

Re-Invention of Apparel Shopping Automatic Body Feature Extraction and Analysis

Adish Khot

Dept. of Information Technology
Vidyavardhini's College of Engg. and Tech.,
University of Mumbai,
Maharashtra, India

Aditya Manze

Dept. of Information Technology
Vidyavardhini's College of Engg. and Tech.,
University of Mumbai,
Maharashtra, India

Tushar Mistry

Dept. of Information Technology
Vidyavardhini's College of Engg. and Tech.,
University of Mumbai,
Maharashtra, India

Abstract—Over the past few years, the online market for fashion has been on a boom for the past decade. Even though there is a substantial growth in the fashion industry the apparel was surpassed by the footwear industry in 2010. The online outlets selling apparel have shot up by 50% but the expenditure per capita on clothes has decreased. With changing demographics and also with an increase in the quality of life of urban people, the Indian retail sector is poised to bloom in the coming decade. Currently estimated at 500 billion dollars, it is forecast to reach 1 trillion dollars in 2020. However, with 0.1% penetration, the online market presently constitutes only 500 million dollars of the total retail market but is expected to grow 140 times and reach 70 billion dollars by 2020. This is estimated to keep convenience in mind, convenience in terms of ease and time, information, decision-making, transactions, and flexibility has been a major factor influencing the adoption of e-commerce. This factor to a huge extent also plays out for apparel e-tailing. Also, e-commerce in India is in its infancy and the available infrastructure is still insufficient. The Indian consumer mindset, engagement, after-sales service, and supply chain, personalization, variety of offerings, return policies and convenience thereof and above all, a greater value proposition to the consumer are some of the key success factors.

Keywords: Fashion; body measure; e-commerce.

I. INTRODUCTION

Although e-commerce isn't a recent concept, there's still a long way to go. The industry is subjected to problems both local and global in nature. Consumers, for the longest time, have been accustomed to going to a store and shopping for their apparel and jewelry. Every person has a personalized body geometry and features. No two people have exactly the same shape. but at the same time, all human bodies share a common structure regardless of age, race and gender.

As per the abstract mentioned, to solve the problem of decreasing sales of online apparel and clothing, taking into consideration the appearances of each individual [1][2][3]. We intend to design a service where in one of the

challenges of feel and fit will be targeted. The service will include extracting the body measurements and compare it with the choice of fashion brand chosen by the user. This will result in a probabilistic output of whether the particular choice of apparel fits the user or not[4][5].

With a targeted approach at finding human body features, the human body contour of the binary images can be represented. by targeting specific human body anatomical references, a basic human blueprint can be obtained with the help of the above approach we can pin point around 60 feature points. The method has been tested on 30 human subjects and all the feature points can be correctly extracted[6][7][8]. This will help the user in getting the best fitting cloth at the same time will reduce the product return percentage because of miss-fit of a product.

II. RELATED WORK

Many different approaches have been taken towards extracting body features and analysis of the extracted features. The "Development of a Wearable Sensor System for Measuring Body Joint Flexion" by Mohammad

H. Mahoor and Saba Bakhshi[9] presents a novel approach for measuring and monitoring human body joint angles using wearable sensors. This type of monitoring is beneficial for therapists and physicians as it allows them to assess patient's activities remotely. In our approach we extract multiple feature points from the images uploaded by the User. The image detection and

processing will be done with the help of OpenCV.

III. PROPOSED SYSTEM

Implementation involves OpenCV environment along with various modules with their library supported by Android. Also, a mobile application along with server and database configuration is necessary.

A. Hardware

- Camera Mobile Sensor

Any Phone Camera will be used to get the images which will give as an input to the software for the process of photogrammetry. Photographs of the front and side body will be taken.

B. Software

- Mobile application

OpenCV[10][11] is a Computer Vision used for the Image Processing of 2D images. OpenCV offers a primary scripting in Python language with various imports, archives and plugins. Python uses the numpy package with numpy Arrays. The application we are using is based on E-commerce shopping. OpenCV is used for image processing of digital 2D images of the body and giving various body measures as an output. CV with Canny Edge and Contour Detection is a multi-stage Algorithm which uses Matlabs for image Processing. The Open CV is easy to design, build, and maintain efficient and reliable code.

- Flutter

The process to create Hybrid Android application, running on Android operating system as well as Apple's iOS software development. The software kit of Flutter includes development tools like debugger and libraries and many more. This Framework includes Dart Platform, Flutter Engine, Foundation Libraries and Design-Specific widgets. Flutter apps are written in the Dart language and make use of many of the language's more advanced features. Flutter runs in the Dart virtual machine which features a just-in-time execution engine. Due to App Store restrictions on dynamic code execution, Flutter apps use Ahead-of-time (AOT) Compilation on iOS. Flutter's engine, written primarily in C++, provides low-level rendering support using Google's Skia graphics library. The Flutter framework contains two sets of widgets which conform to specific design languages. Material Design widgets implement Google's design language of the same name, and Cupertino widgets imitate Apple's iOS design. Platform that is supported for development contains computer running OS X Mojave, Windows and Linux.

C. Server

- Firebase

Firebase is a mobile and web application development platform developed by Firebase, Inc. It provides various services Firebase Analytics, Cloud Messaging, Firebase Auth, Real time Database, Storage, Hosting, ML Kit. Firebase is a cost-free app measurement solution that provides insights into app usage and user management and a cross-platform solution for messages and notifications for Android, iOS as well as web applications. Firebase

ML Kit is a mobile machine learning system for developers featuring a variety of features including text recognition, detecting faces, scanning barcodes etc. Firebase Test Lab for Android and iOS provides cloud-based infrastructure for testing Android and iOS apps.

IV. IMPLEMENTATION

The current proposed system is a combination of entities which play its own significant part in the working of the product.

Here the end user is given access to only send and receive an input. The back-end system comprises fetching input from the user, pre-processing, noise reduction, API services, transmitting the result back to the user. To achieve this result, three major intermediate forms have been considered. Following is a brief description of the stages.

1. When reference object is given:

In order to determine the size of an object in an image, we first need to perform a "calibration" using our reference object. Our reference object should have two important properties:

- Property 1: We should be aware of the dimensions of the object (in terms of width or height) in a measurable unit (such as millimeters, inches, etc.).
- Property 2: We should be able to easily find this reference object in an image, either based on the placement of this object (such as the reference object always being placed in the top-left corner of an image) or with its appearances (like being a distinctive color or shape, unique and different from all other objects in the image).

In either case, our reference should be uniquely identifiable in some manner.

In this example, we'll be using a box r as our reference object and throughout all examples, ensure it is always the left-most object in our image:

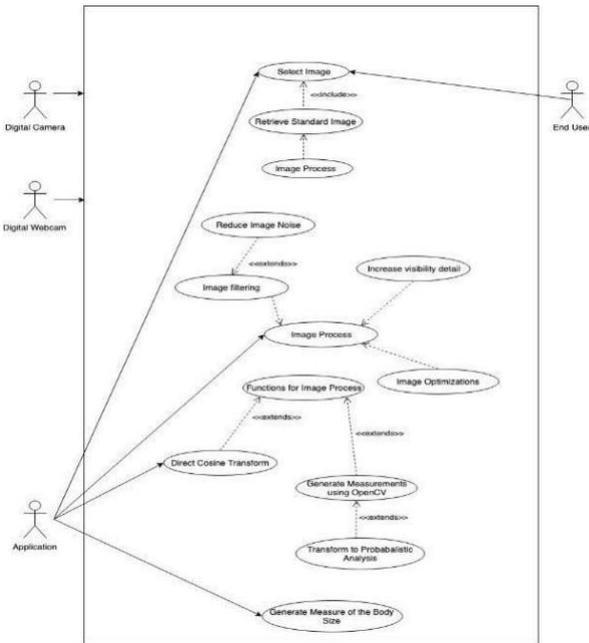


Fig. 1-Use case diagram



Fig. 2-Raw input

By guaranteeing the quarter is the left-most object, we can sort our object contours from left-to-right, grab the box (which will always be the first contour in the sorted list), and use it to define the pixels per metric, which we define as:

$$\text{pixels_per_metric} = \text{object_width} / \text{know_width}$$

The box has a known_width of 7.25 inch Now, suppose that our object_width (measured in pixels) is computed by 150 pixels wide (based on its associated bounding box).

The pixels_per_metric is therefore:

$$\text{pixels_per_metric} = 150\text{px} / 7.2 \text{ in} = 20.83\text{px}$$

Thus, implying there are approximately 20.83 pixels per every 7.2 inches in our image. Using this ratio, we can calculate the size of objects in an image.

Here the white counter are the objects and black is the background. This is done by a background deletion algorithm[12]. After these contours of the image are created

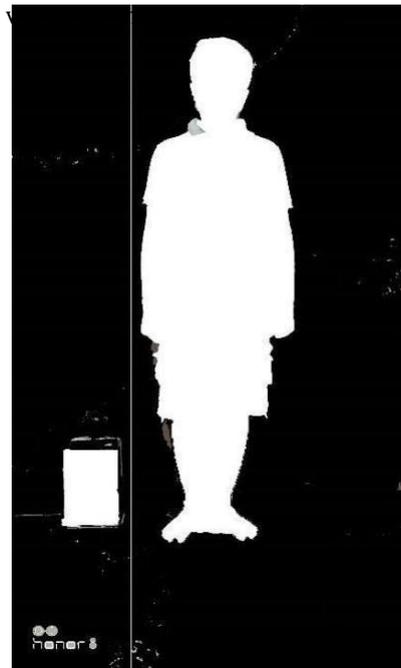


Fig. 3-Silhouette extraction

Then the program scans the image created and always treated the left most contour as the reference object.

The algorithm inspects the image from left to right. Based on that the following output is first generated:



Fig. 4-Reference image measurement

Hence the dimensions of the reference object in this case the box are first shown. In the next scan the dimensions of the object required in this case the height is displayed.

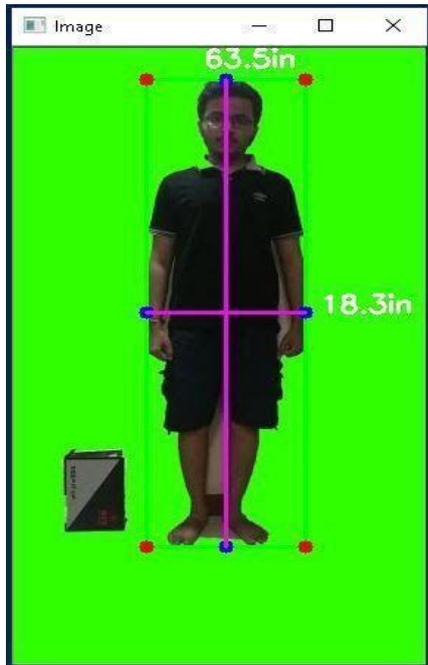


Fig. 5-Measurements by referential ratio

2. When the height of the person and the image is given as input:

When the height of the person and the image is given as input and the parameter we have is the height of the object in real life.

The mathematical complexity is easy to understand that the ratio of the size to the size of the object in real life is the equal as the ratio between the focal length to the distance of that object.

To work out the size of the object on the sensor and its height in pixels, divide the image by height in pixels and multiply its physical height of the sensor.

So, the calculation will be:

$$\frac{\text{distance_to_object(mm)}}{\text{object_height(mm)}} = \frac{\text{focal_length (mm)}}{\text{image_height(pixels)}} * \text{sensor_height(mm)}$$

$$\text{object_height (pixels)} * \text{sensor_height(mm)}$$

If we keep distance_to _object, object_height, sensor_height(mm) and increase the focal_length then distance increases. This is the expected result, but if you zoom your lens to make one object size equal to the size of object used, then the first object must be further away.

If we keep distance_to_object, sensor_height(mm), focal_length and increase the real object_height, the distance increases as if two objects of different real heights appear the same height in the image and the taller object must be further away.

If we distance_to_object, sensor_height, focal_length constant and increase the image_height, then the distance increases, as if two objects (of the same size, remember we're keeping everything else constant) appear the same pixel size in a cropped and real image then the object in the real image must be further away.

If we other parameters constant and increase the object_height in pixels then the distance of two equally sized objects decreases. The object that takes more pixels is closer.

Finally, if we distance_to_object, focal_length, object_height constant and increase sensor size, then distance decreases. Two objects have similar size in pixels when shot with a compact lens(mobile sensor with 20mm lens) and shot with a DSLR(large sensor with 20mm large lens), then the object in the DSLR shot image must be further away (because it appeared the same size but with a wide lens). To resolve this error making it more accurate two dimensional images can be taken as input to increase precision.

3. Body Height from a Whole-Body Image:

Given a whole-body photograph of a person, with the person in upright standing pose (not slouching or leaning), we will show that the metrology technique of Statistical Visual Metrology can be used to estimate his/her body height. anthropometrics[13][14] including body height, and each anthropometric is the straight-line distance between two visible and well-deñned body landmarks (canonical points) are extracted from the image of the individual. the image being mostly calibrated the anthropometrics are chosen such that their ratios can be measured from the image, namely: they need to be either collinear or coplanar, and the vanishing points/lines, if needed, can be readily measured from the image.

Premise of this body height estimation method can be formulated in an information-theoretic sense as follows. Since human body dimensions and proportions;

- (i) vary within a relatively limited range.
- (ii) are correlated.

The projection of a person in an image must encode some information about the absolute scale of the imaged scene. Therefore, we expect to be able to estimate the person's body dimensions, such as body height, to within accuracy

better than a random guess but less than when accurate/complete absolute scale information is available. We currently use the following set of ten anthropometrics: (1) body height, (2) trapezius (or neck) height, (3) acromial height, (4) head to chin distance (or head length), (5) stomion to top of head distance, (6) subnasale to top of head distance,

(7) forehead to chin distance, (8) sellion to chin distance, (9) bi-ocular distance, i.e. between outer corners of the eyes, (10) bitragion distance. For the first four anthropometrics the person is assumed to be in upright standing pose—not slouching or leaning on one side. Anthropometrics 1–8 are all vertical and collinear along the midline of symmetry, and so we only need the vertical vanishing point to compute their pairwise ratios. Anthropometrics 4–10 lie on the facial surface and are nearly coplanar, provided that the person is sufficiently far from the camera. Furthermore, when the head pose is nearly frontal to the camera, the weak perspective model is a good approximation over the facial region, and in this case computation of the pairwise ratios of facial anthropometrics requires no calibration information.

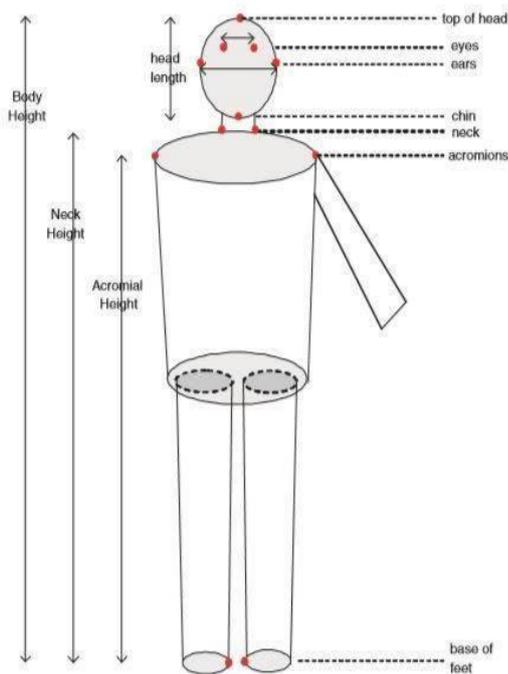


Fig. 6-Obtained feature points

Currently, we compute pairwise ratios of anthropometrics 1–8 and pairwise ratios of anthropometrics 4–10, hence a total of 39 ratios.

However, if the whole body and/or the facial plane are at an angle with respect to the camera, then the weak perspective assumption no longer applies, so computing pairwise ratios of the facial anthropometrics (4–10) requires a lot more information than what is available in an uncalibrated image. Consequently, we only use anthropometrics 1–8 for such images.

V. CONCLUSION AND FUTURE SCOPE

Thus, by using introducing automated measuring system and analysis of body features, the complication endured during apparel selection on the e-commerce market becomes simple and hence the customer tends to incline towards purchasing the commodity than just to have a glance over it.

As the project advances additional features can be added to the system. Following features can be added:

1. 3D modelling: The selected apparel can be a 3D model constructed from the measurements extracted from the images uploaded by the user.
2. Custom clothing: When the system is accurate enough (tolerance $\leq 0.5\%$), the data can be used for custom stitched clothes.

Since the service also focuses on personalizing results, one can hope in reduction of package returns which is a major drawback in the e-commerce ecosystem. This in many aspects is 'Re-inventing apparel Shopping'.

VI. REFERENCES

- [1] Automated body feature extraction from 2D images, Yueh-LingLinMao-Jiun J.Wang
- [2] H. Lim, C.L. Istook, N.L. Cassill, Advanced mass customization in apparel, *J. Text. Apparel Technol.Manage.* 6 (1) (2009).
- [3] C.C. Wang, K.-C. Hui, K.-M. Tong, Volume parameterization for design automation of customized free-form products, *IEEE Trans. Autom. Sci. Eng.* 4 (1) (2007) 11–21.
- [4] Cordier et al, 2001.Cordier, F., Lee, W., Seo, H., & Magnenat-Thalmann, N. (2001). From 2D photos of yourself to virtual try-on dresses on the web. *People and computers XV - Interaction without frontiers: Joint proceedings of HCI 2001 and IHM 2001.*
- [5] B. Allen, B. Curless, Z. Popovic, "Articulated body deformation from range scan data", *ProceedingsSIGGRAPH'02*, San Antonio, TX, USA, pp.612–619, Addison-Wesley, 2002.
- [6] Extracting Main Modes of Human Body Shape Variation from 3-D Anthropometric Data, Zouhour Ben Azouz1,2 Chang Shu 1 Richard Lepage 2 Marc Rioux
- [7] S. Paquette, 3D scanning in apparel design and human engineering, in: *Proc. of Computer Graphics and Applications*, 1996, pp. 11–15.
- [8] R.P. Pargas, N.J. Staples, J.S. Davis, Automatic measurement extraction for apparel from a three-dimensional body scan, *Opt. Lasers Eng.* (1997) 157–172.
- [9] Development of a Wearable Sensor System for Measuring Body Joint Flexion, Mohammad H. Mahoor, Saba Bakhsh
- [10] https://docs.opencv.org/3.4.3/da/d22/tutorial_py_canny.html
- [11] <https://docs.opencv.org/3.4.3/>
- [12] S.A. Rahman, S.-Y. Cho and M.K.H. Leung, "Recognising human actions by analyzing negative spaces," *IET Computer Vision*, Vol. 6, No. 3, 2012, pp. 197–213..
- [13] Arlow et al, 2001 : Arlow, J., Lawrence, K., & Treleaven, P. (2001). *Body XML draft specification*. e-T Cluster IST-2000-26084, Bodymetrics and UCL, UK
- [14] Douty, 1968a. Visual somatometry in health related research. *Journal of the Alabama Academy of Science.* v39 i1.