A Novel Method Of real Time Cloth Size Measurement Algorithm Based On Fpga Platform

Karunamoorthy B, Ramprabu J

Abstract: ***Measurements are the very important parameter in all fields like automobile, textile, farming, construction, etc... This paper present a technique of involuntarily measuring sizes of a garment from a particular picture. The main objective of this paper is to develop real time hardware measurement system based on Field Programmable Gate Array for high accuracy and simulation method using edge and contour detection technique. The simulation can be done by using OPEN CV and hardware platform is based on Xilinx PYNQ-Z1 board which has a combination of ARM Cortex A9 dual processor with an FPGA logic blocks and Logitech C270 USB camera. In this study, we positioned a camera to capture images of tiled cloths of any color and style. Image recognition technique used to propose an automatic cloth measurement. A pattern is introduced to identify the garment along with its size measurements. The pattern can be chosen depending upon the contour area of given cloths. The system provides an effective tool to measure the cloth size. Using this tool we can provide the best performance outcome to the apparel industry.***

Key Words: ***Image Processing, contour detection, Open Computer Vision, Python, FPGA, Xilinx PYNQ-Z1 board, Logitech C270 USB camera, cloth measurement, PC monitor.***

I. INTRODUCTION

The corners and edge detection is important in every Cloth size. In this smart city world we find that online shopping is fetching more market growth when compared to traditional market shopping. The reason for the online shopping growth rate is to that fact that we can shop anytime and anywhere adding convenience to the people. Even though online shopping provides anytime shopping mode its main factor of inveterate is proper fitting. The different brands have diverse and considerably inconsistent grading between sizes. Various sizing like L-XL-S-Medium puts the shoppers into a dilemma for choosing the sizing variants within the shopping zone. Perfect Fit garment sizing is another main setback for the customers as well as the retailers. The outfit's perfect fitting is a main criterion for online fashion retailers.

Manual Labor can be reduced completely for perfect sizing by inculcating automation. The fitting modules are specifically considered for the main consumer group of online shopping. The industry maintains various standards for garments measurement. The process takes a long time for providing the sizing. To make it time effective the proposed system uses image processing along with a field programmable gate array (FPGA) as an alternative to manual labor. This also increases the sizing standards. The sizes of a tiled garment approach of automatically measuring method are introduced in this paper.

At First to be precise, the garment image is captured by the camera firstly. The camera is directly connected to the board and output was taken by the HDMI out port of the board. Then the image from camera is sent to the PYNQ-Z1 board then it first converts the color image into gray scale image. The conversion of gray scale image is very important because all the image processing steps were performed in this gray scale image. Once all the image processing done in hardware and required parameters were measured then the output of the image with values will be display on to the monitor via HDMI cable. The hardware block diagram is shown in fig 1.

Fig 1 Block Diagram

II. LITERATURE SURVEY

Many patented designs have boomed in the garment sector for size measurements. The main criteria are based on the outward configuration of the garments. Most of them depend on the upper clothing. For the perfect sizing, a dressed device has to be considered for measurement but this process involves lots of time. Due to this cost also increases. Moreover, to decrease the measurement mistake, operators have to say again the process several times. The efficiency and correctness of the measurement are both inadequate in the conventional way. TJ Torres and Brain Coffey [4] offered a technique of measuring garment by identifying key points similar to the parts of a predefined garment pattern. The majority of the measurement methods [5], [6] are based on edges. It also depends on the centric of the garment. On the other hand, different types of garments are measured the size in many ways [7]. In addition, the deviation of the camera will make the size measurement

imprecise. Stimulated by the garment pattern in our study, we extend the garment template by addition the information of garment properties and textures. Use the template to recognize the garment type.

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The key element points so as to calculate the garment size by professionally and correctly. Sizing measurement can be done by understanding the relevant features of the garment. Edge detection pattern recognition is also conducted as a part of research methodology. Paler et al. [8] proposed an approach of matching masks to detect corners. But the method implemented created disturbed image pattern creating many difficulties. Davies [9] used understandable Hough transform method to detect the edges with curved and blunted corners. If the garment sides are cut off the edge detection becomes quite difficult. The complication leads to less accuracy in size measurement. [6]. Since there are varieties of garments with various sizing are available it is mandatory that the garment type should be accepted as soon as the image is captured [10]. The method used to recognize the type of garment is the external contour. After finding the external we are using to find the centroid of a contour and measure the parameters with respect to the centroid.

III. OVERVIEW

The proposed automatic measurement method consists of image preprocessing unit, outline finding, hardware system, garment size measuring and feature point extracting. The goal is to design a hardware system, which includes a digital camera to capture a garment image with high quality. In addition it also consists of an LED light and shooting stand. An operating table is also implemented which can help in control of backdrop colors by means of a LED light. To avoid the distortion of the figure caused by the camera lens and calculate the ratio of the image to the real garment size. The calibration will be conducted. It is in the period of preprocessing. After obtaining the image of a garment edge points for further processing the garments outlined structure if provided. This features to provide the size dimensions. After successful processing the output of measured image and the values are shown in display using HDMI cable.

IV. DESIGN OF SHOOTING DEVICE:

A high-definition camera is used to click a picture of the garment and it is sent to the PC for further process. The broad process of capturing images is as follows. Firstly, we the garment is spread on a workbench with a complete white background. The next step is to calibrate the camera to take the real dimension of the image with real time and fix the particular distance from the object. Finally the camera which is connected to a USB port of a PYNQ-Z1 board captures the image of the garment. A suitable and accurate hardware setup is required for perfect capturing of the garments. The capturing device consists of a LED light, digital camera, workbench and shooting stand, as shown in Fig 2.

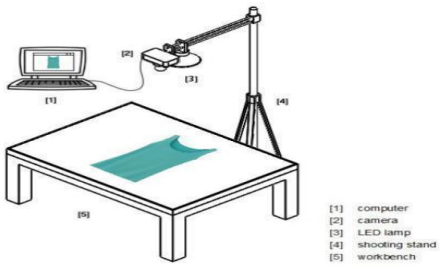

Fig 2. Shooting Device

A. Digital Camera:

The camera is fixed at the end of a beam, while taking into consideration the stability of the shooting stand. Logitech C270 camera is chosen for the following reasons. It has light weight to our expectations. It has good resolution ratio of 16:9 and light sensitivity. It captures the 30 images per second so there is no blur in the input image even some outside interference like movement of image and shaking the image. Pictures taken by the camera C270 have outstanding color performance and indicated in results of experiments. In, which it proves this type of the camera can entirely meet the necessities for shooting. The Logitech C270 camera is shown in Fig 3.

Fig 3. Logitech C270 camera

B. Shooting Stand

The relative position between the surface of the workbench and the camera should have a perfect control. Calibration should be done for the Camera for perfect focus. Once the camera is calibrated no adjustments are to be made. If there are any adjustments to be made then the camera needs to be re-calibrated. This enables the camera to capture the complete and accurate pictures.150 Centimeter distance is made between the workbench and the camera lens. Aligning the camera to the centre of the workbench aids in perfect picture capture. The main significance is located on the steadiness of the whole frame. There are two main problems have to be addressed. One is that, for the shooting stand, the physical frame should be strong enough to bear weight load of the camera. External disturbances results in poor steadiness. Result lead to poor of the shooting process. The camera should be placed in such a way that the lens of the camera should not shake. To avoid shaking of the camera a timber frame that has a weight of 10Kg is provided. To avoid the shake from a height we can use tripods. This helps in to stabilize the camera. By such supporting systems the shooting device provides accurate and stable captures without any disturbances. Due to a variety of types and shapes of garments, the shooting stand should be variable. Beam will be adjusted along the height not only can the spot. But also the installation board is permitted to slide freely. At the side of the beam to adjust its position. Other parts used for the installation. Two sliding setting up boards are installed. First one used for fix the camera. The next is used to install a pendent lamp. The shadow of garments removed by the lamp. The shadow is very likely to be recognized as a part of the garment wrongly.

In which it causes the deviation between the result of the real value and measurement value. It probably fails to recognize correct feature points of the garment from the picture taken under dim-light conditions besides, without the lighting.

V. CAPTURING DEVICE CALIBRATION

Calibration has two effects on measuring: The first one reducing lens distortion. The second one is calculating the scale in the original image [7]. Distortion of lens will poses affect on the size measurement of the garment. Hence it is mandatory to undergo calibration process before measuring the garment size. The result of calibration consists of a distortion coefficients and camera matrix. Then make use of the matrix. The coefficients used to remap the original image to an undistorted one. The angle between the lens plane and the chessboard plane is the error caused by the camera. Considering the two planes, we come across a fact that it gives different viewpoints that leads to distortions or measurement defects in side lengths of the squares of the chessboard. To calculate the relation among the real world units (mm) and the camera's natural units (pixels) we should calibrate and then do the measurement process. The calibration is the final. We pervert the picture to calculate the ratio of the grid average dimension in the real world. The size will be in the final calibration result.

Process Flow

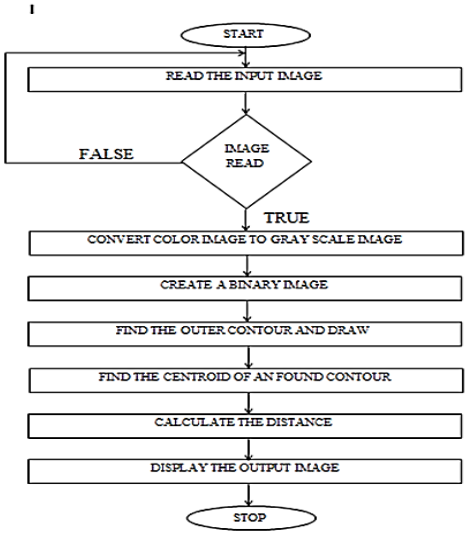

Fig 4.Flow chart

The color image read from camera and the image can be processed from the above flow chart as shown in Fig 4. During the applied threshold we need to remove the image printed in t-shirt like logo or some other image then only we can find the external boundary of the captured image. Finally applied the mask to the original image and contour image and find the horizontal and vertical points. From using these points apply the EUCLIDEAN distance formula to measure the height and width of the t-shirt.

The formula for Euclidean distance is

$$(X, Y) = ((X2-X1)^2 + (Y2-Y1)^2)^{0.5}$$

VI. SIMULATION

The simulation can be done by using the open computer vision with python language in the PyCharm IDE.

C. Simulation Result:

The result of input and output image from simulation is shown in fig 5.a and 5.b.

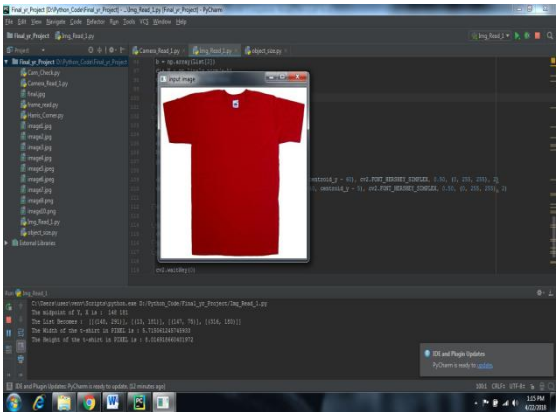

Fig 5.a. Input image

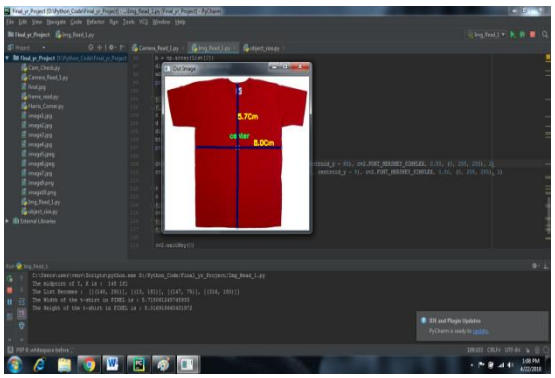

Fig 5.b. Output image

VII. HARDWARE

The hardware platform here we used is Xilinx's PYNQ-Z1 board which has zynq 7000 series integrated chip and it is a combination of cortex ARM A9 dual core processor and an FPGA logic blocks. The only Xilinx board support python language and this board has a so many integrated peripheral and we are using the USB camera port for connecting a camera and HDMI OUT port for displaying the output and powering the board with USB port(5V) or with the battery supply(7.5V to 12V).The Xilinx PYNQ-Z1 board is shown in Fig 6.

Fig 6. PYNQ-Z1 board

The full experimental setup for this product is shown in Fig 7.

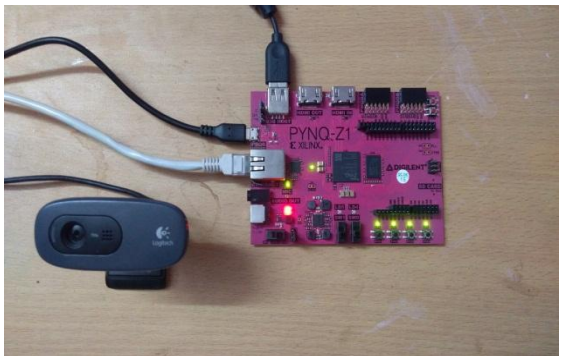

Fig 7. Experimental setup

VIII. RESULT

The final result of the output is shown in monitor. The standard parameter value of the t-shirt was taken by POLO Company. In this product we were measuring the height and width parameter of the t-shirt. From this product we get the accuracy of 98% from the value of POLO company's measurement. The accuracy of the result is shown in table 1.

SIZE	ORIGINAL VALUE(Cm)		SIMULATION RESULT(Cm)		HARDWARE RESULT(Cm)	
	HEIGHT	WIDTH	HEIGHT	WIDTH	HEIGHT	WIDTH
SMALL	68	47	62	40	67	45
MEDIUM	70	48	64	41.5	70	46
LARGE	72	49	65.5	43	72	47
SSXL	74	50	67	44.5	74	48
XXL	76	51	71	46	76	49

Table 1. Measurement value

The automatic measurement method used to calculate the runtime of the whole process. It used to test the efficiency. The elapsed time of labor-intensive measurement is the time a user takes to calculate the whole key dimension with a tapeline. In the conservative way, employees need to measure the dimension by width and length one by one. The proposed method can extract the key dimension at one time. The further than time of automatic measurement is comparatively stable. When compared with that of garment manual measurement. The beyond time of proposed method depends mainly on the time of unfolding the cloth size measurement. The importance of our workbench which lead to the maximum convenience. It used to spread out the garment. It is value noting that the calibration of the camera also consume point in time in our method.

IX. CONCLUSION

An efficient and convenient method of automatic garment sizes measurement was proposed here. A garment size measurement shooting equipment is proposed to capture the garment image with high quality. A white color workbench placed. It makes it appropriate for fast measuring size of garments of different textures or colors. So far we considered only t-shirt image to measure from this product and completed successfully. In future we will consider all garment types and apply the support vector machine (SVM) learning algorithm in all garments to find the all corner points and to teach how to join the corner points with the image recognition of sample corner joined image and calculate the distance of the other parameter like armhole, sleeve opening, sleeve length, collar length with nearly try to get hundred percentage accuracy.

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