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Research Article

Investigate Automation Production Processing Based on LabVIEW

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ABSTRACT

Industry 4.0 smart automation has been actively developing recently. Enterprises actively researched and developed intelligent automation mechanisms to promote the efficiency of production lines. Various innovative production mechanisms must be continuously developed. The purpose of this article is to develop a similar production mechanism based on myRIO through practical functional solutions to improve production efficiency and production line stability. In this study, we used FPGA to change the pin position function by ourselves, integrated smart technology and multiple practical experiments, and used LabVIEW software to design an automation platform based on myRIO controller. The efficiency of developing similar production mechanisms validates the product identification system and platform.

1. INTRODUCTION

Recently, the development of automation production processing has gradually been valued and promoted in the various industry fields. The intelligent automation technology is growing gradually, and it is also testing the new simulation methods [1]. Due to the development of Industry 4.0, the industry researched intelligent automated production modes, mass production and warehouse management can replace some human resources through artificial intelligence. In order to improve production efficiency, improve product yield, and reduce operating costs, people have adopted smart automated production models [2]. High technology is gradually popularizing various production fields, and practical technologies and applications have become the technologies that people are eager to find [3].

MyRIO is vastly used in industry and education, recently. The NI myRIO platform has been listed as the main core controller of intelligent automation platform in various world competitions [4]. Intelligent automation technology integrating precision machinery, information communication, image processing, FPGA, electrical electronics automation and academic theories is a highly cross-field discipline. An overall hardware description with software designed for autonomous investigation will be urgent research topics.

2. METHODS

A. myRIO Controller

In this study, the myRIO controller with Tetrix robot and Matrix base metal kit was selected. It has Real-Time function and FPGA function, allowing users to change the input and output pins and view the required data in real time, making it easy for users to use. In [5], myRIO controller based mobile robots are adopted for autonomous robot systems and competitions. Therefore, myRIO as the main core of the controller, we design the smart automation product line. NI LabVIEW software programming can liberate users from the complexity of traditional general-purpose programming, making it easier for users to find program errors [6], [7]. LabVIEW easily integrates programming, visual development, algorithmic measurement tools, communication models, and image processing to develop innovative technologies [8], [9], [10].

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LabVIEW has programming and interface design functions, and can independently design human-machine interfaces, design programs and realize the functions of automation mechanisms. Overall, graphic drag-and-drop design is easier for beginners and requires no programming. When the software enters the LabVIEW window, it is shown in Fig. 1.

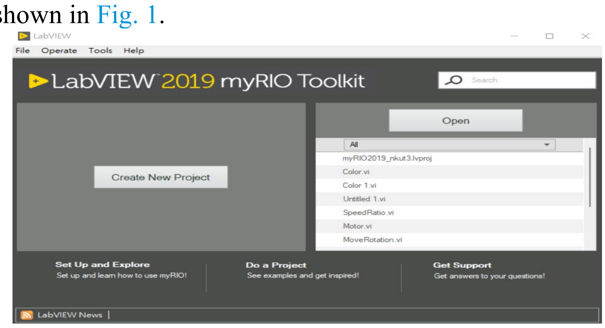

Fig. 1 LabVIEW2019 window

myRIO can provide a variety of interfaces such as DC motors, servo motors, sensors, cameras, and power supplies. The myRIO controller can quickly connect to various controllers and is very convenient to use.

B. Image Recognition

Through Logitech C310 network camera and Microsoft LifeCam network camera, the recognition function can realize RGB and HSL color recognition, Barcode recognition, and automatic mechanism to distinguish similar graphics. It can develop a human-machine interface to present identification results and identification efficiency in real time, improving the efficiency of each production line [11], [12].

C. Motor

RC motor and DC motor have different functions. RC servo motor is usually used to do high torque low speed, which usually is used to do the work for gripping objects. RC servo motor is divided into angle type and continuous type. DC motor is used to do low torque high speed use.

Servo control is a method of controlling many types of RC servos by sending the servo a PWM (pulse-width modulation) signal, a series of repeating pulses of variable width where either the width of the pulse (most common modern hobby servos) or the duty cycle of a pulse train (less common today) determines the position to be achieved by the servo. RC servo motor is to use PWM pulse width to adjust the angle and control the direction of rotation and speed.

The main part of DC motor control is the encoder (reading, pulse width modulation, PWM control, P ID control, Velocity Control). Among them, the encoder reading and pulse width modulation, and PWM control are through myRIO Toolkits and composed of operations and the operation is composed of, and the PID control is to calculate the value of the Encoder and the value of the target, and the final result is sent to the PWM control for control. The top speed control is to control the seconds used in the control. The signal is converted into a value controlled by PID. Through PID, the motor can rotate stably from 0 to 100, and each rotation error can be controlled within the range.

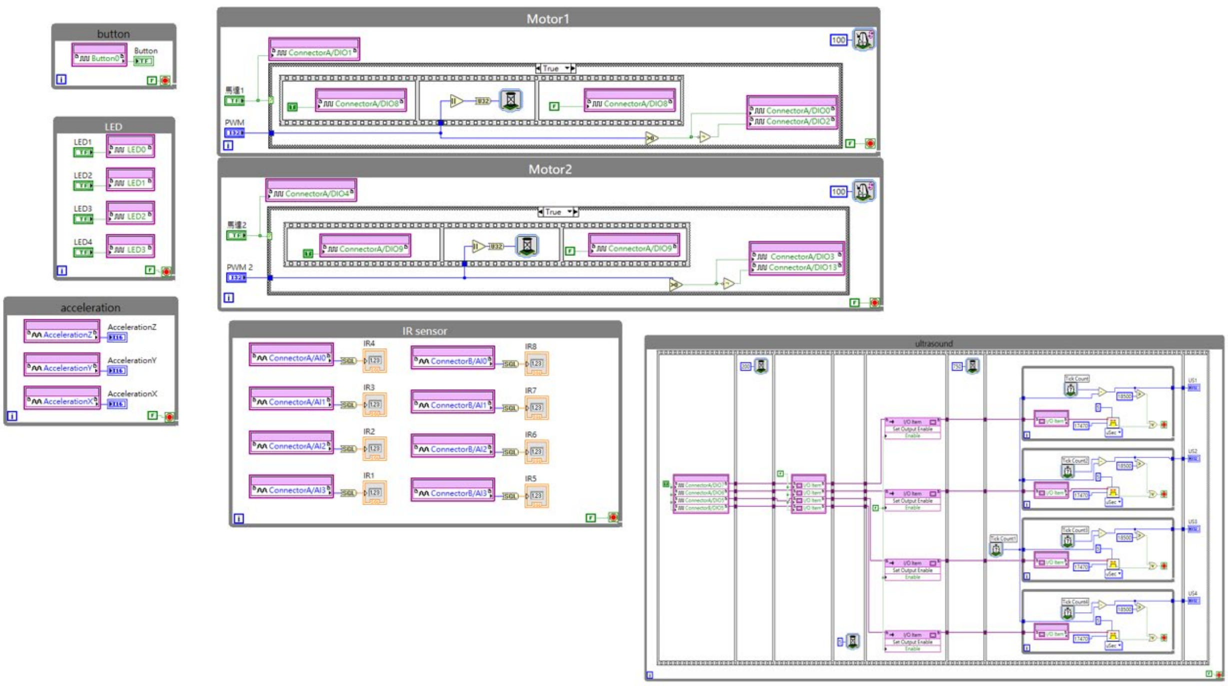

Fig. 2 System FPGA

D. FPGA

FPGA internal logic can be changed at any time according to user needs. Because the parallel processing capability of FPGA is better than Real-Time, we use FPGA to control the input and output of signals and some simpler operations, which can speed up our data processing and reduce the load on the Real-Time side. By writing FPGA, we can also use I/O more flexibly Fig. 2.

E. *Sensors*

Infrared IR sensors use triangulation methods. The detection distance can be converted through voltage and is not easily affected by the reflectivity of various objects. Infrared IR sensors can also be used as proximity sensors to observe numerical changes in the human-machine interface Fig. 3 [13].

The computer connects with myRIO and uses the project to find myRIO hardware by writing ultrasonic program in LabVIEW interface. After the writing is completed, we can test the ultrasound, and you can view the values on the human-machine interface to observe whether there is an error with the actual distance Fig. 4 [14].

3. EXPERIMENTS

In this study, several experiments were conducted to verify the usability of the production line mechanism. Lifting, barcode and color recognition experiments were carried out separately to ensure the efficiency of the production line mechanism by the experimental results.

In Fig. 5, the Vision Assistant is used to edit the items required for images. To find the respective ranges of the corresponding colors, HSL (hue, saturation, lightness) has been used to find the respective ranges of the corresponding colors. Finally, press the selection control again to display the input and output adjustment page, select the desired input and output, and press Finish, which is done. In Fig. 6, we open a new VI and write a shape recognition program in the terminal. First, obtain the target through visual collection and convert the image into black and white, which can greatly improve the processing speed. After binarization and shape appearance training, the shape appearance and area data are obtained. The shape name is obtained through the index array, and then the training results and recognition results are used for comparison. After the comparison is completed, the corresponding shape photos and shapes will be found.

Similarly, the target is photographed by Vision Acquisition, edited by Vision Assistant, the total area value of the Add Array Elements. Finally, the result is judged by Array as shown in Fig. 7. As the same, first, use Vision Acquisition to turn on the camera to get the image, the Vision Assistant reads Barcodes, and then separates the data showing the text and Bollinger signal to obtain Barcodes Recognition as shown in Fig. 8.

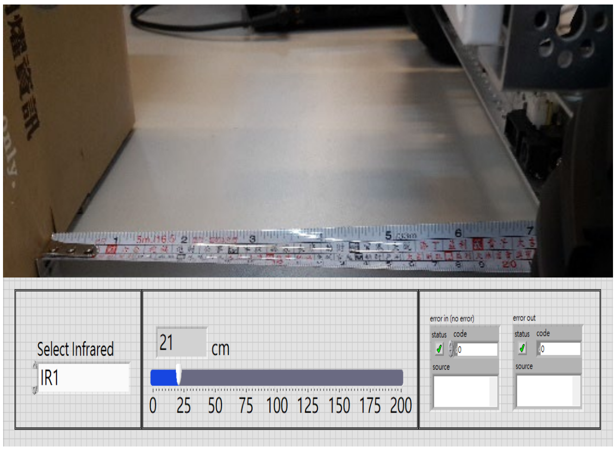

Fig. 3 Distance sensors values

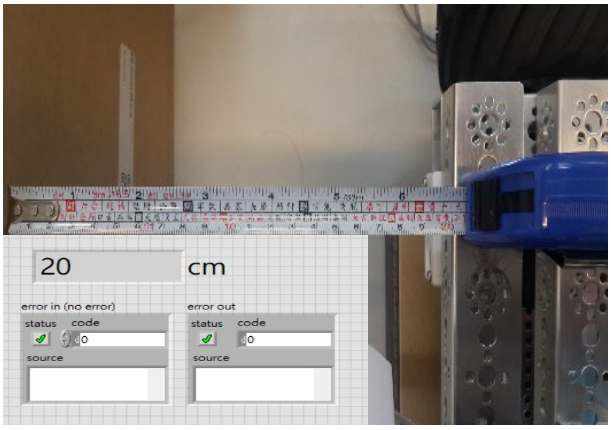

Fig. 4 Ultrasound values

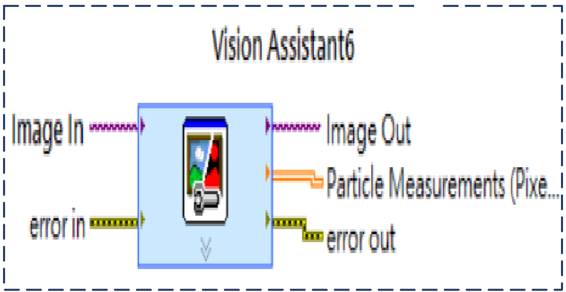

Fig. 5 Vision Assistant

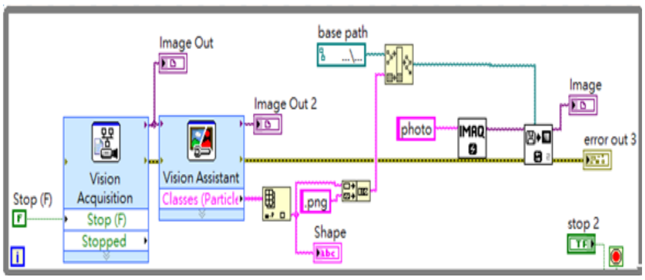

Fig. 6 Pattern Recognition Program

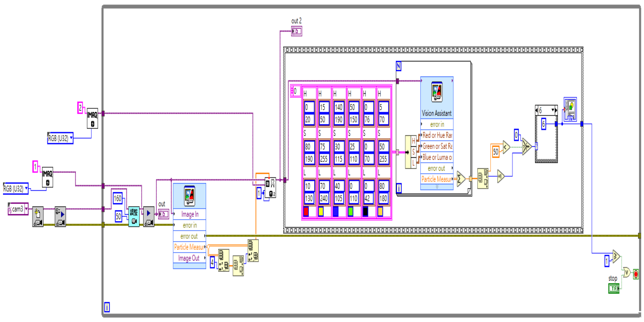

Fig. 7 Colors Recognition Program

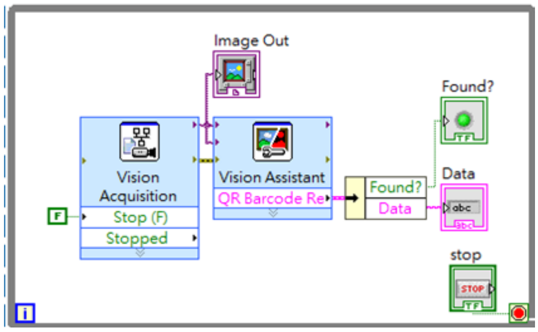

Fig. 8 Barcodes Recognition Program

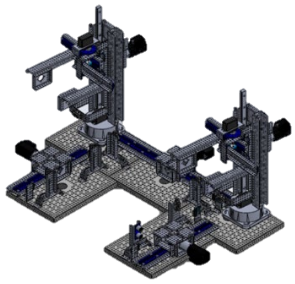

Fig. 9 Production line-like experimental structure

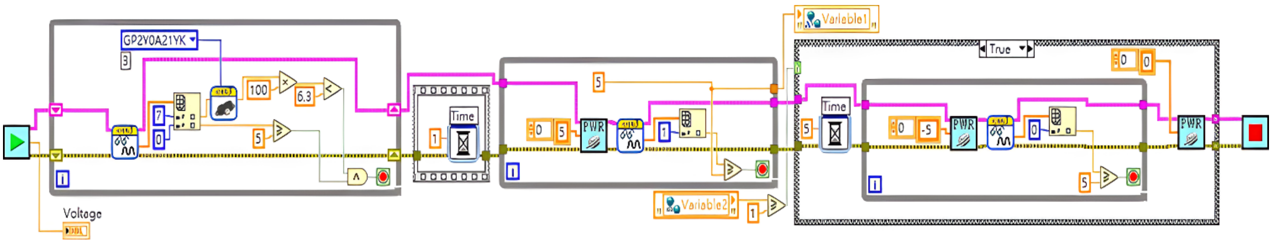

Fig. 10 Step 1 program block flow of LabVIEW

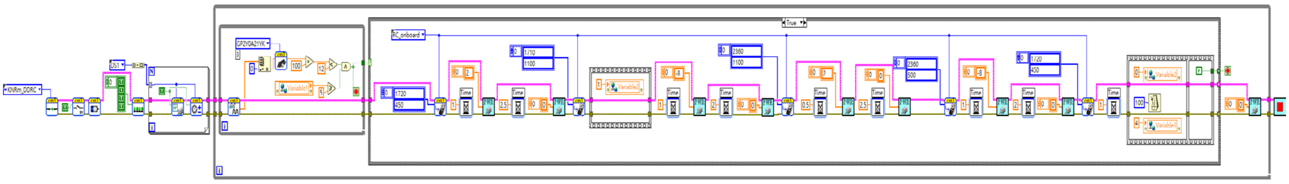

Fig. 11 Step 2 program block flow of LabVIEW

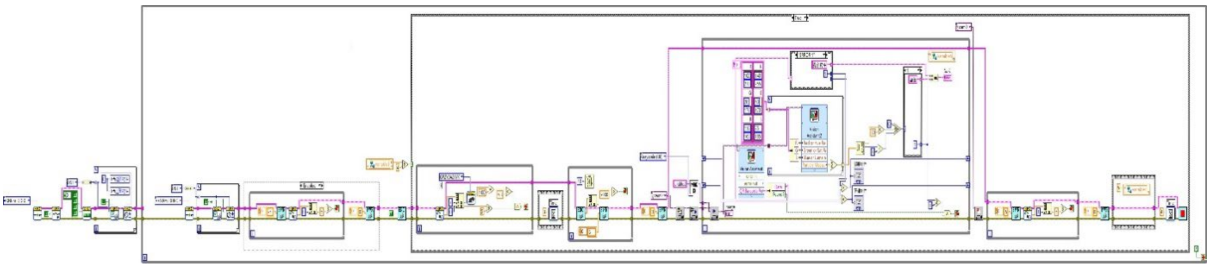

Fig. 12 Step 3 program block flow of LabVIEW

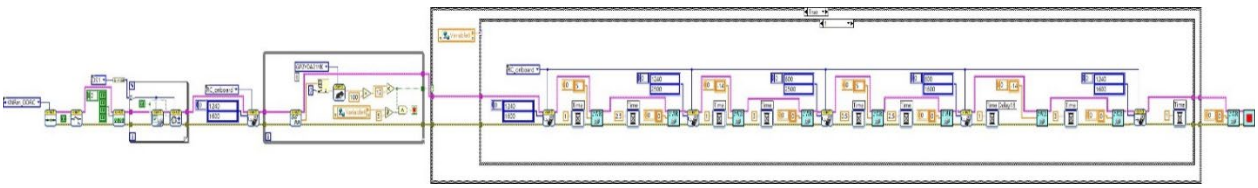

Fig. 13 Step 4 program block flow of LabVIEW

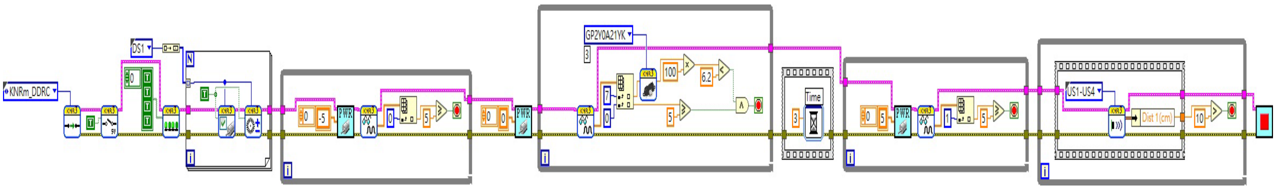

Fig. 14 Step 5 program block flow of LabVIEW

Similar Production Line Steps

The experimental structure of the similar production line is shown in Fig. 9.

A similar production line step is as follows:

Step1

After the start button is pressed, the robot arm and the load platform return to their initial positions, and the object is placed on the load platform. When the infrared sensor senses the object, the load platform starts to move. When the slide rail contacts the micro switch, the slide rail stops moving. Complete step 1 program block flow LabVIEW program as shown in the Fig. 10.

Step 2

When the infrared sensor senses an object, the robotic arm descends to grab the object. The sliding rail movement robot arm rises and stops when it encounters the limit switch. The turntable rotates to the target position, the robot arm descends, the clamp opens, and the object is placed on the load platform. Then, the slider moves the robot arm upward and stops when it encounters the limit switch to complete step 2. The program block diagram of LabVIEW step 2 is shown in Fig. 11.

Step 3

Once an object is placed on the load platform, the infrared sensor senses the object. The linear slide rail starts to move the load platform, and the lens recognizes the object barcode and color. After the recognition is completed, when the load platform slide rail contacts the micro switch, the load platform stops moving to complete step 3. Step 3 The LabVIEW program block diagram is shown in Fig. 12.

Step 4

When the infrared sensor senses an object on the load platform, the robotic arm lowers to grab the object. The linear slide moves to lift the robotic arm. The turntable rotation causes the robotic arm to rotate to the target position. The robotic arm moves down the load platform, placing the object on the storage platform, and then returns to the original position to complete step 4. The program block diagram of LabVIEW step 4 is shown in Fig. 13.

Step 5

When the infrared sensor senses that there is an object on the load platform, the load platform is started, the slider touches the micro switch, and the load platform stops moving. When the ultrasonic sensor on the side of the load platform cannot sense the object, it means that the object has been taken away. The load platform will move to the initial position and stand by, ending the production line process and completing step 5. The program block diagram flow of this step of LabVIEW is shown in Fig. 14.

In order to ensure the stability of the implementation of the production line mechanism, 15 practical experiments were carried out, and each implementation was carried out to identify the object. In 15 implementations, the barcode recognition can be correctly recognized, and the color recognition has one error. The color recognition may be caused by the influence of ambient light. The performance of the production line mechanism can be verified from15 experiments.

Experiment results were carried out on the stability of the whole mechanism. The completion of this mechanism can provide an intelligent automated production module and promote the production line automation technology.

4. RESULTS and DISCUSSION

This article takes the myRIO controller as the main core, and uses Matrix to build and develop an automated production structure through research on practical functions similar to the production mechanism. Combining theoretical methods and practical experiments, an automation structure including an electromechanical system and a smart automation program based on LabVIEW2019 was constructed, and FPGA was used to re-establish pins and WIFI modules for remote monitoring.

The efficiency of the designed automated production line verifies the usability of the designed automation mechanism from experiment results. Then, the designed automated production mechanism can be applied in industry to improve the production capacity, stability, and yield of the production line and fully achieve Industry 4.0.

5. CONCLUSION

To research and design similar production processing, the myRIO controller has been adopted as the main controller. This implement of automation mechanism will complete 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 scheme can popularize intelligent automation education. Laboratory teaching materials continue to be developed and disseminated. In the future, the application of various image recognition can be extended to automated production technology and cultivate cross-field technical talents.

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Authors Introduction

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