Automatic Body Feature Extraction from Front and Side Images

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***Abstract*—Automatically extracting human body features from 2D images is a quick and easy way to acquire anthropometric data. This work proposes a method for detecting feature points on the silhouette of a human body from front and side images using a systematic approach and calculates the distance between two given feature points. The human body contour of binary images can be represented with an effective Freeman's 8-connected code algorithm. As a result, 154 and 174 feature points can be automatically retrieved from front image and side image respectively. Finally, enter number human participants were used to evaluate the suggested method, and all feature points with required geographic geometrical properties were correctly extracted, demonstrating that it was successful and robust.**

I. Introduction

With the widespread use of digital cameras, 2D images can be captured more easily and at a cheaper cost, and they are considered the primary information carriers for human recording and understanding. In recent decades, a study focus has shifted to how to effectively and reliably extract additional information from 2D photos, particularly human images. Automatic body feature extraction from 2D human photos has recently been popular in a variety of disciplines, including non-contact body size assessments, the creation of 3D human models, and the recognition of human actions.

Anthropometry is measurement of properties of human body mainly descriptors of size and shape of the body. Naïve method of measuring anthropometric data with tape measurements is highly dependent on the expertise of the operator and the location of the tape on the body. Manual measuring is the traditional method for collecting anthropometric data. A computational image-based approach provides an alternative to the standard way of manual measuring because several difficulties, such as subjective judgements of landmarks, may be included in manual measurement processes.

In this study, we present an automatic way of measuring anthropometric data by extracting the feature points from front and side images is attempted and it is the replication of the paper [1]. We have also used silhouette curves which are represented using the Canny edge detection operator and Freeman's 8-connected chain codes to detect human body shape.

II. Literature Review

This section summarises the relevant studies and literature that motivated the conduct of this study in order to contribute to the current knowledge of human body measurement. In the paper published by L. Jiang et al. [1], uses front and side images, an automatic method for extracting body feature points is presented. The proposed approach, which measures the variations between segment orientations, can extract a total of 101 feature points. The contours are created by subtracting the background. The silhouette curves are represented using the canny edge detection operator and Freeman's 8-connected chain codes. In addition to the starting point, the freeman code of the second point of the line segment is used to determine the inclination or direction of the line segment which in-turn is used to extract the feature points. In the studies, ten individuals were evaluated, five males and five females, and 101 points were accurately detected. It demonstrates the approach's robustness. The nature of these points reveals that this method is both reliable and effective.

The goal of the research presented in the paper [2], is to create Digital Anthropometry for Human Body Measurement Using OpenCV on Android Platform, which will automatically measure the human body using an Android phone. Shoulder width, sleeve length, body length, back-waist length, back-neck-to-cuff, cross-back, outseam, and inseam are the body sections to be measured and are each represented by a marker. The Hough Circle, HSV Colour space thresholding, and distance formula algorithms were utilised in the system's creation. The Hough Circular was applied to detect the system's feature points, which are the observed circle patterns in an image frame. The colour of each feature point was filtered using HSV colour space thresholding. The distance between the feature points was calculated using the distance formula.

According to the paper [3], many applications are based on 2D images since digital cameras are becoming increasingly popular for capturing photographs. The majority of traditional anthropometric data gathering methods involve a palpation technique to detect body feature points. A diverse range of body traits can be recognised using the shape curve generated from the body contour. In a chain-coded curve, Freeman's chain code algorithm was utilised to express a 2D contour. Using the provided rules, a series of feature points on a human body can be retrieved from the chain-coded border curve. The required anthropometric data can be acquired once the feature points have been accurately identified. The binary picture contours are obtained using a silhouette extraction method in feature extraction. Then, to detect the difference between neighbouring codes on the silhouette curves of a human body contour, an efficient shape coding algorithm is proposed. A silhouette detection method is used to extract silhouettes from photographs after the input images have been acquired. The Canny edge detector (Canny, 1986) is then used to trace the contour of the object's binary picture. The location variation of the 60 extracted feature points on the silhouette curve was examined to assess the performance of the suggested feature point extraction method .It is proposed to use 2D photos to identify feature points in an automated body feature extraction approach. 60 feature points were obtained using the described method. Thirty people, 15 males and 15 females, were evaluated to see if the proposed procedure was effective. All of the feature points for the 30 subjects were successfully extracted. Furthermore, the collected feature points can be used to automate body dimension measurements for a variety of applications.

In the experiment carried out by the authors of the paper [4] described this is the age of consumerism, and consumers. They are aware of and wanting items that are tailored to their specific requirements and preferences. Two images of each female subject are taken with established standards for the ease and correct operation of the feature extraction algorithm. The individual was photographed against a white background, wearing fitted clothing and undergarments that contrasted with the background. The images acquired were edited and processed using Adobe Photoshop CS3 for the ease of applying the algorithm. Every coloured image was edited to obtain a black and white binary image. Edges are significant transitions or abrupt changes in discontinuities in an image. The margins of any image contain the majority of the shape information. The statement of a feature point or an interest point, as well as the extraction of these locations, are included in all non-contact methods of body measurement. "An interest point/feature point is a well-defined position in an image that can be reliably detected." The goal of this study was to develop a model that uses 2D photos of ladies to extract their fundamental body measurements. This study offered a simple and low-cost way for creating custom-fit clothes that avoids the use of expensive 3D scanning technology and time-consuming human measurement procedures.13 fundamental body measurements in pixels were derived from front and side photos of a female participant in this configuration. The distance calculations were then used to convert these measurements into inches.

In the paper [7], according to the authors one of the most significant aspects of image processing and pattern detection is image representation. Chain code is one of the most efficient ways to represent an image. Chain coding is a simple image representation method. The boundaries of an image is represented by chain code. The ability to represent objects using boundary descriptions is quite useful.Because the information in various processes, such as digital image processing, pattern recognition, and machine vision systems, is influenced by this representation. The evolution and enhancement of the chain code representation method has been a popular study area since it was originally developed. Chain codes give an extremely compact region representation, useful for identifying such features of a region as sharp corners, area, perimeter, moments, centres, eccentricity, projection, and straight-line segments, because they preserve information and allow for significant data reduction. There are a few drawbacks to using Freeman chain coding. It's particularly sensitive to noise since the errors add up, there's no spatial information in the image content, and the starting point and scale of the contour aren't invariant, and it's just good for image retrieval. The degree to which the directions of a chain code are members of vast similarly directed sequences is defined as the coherence of that chain code. A coherent or incoherent coherence measure is defined. In contrast to coherent directions, incoherent directions are not part of any large contiguous sequence. The majority of chain codes, particularly those based on Freeman, must be converted to y-axis representation. A region represented by a chain code can perform operations like union, intersection, and point membership, which determines whether a point in the region is difficult to process. The y-axis representation makes the erosion and dilatation of binary pictures by arbitrary structuring elements easier. Experiment shows that the extended freeman chain code with a small angle has a higher probability than the one with a large angle. The combination of codes 1 and 3, or vice versa, is the most common combination for the extended vertex chain code. Many areas of pattern recognition and image processing could benefit from the use of chain coding. Then some algorithm about the chain code, particularly the vertex chain code, must be extended.

The major goal of our project is to obtain accurate measurements between two points using Freeman's 8-connected chain algorithm. Developing an efficient method for detecting objects is the most difficult component of object detection. Image resizing, filtering, other basic techniques for object recognition are only a few examples. To do so, we looked at a variety of filters and noise reduction approaches, including Gaussian Blur, Median Blur, and others. In addition, we learned about canny edge detection technique. Finally, we'll learn how to detect contours. We also looked into how to extract feature points from the processed pixels.

III. Methodology

Our initial steps involve preprocessing an image and applying various methods to extract multiple components present in the given image. The preprocessing starts with resizing and converting the color image into a grayscale image. Then we subtract the background and get binary image of the body shape i.e. silhouettes of the front and side views of the subject are obtained. A binary image is one in which each pixel has only two possible grey values, such as ”0” and ”1.” Binary images are frequently divided into two types: foreground and background. The foreground is represented by 1 and the background is represented by 0. Following the extraction of body silhouettes from the 2D images, the Canny edge detector is used to locate human body silhouettes from the two binary images. The closed contour and single-pixel contour curves are obtained. The Freeman's 8-connected chain codes [5, 6] will be used to encode the edge pixels of the body silhouettes to automatically identify the spots. Because of its simple and compact style of data representation and suitability for fast processing, an 8-direction Freeman's chain code is used for descriptions of object borders in image fields.

A. Dataset

Since the algorithm we are using is not a training algorithm thus we do not require any dataset. However, we are using an algorithm that calculates the measurement between two given points so we have collected 10 images to show the results and real world measurements for accuracy, in particular images of male for this experiment. Since the correct extraction of human body feature points is also critical in the creation of a virtual human model. We will use male images of knowing person in our project. Based on the front and side photographs of a human body, we offer a fast, simple, and robust human body feature point recognition technique.

B. Pre-Processing

The use of image pre-processing aids in picture data cleansing. The purpose is to improve the image data and minimise undesired distortion in order to improve the relevant image features for later processing. Converting a colour image to a grayscale image with all of the important details is a difficult task. The new technique conducts RGB approximation, reduction, and addition of chrominance and brightness to transform a colour image to a grayscale image. The grayscale images created in the experiment demonstrate that the algorithm has kept the important elements of the colour image, such as contrasts, sharpness, shadows, and image structure.

We use the Gaussian Blur() method to blur the image after reading it. This is done to decrease the image's noise. Edge identification necessitates computing numerical derivatives of pixel intensities, which generally results in 'noisy' edges. Edge detection is a type of image processing that identifies the boundaries (edges) of objects or regions within an image. The Canny edge detector was then used to find the image's edges. We used the edged image to find the contours because the edge does not provide the whole bounding region information. We performed dilation on the edge picture before applying the contour detection technique, which closes the image and aids in contour recognition.

C. Silhouette detection

The extraction of a human silhouette is a key step in image processing. The body silhouettes were extracted using a typical background subtraction algorithm to isolate the subject from photos. Extraction of human silhouettes from depth pictures is a different art form that necessitates extra care in image pre-processing. Always perform binary thresholding or Canny edge detection to the grayscale image before looking for contours. We'll use binary thresholding in this case. Thresholding makes the image's object's border totally white, with the same intensity across all pixels. From these white pixels, the program can now discern the object's edges.

D. Feature point extraction

The body's contour curves are thought to be made up of a succession of line segments. On the head of the front curve, a section of line segments. In addition to the starting point, the freeman code of the second point of the line segment is used to determine the inclination or direction of the line segment. While the current line segment is perpendicular to the previous line segment, a different judgement basis is applied. The starting point of the present segment line is regarded as the human body's feature point. Figure 2 contains the algorithm.

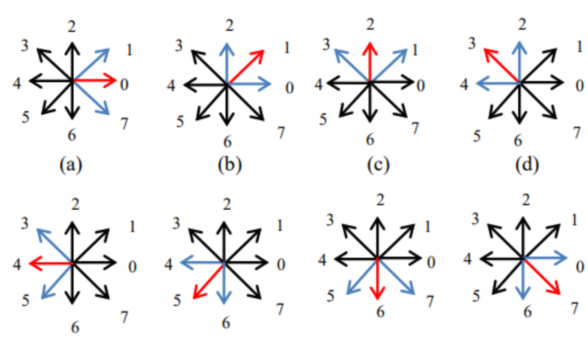

Fig. 1. Eight cases of the line segment directions

The code in Figure 1 moves counterclockwise around the border, keeping track of the direction as we move from one contour pixel to the next. Each code in the eight-connected Freeman's chain code can be seen of as the angular direction, expressed in multiples of 45o that we must move to get from one contour pixel to the next. Figure 1 shows how this work extracts points using the 8-neighbourhood method. The numerals ”0” through ”7” represent 45° increments in counterclockwise orientations starting from a horizontal vector "0" in the Freeman chain coding. A sequence of pixel chain codes indicate the body contours. The current line segment direction is shown by a red line with an arrow, while the directions of the two adjacent segments are represented by blue lines with arrows. If one of the two adjacent segments is in the 45° clockwise direction of the current segment line, the other must be in the 45° counterclockwise direction. So, in total, 16 examples can be used to evaluate a feature point.

C^f = { $f_0, f_1, f_2, \ldots\ldots f_{n-1}$}
P^f = { $p_0, p_1, p_2, \ldots\ldots p_{n-1}$}

Initial point -> f_0
V = [ ]
V.append (f_0)

For i in range (C^f)
    If $P_i - P_{i-1} \neq 0$:
    V.append (P_i)

V = { $v_0, v_1, v_2, \ldots\ldots v_{v-1}$}
F = Feature points = {}

F.append (V_0)

For i in range (V)
    If V_i satisfies judgement conditions
    F.insert (V_i)

For i in range (F)
    highlight (F)

Fig. 2. Pseudo code to detect feature points

E. Distance between the feature points

An image containing an exposure with known dimensions is taken. Upon comparing the pixel in the image to the real-world area, a conversation factor is calculated. This conversation factor helps in converting the pixel to pixel difference in the image to the real-world image.

IV. Challenges

Since we have used real world images it was quite difficult to get volunteers to give their images for the experiments, however we have managed to 3 people's images. Also, the nature of the data is considered as a challenge.

V. Results and Discussion

According to experimental results, the proposed methodology extracts feature points reliably and effectively.Base paper is limited to the detection of feature points where as the proposed project is extended to the point where the real world measurement between two different feature points is calculated. As observed in the Figure 3 more number of feature points in the proposed project is identified due to the irregularities with the nature of the image and pre-processing.

	Number of feature points in front image	Number of feature points in side image
Base paper	71	30
Project	154	74

Fig. 3. Feature points comparison

The measurements shown in the Figure 4 calculated are the Euclidian distance where as in the real world the measurements are non linear. The accuracy of the measurements is based on the reference object taken along with the picture. The nature of the data effects the collection of huge amount of data which can improve to detect more effective feature points.

Project Measurements	49cm (shoulder length)	13cm (thigh length)
Real world Measurements	42 (shoulder leangth)	9cm (thigh length)
	83% accuracy	55% accuracy

Fig. 4. Project measurements and Real world measurement

VI. Conclusion

Overall, The proposed project implies that a digital anthropometry for human body measurements can be created using the feature points extracted from the front and side images.These contactless measurements are highly dependant on the effectiveness of the feature points.A total of 225 feature points are extracted from both front and side images and can be able to calculate the real world measurement with acceptable accuracy and can further be extended in creation of an 3d object based on these feature points

References

[1] L. Jiang, J. Yao, B. Li, F. Fang, Q. Zhang, and M. Q.-H. Meng, "Automatic Body Feature Extraction from Front and Side Images," Journal of Software Engineering and Applications, vol. 05, no. 12, pp. 94–100, 2012.

[2] J. E. Estrada, A. A. Benedito, J. L. Belicano, M. R. Galang, and J. K. Cabrera, "Digital anthropometry for human body measurement on Android platform," 2017 IEEE 2nd International Conference on Signal and Image Processing (ICSIP), 2017.

[3] Y.-L. Lin and M.-J. J. Wang, "Automated body feature extraction from 2D images," Expert Systems with Applications, vol. 38, no. 3, pp. 2585–2591, 2011.

[4] R. Sehgal, R. Gupta and N. Anand, ”Automatic Extraction of 3d Body Measurements from 2d Images,” Journal of Polymer and Textile Engineering (IOSR-JPTE) , vol. 5, no. 3, pp. 07-17, 2018.

[5] H. Freeman, “On the encoding of arbitrary geometric configurations,” IEEE Transactions on Electronic Computers, vol. EC-10, no. 2, pp. 260–268, 1961.

[6] Freeman and Davis, “A corner-finding algorithm for chain-coded curves,” IEEE Transactions on Computers, vol. C-26, no. 3, pp. 297–303, 1977.

[7] “Contour detection using opencv (python/C++),” LearnOpenCV, 18-Oct-2021. [Online]. Available: https://learnopencv.com/contour-detection-using-opencv-python-c/. [Accessed: 07-Dec-2021].