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The exploitation of a portable program used for wire bending machines

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ABSTRACT

The wire bending machines are the common equipment producing the finished metal wires, such as bicycles' rear racks, various hooks, mirror frames and so on. The diversity of products determines the diversity of both the number and the order of wire bending machines' actuators, producing various process requirements. Aiming at the different process requirements, the article developed a 'all-purpose' control program with strong portability, realizing that when the mechanical process requirements changes, users adjust independently the production process without changing the program and external wiring of the control system, which is verified and applied in practice.

KEYWORDS

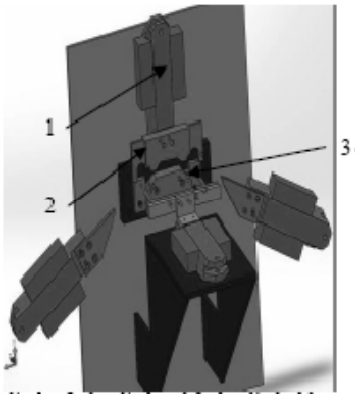
The wire bending machines; Diversity; Portability; Adjust independently.

INTRODUCTION

With the development of science and technology, enterprises put forward higher requirements for the automation technology. The conventional control method is mainly each set of equipment draws up a process, whose control program is cured to the controller. The function realized by the program is also fixed, which cann't be adjusted though it's only a local change of equipment' function[1-4]. When the production process occurs local adjustment, the program needs to be rewrite, increasing the production cycle and the cost of production. This kind of problem is particularly prominent in the wire bending machines introduced by the article. Users need a kind of 'all-purpose' program with strong portability. For this, the article adopts a new programming method, realizing users change the number and the order of actuators only through simple input on the man-machine interface, whicn solves the problem that users feels at a loss what to do facing with the local adjustment of the process[5-8].

THE PROCESS REQUIREMENTS OF WIRE BENDING MACHINES

The wire bending machines are the common equipment producing the finished metal wires, such as bicycles' rear racks, various hooks, mirror frames and so on. Figure 1 is a schematic diagram of a kind of wire bending machine, whose main actuators consist of a feeding motor and some hydro-cylinders. The feeding motor completes the feeding of metal wire and the die head driven by the hydro-cylinder presses the wire on the corresponding die holder, completing the bender of the wire of the required shape. Aiming at the different bending requirements, users only need to change the shapes of die heads and die holders and transform the number and motion sequence of hydro-cylinders. In this case, the article develops a general program, which can be transplanted to each other among the machines of producing different products. This will greatly reduce the production cost and cycle, and brings great convenience to device makers and producers[9-14].



1-hydro-cylinder;2-the die head;3-the die holder
Figure 1 : The schematic diagram of a kind of wire bending machine

SOFTWARE DESIGN

The selection of the control core

As a control core, PLC has many advantages, such as the versatility, high reliability, strong anti-interference ability, strong drive ability and so on. In recent years, the function of PLC has a leap of development instead of only using for the logic control. PLC largely replaced the microcontroller in various fields, gradually becoming the mainstream of general industrial control system. At the same time, the touch screen shows more and more powerful advantage in many aspects of the industrial field, such as monitoring and acquisition of the data, controlling and processing of the front-end data. The comprehensive use of PLC and the touch screen has become the most common control mode in the industrial control[15,16]. The PLC of Mitsubishi Fx series has high integration, low cost and small size. More important, it can be programmed with the ladder diagram, which makes the program easy to understand. The human-computer interface of KUNLUN TONGTAI is high performance integrated

industrial control computer with embedded low power CPU as the core, which has excellent electromagnetic shielding property and humanized operation interface. So the article illustrates the concrete design using the PLC of Mitsubishi FX series and the human-computer interface of KUNLUN TONGTAI[17,18].

The design of the program

In order to simplify the program, the article introduces the method using four hydro-cylinders as an example. To avoid the duplicate input of the same set of process, time registers and the soft components about enabling the output both use the soft components that can keep their previous status when the power is off. The program segment about when to perform the actions is shown in Figure 2, corresponding commentary is listed in the TABLE 1, and the program segment about starting the actions of the feeding motor and no.1 hydro-cylinder is shown in Figure 3,whicn is similar to the program segment about starting the actions of other hydro-cylinders, corresponding commentary is listed in the TABLE 2. After meeting the condition of run automatically, the flag of running automatically is set, timers beginning to time[19].

When a certain timer's time is up, the program jumps into the corresponding program segment about starting the action. Other timers go on timing until their time is up, then it jumps into corresponding program segment, executing corresponding action. Each action is independent of each other, only controlled by the data input in its input box[20].

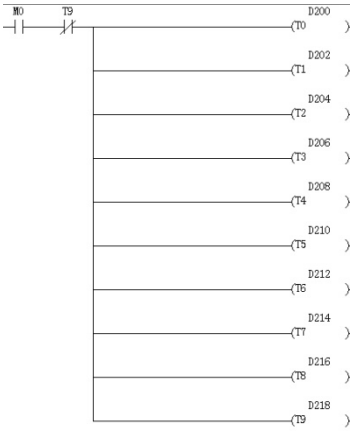


Figure 2 : The program segment about when to perform the actions

TABLE 1 : The comentary about Figure 2

Name	Commentary	Corresponding time Register
M0	the flag of running automatically	———
T0	feeding time	D200
T1	Extending time of No.1 hydro-cylinder	D202
T2	Retracting time of No.1 hydro-cylinder	D204
T3	Extending time of No.2 hydro-cylinder	D206
T4	Retracting time of No.2 hydro-cylinder	D208
T5	Retracting time of No.3 hydro-cylinder	D210
T6	Extending time of No.3 hydro-cylinder	D212
T7	Retracting time of No.4 hydro-cylinder	D214
T8	Extending time of No.4 hydro-cylinder	D216
T9	Cycling time	D218

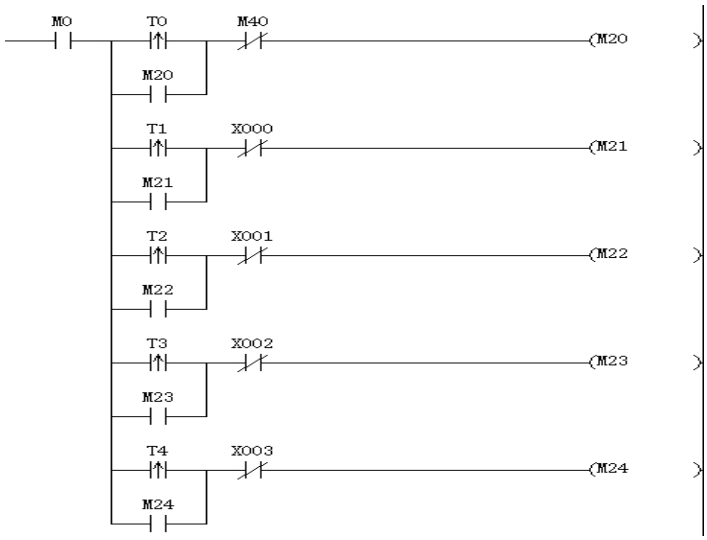


Figure 3 : The program segment about starting

TABLE 2 : The comentary about Figure 3

NAME	COMMENTARY	NAME	COMMENTARY
M20	THE FLAG OF STARTING THE FEEDING	X1	THE SENCOR THE EXTENDING OF NO.1 CYLINDER
M40	THE FLAG OF THE FEEDING COMPLETED	M23	THE SENCOR THE RETRACTING OF NO.2 CYLINDER
M21	THE FLAG OF THE RETRACTING OF NO.1 CYLINDER	X2	THE FLAG OF THE RETRACTING OF NO.2 CYLINDER
X0	THE SENCOR THE RETRACTING OF NO.1 CYLINDER	M24	THE FLAG OF THE EXTENDING OF NO.2 CYLINDER
M22	THE FLAG OF THE EXTENDING OF NO.1 CYLINDER	X3	THE SENCOR THE EXTENDING OF NO.2 CYLINDER

In addition to change the action sequence independently, the program also need to meet the requirement of increasing or decreasing the number of cylinders. The article adopts increases action disable bit in the output block to complete this function. If a certain hydro-cylinder is forbidden to act, it's disabling bit is set. Then the program segment about controlling the output will be shielded, realizing the increase and decrease of the number of actuators. The program segment about controlling the output is shown in the Figure 4,corresponding commentary is listed in the TABLE 3.

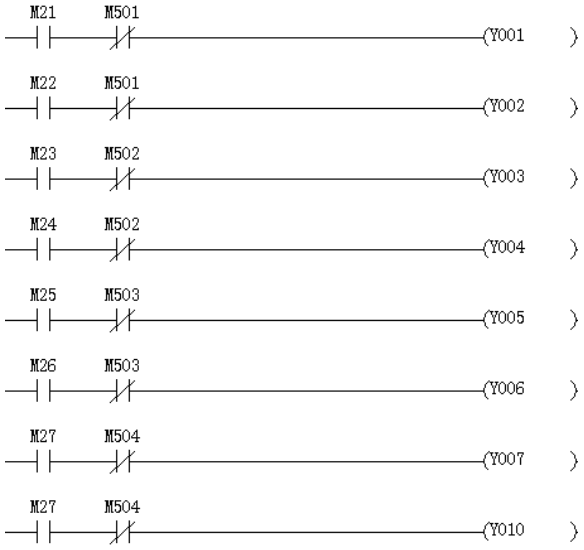


Figure 4 : The program segment about controlling the output

TABLE 3 : The comentary about Figure 4

NAME	COMMENTARY	NAME	COMMENTARY
M501	THE DISABLING BIT OF NO.1 CYLINDER	M503	THE DISABLING BIT OF NO.3 CYLINDER
Y1	THE OUTPUT FLAG OF THE RETRACTING OF NO.1 CYLINDER	Y5	THE OUTPUT FLAG OF THE RETRACTING OF NO.3 CYLINDER
Y2	THE OUTPUT FLAG OF THE EXTENDING OF NO.1 CYLINDER	Y6	THE OUTPUT FLAG OF THE EXTENDING OF NO.3 CYLINDER
M502	THE DISABLING BIT OF NO.1 CYLINDER	M504	THE DISABLING BIT OF NO.4 CYLINDER
Y3	THE OUTPUT FLAG OF THE RETRACTING OF NO.2 CYLINDER	Y7	THE OUTPUT FLAG OF THE RETRACTING OF NO.4 CYLINDER
Y4	THE OUTPUT FLAG OF THE EXTENDING OF NO.2 CYLINDER	Y10	THE OUTPUT FLAG OF THE EXTENDING OF NO.4 CYLINDER

Some the wire bending machines can product two or more products by only change the action sequence without any change in the mechanical structure. To this situation, it obviously greatly increased the input time that alternately input the same sets of parameters between the two or more products. So for the frequent set that often need to be input, the 'one key calling' program segment can be added in the program, which is shown in the Figure 5,which brings the users great convenience. Besides, if a program concludes two or more processes, this can solve the malpractice of that a set of process occupies a set of soft component memory in one program. Adopting the 'one key calling' program segment, a plurality of sets of process can use only a set of soft components in the same program. The specific data needed depends on which 'one key calling' program segment they call. This can reducing the occupancy rate of the soft component memory.

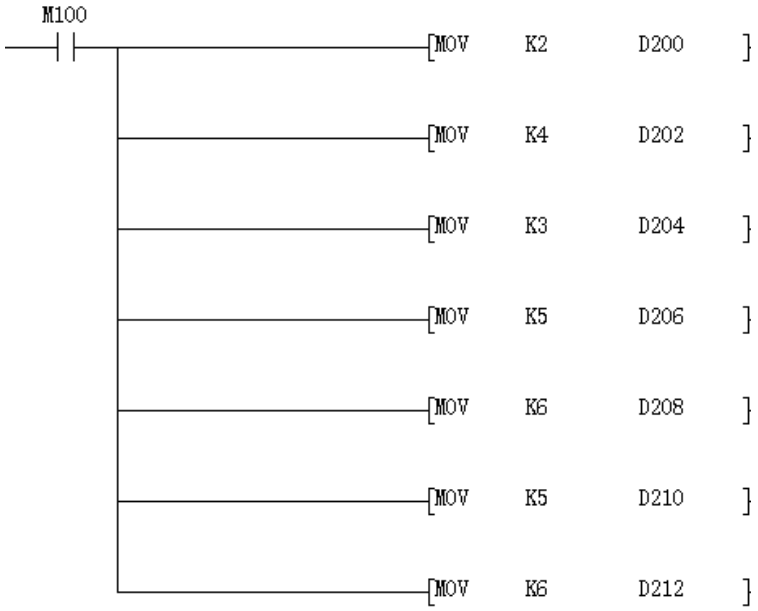


Figure 5 : 'one key calling' program segment

The design of the setup window in the man-machine interface

The setup window in the man-machine interface is shown in Figure 6. Whether the hydro-cylinders act depends on the set operation of the corresponding labels. The input boxes can be input in the data of the time register, which determines the acting time of the hydro-cylinders.

Besides, In order to facilitate the input, the number input in the touch screen will be ratio conversed and rounded, make screen input values correspond to the actual value.

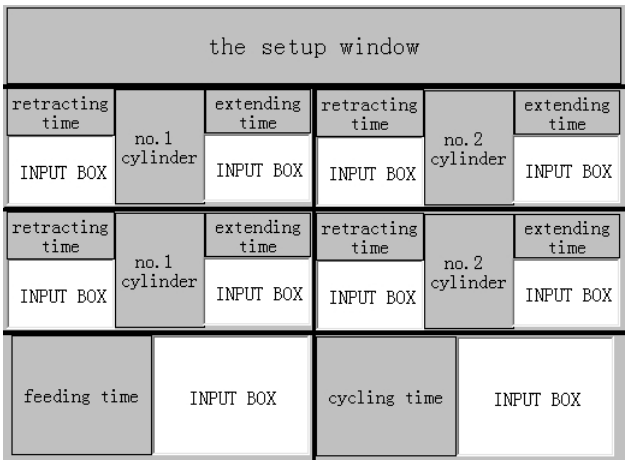


Figure 6 : The setup window

TABLE IV shows two processes of the wire bending machines. After users input the data shown in TABLE V, the corresponding process is completed.

TABLE 4 : Two processes of the wire bending machines

ORDER	PROCESS 1	PROCESS 2
1	THE MOTOR FEEDS	THE NO.1 CYLINDER STRETCHS
2	THE NO.1 CYLINDER STRETCHS	THE MOTOR FEEDS
3	THE NO.2 CYLINDER AND NO.3 CYLINDER STRETCH	THE NO.4 CYLINDER STRETCHS
4	THE NO.1 CYLINDER RETRACTS	THE NO.1 CYLINDER RETRACTS
5	THE NO.4 CYLINDER STRETCHS	THE NO.2 CYLINDER STRETCHS
6	THE NO.4 CYLINDER RETRACTS	THE NO.2 CYLINDER AND NO.4 CYLINDER RETRACT
7	THE NO.2 CYLINDER AND THE NO.3 CYLINDER RETRACT	

TABLE 5 : The parameter setting table

REGISTER	THE SETTING(S)	
	PROCESS 1	PROCESS 2
D200	2	4
D202	4	2
D204	8	8
D206	6	10
D208	14	12
D210	6	FORBIDDEN
D212	14	FORBIDDEN
D214	10	12
D216	12	6
D218	16	14

CONCLUSIONS

Aiming at the process characteristics of the wire bending machines, the article breaks the inherent thinking of that a set of process corresponds to a set of software program, developing a set of portable program meeting the need of the diversity of the number and the action sequence of the actuators. Only through simple input on the man-machine interface, users can realize different processes,

which has a strong reference and scalability. The program segment of 'one key calling' based on this method has the advantage of saving the device memory when use in the usual program, which can be used to solve the program of the shortage of device addresses, having a certain reference value. The method introduced in the article has been applied in practice, which confirms the validity of the control system, reducing the production cost and strengthening the enterprise strength.

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