

Designing Controller of the Automatic Billet Drilling Machine Model in the Laboratory Using Plc

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ABSTRACT: The field of assembling and designing tools for construction and home repair work is now becoming more popular than ever. This led to the introduction of many different types of tools and equipment, making the work of construction workers easy, typically the automatic drilling machine.

KEYWORDS: PLC, drilling machine.

I. INTRODUCTION

The automatic drilling machine works with a separate principle. The machine uses compressed air with the main shaft rotating according to the electric motor with the machining stroke controlled by the pneumatic system. With this spindle section, the drill will be allowed to push straight down at a speed compatible with the operating mode level suitable for each type of work. So, the drill bit can automatically eat the workpiece when drilling. The product does not require the operator to use the handpiece or his work schedule to pull the drill rod like in other machines. Existing automatic drilling machine products include high-end drills with self-feeding punching modes, widely used for large-volume, high-precision, labor-saving, high-precision, labor-saving, high-lifting jobs. high work productivity.

II. HIGHLIGHTS OF AUTOMATIC DRILLING MACHINE

Highlights of each design in the array of structures to give birth to different features that today's consumers can find different types of automatic drilling machines.

Corresponding to 3 main product groups: automatic drilling machine that feeds the workpiece with an intermediate pulley, an automatic drill that feeds the workpiece with an independent motor, and an automatic drill with a gearbox.

The role of the automatic drilling machine and the urgency of the topic

- Application in industrial wood CNC blanking machine supports the process of drilling holes to catch cam screws to create links between planks to form finished products. Suitable for workshops that need large output. There are many ways to create links, but when using a cnc drill, the machining speed will be faster, the quality will be uniform. Save time and labor costs.

- Similar to a regular drill

- The automatic bench drill uses a power core powered by an electrical conductor, so the drill series is composed of an electric motor.

- In the belt drive part, a toothed pulley is used as an intermediate pulley device for the machine.

- The construction of the automatic drilling machine allows the user to not have to interfere in all material handling, which creates the need for a circular slider linear guide device.

- When the engine stops working, the machine allows to change the speed level automatically.

- Compressed air supply unit with separate air compressor.

- The compressed air pressure of the machine produces an average within the range of 5-7 kg/cm².

- Save users time and effort

- The pneumatic cylinder in the main shaft part is integrated into the machine and the feed rate is controlled by the pneumatic valve.

- The engine uses shock cage type, physical transmission through pulley, gearbox.

- No need to use manual operation, the machine can still pull the drill bit easily thanks to the workpiece eating by itself.

- The automatic drilling machine can be used effectively with all kinds of sliders, square sliders when installing and operating.

- Bringing regular and accurate workpiece feeding, improving work efficiency, borehole products also have high aesthetics.
- With modern features, consumers can simultaneously handle the operation of many different automatic drilling machines, reducing production costs and saving workers' time.
- With the stroke threshold, the drill allows the pre-setting of the depth of the drill bit to be reached.



Figure 1. Pictures of automatic drilling machines

III. TECHNOLOGY REQUIREMENTS

Conduct research and build a model of automatic billet drilling machine using PLC mitsubishi as the central controller with the following requirements:
 The system operates in two modes:

-Manual Mode:

In Manual mode, the operator can turn on and off each actuator such as cylinder, engine by corresponding buttons on the control panel for the purpose of checking the operation of the equipment to ensure the equipment normal operation and ensure the safety of the operator or for other purposes...

-Automatic mode:

Automatic mode is the main running mode, when the start button is pressed, the system enters the main mode, this mode performs consecutive drilling of 5 holes in a straight line on the wood billet with the following parameters:

Ordinal number	Parameter name	Information
1	Type of workpiece	Wood billets in the form of bars
2	Size	100x500X10mm
3	Size hole	D=4mm- Can be adjusted
4	Hole distance	5cm – Can be adjusted

From the above technology requirements, we can give an overview structure diagram of the system as shown as Figure 3.

The whole system is controlled by the programmable controller PLC FX1N 24MR.

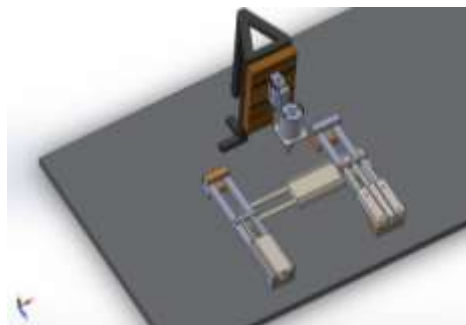


Figure 2. Simulation of system design by 3D software

The extreme sensors have the function to ensure the safety of the axes and the whole system from being overrun, and at the same time determine the position of drilling down, drilling up to carry out the extraction and transport to the exactly position.

Pneumatic system includes pneumatic valve, pneumatic cylinder and vacuum valve, the duty of pneumatic cylinder plays the role of X,Y,Z axis moving in X,Y,Z direction to hold workpiece when drilling and transfer the workpiece to the next drilling position to perform drilling. The pneumatic

valve has the function of directing the air flow to control the cylinder.

The automatic drilling system has the following general structure:

- Central controller.
- Drive system.
- Pneumatic cylinder system.
- Signaling system.
- Control system, human-machine interface.



Figure 3. The overall structure diagram of the system

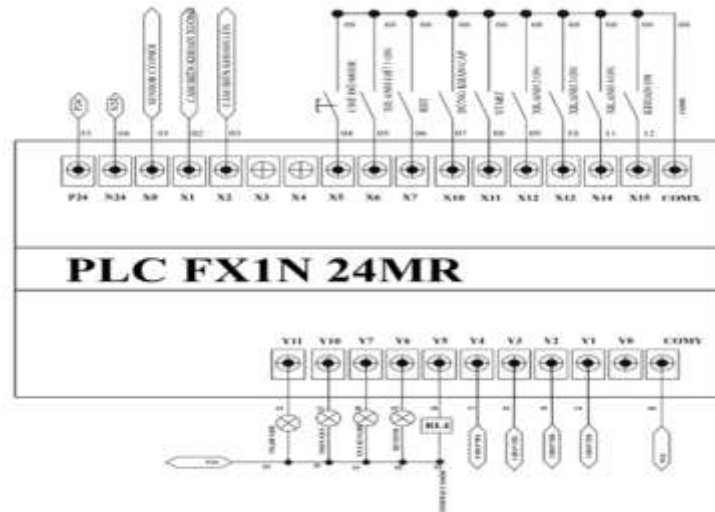


Figure 4. Connection diagram used in automatic billet drilling machine model

IV. INTRODUCTION OF ENGINE AND PNEUMATIC VALVE

DC motor 775

Motor 775 is a type of motor with a rotating shaft, using a DC power supply of 12V or

more. And can be applied in practice, its applicability is very high, can make a lot of life tools such as lawn mowers, wood cutters, grinders, drills, pumps...



Figure 5. Image of Motor 775

Ordinal number	Name	Parameter	Units
1	Device name	Motor 775	
2	Shaft Diameter	5	mm
3	Shaft length	17	mm
4	Motor length	66.7	mm
5	Diameter of round face before shaft	17.5	mm
6	Height of round face in front of	4	mm

	shaft		
7	Motor diameter	42	mm
8	Engine overall length	98	mm
9	Motor fixing screw size	M4	mm
10	Torque	2 Kg/cm or 0,2 N/m	

Table 1. Parameter table of drill motor 775

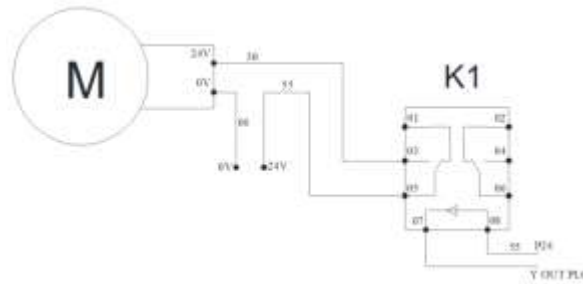


Figure 6. Drill motor connection diagram

Introduction of reversing valve

The reversing valve is a type used to control and regulate the compressed air flow through the valve.

Operation by opening/closing switch positions and functions for each other.



Figure 7. Pictures of pneumatic valves used in the system

Ordinal number	Name	Parameter	Units
1	Device name	Reversing valve	
2	Type	5/2 SMC	
3	Port number	Valve 5/2	
4	Status number	5	mm
5	Outlet diameter	2	mm
6	Air inlet diameter	4	mm
7	Code	9.6	mm
		SY3	

Table 2. Parameter table of pneumatic cylinders used in the system

Reversing valve: when there is no signal to act on door (12), door (1) is blocked and door (2) connects to door (3). When there is an impact signal at door (12), for example by compressed air flow, the valve stem will move to the right, door

(1) connects to port (2) and door (3) is blocked. In case the signal acting on the door (12) is lost, under the action of the spring force, the valve barrel will return to its original position.

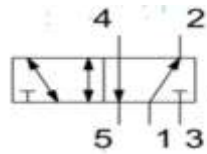


Figure 8. Reverse valve symbol

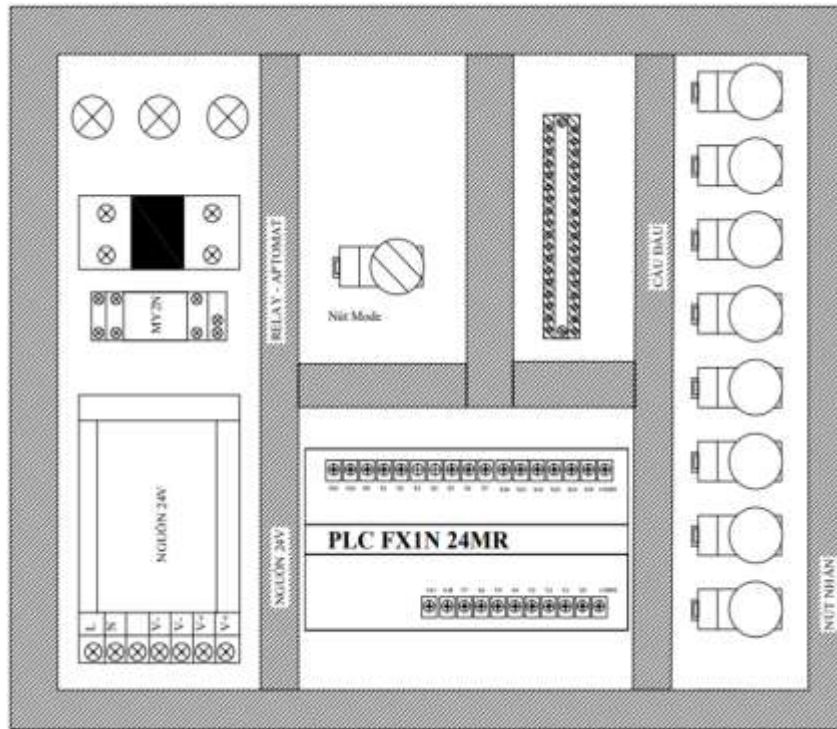


Figure 9. System equipment distribution diagram

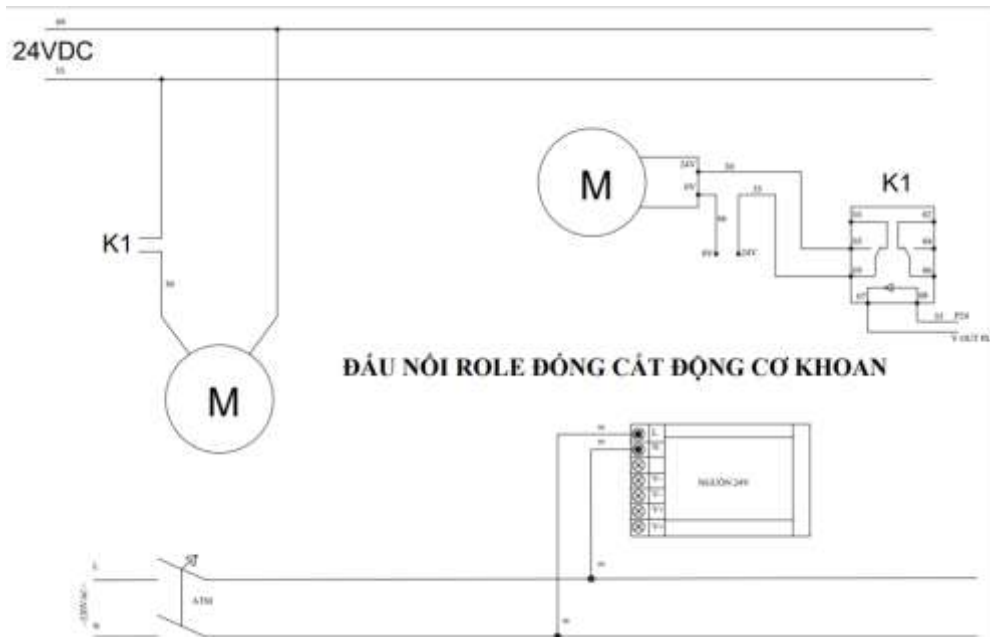


Figure 10. System dynamic connection diagram

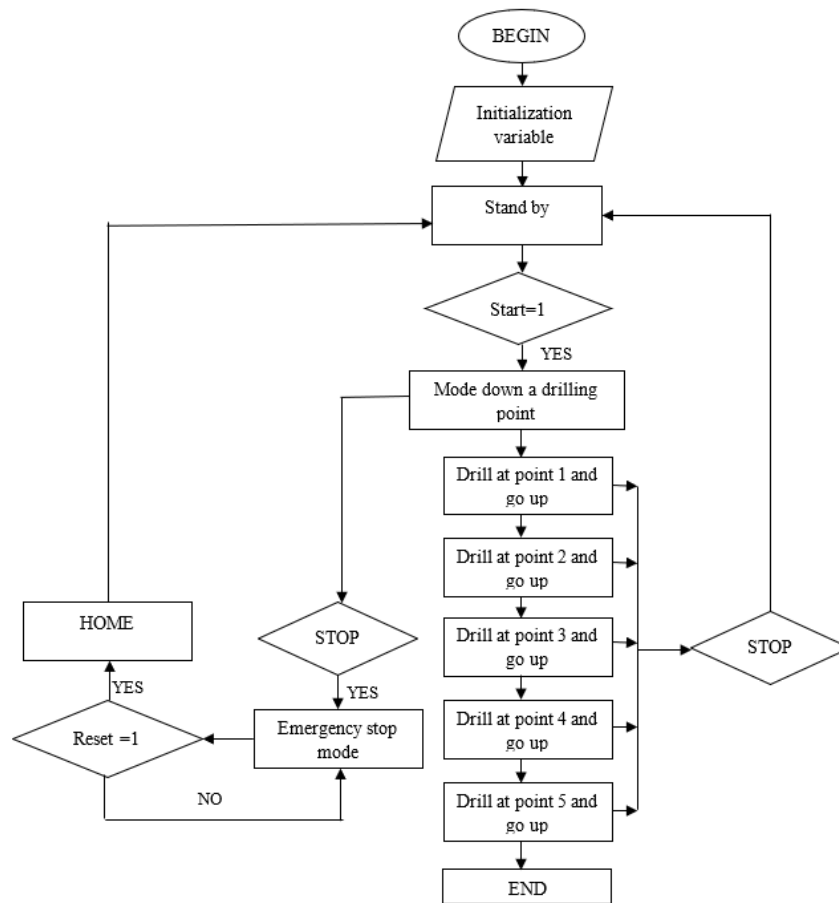


Figure 11. Algorithm flowchart

V. RESULTS AND DISCUSSION

Use GT Designer 2 software to write a programming program for Mitsubishi FX1N PLC to control the model according to technology requirements.

After the process of conceptualizing the design, designing the model on the simulation space, designing the connection diagram and programming the system, testing the system, the conclusion is that the system operates stably and with high accuracy. up to 90%. During the operation of the mechanical structure, the level of reliable operation has not been achieved, so there

are still some minor errors such as: the drill bit slips, the wooden bar is turned on when pressing reset, which can cause danger to the operator. . The topic has achieved the control of the experimental model at a simple level.

In the future, it is possible to improve the model control to a higher level such as:

- Changed the programming code for more optimal control
- Change the depth and size of the borehole
- Developing a system of error reporting through the screen such as: reporting problems with broken drill bits, unsatisfactory drill holes...



Figure 12. The image of the system after complete

VI. CONCLUSION

In the process of implementation, the most difficult thing when designing and constructing is hardware design because the model has a lot of details. Therefore, it is not easy to calculate to put these details on a specific model reasonably. This is also the most consuming part of the process.

Using GT Designer 2 software to write control programs is relatively convenient.

The result: The system operates stably, with high accuracy, which can be put into production processes in industrial plants with high accuracy requirements.

- Add the number of safety devices.
- Add new features, for example camera.

- Increase system accuracy. ...
- Add HMI monitoring system.

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