



## **The Design of Strainable Traffic Light System Based on LabVIEW and DAQ**

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**Abstract:** The strain-type traffic light system designed for this project is different from traditional traffic lights with a fixed refresh time. It can calculate the current suitable traffic light working time in real time according to the changes in traffic flow and its own algorithm, and when necessary it transfer control to the staff. It can greatly reduce the many shortcomings of traditional fixed refreshing traffic lights, and has many advantages such as high flexibility, strong stability, easy operation, and easy maintenance. It is one of the necessary development directions for traffic lights in the future.

**Keywords:** LabVIEW; data acquisition; traffic lights.

### **1. Introduction**

In the middle of the 19th century, horse-drawn carriages were popularized in many European countries. However, there is a lack of effective traffic control, and traffic accidents occur frequently. Traffic lights were born for this. The world's first traffic light was born in Westminster, London, and was designed by De Hart, a British mechanic at the time. The lamp post is 7 meters high and has a red and green lantern hung on it. Since there were no electric lights at the time, gas lamps with potential safety hazards were used, and workers were required to hold a long pole to pull the leather belt to change the color [1,2]. However, the traffic light exploded after only 23 days of service and killed the police officer who was operating the traffic light. Since then, the UK has suspended the use of such traffic lights. With the deepening of electrical research and the popularization of automobiles, traffic lights have gradually entered people's sight. In 1914, the first electrically controlled traffic light was put into use in Cleveland, Ohio, USA. This electrically controlled signal lamp laid the foundation of modern traffic command. In 1918, the first three-color traffic light came out in New York, USA. The difference from modern three-color lights is that the

yellow lights at that time were set up to change the vehicle left and right. According to data, the earliest traffic lights appeared in China in 1923 in the British Concession of Shanghai. It was manually controlled by Indian Sikhs hired by British colonists at the time. In 1927, Hu Ruding of our country suggested that the yellow light should be used as a reminder. His suggestion has been recognized by the world. The message conveyed by the three-color light is the same as that of modern times. In the following decades, due to technical limitations, traffic lights have been manually controlled. Until the 1970s, Microsoft was founded and rose rapidly. Microsoft has designed an automated and highly reliable operating program for traffic lights, and rolled it out globally. The traffic lights at this time are no different from the current traffic lights. So far, modern traffic lights are relatively complete [3,4]. Although the development of traffic lights has been relatively perfect today, there is still room for improvement. Such as reducing costs, improving reliability, enhancing display effects, saving power consumption, and becoming intelligent. Among them, intelligence must be the top priority for the development of traffic lights in the future. "Made in China 2025" clearly indicates that intelligent manufacturing has become a new development direction of my country's modern advanced manufacturing industry. The domestic smart manufacturing industry has sprung up one after another, and the industry prospects are extremely good. And transportation is one of the mainstays of industrial development. Therefore, intelligence and transportation will blend in, promote and influence each other in the future. Transportation has paved the way for the intelligent industry, and the intelligent industry will gradually promote more intelligent transportation and traffic control [5,6].

## **2. Scheme design**

The Fig.1 shows the front panel window of the system, which simulates the crossroad in the real scene. The on and off of the Boolean indicator on the front panel of the system corresponds to the on and off of traffic lights in the real scene. The 12 Boolean quantities corresponding to traffic lights at intersections are "North Red", "North Yellow", "North Green", "South Red", "South Yellow", "South Green", "East Red", "East Yellow", "Dynamic Green", "West Red", "West Yellow", "West Green". The two scales can display the traffic flow of the current road section. Since the working status of the traffic lights corresponds to each other, only one traffic flow data is needed for the corresponding direction. In the control setting area, you can see the red light duration of the current road segment and the estimated red light duration of another road segment. If you need to manually control the red light duration of a specific road section in the next time period, you can first adjust to manual mode in the setting area, and then adjust the red light duration yourself [7].

As shown in the Fig.2 is the block diagram window of the system. There are three large blocks from top to bottom. Their functions are data acquisition and information processing, calculation of Boolean indicator alternate duration, Boolean indicator alternate process, and output of the result to the external physical part.

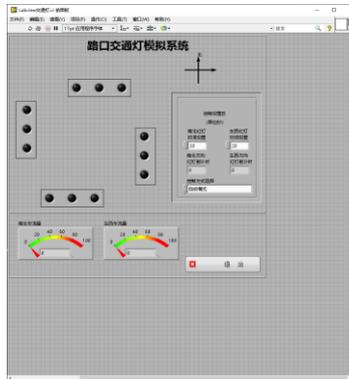


Fig 1. Front panel window of strain-type traffic light system

The east-west direction is green, and the north-south direction is red. At this time, the north-south traffic flow meter and the east-west traffic flow meter are changing in real time, and also the north-south red light time setting and the east-west traffic light time setting of the control area are also changing. In the automatic mode, the time setting will only display the traffic light duration calculated by the system, and the manual control is locked.

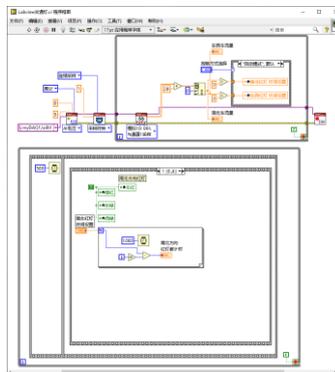


Fig 2. Strain type traffic light block diagram window

When the countdown to the north-south red light is 0 (that is, the duration of the green light in the east-west direction is 0), the yellow light corresponding to the road section in the east-west direction starts to flash. At this time, the north-south direction still remains red.



Fig 3. Auto run effect preview 1

After the yellow light flashes in the east-west direction, it turns to red. At this time, the north and south red lights go out and turn to green lights. The time length is set by the system as the reading of the moment when the green light is on and the time of the red light.

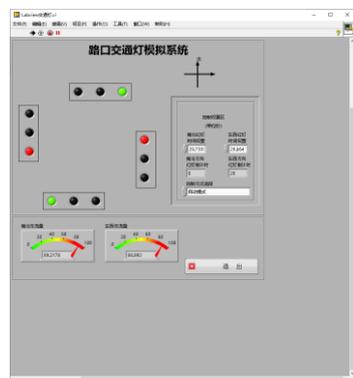


Fig 4. Auto run effect preview 2

The north-south indicator lights change the same thing, and return to the initial indicator state after the change. After that, the program automatically circulates.

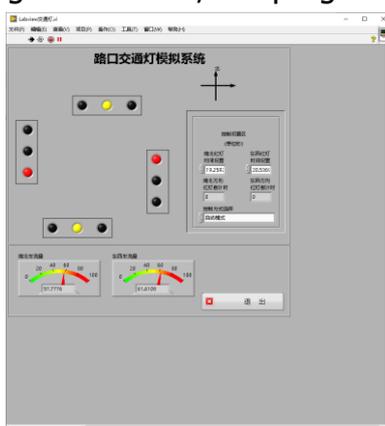


Fig 5. Auto run effect preview 3

In manual mode, the system cannot automatically collect data and automatically set the lighting effect change time like the automatic mode, but instead manually set a fixed lighting effect change time. It is no different from the traffic lights currently in

use.

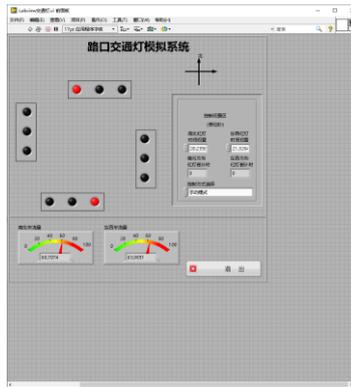


Fig 6. Manual intervention preview 1

When open to traffic in the east-west direction, set the east-west red light duration of the next state. At this time, the system is still running normally and has no effect.

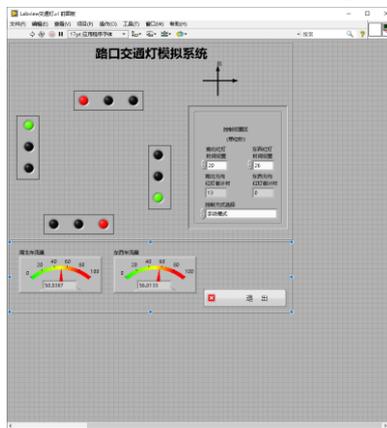


Fig 7. Manual intervention preview 2

In the next state, the east-west traffic light duration becomes 25, and the north-south green light duration is the same as the east-west red light duration.

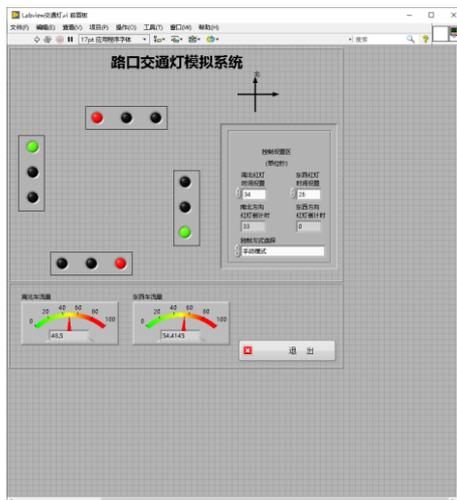


Fig 8. Manual intervention preview 3

The red light time setting for the north-south direction is the same. After the red light for the north-south direction ends, the program returns to the original state and runs continuously according to the set time until the red light time for the north-south and east-west directions is reset, or the control method is changed to Automatic mode.

### 3. System design

Create a virtual capture card first, and the virtual capture card simulates output sensors to receive traffic information on the road. The sensor will output an analog voltage of 0-5V, and the voltage level is positively related to the traffic flow detected by the sensor. The output voltage can be used as a direct basis for the traffic volume. After the system obtains the analog voltage output by the sensor, it converts the voltage information into intuitive digital information on the traffic meter through calculations, and also converts it into the operating time of the red light on the north-south road in the automatic operation mode of the system.

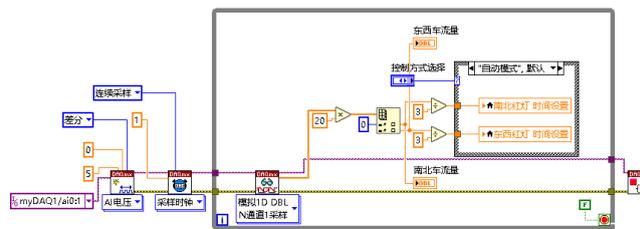


Fig 9. Information collection and information processing part

The Fig. 9 shows the initialization of the running program. Since the traffic lights are operated in pairs, the Boolean quantities of "North Red", "North Yellow", "North Green" and "South Red", "South Yellow" and "South Green" are bound here, "East Red" and "East Yellow" "East Green" is bound to the Boolean quantities of "West Red", "West Yellow" and "West Green". Initially they are all assigned the value FALSE, and the indicators are all off. Red lights in the north-south direction (ie, green lights in the east-west direction) are shared, and red lights in the east-west direction (ie, green lights in the north-south direction) are shared.

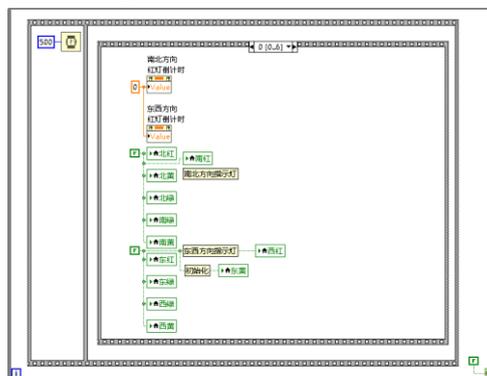


Fig 10. Traffic light operation program 1

The Fig. 10 shows the red light display in the north-south direction. In fact, the red light in the north-south direction is the green light in the east-west direction, so the boolean quantities "North Red", "South Red" and "East Green" West Green" are bound. Assign the value of TRUE to these four booleans, and the indicator lights are on.

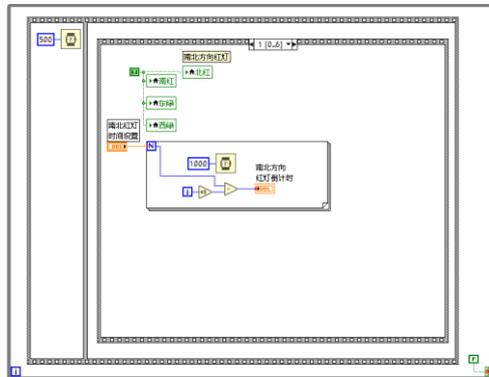


Fig 11. Traffic light operation program 2

When the countdown to the red light in the north-south direction is over, assign FALSE to the boolean quantities "East Green" and "West Green", and the boolean indicator corresponding to the green light in the east-west direction goes out.

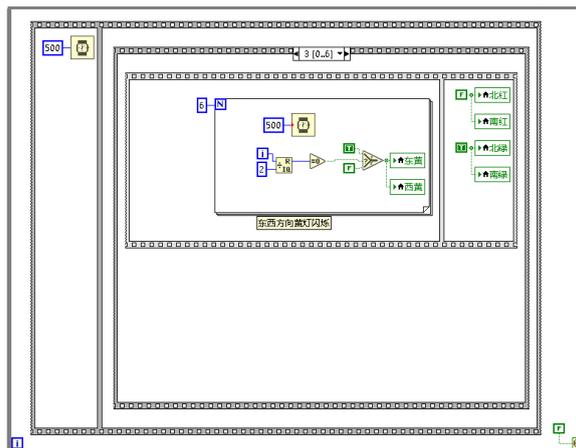


Fig 12. Traffic light operation program 3

The picture shows the yellow light flashing in the east-west direction, and assigning TRUE and FALSE alternately to "East Yellow" and "West Yellow" to make the corresponding indicator light flash. During the flashing period, the red light in the north-south direction remains on. After the flashing is completed, assign TRUE to "North Green" and "South Green", and assign FALSE to "North Red" and "South Red", so that the north and south green lights are on and the red lights are off.

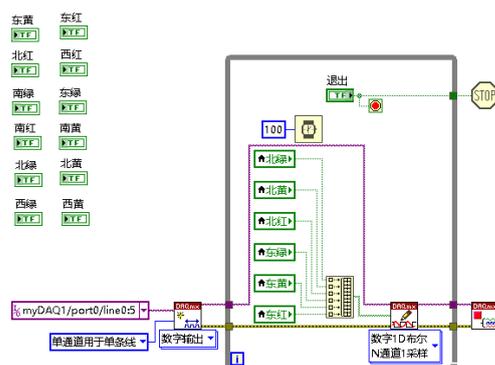


Fig 13. Connect the external device part

#### 4. Conclusion

In view of the preciousness of the DAQ digital channel port, combined with the actual working situation, I designed a set of digital signals for the north-south and east-west indicator lights. This will not only reduce costs, but also improve the stability of the program. The analog voltage range of the sensor output is 0-5V. In order to make the traffic flow display meter closer to cognitive habits, I designed the 0-100 display data obtained by multiplying the analog voltage by 20 to make the detected traffic flow more intuitive. In order to avoid excessive congestion on a road, and also to avoid excessive waiting on road sections with fewer vehicles, this system sets the green light for longer periods of time on road sections with larger traffic, which improves the flexibility of use.

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