

Application of Labview, PLC and image processing in product classification and storage using AC Servo drive system

Hung Quoc Duong¹

¹Department of Automation, Faculty of Electrical Engineering, Thai Nguyen university of Technology, Viet Nam

Date of Submission: 10-05-2024

Date of Acceptance: 20-05-2024

ABSTRACT: In factories, the process of classifying and storing products of the same type in the right location plays a very important role, this requires fast speed and high accuracy. Products after being assembled or processed need to be inspected and classified before moving to the next stage. Usually this inspection step is done by people using their eyes to check. This does not achieve high accuracy and productivity. Today, product appearance inspection solutions using cameras can replace most of the tasks that workers are performing with their eyes.

This article presents the exploitation of Labview software application to process images taken from industrial cameras to check printed QR code labels on products. The PLC is programmed to control the actuators to store the product in its correct location. Design and manufacture an experimental model of an automatic product sorting and stacking system using Mitsubishi Q PLC and Mitsubishi AC Servo.

KEYWORDS: Programable Logic Controller; Labview; Camera Processing; AC Servo; Position control.

I. INTRODUCTION

With the development of science and technology, standards in measuring, testing and classifying goods have increasingly high requirements for accuracy before leaving the factory. In Vietnam today, there still exist many factories that still mainly use manual labor to inspect and classify products with their eyes. This requires workers to concentrate highly, easily causing confusion, productivity and speed are not high.

To reduce the above disadvantages, many solutions have been proposed, in which the use of scara robots equipped with a vision system to classify and inspect products is quite feasible, but the investment cost is large, therefore It is very difficult to deploy for small and medium factories. At the same time, these robots are all imported

goods, difficult to master the technology and completely dependent on their company..

Image processing technology allows designers to implement computer vision problems to replace manual workers. Some studies can include: Image processing in industrial machines [1]; [5], [7]; product surface inspection [2]; [3] or product resolution [6]; Image processing technology is not only applied in industry but also in the military [11] or university laboratories [9].

Data from industrial cameras is processed using many different tools, of which Labview is an effective solution. LabVIEW [12] (Laboratory Virtual Instrumentation Engineering Workbench) is an efficient programming environment for multi-channel communication between devices. For engineers, scientists or educators, LabVIEW has become one of the most popular tools for building applications that collect data from sensors and develop algorithms. LabVIEW is used in many different fields such as measurement, automation, mechatronics, robotics, physics, mathematics, biology. In particular, LabVIEW's extremely powerful image processing capabilities with reliable standard functions have initially changed the thinking in design research of engineers around the world.

In this article, we introduce a study of the application of Labview, PLC and image processing in the process of classifying and storing products using AC Servo drive systems. Research results are the basis for manufacturing systems that combine image processing and position control in industry.

II. IDENTIFICATION, IMAGE PROCESSING AND CONTROL

2-1-Identify and process images

In LabVIEW to acquire images, process images and recognize objects, many ways can be used. However, with two "Toolkits NI", "Vision Acquisition" and "Vision Assistant", we can build a program to capture and recognize images quickly

and with high reliability. The process of image acquisition, image processing as well as control

signal output includes the steps shown in Figure 2.1.

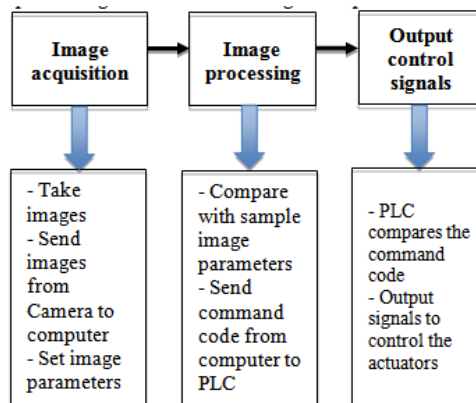


Figure 2.1. acquire images, process images and output control signals

Image acquisition in the LabVIEW environment is performed through Toolkits Vision Acquisition. This is a basic Toolkit that allows building a program to receive images from cameras flexibly through many different standards. In this study, we use the Basler ACA2500-14GM Industrial Camera, which communicates with the computer via Ethernet.

After acquisition, the image will be transferred to Toolkits Vision Assistant for processing. This is an important step because all the main tasks of image processing are concentrated here. Vision Assistant allows building image processing and recognition programs. For example: Color Matching - identify objects by color, Color Location - identify objects by color area distribution, Color Pattern Matching - identify

objects by pattern, Object Tracking - track objects, QR Barcode report

In this study, we use cameras to check Barcode. Therefore, use Barcode recognition application to process images. Post-processed data, if the product's Barcode has no errors, will be classified into types A; B; C; D; E; F. If the Barcode has an error, it will not belong to the above products and send an error message.

Data after the image processing block will be sent from the computer to the PLC system via RS232 standard in the form of command codes. The PLC will control the AC servo actuators to perform position control to preset positions. Image recognition and processing are built on Labview software as shown in Figure 2.2.

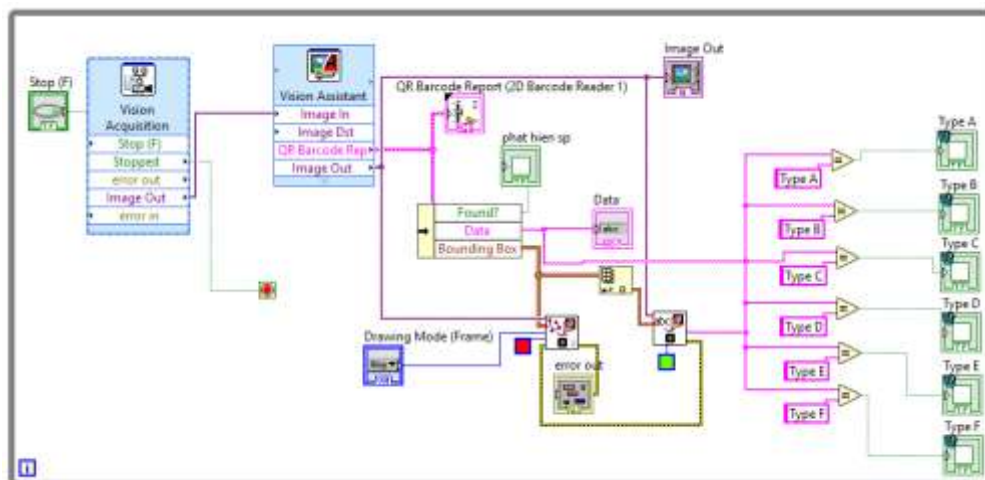


Figure 2.2. Identify and process images on Labview

To observe photos taken from the Camera, we built a screen to monitor images processed on the "QR

Barcode Report (2D Barcode Reader 1) block of Lavalin as shown in Figure 2.3.

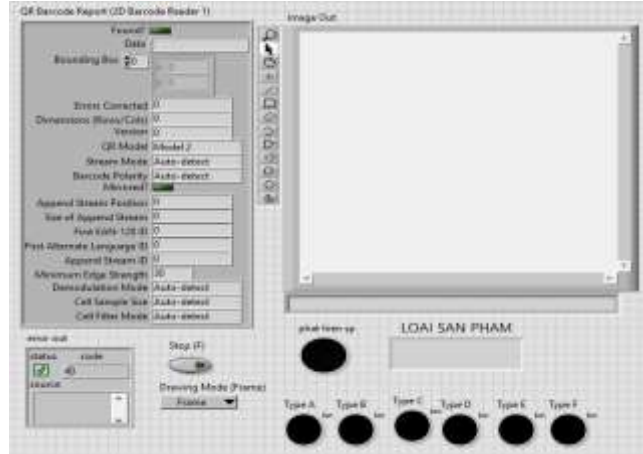


Figure 2.3. The image monitoring screen is processed

2.2. Control

Data after the image processing block will be sent to the central controller, a PLC system including: CPU_Q Mitsubishi; QD75MH2 position control module and other DI/DO modules. The program in the PLC will compare these command

codes and control the AC Servo and pneumatic drives to transport products to locations for each type. Position control is performed according to the PID algorithm of AC Servo units. The PLC program algorithm flow chart is presented as Figure 2.4.

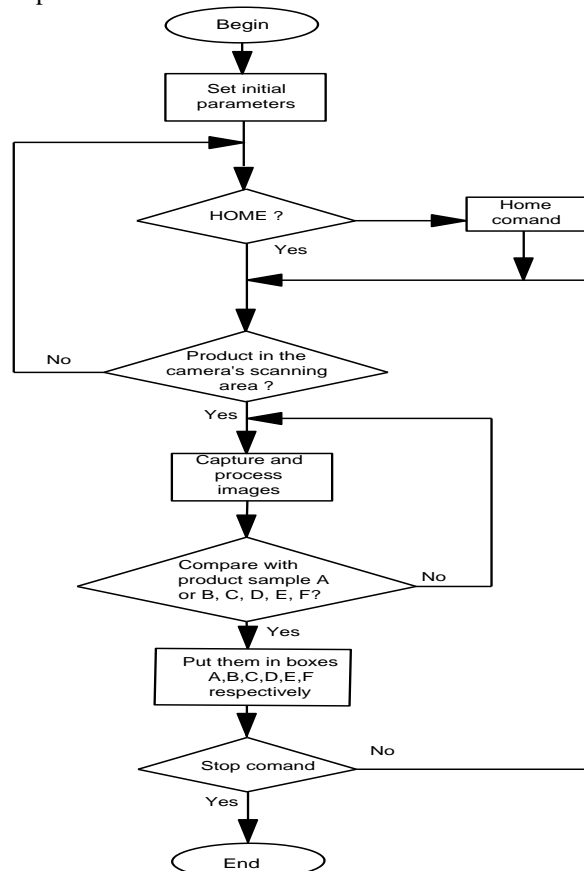


Figure 2.4. PLC program algorithm flow chart

To control and monitor the system, we create an HMI interface with 2 operating modes: manual (Figure 25.a) and automatic (Figure 2.5b).

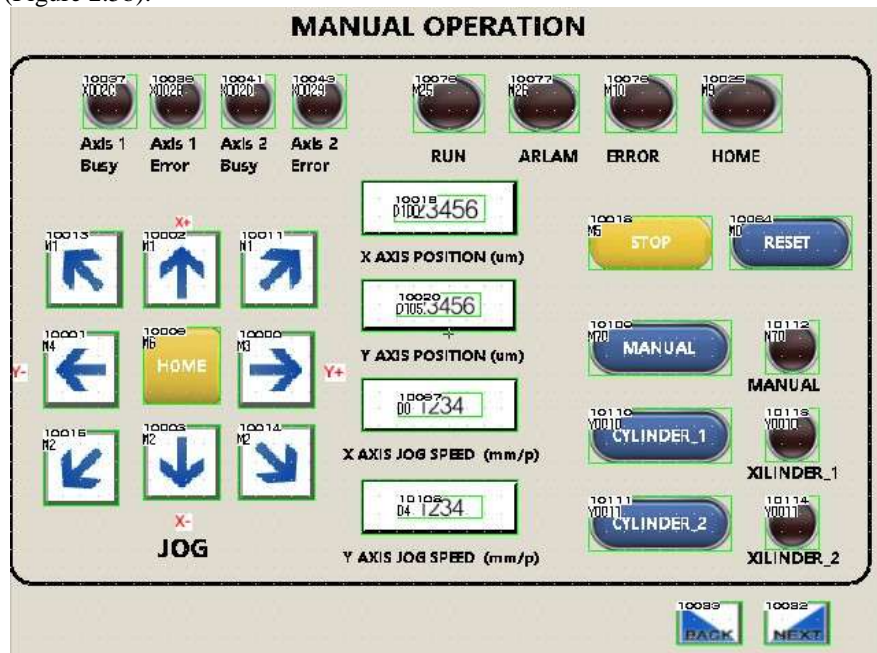


Figure 2.5a. HMI interface for manual operation mode

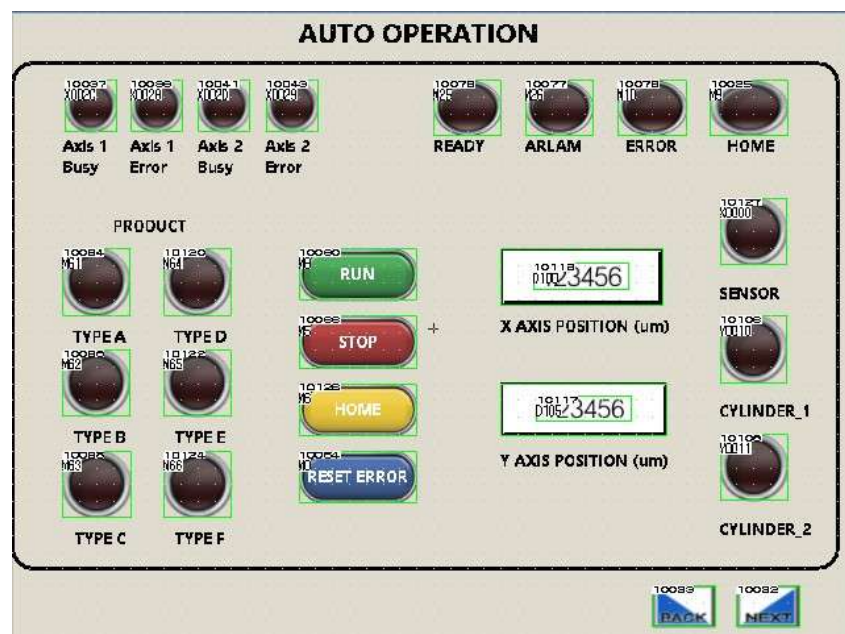


Figure 2.5b. HMI interface for auto operation mode

III. RESULTS AND DISCUSSION

After completing the installation of the experimental model as shown in Figure 3.1. Image processing data is displayed as shown in Figure 3.2.

Products are classified and placed in the desired position (Figure 3.3). We tested the image processing algorithm on Labview and the control algorithm for the actuators loaded into the PLC.



Figure 3.1. The experimental model

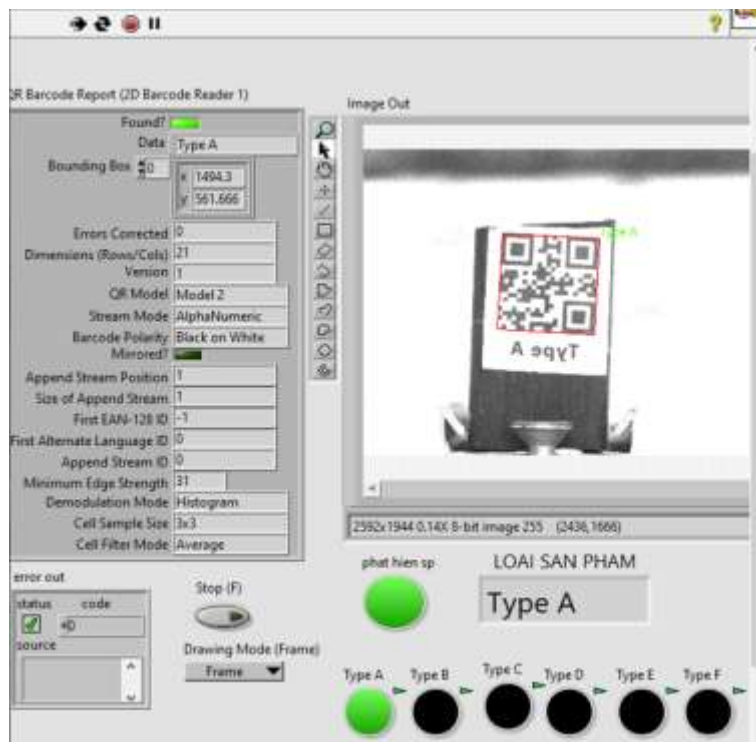


Figure 3.2. Image Processing Data on Labview



Figure 3.3. PLC controls the AC Servo and pneumatic systems to place products in their respective positions

Test results show:

- Image processing is relatively fast and accurate.
- AC Servo system works at high speed, PID algorithm stabilizes position with closed loop feedback for high accuracy.
- Machine vision applications have completely replaced the human eye, therefore:
 - + Reduce confusion, reduce labor, reduce product costs.
 - + Reduce the rate of scrap products.
 - + Reduce production space.

The article introduced the results of applying Labview, PLC and image processing in the product classification and storage process using the AC Servo drive system. Research results are the basis for manufacturing systems that combine image processing and position control in industry.

REFERENCES

- [1]. Golnabi H, Asadpour A- "Design and application of industrial machine vision systems". Robotics and Computer-Integrated Manufacturing, 23(2007), 630-637.
- [2]. Zhang Z., Chen Z., Shi J., Jia F., Dai M- "Surface roughness vision measurement in different ambient light conditions". 15th Int. Conf. Mechatronics and Machine Vision in Practice, Auckland (New Zealand), 2-8 December 2008.
- [3]. Bhuvanesh A., Ratnam M- "Automatic detection of stamping defects in lead frames using machine vision". overcoming translational and rotational misalignment. Int. J. Adv. Manuf. Technology, 32 (2007), pp 1201-1210.
- [4]. Remigiusz Labudzki, Stanislaw Legutko: Applications of Machine Vision.
- [5]. Cheng Y., Jafari M- "Vision-based online process control in manufacturing applications". Trans. on Automation science and engineering, 5(2008)1, pp 140-153.
- [6]. Jian-hai H., Shu-shang Z., Wei S- "Research on sub pixel detecting on-line system based on machine vision for inner diameter of bearings". Int. Conf. on Robotics and Biometrics, Sanya, 15-18 December 2007, pp 2049-2052
- [7]. Fernandes, A.O.; Moreira, L. F E; Mata, J.M., "Machine vision applications and development aspects", Control and Automation (ICCA), 2011 9th IEEE International Conference on , vol., no., pp.1274,1278, 19-21 Dec. 2011
- [8]. S.Sathiyamoorthy - "INDUSTRIAL APPLICATION OF MACHINE VISION"; IJRET: International Journal of Research in Engineering and Technology, Volume: 03 Special Issue: 07 | May-2014; pp 678 - 682
- [9]. Tran Hong Van, Nguyen Kim Đang, Nguyen Duy Phu- "USING LABVIEW AND SIEMENS LOGO! TO CONTROL AND SUPERVISE ELECTRIC EQUIPMENT IN THE CLASSROOM BY LAN NETWORK " - SCIENCE AND

- TECHNOLOGY MAGAZINE,
UNIVERSITY OF DA NANG, 2008
Volume:10 | 2013; pp 173 - 178
- [10]. Tran Ngoc Hai, Tao Quang Bang, Tran Xuan Tuy, Ho Đac Van Nhan – “Digital image processing digital using Labview software for autonomous inspecting and label-sorting machines in packing process”; THE 5TH NATIONAL SCIENCE AND TECHNOLOGY CONFERENCE ON MECHANICS - VCME 2018.
- [11]. Vu Đuc Linh, Nguyen Anh Van, Nguyen Cong Minh – “Researching, designing the tracking system for gun model using imageprocessing technology”;THE 5TH NATIONAL SCIENCE AND TECHNOLOGY CONFERENCE ON MECHANICS - VCME 2018.
- [12]. Raul G. Longoria. Basic Vision LabVIEW , The University of Texas at Austin, 2010