Application for Real-Time Object Measurement

Project Report Submitted in Partial Fulfilment of the Requirements for the Degree of

Bachelor of Engineering
in
Computer Science & Engineering

Submitted by

Amit Mangal: Roll No. 19UCSE4002

Mohammed Naved Mansury: Roll No. 19UCSE4009

Under the Mentorship of **&** ***Under the Guidance of***

Dr. N C Barwar
H.O.D.

Ms. Simran Choudhary
Assistant Professor

Department of Computer Science and Engineering
MBM University, Jodhpur

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Department of Computer Science & Engineering

M.B.M. University, Jodhpur

CERTIFICATE

This is to certify that the work contained in this report entitled **"Application for Real Time Object Measurement**" is submitted by the group members Mr.. Amit Mangal (Roll. No: 19UCSE4002) and Mr. Mohammed Naved Mansury (Roll No: 19UCSE4009) to the Department of Computer Science & Engineering, M.B.M. Engineering College, Jodhpur, for the partial fulfilment of the requirements for the degree of **Bachelor of Engineering** in **Computer Science & Engineering**.

They have carried out their work under my supervision. This work has not been submitted elsewhere for the award of any other degree or diploma.

The project work in our opinion, has reached the standard fulfilling of the requirements for the degree of Bachelor of Engineering in Information Technology in accordance with the regulations of the Institute.

Ms. Simran Choudhary
Assistant Professor
(Guide)
Dept. of Computer Science & Engg.
M.B.M. University, Jodhpur

Dr. N C Barwar
(Head & Mentor)
Dept. of Computer Science & Engg.
M.B.M. University, Jodhpur

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DECLARATION

We, ***Amit Mangal and Mohammed Naved Mansury,*** hereby declare that this project titled **“Application for Real Time Object Measurement”** is a record of original work done by me under the supervision and guidance of ***Ms. Simran Choudhary***.

I further certify that this work has not formed the basis for the award of the Degree/Diploma/Associateship/Fellowship or similar recognition to any candidate of any university and no part of this report is reproduced as it is from any other source without appropriate reference and permission.

Amit Mangal

Amit Mangal
8th Semester, CSE
Roll No. - 19UCSE4002

Naved.

Mohammed Naved Mansury
8th Semester, CSE
Roll No. - 19UCSE4009

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ABSTRACT

In industrial production processes, computer vision measurement systems are becoming more and more popular. The accuracy of a commodity cannot be guaranteed using traditional manual measurement methods. As a result, it is critical to raise the manufacturing industry's technology level by researching a low-cost, high-precision, and high-efficient quality automated measurement device.

Off-line or part-spot inspection is the most common method of measuring part dimension in general industrial development. However, as consumers expect higher quality from packaging materials, component dimension calculation is becoming more common, which necessitates a 100 percent inspection, raising the bar for inspection performance and implying higher costs.

The use of general optical instrument geometric measuring equipment is inconvenient in the reading process, takes a long time to calculate, has a high degree of human error in staff, and has a low level of automation. The use of computer vision technologies in geometric measurement allows for fast measurements of object dimensions or relative positions (products or parts). It can achieve real-time online, non-contact, high accuracy, rapid speed, and good versatility.

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Chapter 1

INTRODUCTION

Machine vision, according to the Automated Imaging Association (AIA), includes both industrial and non-industrial applications in which a combination of hardware and software provides operational guidance to machines in the execution of their functions based on image capture and processing.Industrial computer vision uses many of the same algorithms and methods as academic/educational and governmental/military computer vision applications, although there are several differences.

In the field of precision research, machine vision technology is the most exciting new technology. Computers are often used to mimic humans or to replicate those intelligent behaviors related to human vision. It processes and understands representations of objective things by extracting knowledge from them. Finally, it is used in the identification and monitoring of real events.It has a wide range of applications in a variety of areas, including agriculture and industry.

Among them, geometric measurement test and automatic visual recognition test are examples of machine vision in automatic detection, and geometric measurement test technology is an essential part of manufacturing technology.

The automated retrieval of information from digital images for procedure or quality management is known as machine vision. Since automatic machine vision is more suited to routine inspection procedures than human inspectors, most factories use it instead of human inspectors. It is more effective, more objective, and continues to operate. Computer vision is used in manufacturing for a variety of tasks including measurement, counting, location, and decoding. Reduce errors, increase yield, make regulatory compliance easier, and monitor parts with machine vision. Manufacturers can save money and make more money.

We must first decide the reference object before calculating the size of each object. The measurements of the reference points would then be used to determine the size of other objects. Next to the reference object, we calibrate the camera. The left-most object in the picture is always the reference object. Furthermore, the reference object may be u to calibrate your pixels per metric variable. The reference object can also be used to calibrate your pixels per metric variable, and therefore the size of all points in all frames can be calculated from there.

Lighting, mirror, image processor, visual processing, and communications are the main components of a computer vision system .The portion to be examined is illuminated, causing its characteristics to stick out and be seen clearly by the camera.

1.1 Problem Statement

Off-line or part-spot inspection is the most common method of measuring part dimension in general industrial development. However, as consumers expect higher quality from packaging materials, component dimension calculation is becoming more common, which necessitates a 100 percent inspection, raising the bar for inspection performance and implying higher costs.

The use of general optical instrument geometric measuring equipment is inconvenient in the reading process, takes a long time to calculate, has a high degree of human error in staff, and has a low level of automation. The use of computer vision technologies in geometric measurement allows for fast measurements of object dimensions or relative positions (products or parts).It can achieve real-time online, non-contact, high accuracy, rapid speed, and good versatility.

Algorithms in vision processing examine an image and collect required detail, perform the correct inspection, and make a decision. Finally, communication is usually achieved through discrete I/O signals or data transmitted over a serial connection link to a computer that is logging or using information

1.2 Motivation

Computer vision excels at quantitative calculation of an organized scene because of its tempo, precision, and repeatability, where human vision excels at qualitative analysis of a dynamic, unstructured scene. On a manufacturing line, for example, a

Hundreds, if not thousands, of pieces can be inspected every minute using a computer vision device. A computer vision device with the proper sensor resolution and lenses can easily inspect target features that are too limited for the human eye to view.

Computer vision avoids product failure and removes the time and costs involved with mechanical component wear and tear by avoiding direct interaction between a test device and the parts being tested.By minimizing human interaction in the production process, machine vision provides added safety and organizational advantages.

Furthermore, it saves human personnel from toxic conditions and avoids human pollution in clean rooms.

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Chapter 2

Related Work

2.1 System Design Method

The measurement system of machine vision is composed of two parts: hardware system and software system. The hardware system mainly completes image acquisition and result output. The software system mainly completes the function of image preprocessing and size measurement. The measurement system mainly includes four functions: image acquisition, image analysis and processing, dimension measurement, and result output. Among them, the hardware of the image acquisition part mainly includes light source, lens, camera, and image acquisition card.

The image acquisition part is responsible for the optical imaging of the target object's characteristic information, and then converts the optical signal into an image data acquisition card transmitted to the computer through the image sensor; the image analysis and processing part realized by the image processing analysis software based on the personal computer platform; the processing result is responsible for outputting the measurement result to the computer display, and the dimension measurement is completed by the corresponding software.

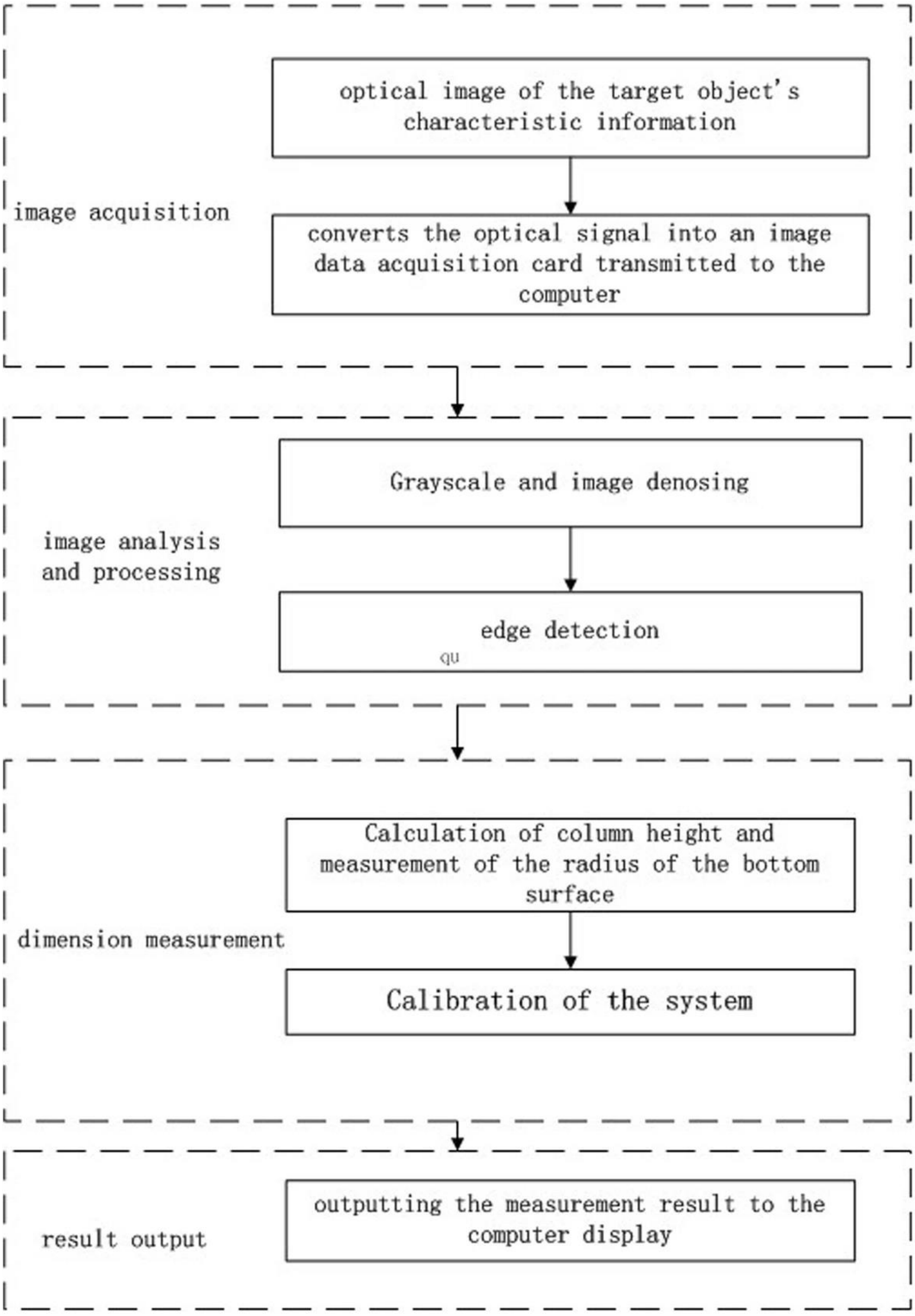


Fig 2.1. Processing flow of the machine vision measurement system

2.2 Calibration of the System

The digital images collected from the machine vision system record the size relationship between the target objects. But this size relation is in pixels. In order to obtain the specific geometric size of the target, the relationship between the position of pixels in the image and the relation of the position of each point in the real world must be established. This process is called the calibration of the system. The measurement calibration method is used in this measurement system: taking a known mass block as a standard part, the mass image is selected with the same measurement conditions as the actual measurement, and the pixel value in the image pixel coordinate system is calculated. The ratio of the actual dimension of the gauge block to its pixel dimension is the camera's calibration dimension. In the measurement, the obtained image of the mass is first processed, and the number of pixels in the image coordinate system is counted and expressed by P. It is compared with the actual length L of the mass to obtain the actual dimension S corresponding to each pixel. It is expressed by the following formula:

$$S = L/P \quad \text{……(1)}$$

Among them, S represents the actual dimension corresponding to one pixel, namely, the calibration value. Since the calibration process also introduces errors, multiple calibration averaging methods can be used. After obtaining the system calibration parameters, the pixel dimension obtained by the image measurement can be converted into the actual dimension. However, the calibration coefficients of such systems need to be recalibrated after replacing the different parts to be measured or the measurement conditions (illumination, sight distance, focal length, and so on).

2.3 Image Acquisition

The measurement system captures images that reflect the surface characteristics of the shaft through a CCD camera. Since shaft parts belong to non-transparent bodies, in order to obtain high-contrast images and facilitate subsequent image processing, the backlighting mode is adopted here. The light source sends out light waves, which is irradiated by the annular light tube to the measured part, so that the part is as much as possible in the controllable background of uniform illumination (In order to reduce the influence of ambient light on the parts, a circular cylinder is surrounded by an opaque cylindrical cavity mask and a piece of wool glass is placed on the light source to reduce the scattering.).

The optical system is imaged on the photosensitive surface of the array CCD. The image acquisition card receives the analog signal input from the CCD camera and converts the A/D into the discrete digital signal to communicate with the computer. By processing the collected image data, the computer can quickly and accurately calculate the dimension of the part and send the result directly to the graphics card to show it. The system schematic diagram is shown in Fig. 2.2.

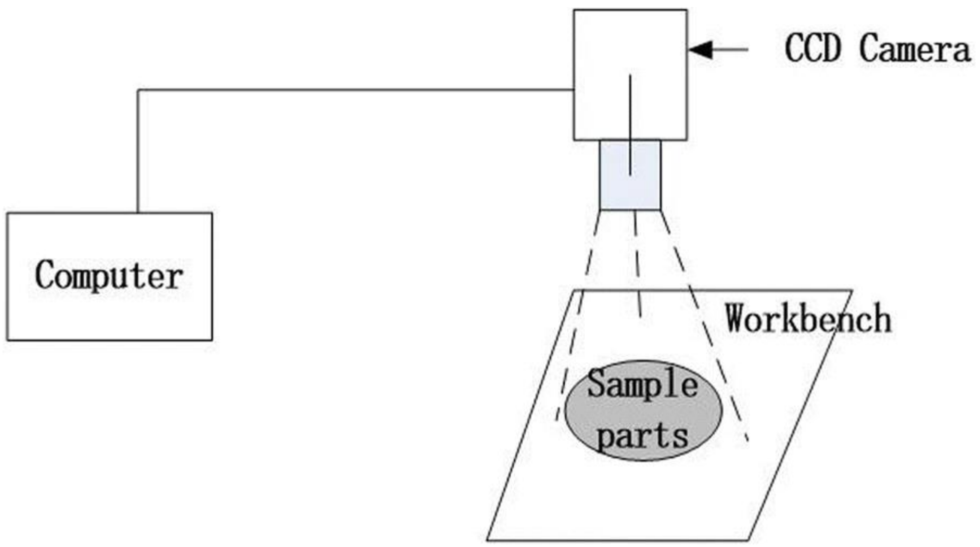


Fig 2.2. Schematic Diagram of Machine Vision System

2.4 Image Analysis and Processing

The image analysis and processing module is mainly composed of OpenCV and VC++ mixed development programming software. Mainly completed functions include image preprocessing, edge detection, and dimension measurement algorithm implementation.

2.4.1 Image preprocessing

Image preprocessing mainly includes two steps: image grayscale and image denoising. The image captured by the camera is a 32-bit-RGB image. The color of each pixel is represented by a combination of red (R), green (G), and blue (B). Each color is represented by 8 bits, so it can contain 224 different colors in theory and can reproduce the real color of the image. But the image measurement of the workpiece size is concerned with the edge features of the workpiece image. These features can be expressed by the change of the gray level of the image, so in order to reduce the amount of operation in the process of image processing, the image captured by the camera can be first grayscale.

Grayscale processing is a process of processing a collected color image into a grayscale image using a correlation algorithm. Grayscale processing maps the gray value of the image to a new range, which makes it easy to identify certain features of the image and facilitate the subsequent image manipulation. The grayscale histogram of the natural image is often at a higher frequency in the low-valued grayscale interval, making the darker details in the image often invisible. In order to make the image clear, the gray range of the image can be pulled apart, and the gray level with smaller gray frequency is made larger, so that the grayscale histogram tends to be consistent within a large dynamic range, that is, histogram equalization processing. After histogram equalization, the details of the image can be clearer and the proportion of each gray scale is more average. The image denoising is done by using a wavelet to denoise the selected part images. The denoising process includes three steps: multi-scale decomposition, multi-scale denoising, and wavelet inverse transform. The wavelet transform is used to reconstruct the noisy signal, which can remove Gaussian noise and salt-and-pepper noise in the signal.

2.4.2 Edge Detection

For images with higher signal-to-noise ratio, the least-squares linear regression and the spatial moment sub-pixel localization algorithm can achieve sub-pixel accuracy for straight-line edge detection, and satisfactory results are obtained. Least squares linear regression sub-pixel positioning accuracy is approximately 0.1 pixel, spatial moment sub-pixel positioning accuracy is approximately 0.01 pixel, and the least squares linear regression sub-pixel positioning algorithm is much faster than the spatial moment sub-pixel positioning algorithm. Therefore, this paper uses least squares linear regression to reduce the two-dimensional edge fitting to one-dimensional edge location, so that the straight edge location can reach sub-pixel accuracy.

In the linear filtering edge detection method, the Canny optimal operator is the most representative, and it is also one of the operators that detect the stepwise edge effect better. First, the Canny operator is used as an integer pixel level edge location function to extract the entire pixel level edge. Then, the edge sub-pixel location is performed using a least squares linear regression. Canny operator edge detection algorithm is implemented by calculating the gradient size and direction of each pixel in the filtered image. The following 2×2 template can be used as a first-order approximation to partial differentiation in the x direction and y direction

$$p = \frac{1}{2}\begin{bmatrix} -1 & 1 \\ -1 & 1 \end{bmatrix}, Q = \frac{1}{2}\begin{bmatrix} 1 & 1 \\ -1 & -1 \end{bmatrix}$$ …….(2)

The resulting gradient size and direction are :

$$M(x,y) = \sqrt{P^2(x,y) + Q^2(x,y)}$$

$$\theta = \arctan[Q(x,y)/P(x,y)]$$ …….(3 & 4)

Next, the gradient is non-maximally suppressed, and the edges are refined by inhibiting the amplitude of all non-ridge peaks in the gradient direction. Finally, double threshold segmentation is carried out, and two gradient thresholds are selected. The high threshold is usually 2~ 3 times of the low threshold. First, the pixel points of the gradient value less than the high threshold are removed from the set of edge points, and the edge point set F is obtained, and then process the pixel set M with the gradient between the high and low thresholds. If a point in M has a neighboring point in F, then this point is added to F, and finally the edge point set is obtained.

After a high signal-to-noise ratio image is obtained by edge extraction, a vector set Ei = {E1,E2,…,En} containing edge pixel points is obtained to perform regression processing on the straight edges of the mechanical parts. Since the detected parts are ground with high precision, their edges can be approximated as a straight line, which satisfies the accuracy requirements. Moreover, the detection image is carefully designed, the contrast between the target and the background luminance in the captured image is high, and the edge vector group obtained through the first step processing includes all the edge points of the entire pixel accuracy. Therefore, directly performing linear regression on Ei not only has higher positioning accuracy, but also has a faster calculation speed. If Ei contains too much noise, linear regression is performed directly on Ei, and the returned straight line may deviate from the true edge position, resulting in a large error, and it is not suitable for direct regression at this time.

When the model is determined, the main task is to estimate the parameters. The linear coefficient α is estimated using least squares linear regression.

$$Q(\alpha) = \sum (yi - \alpha 0 - \alpha 1xi1 - \cdots - \alpha pxip)^2 \qquad \text{…….(5)}$$

Find the minimum of formula (6), which is the point α : $Q^{'}(\alpha) = \min_{\alpha=20} Q(\alpha)$

Since Q(α) is a non-negative two types of α, let Q(α) be about the first-order partiality of α equal to 0, then the least square estimation of α can be obtained.

$$\begin{cases} \dfrac{\partial Q(\alpha)}{\partial \alpha_0} = -2\sum_{i=1}^{n}(y_i - \alpha_0 - \alpha_1 x_{i1} - \cdots - \alpha_p x_{ip}) = 0 \\ \dfrac{\partial Q(\alpha)}{\partial \alpha_i} = -2\sum_{i=1}^{n}(y_i - \alpha_0 - \alpha_1 x_{i1} - \cdots - \alpha_p x_{ip})\, x_{ij} = 0 \end{cases} (i = 1, 2, \cdots, p) \qquad \text{…….(6)}$$

Formulate (7) equations into normal equations about parameter α.

$$y = [y1 \;\; y2 \;\; \cdots \;\; yn]^T, X = \begin{bmatrix} 1 & x_{11} & \cdots & x_{1p} \\ 1 & x_{21} & \cdots & x_{2p} \\ \cdots & \cdots & \cdots & \cdots \\ 1 & x_{n1} & \cdots & x_{np} \end{bmatrix}, \alpha = [\alpha_0 \;\; \alpha_1 \;\; \cdots \;\; \alpha_p]$$

The formula (7) can be expressed as:

$$X^T X\alpha = X^T y$$

…….(7)

From this, the least square estimate of the linear parameter can be calculated as -

$$\alpha = \left(X^T X\right)^{-1} X^T y$$

……(8)

If the edge points satisfy a normal distribution, the least square estimate of the linear parameter is an unbiased estimate. From (9), the parameters of the linear estimation are obtained to obtain the straight line of the regression. The straight line is the sub-pixel position passing through the edge pixels. The more points that participate in the estimation, the higher the regression accuracy, and the smaller the impact of noise.

2.4.3 Geometric Dimension Measurement

After the previous image processing, the obtained part image can be directly calculated. In this paper, the contour information of the image is measured by the principle of geometric measurement. For cylinder parts, the geometric measurement includes shaft radius and column height.

- Calculation of column height

  Because of the particularities of shaft parts, Hough transform can be used to detect straight lines. Its basic idea is each data point on the straight line is transformed into a straight line or curve in the parameter plane, and the relationship between the parametric curve corresponding to the collinear data point intersects with one point in the parameter space, and the extraction problem of the straight line is transformed into a counting problem. The main advantage of the Hough transform in extracting a line is that it is less affected by gaps and noise in the line. From the derived edge image, two straight line segments can be detected, and the position parameters of each straight line are obtained in turn, that is, the edge line of the cylinder (column height).

- Measurement of the diameter of the bottom surface

The circle or arc on the part image is also a collection of sub-pixel points after sub-pixel edge detection. Fit the circle using the principle of least square fitting, and then find the diameter of the circle part. The measuring principle of the diameter of parts is shown in Fig. 2.3 . The calibration value of point B is calculated first because the radius R of the part is the length of the line segment OB in the figure, that is, the corresponding actual distance between the pixels in the AB segment. According to the linear nature of the calibration formula and the geometric relationship from point A to point B, it can be known that the calibration value of the pixel point from point A to point B is monotonically increasing. Therefore, a suitable point must be found between these data points. The number of pixels in the AB segment multiplied by the calibration value of this point is R.

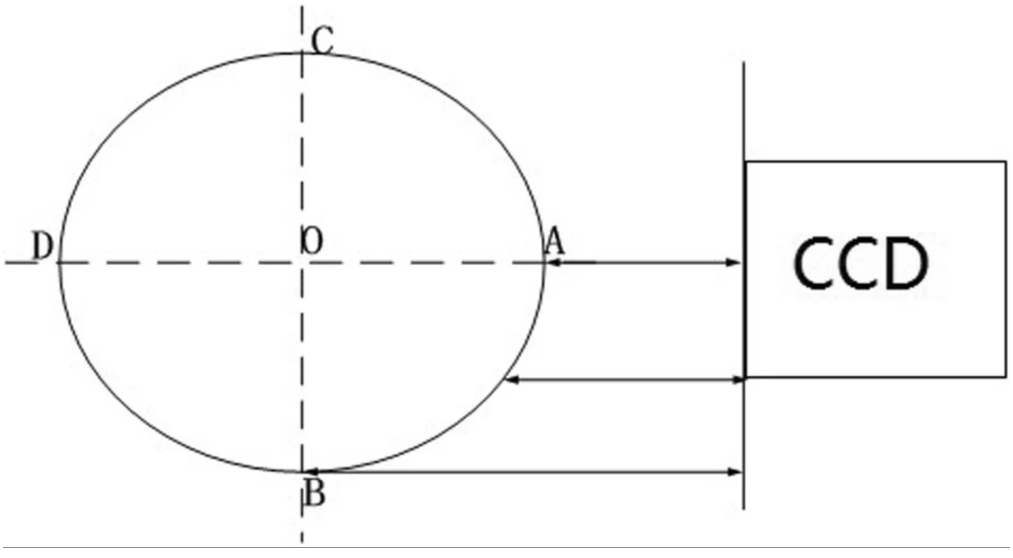


Fig 2.3. Part Diameter Measurement

Assume a real number ϕ, and $0 < \phi < 1$. The above points to find can be expressed as :

$$Y_A\phi + Y_B(1-\phi)$$ …….(9)

This results in

$$R = N\left[Y_A\phi + Y_B(1-\phi)\right]$$ …….(10)

Since formula (11) only *R* and φ are unknowns, where *R* is the desired value, an initial *R* value can be calculated given an initial value of φ. However, this *R* value is not the final result, and it needs to be continuously revised until it reaches the requirement. After obtaining an initial *R* value, the calibration values of each point from point A to point B can be calculated, and then accumulated to get the next *R* value. If the difference between the two adjacent *R* values is less than a sufficiently small ε, the *R* value is the final result. If it is not smaller than ε, a new φ value is obtained by formula (10). Then, use this value of φ to find the next *R* value. This loops until the final result is found *R*(set ε = 0.0012 mm here). The expression used to calculate the calibration values corresponding to the *n* and *n* + 1 points *Yn* and *Yn* + 1, and the distance *L*n + 1 of the point from the camera is -

$$Y_n = a' + b'L_n + c'N$$

$$Y_{n+1} = a' + b'L_{n+1} + c'(N+1)$$

$$L_{n+1} = 244 - \sqrt{R^2 - \left(\sum_{i=1}^{n} Y_i\right)^2}$$ …….(11, 12, & 13)

Where n = N,1,2,3......,Yn and Yn + 1 represent the corresponding values of the N and n + 1 points on the AB semicircle, and Ln + 1 represents the distance from the camera. a’, b’, c’ are given parameters. Through the calculation of the above process, the final measurement result is obtained.

Chapter 3

Work Done

3.1 Capturing and Decoding Video File

We will capture the video using the VideoCapture object and after the capturing has been initialized every video frame is decoded (i.e. converting into a sequence of images).

```
url = "http://192.168.1.8:8080/shot.jpg"
while True:
        #ret, image = cap.read()
        img_resp = requests.get(url)
        img_arr = np.array(bytearray(img_resp.content), dtype=np.uint8)
        img = cv2.imdecode(img_arr, -1)
        img = imutils.resize(img, width=1000, height=1800)
```

Fig 3.1. Capturing and Decoding the File

3.2 Grayscale conversion of image

The video frames are in RGB format, RGB is converted to grayscale because processing a single channel image is faster than processing a three-channel color image.

```
        gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
```

Fig 3.2. Grayscale Conversion

3.3 Reduce noise

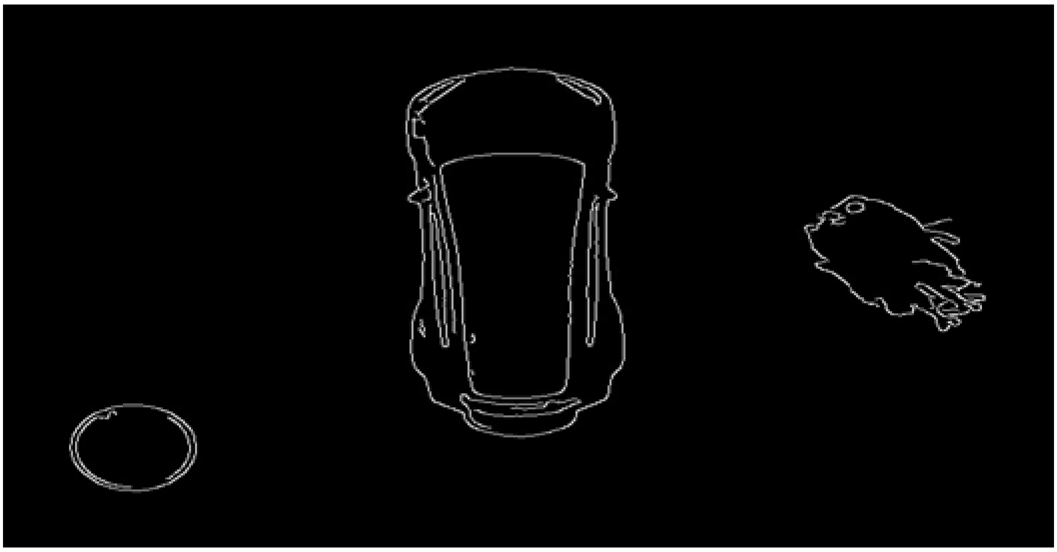
Noise can create false edges, therefore before going further, it’s imperative to perform image smoothening. A Gaussian filter is used to perform this process.

```
        gray = cv2.GaussianBlur(gray, (7, 7), 0)
```

Fig 3.3. Reducing Noise

3.4 Canny Edge Detector

It computes gradients in all directions of our blurred image and traces the edges with large changes in intensity.



```
        edged = cv2.Canny(gray, 50, 100)
        edged = cv2.dilate(edged, None, iterations=1)
        edged = cv2.erode(edged, None, iterations=1)
```

Fig 3.4. Canny Edge Detection

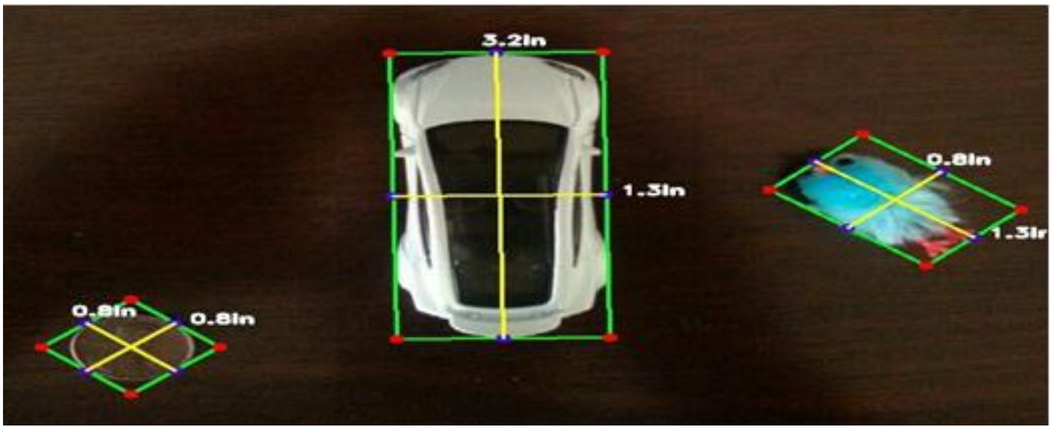
3.5 Finding midpoints on contours

These mid-points act as anchors for Euclidean distance calculation.

```
def midpoint(ptA, ptB):
        return ((ptA[0] + ptB[0]) * 0.5, (ptA[1] + ptB[1]) * 0.5)
```

Fig 3.5. Finding Midpoints

3.6 Finding Euclidean distance from the midpoints generated over the contours




```
                cv2.line(orig, (int(tltrX), int(tltrY)), (int(blbrX), int(blbrY)),
                        (255, 0, 255), 2)
                cv2.line(orig, (int(tlblX), int(tlblY)), (int(trbrX), int(trbrY)),
                        (255, 0, 255), 2)
```

```
                dB = dist.euclidean((tltrX, tltrY), (blbrX, blbrY))
                dA = dist.euclidean((tlblX, tlblY), (trbrX, trbrY))
```

Fig 3.6. Finding Euclidean Distance

3.7 Methodology

Because of the focus on process adaptability and result satisfaction, Agile is the best suited methodology to be applied.

In the Agile model, methods break the product into small incremental builds. These builds are provided in iterations. Each iteration typically lasts from about one to three weeks and is like training.

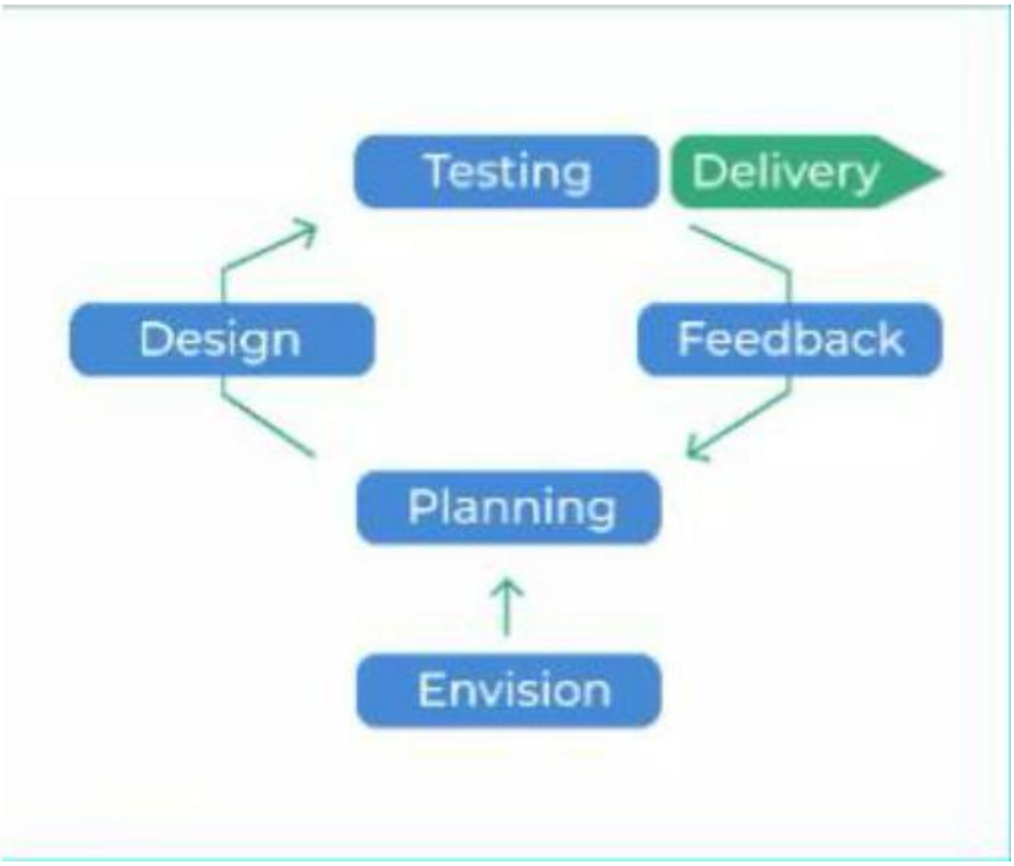


Fig 3.7: Agile Model Flow Diagram

Chapter 4

Result

In Fig 4.1 shown is the output of our algorithm stating the dimensions of the different figures in the input image. The dimensions in the output will vary to the actual measurements of the objects because of the difference in pixels of the image. For example, if we hold the camera above the normal height, the dimensions will decrease as the same object will cover less number of pixels and vice versa if we hold the camera closer to the object.

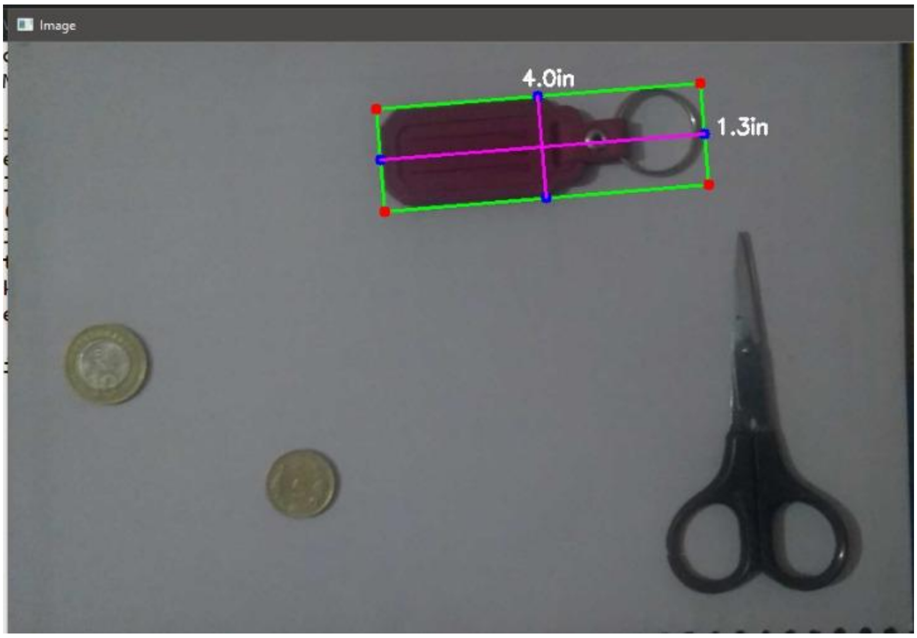


FIg 4.1.1. Output Dimensions Part 1

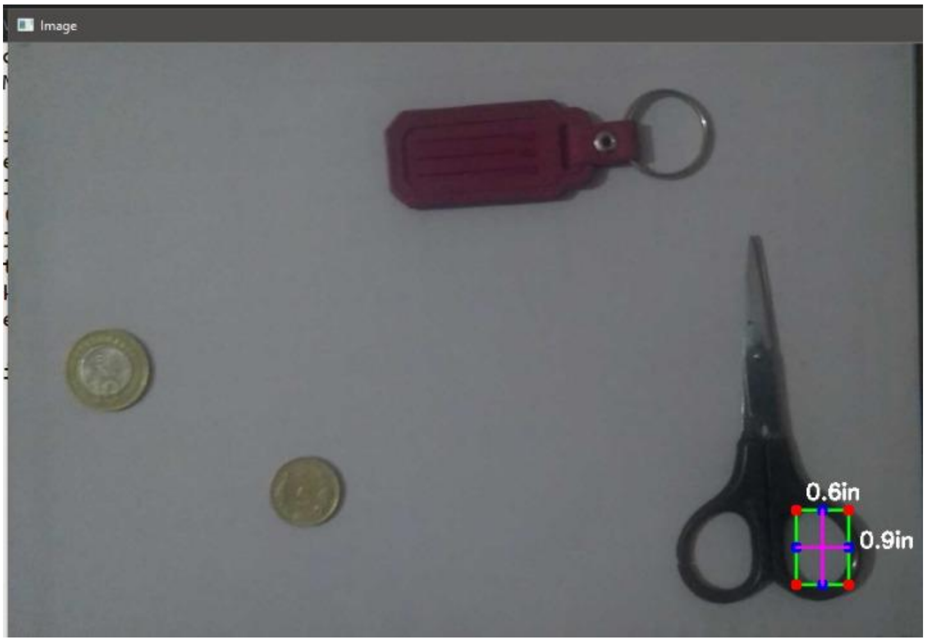


Fig 4.1.2. Output Dimensions Part 2

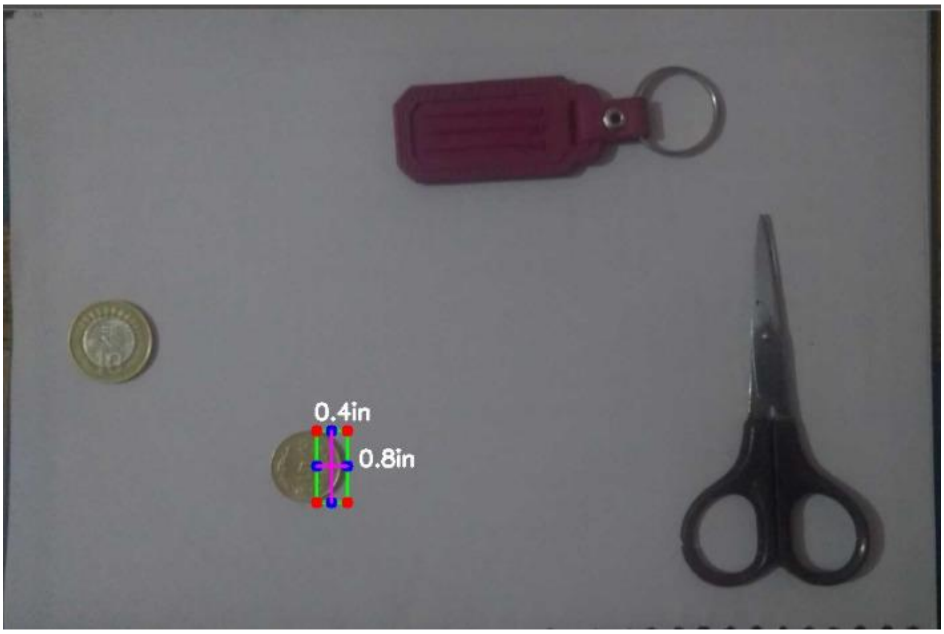


Fig 4.1.3. Output Dimensions Part 3

Sample Object	Original Dimensions	Orthogonal View (Dimensions in inch)		Perspective View (Dimensions in inch)	
		Output	% Accuracy	Output	% Accuracy
Object - 1	4.08*2.625	4.1*2.7	96.74%	4.4*2.9	83.93%
Object - 2	4.4*3.8	5.8*4.5	64.06%	6.4*5.3	49.29%
Object - 3	2.1*1.5	2.1*1.5	100%	2.3*1.9	72%
Object - 4	2.625*1.95	2.7*2.0	94.8%	2.9*2.1	84.05%
Object - 5	7.1*4.3	7.4*5.6	74%	8.0*6.0	63%
Object - 6	2.0*1.6	1.9*1.4	83%	2.3*1.6	86.9%
Object - 7	0.4*0.4	0.4*0.4	100%	0.5*0.4	80%
Object - 8	2.0*0.5	2.1*0.5	95.2%	2.1*0.5	95.2%

Table 4.1. Sample output dimensions in orthogonal and perspective views

	Orthogonal View	Perspective View
Accuracy	88.22%	76.8%

Table 4.2. Average accuracy calculated using various sample objects

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Chapter 5

Conclusion & Future Work

5.1 Conclusion

The computer vision measurement system is more and more widely used in the industrial production process. Because the traditional manual measurement method has strong dependence on the operator, the operator has labor intensity, low efficiency, the product quality is not effectively guaranteed, and many human errors may be produced. It is difficult to meet the requirements of large quantity, high-efficiency, and high-precision product testing. Therefore, it is of great significance to improve the technology level of the manufacturing industry to study the automatic measurement system for the dimension of shaft parts with low cost, high precision, and high efficiency. In this paper, a CCD camera is used to collect the parts in real time, and a series of preprocessing operations such as image grayscale processing and wavelet denoising are used.

An improved single pixel edge detection method based on the Canny detection operator is proposed to extract the edge contour of the part image. Using the code program in the cross platform computer vision library OpenCV, the geometry algorithm is used to measure its contour, thus the bottom radius of the cylinder contour and the height of the column are obtained, and the repetitive error is tested and analyzed.

5.2 Future Work

The results from various sample cases shows inefficiency in two cases -

1. The object's measurement highly depends on how much closer they are placed to the camera. The measurement will change with the change in their height from the ground/distance from the camera lens. Therefore, to resolve this problem we need to take the distance of the object from the camera lens in account and can improve the project to show better results.

2. The accuracy in case of perspective view is very less, because right now it doesn’t matter to the algorithm in what view the photograph is taken. For that we can use the sensor to calculate the angle with the horizon of the camera lens and then we need to adjust the pixel dimensions. This will improve our efficiency in case of perspective view.

References

[1] Dimension Measurement | Machine Vision Applications | Machine Vision Basics | KEYENCE America

[2] Brown L G. A survey of image registration techniques[M]. ACM 24(4), 325–376 (1992)

[3] EURASIP Journal on Image and Video Processing volume 2018, Article number: 101 (2018)

[4] J.H. Lee, Y.S. Kim, S.R. Kim, et al., Real-time application of critical dimension measurement of TFT-LCD pattern using a newly proposed 2D image-processing algorithm[J]. Opt Lasers Eng 46(7), 558–569 (2008)

[5] S.D. Ma, Z.Y. Zhang, Computer vision-theory and algorithm[M] (Science Press, Beijing, 1998)

[6] R. Keys, Cubic convolution interpolation for digital image processing[J]. IEEE Trans Acoust Speech Signal Process 29(6), 1153–1160 (2003)

[7] E.N. Malamas, E.G.M. Petrakis, M. Zervakis, et al., A survey on industrial vision systems, applications and tools[J]. Image Vis Comput 21(2), 171–188 (2003)

[8] G. Chen, K. Yang, R. Chen, et al., A gray-natural logarithm ratio bilateral filtering method for image processing[J]. Chin. Opt. Lett. 6(9), 648–650 (2008)