Research on Design of Implementation Mechanism for Similar Production Line

Chia-Nan Ko
Department of Automation Engineering, Nan Kai University of Technology, Taiwan

Yi-Yu Li
Department of Automation Engineering, Nan Kai University of Technology, Taiwan

Ting-Ru Ko
Department of Automation Engineering, Nan Kai University of Technology, Taiwan

Ting-Yi Chen
Department of Automation Engineering, Nan Kai University of Technology, Taiwan
E-mail: t105@nkut.edu.tw

Abstract

Recently, enterprises are actively investing in the research and development of practical technologies for similar production line organizations. Faced with various technological innovations in intelligent automation. In this paper, the object is to research and integrate intelligence through practical functional solutions to design and establish a production line implementation mechanism. We use a myRIO controller as the main core to plan the factory automation production line structure through the practical function research for building similar production line implementation organizations. In this paper, combining theoretical methodology and practical experiments to construct institutional design, electromechanical system and intelligent automation procedure based on LabVIEW2018. Evaluate the efficiency of the design automated production lines to improve the capabilities of similar production lines.

Index Terms: Similar Production Line, Intelligent Automation, myRIO, Image Recognition

I. INTRODUCTION

In recent years, the application of intelligent automation production has become more and more extensive, and intelligent automation education has gradually been valued and promoted in the field of factory automation. The intelligent automation industry is growing year by year in Taiwan, and it is also testing the new education methods of the industry [1]. Intelligent automation education not only inspires student's interest and creativity in science and technology, but also cultivates cross-field practical talents in intelligent automated production. With the promotion of Productivity 4.0, the industry has transformed to seek intelligent automated production mode, so that factory mass production and warehouse management can replace a large number of human resources through artificial intelligence, improve production efficiency, reduce operating costs, and improve industrial competitiveness [2]. The intelligent automation education is the Ministry of Education continues to promote science and technology education syllabus, from primary school to cultivate basic education of information technology. Then cultivate robot practical technology and application talents, in the face of the future high-tech society gradually popularized various scientific and technological thinking [3].

The NI myRIO platform has been listed as the main core controller of the robot platform in various world competitions in recent years. Intelligent automation is a highly cross-field discipline, but also the integration of precision machinery, electrical electronics, information communication, automation and other academic theories and application technologies, its industrial correlation is high (such as IC industry, service industry, manufacturing), with locomotive industry characteristics,

a wide range of applications, for intelligent life value, improve the quality of life, and automation academic and technology application development is one of the most important indicators of national competitiveness [4].

II. Methods

A. *myRIO Controller*

The controller uses the main core of the myRIO controller, with Tetrix_Robotics and Metrix Base Set metal kit, suitable for intelligent automation product line. The system is designed with NI LabVIEW2018 program as the design platform, allowing users to more easily integrate peripheral motors, sensor control and metal kit creative assembly, and then match NI LabVIEW software writing program can free users from the complexity of traditional general programming writing, programming writing is similar to C language, the only difference is that LabVIEW will programming, algorithms, visual development, measurement tools, communication mode, image processing in one, the function is relatively powerful, LabVIEW is different from other programming languages writing, easier for users to do development integration.

This article develops intelligent automation production line using LabVIEW2018 (Laboratory Virtual Instrumentation Engineering Workbench) program platform, LabVIEW is a graphical program compilation platform developed by National Instrument. LabVIEW2018 consists of three parts: Block Diagram, Front Panel, and Icon/Connector. LabVIEW has programming, programming and interface design functions, which can design the functions of the robot as a whole, and the diagram-controlled drag-and-drop design is easier for beginners without programming. When the software enters the LabVIEW window as shown in Fig. 1.

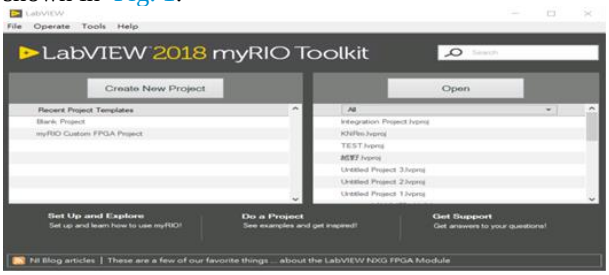


Fig. 1 VIEW 2018 window

The myRIO adapter board design allows the robot architecture to be easily combined with various controllers, which can provide various interfaces such as DC motor, RC motor, sensor and power supply, and the myRIO controller can quickly connect to various controllers.

B. *Image Recognition*

Using the Logitech C310 network camera and Microsoft LifeCam Cinema camera, the recognition of object graphics allows the robot to distinguish between similar graphics and colors, and develops a human-machine interface to immediately present the recognition results.

C. *Motor*

RC servo motor in the control of the robot, usually used to do robot gripper, but RC motor and DC motor is different, is that RC motor is usually used to do high torque low speed use, DC motor is used to do low torque high speed use, RC servo motor is divided into angle type and continuous type.

The angle servo motor is an angle control of 180 , ånd the circuit configured by the motor is simpler than the DC servo motor with three lines that can be controlled, GND-black, 5V-red, SIG-white (yellow), and the function of its foot position, which is to change the PWM pulse width to do angle control.

The difference between continuous RC servo motor and angle RC servo motor is that although they are both control PWM signal adjustment control, one is to use PWM pulse width to adjust the angle, is to control the direction of rotation and speed.

D. *sensors*

Infrared distance sensor is a distance measurement sensor assembly, composed of a PSD (position sensitive sensor), IRED (infrared light-emitting diode) and signal processing circuit, using triangulation method, the detection distance is not easily affected by the reflectivity of various objects, the temperature of the environment and the continuous operation time, the output voltage corresponds to the detection distance, so this sensor can also be used as a proximity sensor [5].

The ultrasonic wave is connected to the circuit board, confirm whether the pin position is correct, if there is no problem, the computer connects with myRIO and uses the project to find myRIO hardware, connect and turn on new VI, write the ultrasonic program in the program interface, after the writing is completed, you can test the ultrasound, and you can view the value on the human-machine interface to observe whether there is an error with the actual distance [6].

III. Experiments

Use Vision Assistant (Image Assistant) as shown in Fig. 2 to edit the desired items. RGB uses the three primary colors to find the respective ranges of the corresponding colors. Use Vision Assistant to edit the desired items. Select Color Threshold, RGB uses the three primary

colors to find the respective ranges of the corresponding colors. Press Select Control again to display the input and output adjustment page, select the desired input and output, and press Finish, which is complete. Open the new VI and write the shape recognition program in the terminal (as shown in Fig. 3. At first, the target is taken by Vision Acquisition, then edited by Vision Assistant, the shape name is taken out by Index Array, and finally the corresponding shape photo is found on the computer side by using the name.

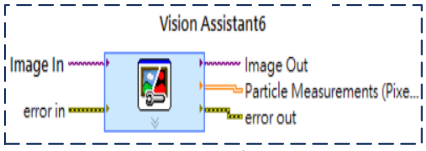


Fig. 2 Vision Assistant

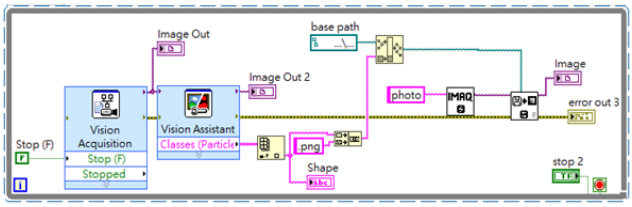


Fig. 3 Pattern Recognition Program

Similar Production Line Steps

The experimental structure of the production line is shown in Fig. 4.

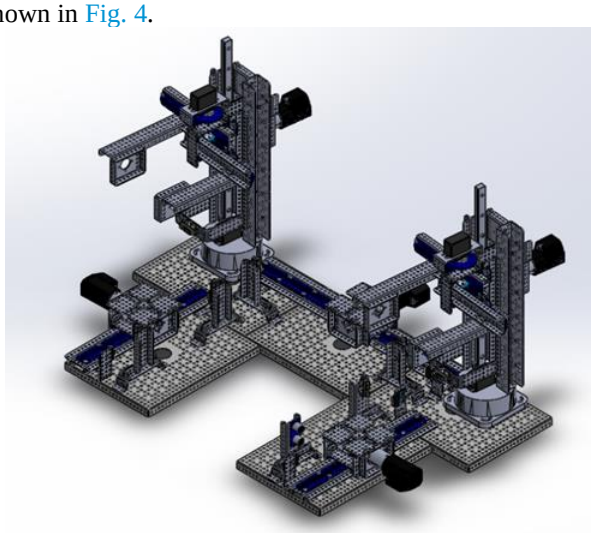
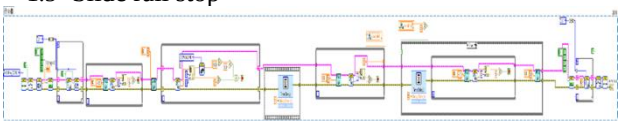


Fig. 4 Experimental structure of the production line

Similar Production Line Steps are shown as follows:

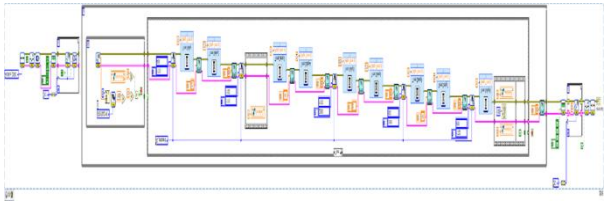
Step1

1.1 The object is put into the load platform
1.2 Infrared sensing object
1.3 Slide rail movement
1.4 Micro (limit) switch
1.5 Slide rail stop



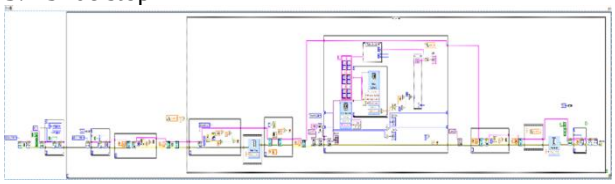
Step 2

2.1 Infrared sensing object
2.2 Arm descent
2.3 Grip object
2.4 Arm rise
2.5 Slide rail movement (return)
2.6 Turntable rotation
2.7 Arm descent
2.8 Object placement load platform
2.9 Arm return



Step 3

3.1 Object on the carrier platform
3.2 Infrared sensing object
3.3 Slide rail movement
3.4 Move under the lens (how to judge the stop?)
3.5 Lens recognition barcode and color
3.6 Micro (limit) switch
3.7 Slide stop



Step 4

4.1 Infrared sensing object
4.2 Arm descent
4.3 Gripping object
4.4 Arm rise
4.5 Turntable rotation (F left turn, T right turn)
4.6 Arm drop
4.7 Object placement load platform
4.8 Arm return

Step 5

5.1 Infrared sensing object
5.2 Slide rail movement
5.3 Micro (limit) switch

5.4 Slide rail stop
5.5 Ultrasonic sensing object (no object)
5.6 Slide rail movement return

IV. Results and Discussion

We use a myRIO controller as the main core to plan the factory automation production line structure through the practical function research for building similar production line implementation organizations. In the experiments, combining theoretical methodology and practical experiments to construct a structure design, electromechanical system and intelligent automation procedure based on LabVIEW2018. In the experiments, all 15 experiments can complete shape and color recognitions.

The efficiency of the designed automated production lines has verified the availability of designed structure. Then, the designed automated production lines can improve the capability of similar production lines.

V. Conclusion

This article mainly uses the myRIO controller developed the use of trapezoidal acceleration and deceleration control. We illustrated the results and used NI LabVIEW Vision Assistant to analyze image recognition. This program completes 15 units of teaching materials, which can provide basic teaching materials for intelligent automation applications and cultivate technical talents in cross-field intelligent automated production.
The completion of similar production line materials in this program can enable promote the intelligent automation education. The experimental teaching materials continue to be developed and promoted, and it is hoped that in the future, the application function of image recognition can be extended to automated production technology to cultivate cross-field technical talents.

References

[1] Duncan McFarlane, Ajith Parlikad, Andy Neely, and Alan Thorne, "A Framework for Distributed Intelligent Automation Systems Developments," Proceedings of the 14th IFAC Symposium on Information Control Problems in Manufacturing, vol. 45, no. 6, pp. 758-763, 2012.
[2] Diana Kwon, "Self-Taught Robots," Science American, vol. 318, no. 3, pp. 26-31, March 2018.
[3] Janna Anderson, Lee Rainie, and Alex Luchsinger, "Artificial Intelligence and the Future of Humans," Artificial Intelligence, December 2018.
[4] Ren C. Luo, Yu-Ting Hsu, Yu-Cheng Wen, and Huan-Jun Ye, "Visual Image Caption Generation for Service Robotics and Industrial Applications," 2019 IEEE International Conference on Industrial Cyber Physical Systems (ICPS), 2019.
[5] En-Chen Chen, Cheng-Yang Shih, Ming-Zhi Dai, Han-Cheng Yeh, Yu-Chiang Chao, Hsin-Fei Meng, Wei-Ren Liu, Yi-Chen Chiu, Yao-Tsung Yeh, Chien-Jen Sun, Sheng-Fu Horng, and Sheng-Fu Horng, "Polymer Infrared Proximity Sensor Array," IEEE Transactions on Electron Device, vol. 58, no. 4, pp. 1215-1220, 2011.
[6] Fabio Ardiani, Mourad Benoussaad, and Alexandre Janot, "Improving Recursive Dynamic Parameter Estimation of Manipulators by knowing Robot's Model integrated in the Controller," IFAC Papers On Line, vol. 55, no.20. pp. 223–228, 2022.

Authors Introduction

Prof. Chia-Nan Ko

He is currently a Professor in Department of Automation Engineering, Nan Kai University of Technology, Tsaotun, Nantou, Taiwan. His research interests include neural networks, PID control, fuzzy logic control, support vector regression, and wavelet theory.

Yi-Yu Li

He is currently a third-year college student in Department of Automation Engineering, Nan Kai University of Technology, Tsaotun, Nantou, Taiwan. His research interests include automation engineering, design of automation, and mechanical drafting.

Ting-Ru Ko

He is currently a second-year college student in Department of Automation Engineering, Nan Kai University of Technology, Tsaotun, Nantou, Taiwan. His research interests include automation engineering and mechanical drafting.

ing-Yi Chen

He is currently a fifth-year grade student in Department of Automation Engineering, Nan Kai University of Technology, Tsaotun, Nantou, Taiwan. His research interests include automation engineering and mechanical drafting.