools to reduce return rates. Sources: Let's Bloom, Coresight Research.

Statement 1. *With the rapidly growing online fashion retail market, returns are increasing proportionally to sales. Many retailers seek ways to reduce returns due to size/fit mismatches.*

Statement 2. *To address this issue, companies have developed methods to cluster customers into data groups using questionnaires. These can take 1-2 minutes to complete and may require personal data not available to the user or be too broad or perception-dependent to provide consistent size suggestions.*

2 Proposed Solution

Here we present YouFit, an accurate and fast AI-based size suggestion algorithm that uses one frontal picture and the subject's height to reconstruct body measurements accurately to suggest the optimal size.

3 Methodology

In this case study, we evaluate the precision of YouFit's sizing technology on a diverse group of 27 participants, aged between 20 and 33 years.
The average height of the cohort is 174.62 cm (approximately 5'8"), with a standard deviation of 7.8 cm.
The group comprises 23 males and 4 females, including 2 individuals exceeding 190 cm (around 6'2") in height, identified as outliers.
We manually measured 11 dimensions for each participant: Height, Chest, Forearm, Inner Leg, Thigh, High Hip, Waist, Arm Length, Shoulder to Armpit, Shoulder Width, and Bicep. These measurements serve as a reference for assessing YouFit's accuracy.
Each participant was photographed once, under not optimal lighting conditions and wearing also loose-fitting or bulky attire to simulate real-world scenarios. Our AI model was then tasked with estimating the measurements from these photographs, using only the provided height and gender as input parameters.

Reference Outlier Sample (197cm / 6'5" ft)

Reference Male Sample

Reference Female sample

The results from YouFit were meticulously compared to the manual measurements to identify any discrepancies.
To ensure fairness in comparison, we also factored in the potential margin of error associated with manual measurement techniques. As you can see the formula below the sample mean for each measurement is taken and than a 5% margin error is computed, that margin of error is then the reference for the margin of error adjustment

$$5\% \times \bar{x} = 0.05 \times \frac{1}{n} \sum_{i=1}^{n} x_i$$

4 Results

4.1 Error Distribution Across Measurements

Figure 2 presents the error distribution for each body part. The boxplots show the variability and presence of outliers in the error distribution. Although outliers are shown for multiple measurements, the highlited people are known outliers, and usually tend to fall in the XXL/XXXL or XXS/XXXS ranges for multiple apparels thus falling in the "natural anomalies" and being highlighted as so.

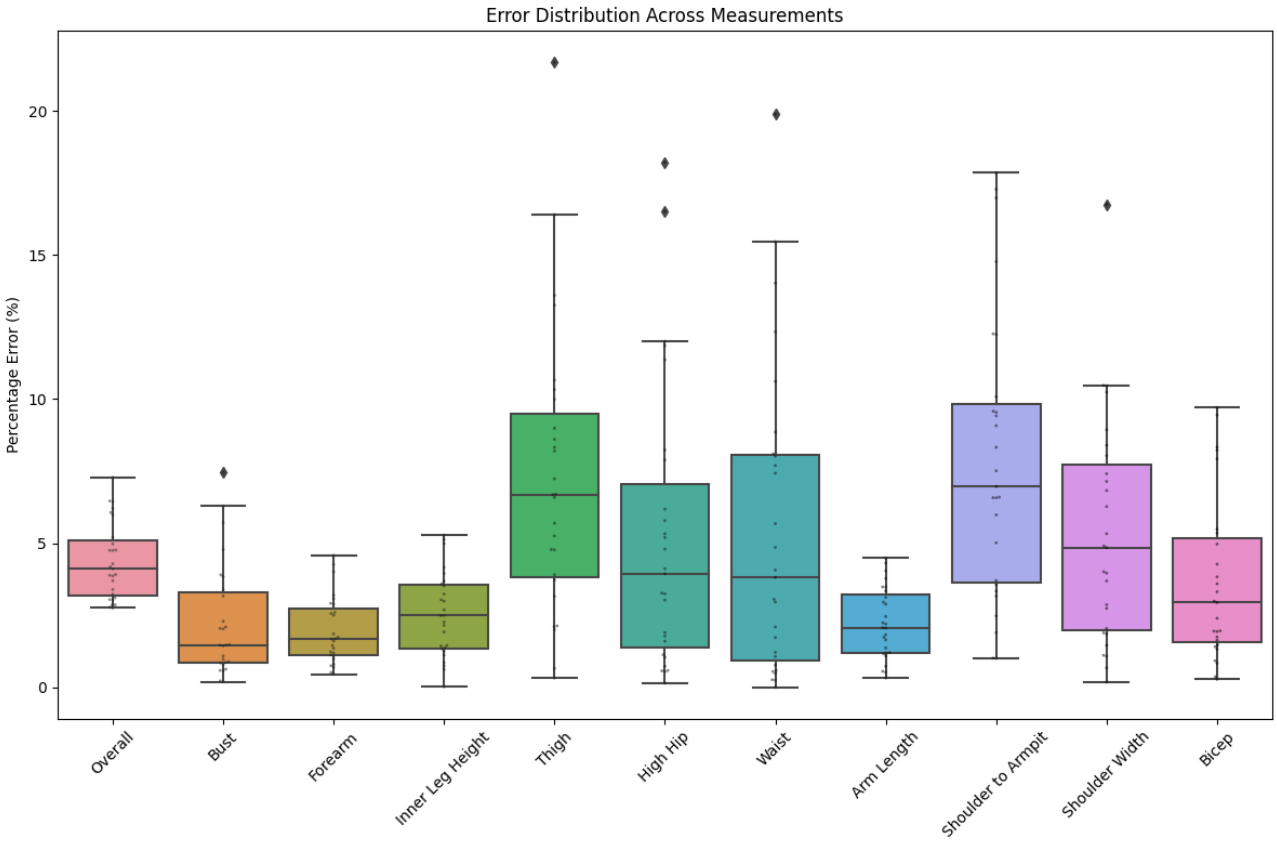

Figure 2: Error distribution across different body measurements.

4.2 Mean Absolute Percentage Error (MAPE) Across Body Parts

As opposed to the abstract here we can have a better view regarding MAPE, specifically MAPE after error adjustment to highlight the difference performances, we can see that we have a higher error regarding the regression of thigh and Shoulder to Armpit. Both these measurements are known to be of high variance and harder to properly measure, the higher amount of residual error might lie in the higher complexity of consistently identify the same points where to measure and this in higher hand-measured error more than in the model itself.

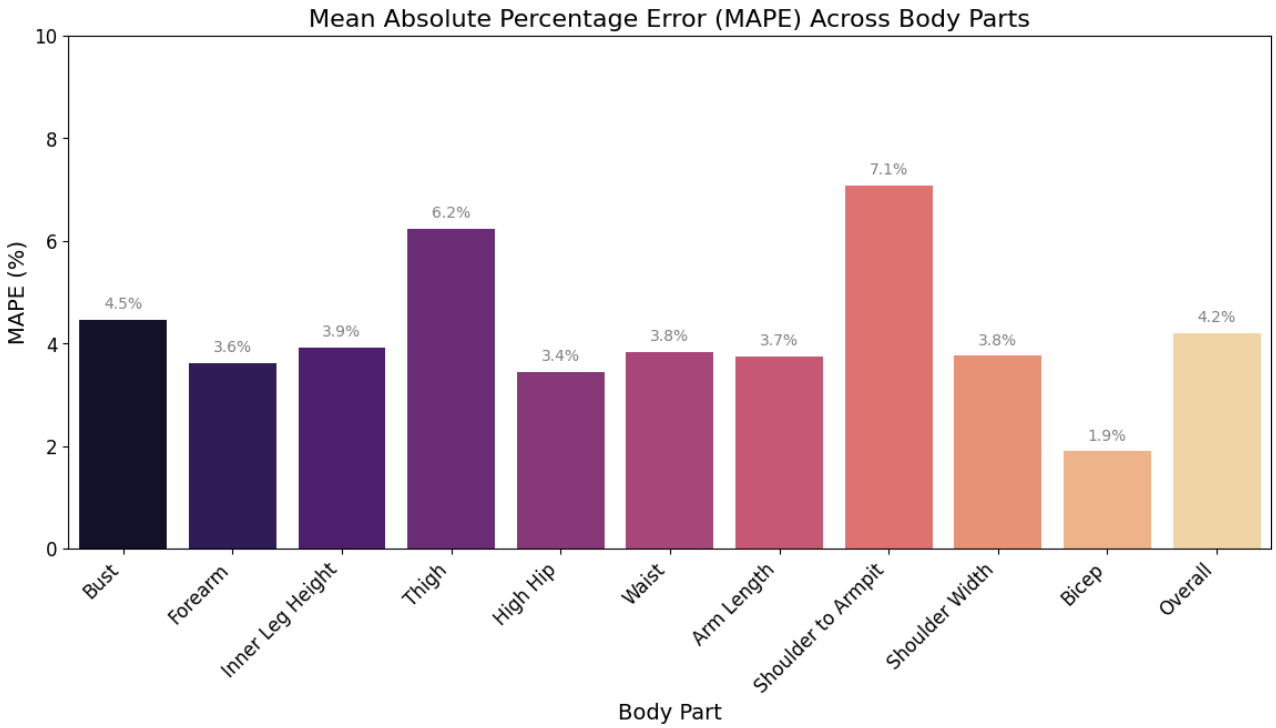

Figure 3: Mean Absolute Percentage Error across body parts, providing an insight into the error percentage relative to the size of the body part.

4.3 Comparison of MAE Adjusted vs. MAE Without Adjustments

The comparison in Figure 4 shows the difference between the MAE values after considering hand-made error and those without. This highlights the effectiveness of the error adjustment process and is useful to understand the true error of the system. It is to mention that measurements taken from the body are proven to highly variable even throughout the day, thus we have to acknowledge that there exist an underlying systematic error that cannot be further reduced but will be labeled as negligible

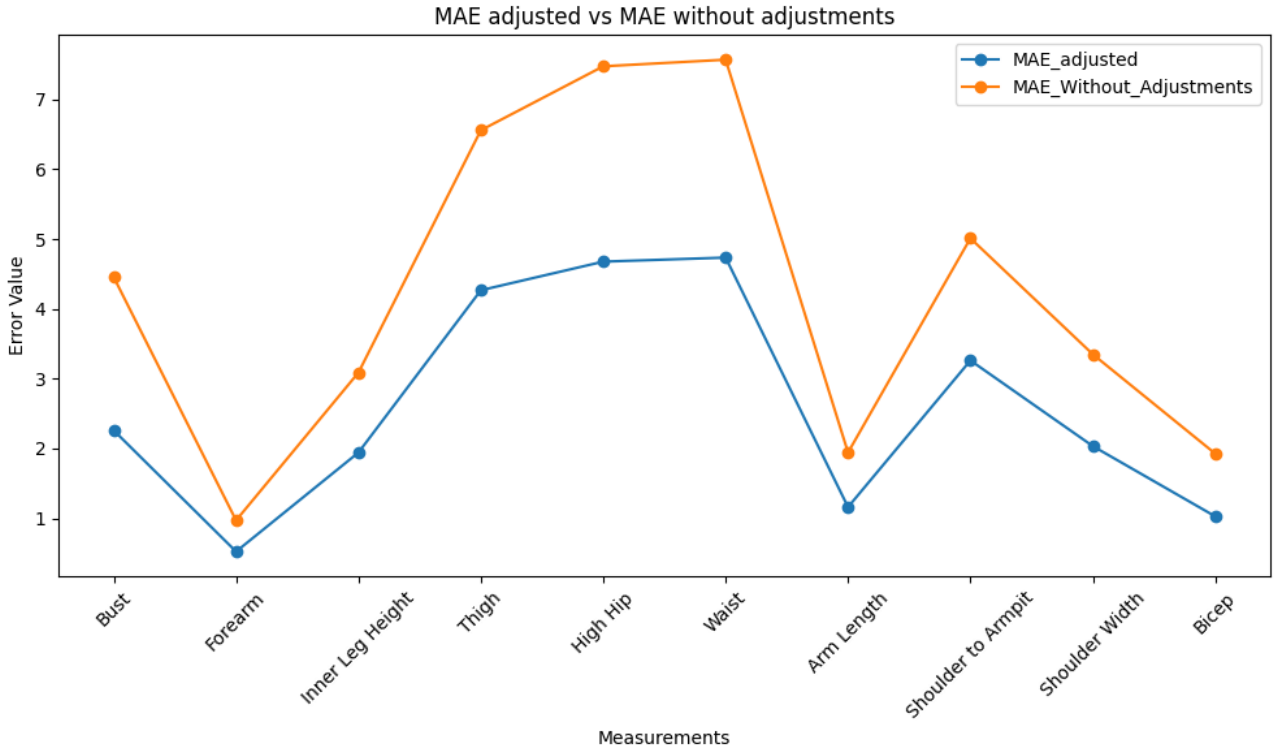

Figure 4: Comparison between the adjusted MAE and the non-adjusted MAE values.

5 Discussion

The results from our case study suggest that YouFit's AI algorithm is quite effective at predicting body measurements within an acceptable error margin. When we look at the error distribution across different measurements, we see a consistent accuracy in predictions, though, as expected, there's some variability depending on the body part being measured. This indicates that while the algorithm performs well overall, there are areas where it could be improved, especially in predicting measurements for body parts where higher variability was observed.

YouFit's potential to reduce size and fit mismatches in online fashion retail could be significant. By decreasing the likelihood of returns due to incorrect sizing, it addresses a key pain point for both retailers and consumers. However, it's important to discuss that the effectiveness of YouFit in real-world applications will depend on various factors, including the diversity of body shapes and sizes in the target population and the ever increasing problematic of properly build Size Tables.

Moreover, while YouFit shows promise in reducing return rates, the broader impact on customer satisfaction and operational efficiency for online retailers also warrants discussion. For instance, reducing returns could lead to lower logistics costs and a smaller carbon footprint, contributing to more sustainable business practices. On the customer side, a better fit prediction could enhance the shopping experience, potentially leading to higher customer loyalty and repeat purchases.

In summary, YouFit's AI algorithm demonstrates a solid foundation for predicting body measurements with a reasonable degree of accuracy. However, the discussion should also consider areas for improvement, the algorithm's adaptability to diverse body types, and the broader implications for the online fashion retail industry.

6 Conclusion

YouFit presents a promising solution to the size/fit mismatch problem in online fashion retail. By leveraging AI to predict body measurements from a single frontal image and height data, it offers a quick and efficient alternative to traditional size selection methods. The case study's findings suggest that YouFit could significantly aid retailers in reducing return rates due to size mismatch, ultimately benefiting both consumers and businesses.

Acknowledgements

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