The Design of Solar Street Lamp Monitoring System Based on ZigBee Wireless Communication Technology

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Abstract. The solar street lamp monitoring system was designed based on ZigBee wireless communication technology in this paper. The design constructed communication network based on ZigBee wireless communication technology, which was included database, B/S architecture combined with geographic information system and solar intelligent control terminal for field controller. The design can be in a wide range of storage battery on-line monitoring, street lamp remote monitoring, single street lamp controlling, data acquisition centralizing, storage battery charging and discharging circuit controlling intelligence, drive control rationalization, and street lamp control humanization.

1. Introduction

The storage battery charge and discharge circuit of solar street lamp system requires high voltage quality. When the charge and discharge is unsuitable, the equipment is easy to be damaged. That causes the existing solar street lamp of high cost and low service life, greatly restricts the promotion of this green energy solar street lamp. With the large-scale application of solar lamp, how to realize intelligent control to solve these problems has become an important direction of research in the domestic and foreign [1-4]. The ZigBee wireless communication technology is a new kind of close range, low complexity, low power consumption, low data rate and low cost wireless network technology [5-8]. The application of this technology can realize the remote wireless monitoring network of lamp system, monitoring the relevant parameters of lamp, the intelligent control on the street lamp. At present, large-scale solar streetlight system adopts ZigBee single technology to realize wireless communication is still blank in the domestic and foreign.

2. System design

The system consisted of host computer in monitoring center and ZigBee intelligent monitoring terminal in the street scene which adopted ZigBee wireless network connection of large scale area, realized the construction of wireless networks. The constructions of backbone network were a small amount of communication distance far module, which would solve the problem of low cost for communication and network construction in large areas. And then constructed subnet based on backbone network through the channel isolation, intelligent monitoring terminal of each lamp was the node subnet, so all the street lamps had realized the networking, as shown in Fig. 1.

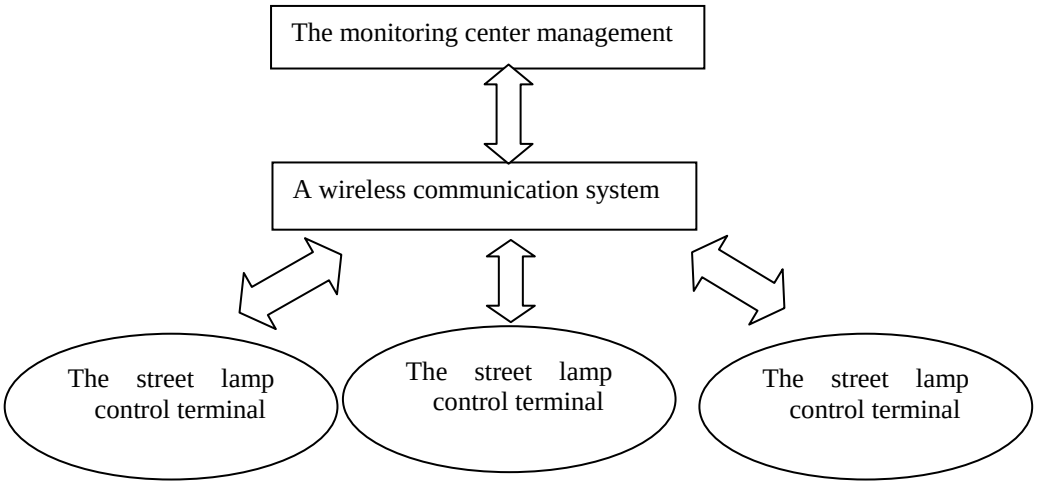

Fig. 1 System design scheme

3. The monitoring center management

The monitoring center management used B/S architecture, constructed server based on database, communicate via Ethernet. The operator through the browser could operate the system within its competence, and could monitor the real-time situation. The B/S system architecture diagram was as shown in figure 2.

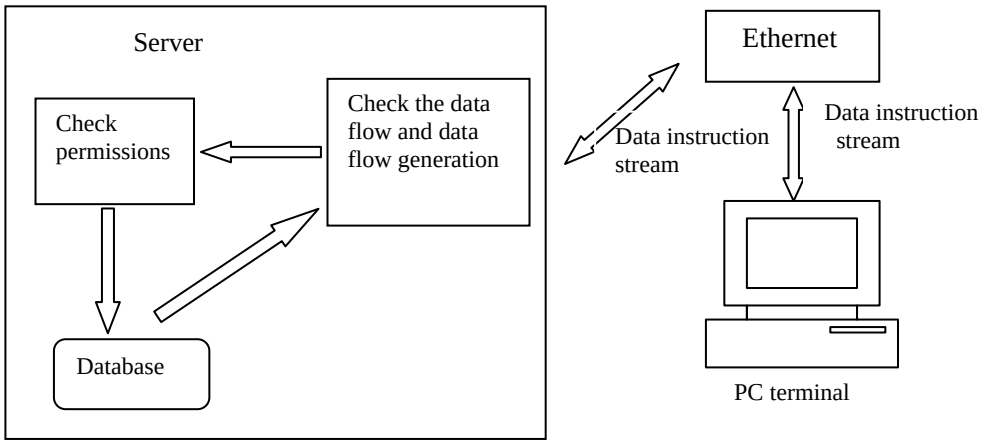

Fig. 2 Schematic diagram of the B/S architecture system monitoring center

① Database: storage, use and management of data resources.
② Server: worked stably, automatically determined the user permissions according to the user query and generated report, managed users and user groups, managed street lamp information, and analyzed all kinds of parameters.
③ PC terminal: provided a friendly user interface, according to the user permission to use this system. The interface function diagram of street lamp monitoring center was as shown in Fig. 3.
④ The application interface of street lamp monitoring center was as shown in Fig. 4.

4. The realization of wireless communication

The ZigBee network was a up to 65535 wireless module consisted of a wireless mobile communication network platform, similar to the existing CDMA network or GSM network. Every ZigBee network data transmission module was similar to the mobile network base station and they could communicate with each other within the scope of the entire network. The distance between each network node was from the standard 75 meters, to expand after a few hundred meters, even a few kilometers. The distance of communication of ZigBee module was 100 meters and 1200 meters in this system. The 1200 meters ZigBee wireless module was used in the backbone network, and the

100 meters ZigBee wireless module was used in the subnet.

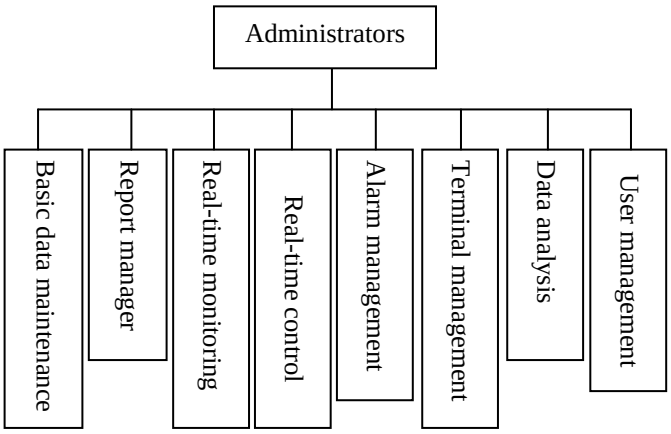

Fig.3 The interface function diagram

Fig.4 Monitoring center application case

First, the ZigBee coordinator of monitoring center in the system sent information in the form of broadcast and the backbone network router received information compared with its information. If the information met the requirements, accepted this information, then through the bridge passed to the network coordinator, otherwise this information was ignored. The coordinator in a subnet received the information, and then sent to the intelligent terminal, so that the corresponding street lamp acted. Finally, the running specific parameters of every street lamp were shown on the interface of the monitoring center.

This system was divided into 60 sub networks and 1 backbone network, each subnet set a gateway, subnet connected backbone network through the gateway.

5. Intelligent control terminal

Every street lamp was connected with a ZigBee intelligent control terminal, that was mainly responsible for the acquisition of voltage and charge current information between two ends of the storage battery, and then installed some special sensors to collect information of temperature and light intensity. Intelligent control terminal through its own ADC, respectively, 0V-26V voltage signal and 0 ~ 6A current signal were converted to digital signal. When the digital signal was converted, the intelligent monitoring terminal would fulfill two functions. The first function was that transferred to the coordinator network through the ZigBee wireless transmission technology. The second function was that circuit switched when monitoring the input voltage was lower than 23.5V or higher than 26V, the storage battery power supply converted to electric power supply. The sub network coordinator had two functions, the first function was responsible for the collection of these signals, and saved it to the terminal computer to establish the database; the second function was that generated a control signal and transferred, to forced convert the LED driver and the storage battery charge.

Intelligent lighting control terminal consisted of storage battery charge and discharge management module, current and voltage acquisition module, lamp driving module, clock module and ZigBee wireless communication module, was as shown in Fig. 5. The current detection module real-time collected current parameter. The voltage detection module real-time collected voltage parameter. The ZigBee wireless communication module was connected to the ZigBee wireless network.

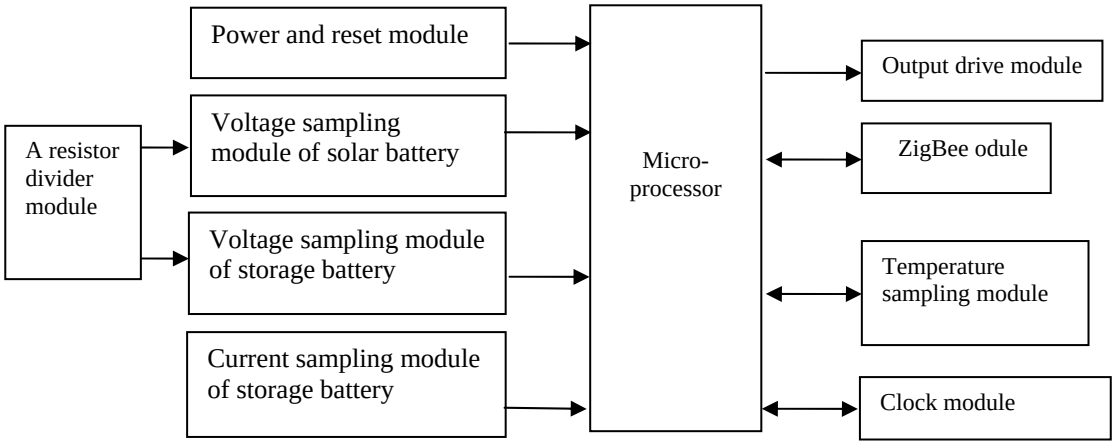

Fig. 5 Terminal structure diagram

6. Conclusions

The solar street lamp system and ZigBee wireless communication technology were integrated, and put forward the design of the monitoring system, so achieved a technological innovation in this paper. The design mainly included the monitoring center management, wireless communication, and intelligent monitoring terminal, and those functions were introduced. The practical application in this system reflected the advanced and reasonable design, and the realization of system functions improved the stability of solar street lamp system.

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