Video control system for a drilling in furniture workpiece

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Abstract. During last 5 years, Russian industry has been starting to be robotic, therefore scientific groups got new tasks. One of new tasks is machine vision systems, which should solve problem of automatic quality control. This type of systems has a cost of several thousand dollars each. The price is impossible for regional small business. In this article, we describe principle and algorithm of cheap video control system, which one uses web-cameras and notebook or desktop computer as a computing unit.

1. Introduction

Machine vision system consists of defined tasks such as counting objects on a conveyor, reading serial numbers, and searching for surface defects. Manufacturers often prefer machine vision systems for visual inspections that require high speed, high magnification, and repeatability of measurements. The system using in a different part of industry for solving different type tasks. In our case, we had tried to solve problem of control drilling operations. A control of drilling operations is set of tasks: location and size control of holes, the shape and size of the workpiece. In other hand, we understand that most of systems (from famous companies as “Datalogic” or “Cognex”) direct to high price market. It pushed us to try use cheap webcam (with a price about 20 US dollars) as base element of system. Such step make a possible using this type of system for small business and/or start-ups.

Nevertheless, using cheap camera make us calibrate it. Geometry calibration estimates the parameters of lens and image sensor of video camera. We have to use these parameters to correct lens distortion, and high precision measure the size of an object in world units [1].

Our system consist of web camera fixed to a rod, the camera is strictly oriented to a measure table, shown on Figure 1.
Figure 1. The measure table with fixed web-camera.

An operator places finished workpiece on the table. Next, the camera catches picture of the workpiece and processing it, comparing with original scheme. After processing, an operator will get a grayscale image of workpiece, where he sees color legend of analysis, shown in the Figure 2.

Figure 2. Grayscale image of workpiece with color legend.

Legend has a color graduation. Where green halo is successful matching between drawing and workpiece for location and diameter of holes. Red halo is holes, which exists in the origin scheme, but skip in the workpiece. The last, blue halo is opposite to red; hole exists in the workpiece, but skip in the origin scheme. Moreover, if diameters not matching, then the system uses red halo and show the difference of diameters.

2. Algorithm
Let’s descry algorithm of processing, shown in the Figure 3. The first stage is the recognition of the drawing. We work with SVG (Scale Variable Graphic) format drawings, as one of the most common and simple for text concertation. From drawing, we get three parameters: the shape of workpiece, the radius of holes, and the location of hole centers. At the same time, system is processing workpiece snapshot. Image processing consists of the following steps. Subtraction of the background (measuring table) [2]. Recognition of a workpiece contour [3].
Further, inside the contour, system recognize the holes in a given range of radii [4]. After it, system matching data from origin scheme and image processing. The last block take decisions for each hole.

![Algorithm scheme](image)

**Figure 3.** Algorithm scheme.

### 3. Conclusion

Thus, we developed the prototype and the algorithm for video controlling of drilling operations, where cheap web camera (cost about 20$) was used as a recording device. The computational block was a general-purpose computer. Computations were made in the software package MATLAB Image Processing. The introduction of the system to the furniture industry will reduce the level of losses due to drilling defects. In addition, we plan to use this system in other projects for automatic process control. For example, we will try to improve radio-tomography research [5] using this prototype as aim system.

By this article, the authors would like to emphasize a necessity of R&D support for small and medium-business automatization in technical department of Universities.

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### References

[1] Heikkila J, and Silven O 1997 *IEEE International Conference on Computer Vision and Pattern Recognition*

[2] Zhao Cong et al 2011 *EURASIP Journal on Image and Video Processing* 2011

[3] Gonzalez R C et al 2004 *Digital Image Processing Using MATLAB*

[4] Atherton T J, Kerbyson D J 1999 *Image and Vision Computing* 17 795–803

[5] Shipilov S E et al 2017 *Optical and Quantum Electronics* 49 339