Apply RPA (Robotic Process Automation) in Semiconductor Smart Manufacturing

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ABSTRACT

To reduce human resources in trivial and repetitive work, we come up with a method that used Robotic Process Automation (RPA) [1], which is an emerging form of business process automation technology based on the notion of software robots or artificial intelligence workers, to achieve automatically remote control equipment, such as picture shown on Figure 1. It is expected that applying this method to the factory can achieve the goal of unmanned factory.

INTRODUCTION

Nowadays, there is still a lot of work that needs to be done manually in the factory, and some of the work is highly repetitive and long-lasting. However, there are some problems might happen. Such as it easy to mistake when doing repetitive work but not easy aware. Once an undetected error occurs, problems are prone to appear during product production. Moreover, the operator cannot do anything else during these works. Then other work must be postponed or handed over to others.

To solve problems mentioned above, we apply RPA to works by developing a program that can automatically finish the works via controlling computer. Accordingly, it can reduce miss-operation rate and release the human resource.

METHODOLOGY

After receiving the operation flow of work, we will start to design the program. The program has two parts, as shown in Figure 2, the first part is controlling the equipment, the second part is to recognize the screen image, such as where to click or get the information form screen.

Control Equipment

To control equipment, we would let the computer connect equipment. And then control the computer to achieve the purpose of controlling the equipment.

There are three parts to control computer. First, the program would control or simulate mouse signal. Second, the program would control or simulate keyboard signal. Last, the program would get computer screen image, which is the real-time equipment image. According to above three items, the program then can control the equipment via control the computer.

In addition to controlling the equipment, the operation flow also includes controlling the other related instruments, such as joysticks and knobs shown on Figure 3. We would establish a web service to connect the signals to the program so that the instruments can be controlled through the program.

Image recognition

We would mainly use the image recognition and Optical Character Recognition (OCR), which is the mechanical or electronic conversion of images of typed, handwritten or printed text into machine-encoded text, to identify where to click or input and get the information from the screen.

On the other hand, except for general image recognition, we often need to judge good picture and bad picture in RPA. For example, CD measurement is a very important step during the entire manufacturing process, to keep the stability of the product. Whether the picture for measurement is fuzzy or not, determine the accuracy of CD measurement. There are two methods we used to judge the fuzzy picture. One is to compute some statistic index of all pixel information, and the other is ANN (Artificial Neural Network), that is providing a large number of labeled pictures for the computer to let it learning what difference between fuzzy and clear picture. We found the two methods have the similar accuracy of fuzzy judgment, but calculating statistic index is more efficient than the other. To promote the efficiency of RPA, we choose to calculate statistic index and set criteria to judge the fuzzy picture.

Combining the above methods, the program can complete the actions of steps from connecting to the equipment, acquiring the screen of the equipment, identifying the position of the required action, and performing the action correctly, such as move the mouse or key-in words.

Following the steps in order, then the program can automatically complete the work. The program flow as shown on Figure 4.

TECHNOLOGY

Control Equipment

Because we need to control equipment through control computer, we have to know how to control computer. And we find that there are several ways to control mouse and keyboard on the computer. Some of them send the virtual code to the computer. Some of them send scan code. Sometimes, these two different ways to control mouse and keyboard were both useful. But in our program, only the second way - send scan code to the computer would work.

For controlling the relevant instrument, we need to additionally connect the signal of the instrument to the PC, and then transmit the command to control the instrument through the web service. To confirm the instrument could be successfully controlled, we would test the result of transmission and command, such as the stability of the transmitted signal, or the moving distance of the instrument through the command.

Image recognition

The OCR function is needed to obtain the screen image first, and then recognized the text after image pre-processing in order to reduce noise. Because the OCR function would not achieve 100% accuracy, image pre-processing is more important. So we will try some ways to raise the accuracy, such as turn RGB image to gray level image, set a threshold to binaries the image and enhanced the image comparison, and so on.

RESULTS AND CONCLUSION

Since the program has finished, we tested this program to a work. And the success rate was about 90%. According to the result of testing, we can know that it is very feasible to apply RPA in the factory. Moreover, we could claim that the operator could even be replaced by it. It can improve manually operation quality and efficiency. And decrease the mistake probability that would cause product production failed. Moreover, it can reduce human resource.

It can expect that with more and more RAP applied to the factory, the miss-operation rate will be reduced significantly, and the released human resources will be used in other works to achieve greater efficiency.

REFERENCE

[1] Cathy Tornbohm, John E. Van Decker (2017). When and How to Use Robotic Process Automation in Finance and Accounting. *Gartner*, ID: G00341659.

APPENDIX

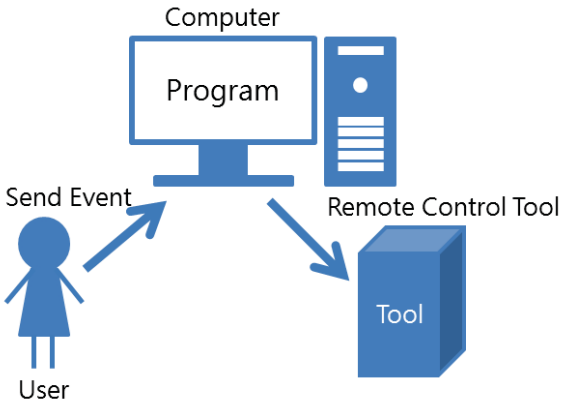

Figure 1. The flow of applying RPA to equipment remote control.

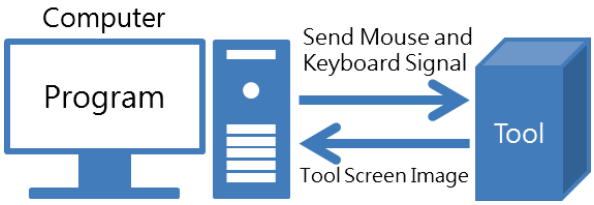

Figure 2. Interaction between RPA program and tool.

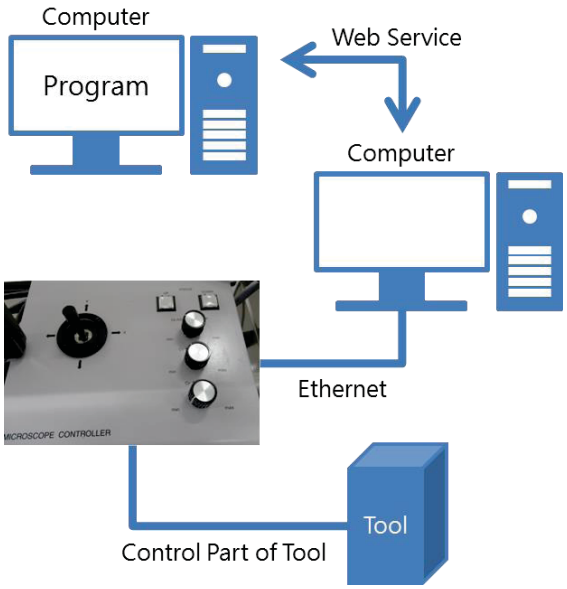

Figure 3. The flow of control related instruments.

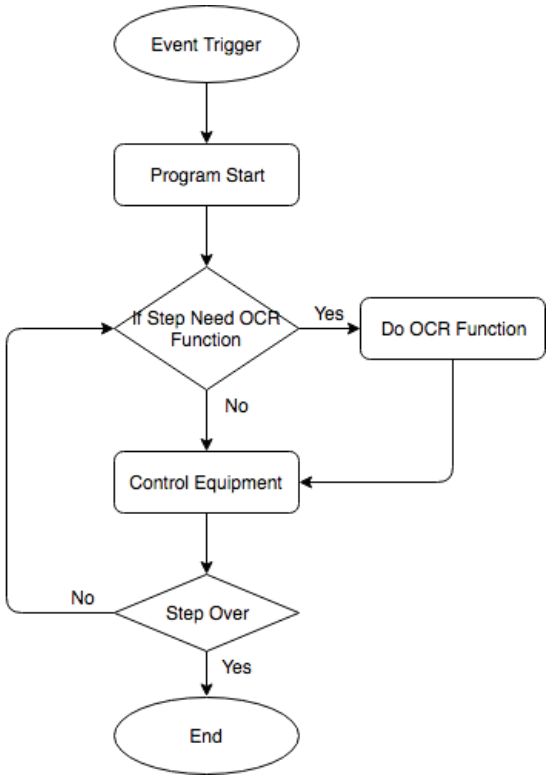

Figure 4. The program flow.