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Preliminary Study of the Feasibility of a Webcam as a Measuring Tool for Product Geometry (Circular Object Case Study)

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ABSTRACT

This final straightforward report discusses the initial feasibility study of a webcam as a product geometry measurement tool (a case study of circular objects). Measurements are obtained from reading the 2D imaging surface of the shooting measuring object. In this test the measurement is focused on measuring the diameter of an object in the form of a circle. The image obtained from the results of formal RGB shooting and displayed on a PC monitor by so/Mere webcam, then called using Matlab software. Imaging is processed from RGB format to gray scale and then to monochrome, then the diameter of the image surface is calculated.

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1. INTRODUCTION

Webcam is a special PC (Personal Computer) camera which is a multifunctional product, because it can be used as a digital camera, for video conferencing and commonly used for chat purposes. Webcams are categorized into digital cameras because starting from shooting/video recording, processing, and storage using digital devices. From a physical standpoint, the webcam looks like a compact camera so it's quite light and easy to move around. On the other hand, a webcam is a camera that is relatively cheap but has a fairly good ability to capture objects. The webcam can be used for shooting with resolutions up to 640 x480 pixels and for video recording an average of 30 images/second. Based on the above, an idea emerged to use a webcam as a product geometry measurement tool, in this case the part taken is the result of shooting. Measuring objects are photographed using a webcam at a certain distance, then processed using image processing software, so that the dimensions of the measuring object are obtained.

2. RESEARCH METHOD

2.1 Working Principles of the Tool

Broadly speaking, the working principle of this test tool is that the test tool is placed on a flat table, then connected to a PC. Setting the desired measuring distance using a block gauge that is

placed parallel to the surface of the webcam, when it is aligned the lock is half locked. To find out the level of the arm, it can be seen through the water level in the waterpass. If the water level is the same, then the lock is fully locked. The block gauge was removed from the webcam surface and replaced with a measuring object. The accuracy of the placement of measuring objects is controlled directly from the PC. After the measuring object is photographed, the imaging results of the measuring object are transferred to the calculation program, then processed until the diameter of the measuring object is obtained, which is still a pixel value.

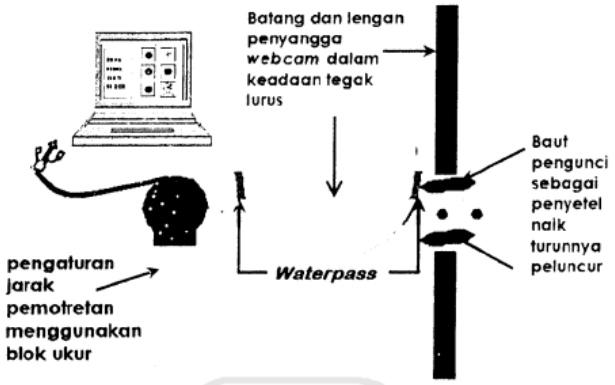
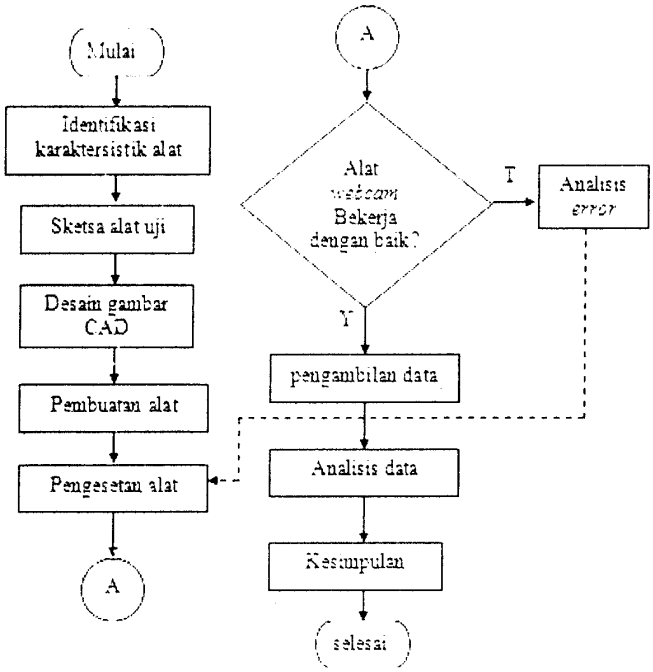


Image 1. The working principle of the tool

2.2 Flowchart of Test Equipment Design Process



3. RESULTS AND DISCUSSIONS

To find out the performance of the test equipment that has been made, it is necessary to test the test equipment. The data obtained through testing is then analyzed, so that the feasibility of the webcam as a measuring tool can be determined. The experiment was carried out in the Industrial Metrology Laboratory with a conducive atmosphere for testing.

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3.1. Test Preparation

Before carrying out the test, first prepare the equipment that will be used for the experiment. After the equipment to be used is ready, the test equipment is arranged in such a way as to make it easier to carry out the experiment. A tool for recording experimental data also needs to be prepared to record the results of the experiments that have been carried out. The measuring object image is as follows:

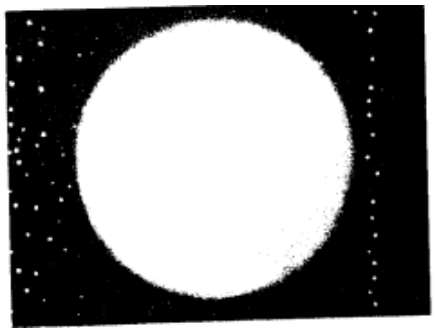

Figure 3. Circle object without thickness

The description of the measurement data is as follows
d = Object measure(mm)
S = camera distance to object (mm)
7, - Pixel average of 4 shots (pixel)
Until found:
R=£
Where:
R = Resolution (pixel I mm)

Table 1. Measurement data d=10 mm

No	D(mm)	S(mm)	P(pixel)	R=p/d
1	10	20	254	25
2	10	25	224	22
3	10	30	202	20
4	10	35	186	19
5	10	40	….	…

Table 2. Measurement data with d = 15mm

No	D(mm)	S(mm)	P(pixel)	R=p/d
1	15	20	364	24
2	15	25	324	22
3	15	30	292	19
4	15	35	266	18
5	15	40	248	17
6	15	45	235	16
7	15	50	216	15
8	15	55	…	…

Table 3. Measurement data with d = 50 mm

No	D(mm)	S(mm)	P(pixel)	R=p/d
1	50	85	464	9
2	50	90	444	9
3	50	95	426	8
4	50	100	402	8

From the results of the average pixel per object diameter (mm) to the measurement distance, the average resolution value (# = pixels Imm) is obtained so that a table can be made and drawn in a graph as follows:

Table 4. Measurement data with d = 50 mm

No	S (mm)	R (*pixel* / mm)									$\bar{R}$ (*pixel* / mm)
		i	II	III	IV	V	VI	VII	VIII	IX	
1	20	25	24								24
2	25	22	22	22							22
3	30	20	19	20							20
4	35	18	18	18	18						18
5	40		17	16	16						16
6	45		15	15	15	15					15
7	50			14	14	14					14
8	55			13	13	13	13				13
9	60			12	12	12	12				12
10	65			12	11	11	11	12			11
11	70			11	11	11	11	11			11
12	75			10	10	10	10	10	10		10
13	80			10	10	10	10	10	10		10
14	85			9	9	9	9	9	9	9	9
15	90			9	9	9	9	9	9	9	9
16	95			9	8	9	8	8	8	9	8
17	100				8	8	8	8	8	8	8

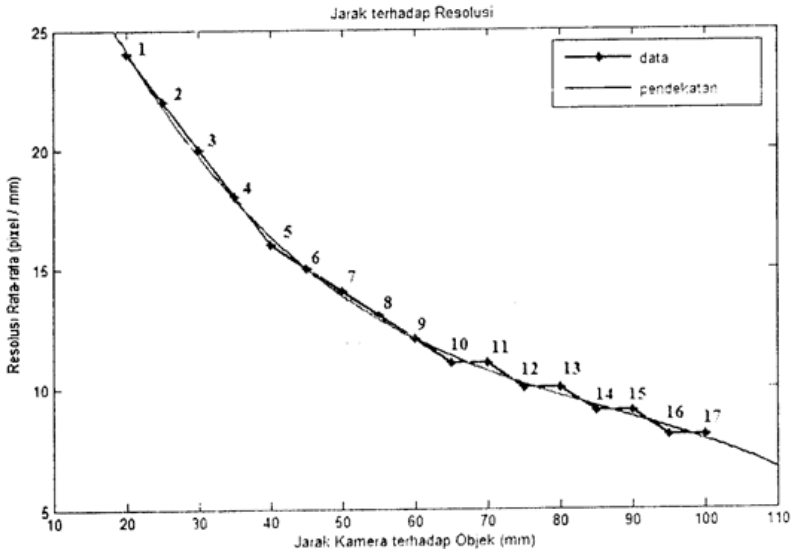

Figure 4. Distance graph against Average resolution

3.2. Finding the Diameter of an Object

a. The measuring object is a coin

The measuring object is a coin that has a certain thickness (t). In this test, the thickness of the coins was added by providing a block gauge with a certain thickness. The initial measurement of coins using a micrometer with an accuracy of 0.01 mm with rings 0-25 mm. The image of the measuring object used is as follows:

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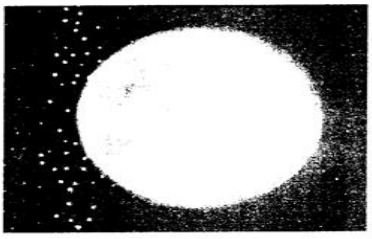

Keterangan:
- Koin perak
- d = 18,50 mm
- t = 1,25 mm

Gambar 4.17 koin 1

Keterangan :
- Koin emas
- d = 20,00 mm
- t = 1,50 mm

3.3 Discussion

From the results of the analysis above, several things were obtained, including: The characteristics of a webcam are the same as a camera, namely the pixel value and resulting resolution are inversely proportional to the measurement distance. This can be seen from the increase in measurement distance gives a decrease in pixel value or resolution. The test tool has limited readings. the webcam is less stable to use as a measuring tool because from the measurement results obtained the deviation values vary and are not constant even though the distance given is the same. The difference in the price of the test value is relatively large with the initial measurement value. For measuring objects without thickness, the largest deviation value is 5.79% and for measuring objects with thickness, the largest deviation value is 3.88%.

Lighting greatly affects the imaging results. 5.3.1 Factors that cause measurement error Factors that result in measurement error can be caused by three things, namely: Deviation originates from the Webcam test equipment which is sensitive to light input. Light that is too bright makes the measuring object unreadable, even though it is readable the size of the given boundary circle will widen (out of the measuring object). Light that is too dim also makes the measuring object unreadable, even though the size of the given boundary circle is readable it will shrink (enter the measuring object).

Deviations originate from the measuring object. The color of the measuring object greatly affects the measurement results. Colors that tend to be bright, such as the new gold and silver coins, make readings enlarged even when the scring is not legible, while colors that are opaque, such as the color of the measuring object without thickness, make the reading smaller and unreadable. The contours on the surface of the coin cause the circles to give irregular readings. Deviations originate from the measurer Errors when setting up the test equipment and placing the measuring object can cause differences in measurement prices even at the same measuring distance and measuring object.

4. CONCLUSION

From the research results it was found that the webcam can be used as a measuring tool with accuracy values above 5% at a measurement distance of 20 - 100 mm. From this it can be concluded that measurements using a webcam can be used for measurements that do not require high accuracy.

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