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城市之光—基于 AIoT 技术的城市节能智慧路灯系统

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Summary. *The work designed by me is proposed to address the huge energy consumption problem in the field of urban traffic lighting in China. It is a street light control system integrating adaptive light regulation and environmental energy capture, which is capable of automatic switching and dimming control of intelligent street lights under the influence of multi-variable factors.*

Since the reform and opening up, China's rapid economic development and huge consumption of electric power resources have made electric energy very tight. In China's overall electricity consumption, urban lighting accounts for a large proportion of electricity consumption, and urban street lighting is an important part of urban modernization, which creates a good production and living environment for people.

However, with the rapid development of China's economy, the number of street lighting is increasing year by year, and the proportion of its electricity consumption in the total urban consumption is also increasing. To reduce the annual consumption of urban electric energy, it is significant for the existing street lighting equipment and control methods to be transformed.

By fully considering energy consumption, multi-source parameters, device size, protocol transmission, scalability, and reliability of use, this paper uses big data, Internet of Things, artificial intelligence, and other technologies to create an integrated smart streetlight comprehensive solution that integrates lighting adaptive control, environmental energy capture, intelligent monitoring of traffic flow, and cloud-based monitoring.

The overall architecture of this system from the lower to the upper layer is the sensing layer, control layer, transmission layer, network layer and application layer in order.

The sensing layer contains current and voltage detection sensors, light intensity sensors, weather environment monitoring sensors, high-definition camera modules and LED street light modules, which are used to collect data of street light current and voltage, light intensity, weather environment and video monitoring, and are the basis for intelligent control of the intelligent street light control system.

The centralized controller of the control layer adopts Arduino and Raspberry Pi, which on the one hand processes the data collected by the sensing layer and transmits the information to the monitoring center, and on the other hand receives the lighting control commands from the monitoring center to realize the control of street light switching and brightness.

The transmission layer consists of NB-IoT and ZigBee wireless communication technology to form the whole communication system; the data layer mainly collects the street light working status information, light intensity data and weather environment information from the centralized controller of the control layer and stores them in the database server.

The data layer mainly collects the street light working status information, light intensity data and weather environment information from the centralized controller in the control layer and stores them in the database server, which will analyze the collected information more specifically through cloud computing technology and transmit the analysis results to the application layer.

The application layer will process the received data and information and present them in the form of maps and charts in the cloud platform of the monitoring center.

The communication architecture of the whole system consists of two parts: the NB-Iot wireless network is used to communicate between the IoT cloud platform and the gateway nodes, and the ZigBee wireless network is used to communicate between the gateway nodes and the terminal nodes.
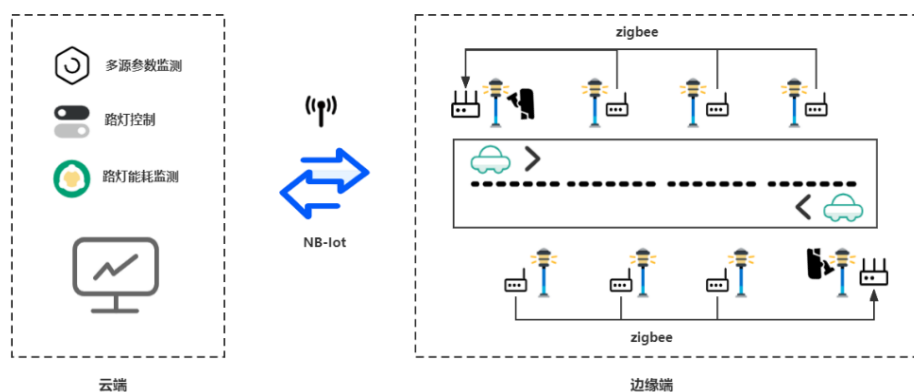

Figure 1

The system realizes the adaptive light adjustment algorithm, the controller controls to turn on the street light according to the brightness of external light, then detects the light intensity through the light intensity module, and the video intelligent processing technology monitors the traffic flow to control the power of turning on the street light, which can turn on and off the street light at the right time and adjust the brightness to save energy to the maximum. At the same time, the wind power generation module and solar power generation module together capture energy for the street light, and the captured energy is stored in the battery to supply the street light lighting, which increases the supply of clean energy through environmental capture.

At the same time, the system adopts the way of cloud-edge collaboration to realize real-time monitoring, processing and reporting of road traffic flow and environmental parameters, as well as the adjustment of lighting patterns. The model training is carried out in the cloud and the model inference is carried out at the edge. Compared with the centrally deployed cloud computing service, this system solves the problems of long time delay and large convergence traffic, and provides better support for traffic flow monitoring with high real-time and bandwidth requirements.

In the future, the advantages of distributed architecture and flexible design of the system can be used to extend the functions of the smart street light so that it can monitor road damage, whether road manhole covers are missing, and the condition of roadside parking lots, such as training a target detection model for road cracks, detecting whether cracks exist on the road in real time through smart cameras, and reporting to the data center for processing to truly achieve integrated collaborative management. On the basis of the above, combined with the relevant concepts of intelligent transportation, it can be developed into a wider range, more applicable and more integrated distributed intelligent IoT management system.

脑机接口——让盲人重见光明

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Summary. *As a new type of human-computer interaction method, Brain-Computer Interface (BCI) technology is regarded as one of the disruptive technologies that can change the future world of human beings because it can directly read human thinking. This paper is mainly for the introduction of visual brain-computer interface.*