Simulation and Research of Urban Intelligent Traffic Light Control System

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Abstract. Intelligent traffic light control system belongs to the field of transportation public safety control. So far, the traffic light control system on the market cannot change the working time of the traffic lights according to the actual traffic flow, which is not conducive to the easing of the traffic flow and easy to cause traffic jams. Therefore, it is necessary to solve the problem of the existing traffic light control system which cannot adjust the working hours of the traffic light according to the actual road conditions, so as to alleviate the traffic jam at the intersection to a certain extent. In this paper, the design of intelligent traffic light control system uses AT89C51 MCU as the core device. The system controls the traffic of different times and different conditions, and it can alleviate traffic jams to a certain extent. This paper analyzes the hardware and software designs of intelligent traffic light control system, and simulates traffic light control by simulation software. The system of this paper is simple in structure, economical and practical, reliable in operation and it can effectively dredge the traffic.

1. Development and Research Significance of Intelligent Traffic Light Control System
The earliest traffic lights appeared in London in 1858, they were mainly used in the streets by two colors signal lights of red and blue, and the work type of the signal lights was the mechanical wrench type. Then in London in 1868, the world's first traffic light came. Yet the yellow light was invented by Hu Ruding in China. In order to remind people to pay attention to the dangers at the intersection, he put forward a suggestion of adding a yellow light between the red and green lights. With a variety of transportation tools appearing in people's life more and more, in order to direct the traffic more conveniently, three colors lights of red, yellow, green appeared for the first time in 1918 in New York. With the deep development of automobile electronic technologies and computer control technologies, the control mode of traffic lights has developed from the original pure mechanical control to the current computer timing control, the control mode of traffic lights is becoming more scientific and automatic[1][2].

With the continuous increase of traffic tools in China, the urban traffic flow is also increasing, and the urban traffic congestion has become an urgent problem to be solved. The problem of traffic congestion in large and medium-sized cities has become more and more serious. The serious traffic congestion has also seriously affected people's life. Among them, the problem of traffic congestion at urban intersections is getting worse. At present, the existing traffic light control systems on the market are only based on the time control to transform the different colors of the traffic lights, they cannot change the working time of the traffic lights according to the real time traffic flow of the actual intersections, so they are easy to cause the traffic jam at the intersections to a certain extent and they are not conducive to slow the traffic flow at the intersections. At present, many scholars are doing the
simulation research and analysis of intelligent traffic light control system, but almost the existing traffic light control system works in a single fixed timing control, so it can not adjust traffic according to the actual conditions\cite{3}\cite{4}.

The traffic light control system designed in this paper adjusts the intermittent time of the traffic lights according to the real-time road conditions, which can alleviate the traffic jam caused by more cars on one side and less cars on the other side. The system uses PROTUS simulation software to simulate the traffic light control, and verifies the feasibility of the system.

2. Research and Design of A Urban Intelligent Traffic Light Control System

Urban intelligent traffic light control system belongs to the field of transportation public safety control. At present, the existing traffic light control systems on the market can not change the working time of traffic lights according to the actual traffic flows which are not conducive to relieve the traffic flows to a certain extent, and they are easy to cause traffic jams\cite{5}. Under this premise, how to achieve more reasonable traffic light control at the intersection and reasonable allocation working hours of traffic lights, so as to alleviate the intersection traffic congestion becomes particularly important. So we can design a reasonable intelligent traffic light control system which uses the control unit ECU to conduct perception of real-time road conditions and information processing, so the system has the advantages of low cost, high stability and reliability. This control system is more specifically related to the intersection of the traffic light conversion time control, so it can alleviate the intersection of traffic congestion to a certain extent, and it can bring greater convenience to people's life.

2.1. Hardware Circuit Design of the System

The intelligent traffic light control system is mainly composed of control module, traffic flow identification module, time display module and traffic light conversion module\cite{6}. In addition, the control module is mainly composed of reset circuit, crystal oscillator circuit and power supply circuit. The system identifies the traffic flow at the intersection through the traffic flow identification module, passes the traffic flow information to the control module, and calculates the traffic flow by software programming on the control module, and adjusts the working hours of the traffic lights in time, so it can realize the reasonable time distribution and effective control of urban traffic\cite{7}. The hardware circuit of intelligent traffic light control system is shown in Figure 1.

![Figure 1. Hardware circuit of the system.](image)

2.2. Hardware Circuit Design of the System

This intelligent traffic light control system software design process flow chart is shown in Figure 2.
Figure 2. The flow chart of software design.

This traffic light control system aims to reasonably allocate the working hours of red light, yellow light and green light, alleviate traffic congestion, provide convenience to people's life, so it can produce certain benefits:

1. Quick real-time response: The vehicle information at the intersection can be monitored at any time through the traffic flow identification module, so the system can adjust the working time of the traffic lights in time.

2. High precision of the system: The system takes the control unit ECU as the main body, collects vehicle information, programs through software, accurately adjusts the working time of the traffic lights, takes real-time sampling and effectively alleviates traffic jams.

3. Small space: The system adopts MCU control system, reasonably configures the input circuit and output circuit, takes up small space and it can be directly installed on the traffic lights.

3. Simulation Analysis of Intelligent Traffic Light Control System

The system uses PROTUS simulation software for simulation, after the completion of the drawing of hardware circuit by simulation software, we can add software applications to AT89C52, then we can
carry out the simulation of the system. We can start system simulation by clicking the button at the bottom of the software interface as shown in Figure 3.

![Figure 3. Add software program to AT89C52.](image)

In the process of simulation, we can operate each control button and traffic flow simulation unit to simulate the traffic conditions of different road conditions, and change the working time of traffic lights by calling different time conversion programs, so as to alleviate the traffic jam problem to a certain extent. The simulation process is shown in Figure 4.

![Figure 4. The simulation process.](image)

4. Conclusion
The research object of this paper is the intelligent traffic light control system. The system uses ECU to complete real-time perception of real-time road conditions and information processing, which has the advantages of low cost, high stability and reliability. The intelligent traffic light control system is mainly composed of control module, traffic flow identification module, time display module and traffic light conversion module. The system uses the PROTUS simulation software to simulate the hardware and software of the system, and the feasibility of the system is verified.

The system of this paper identifies the traffic flow of the intersection through the traffic flow identification module, transmits the traffic flow information to the control module, and calculates the traffic flow through the software programming of the control module, adjusts the working time of the traffic light in time, so as to realize the reasonable time allocation and effective control of the urban
traffic.

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