Lighting Control System Design of Tobacco Distribution Center Warehouse Based on Industrial Controller PCC

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***Abstract*—With the large scale and multi-function of the warehouse of the tobacco distribution center, its energy consumption is very huge, and the energy saving potential is significant. As one of the main power system of tobacco distribution center, lighting system is still controlled by manual mode, which cannot meet the development needs of the current intelligent and energy-saving warehouse. Therefore, it is urgent to develop an intelligent and efficient lighting control system for tobacco distribution center warehouse. In this paper, based on the industrial controller PCC and automation project software Studio Automation, with a tobacco distribution center as an example, the intelligent warehouse lighting control system is developed. Through the hardware selection and software design, the control of the lighting system is realized. The simulation results show the effectiveness of the design.**

Keywords-tobacco distribution; industry controller; lightning system; intelligence

I. INTRODUCTION

In recent years, State Tobacco Monopoly Bureau has been trying to speed up the implementation effect of emission reduction projects, to strengthen energy management, strengthen the key energy using units of energy-saving management, continue to promote energy-saving emission reduction work level [1], the comprehensive construction of a resource-saving and environment friendly type tobacco industry.

Tobacco distribution center warehouse is a key link in tobacco production and circulation. It integrates the functions of cigarette storage management, sorting operation, distribution service, equipment application, information processing, logistics support and so on. With the large scale and multi function of the warehouse of the tobacco distribution center, the energy consumption is very huge, and the energy saving potential is significant. As one of the main power system of tobacco distribution center, lighting system is still controlled by manual mode, which can not meet the development needs of the current intelligent and energy-saving warehouse. J. Ran proposed applications of LED lighting lamps in tobacco industry energy saving reconstruction, and got a remarkable energy saving and emission reduction effect in [2]. Based on the industrial controller PCC and automation project software Automation Studio, design of tobacco distribution center warehouse lighting control system is discussed in the paper.

II. HARDWARE SYSTEM DESIGN

A. Type Selection of Industrial Controller

Industrial controller (PCC) is a new type of qualitative time multitask PLC, which is designed by B&R for applications in industrial environment [3]. It has all functions of traditional PLC. At the same time, it also has options available to a variety of high-level language programming environment, incorporates the latest IT network technology, with more powerful network communication ability, mathematical ability, anti-interference capability and control capability, which represents the direction of future development of PLC. According to the requirements of the design, X20 series PCC X20CP1484-1 is chosen as CPU, as shown in figure 1. The X20 connection mode is the slot mode, which can be quickly installed without tools. When in use, user can insert the appropriate cable into the connecting hole. Users can also remove the terminal from the module, the line will be connected to the next, and then insert the module. This way makes the connection convenient, fast and high security.

FIGURE I. X20CP1484-1 PCC

B. I/O Module Selection

B&R X20 PCC I/O modules consists of digital input modules, digital output modules, digital mixed modules, analog input modules, analog output modules, temperature modules, counter modules and other functional modules.

Here, X20DI9371 and X20DO9322 are chosen as digital input module and output module, respectively. The DI9371 module is equipped with twelve inputs for 1-wire connections. The DI9371 designed for sink input wiring. The DO9322 module is equipped with twelve outputs for 1-wire connections. The DO9322 designed for source output wiring. Their pin assignments are shown in figure 2 and figure 3.

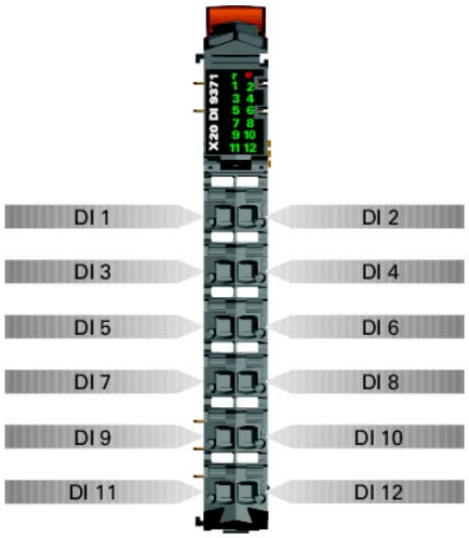

FIGURE II. DI9371 PIN ASSIGNMENTS

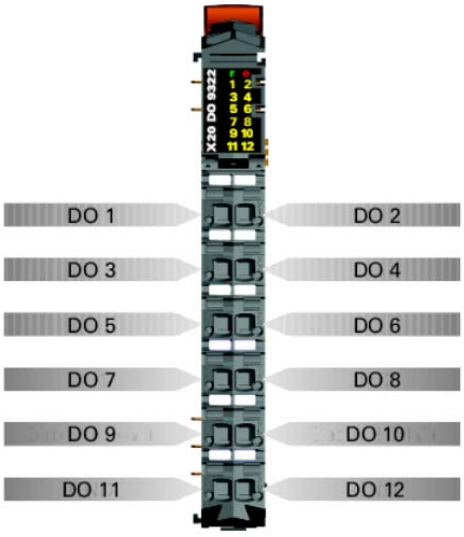

FIGURE III. DO9322 PIN ASSIGNMENTS

C. *Type Selection of Illumination Meter*

Illumination meter is a kind special measuring instrument for photometric and brightness, which is usually composed by selenium light battery or silicon photocell and microampere table composition [4]. The photoelectric sensor elements are used to convert optical signals into electrical signals, and the signals are amplified and converted by A/D, and finally the data is displayed by the digital tube.

Type ALPD004101 is used for the Illumination meter. ALPD004101 transmitter uses photosensitive diode sensor components to detect the sensitivity of the environment. It has high precision, strong reliability. Due to the wide range of detection, good stability, it can be applied to the general building indoor, outdoor and other industrial, commercial use. Its input power requirement is 12 ~ 24V DC power, the light measurement range is 0-20000Lux, the output form is 4-20mA current. The physical diagram of the illumination meter is shown in figure 4.

FIGURE IV. ILLUMINATION METER

D. *Touch Screen Selection*

The man-machine operation interface selects B&R 4PP320.1043-31 type touch display screen, the outline is shown in figure 5 the specific parameters as shown in Table 1.

FIGURE V. FRONT VIEW OF 4PP320.1043-1

TABLE I. PARAMETERS OF 4PP320.1043-1 TYPE TOUCH SCREEN

Features	**Power Panel 4PP320.1043-1**
Type	Color TFT
Diagonal	10.4 in (264 mm)
Colors	262144 colors
Resolution	VGA, 640 x 480 pixels
Rated voltage	18 - 30 VDC
Rated current	0.63 A
Starting current	Max. 2.8 A
Power consumption	Typically 15 W
Protection	IP20 back side IP65 front side

III. SOFTWARE DESIGN

A. *Program Flow*

The program design process is shown below:

1. Click the start button, the warehouse control system to enter the stage of preparation.

2. Choose the lighting control mode, the default to auto mode control. Then, go to the next step; otherwise, enter the manual control mode, the lighting of each region can control alone.

3. Under automatic control mode, judge the warehouse is activity or not: if there is no activity, then all the lights set off; if detecting someone in the warehouse, then enter the next step.

4. Judge the lighting intensity of each region. If the intensity is satisfied, the lamp group in the corresponding area is closed; if the area of the illumination is not reached, the illumination remains on the open state.

B. *Human-machine Interface Design*

Automation Studio software tool is used to design the human-machine interface design of lighting control system [5]. It can realize the control, display, motion control and communication of product development. Along with the integrated visualization Visual Components, there is an effective tool in Automation Studio that can be used to a create visualization of control integrated or remote QVGA to SXGA displays with keys and touch screens. Integration of the visualization system in the control means that the communication times that are normally required for remote visualization systems are no longer an issue.

Interface warehouse is divided into four regions, each region is installed illuminance meter measuring the respective region of light intensity and air conditioning machine is arranged in the warehouse, with a red arrow represents the model of heating, with blue arrows represent the cooling mode. Lighting control mode is set up two, there are manual control and automatic control mode. Manual control, each area is equipped with independent switch control of their respective area lighting. With emergency stop button in case of emergency press emergency stop, ensure safety.

The design of the man-machine interface is shown in figure 6.

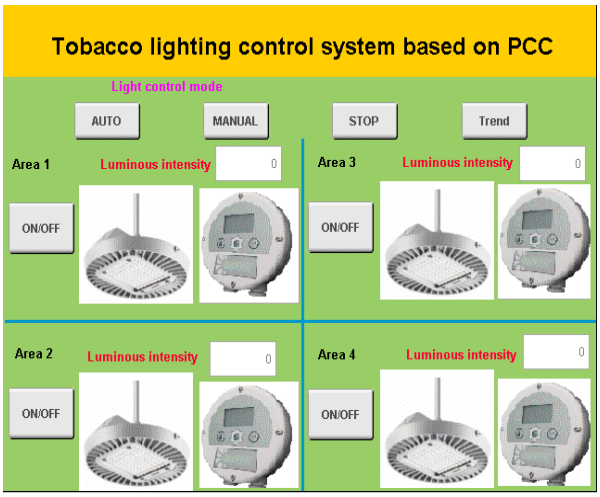

FIGURE VI. HUMAN-MACHINE INTERFACE OF LIGHTING CONTROL SYSTEM

IV. SIMULATION AND ANALYSIS

In order to identify the validity of proposed lighting control system, control effects in two modes are respectively studied: automatic mode and manual mode.

A. Control Effect in Automatic Mode

Control zone of the lighting is set to 151lex~301lex. Light intensity in four areas are respectively set as: 140lex, 350lex, 150lex and 360lex. In area 1 and 2, there is someone activity, while in area 3 and 4, it is set to no activity. The control logic is as shown in Table 2. The corresponding man-machine interface is shown in figure 7.

TABLE II. AUTOMATIC MODE LIGHTING CONTROL TABLE

Area	Light intensity(1511ex-3011ex)		People active	Light status
1	140	<lower set	yes	On
2	350	>upper set	yes	off
3	150	<lower set	no	off
4	360	>upper set	no	off

B. *Control Effect in Manual Mode*

In manual mode, you can only control the illuminated part of the four regions of the warehouse and open the button corresponding to the region, region corresponding to the lamp is lit, this time from light pictures of the impact strength, regardless of the light illumination strength is in the appropriate range, regardless of whether the detection to the warehouse activities, as long as in manual mode, only by manual switch control. As shown in figure 8, under the premise of the previous automatic mode, switch to manual mode, respectively, opened the four areas of the lighting switch, the four areas of the lights are lit.

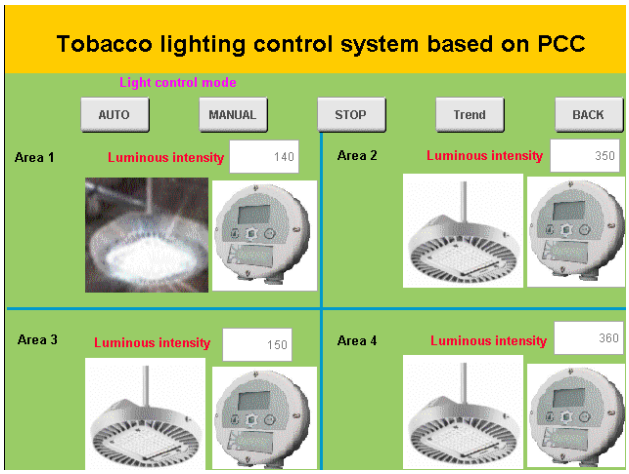

FIGURE VII. SYSTEM CONTROL EFFECT IN AUTOMATIC MODE

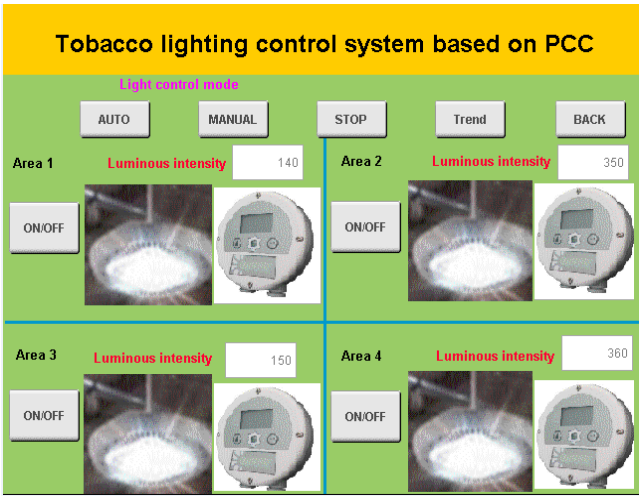

FIGURE VIII. SYSTEM CONTROL EFFECT IN MANUAL MODE

Through the analysis of part A and part B, it is seen that: the design of lighting control system based on industrial controller PCC can achieve the desired control effect.

V. CONCLUSIONS

Aimed to current traditional control mode of tobacco distribution center warehouse lighting system, a new intelligent distribution center warehouse lighting control system is designed through the selection of hardware and software design. The system uses the high performance industrial controller PCC, the illumination meter and the touch screen, and has made the control interface on the Automation Studio software platform. The simulation results show that the designed lighting control system achieves the expected control effect.

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