

Design of Video Surveillance System based on Power Line Carrier and RFID

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Abstract. The paper firstly introduces the basic knowledge of the communication system and power line carrier technology in detail, then analyzes the channel characteristics and interference noise in the process of power line communication and establishes corresponding channel transmission model through principle of automatic control. Then the paper establishes the overall framework required by the paper task to analyze and demonstrate the feasibility and superiority of the power line communication in this design in detail. A detailed description, demonstration and simulation is carried out for the realization of single-lamp power line carrier in receiving and transmission module, realization of single lamp controlled by single chip microcomputer, realization of single lamp current detection, realization of single lamp voltage regulation and analysis of energy saving, etc.

Power Line Carrier Technology

Foundation of communication system

The Paper mainly completes the control of main single chip microcomputer on the subordinate single chip microcomputer, control of subordinate single chip microcomputer on street lamp and the transmission of street lamp conditions to the main single chip microcomputer by the subordinate single chip microcomputer and the display of such condition on the display screen of the main single chip microcomputer. The power line carrier technology completes the transmission of control signals and street lamp. Therefore, it is necessary to understand the communication foundation and power line carrier technology.

Communication is a method to exchange and transmit message from one place to another. Communication systems include transmission device, receiving device, transmission medium and necessary other equipment to achieve the reliability of the communication.

The communication system is divided into wire communication system and wireless communication system according to the difference of the medium^[13].

Wire communication adopts conductor (such as telephone wire, coaxial cable, waveguide, fibre optics, etc) to complete the communication as transmission medium, with complex routing, large cost and higher cost.

Wireless communication travels in space to achieve the purpose of transmitting information based on electromagnetic wave with low cost, but there are attenuation, multipath interference and electromagnetic interference, of which the reliability and security is restricted.

Considering widespread existing routing resources of the power network, we shall give full play to its potential to save limited natural resources. It has very important research significance for us to regard the power line as the transmission medium to transmit the condition of the street lamp and

control the street lamp through power line carrier technology.

In the establishing process of communication system, the proper communication method shall be selected first according to the site environment and functions to be finished, which can improve the transmission efficiency of data as well as stability and reliability of the system. According to the relation between time and channel, communication is divided into simplex, half-duplex and full duplex.

Simplex communication: refers to that the message can be transmitted towards one direction and can only occupy one channel.

Half-duplex communication: refers to that both sides can receive and transmit the message, but receiving at one end and transmission at another end is not allowed simultaneously.

Full duplex communication: refers to that the transmitting end and receiving end can receive and transmit the message at the same time and can be converted to each other, which is a two-way channel in general.

The communication system is mainly to transmit the message quickly and accurately, of which main evaluation indicators are effectiveness and reliability. The effectiveness solves the “speed” of message transmission and the reliability solves “quality” of message transmission.

Power line carrier technology

Power line communication (PLC) is a wire communication method to transmit analog or digital signals through carrier method by using existing power lines as channels, of which the obvious characteristic is that as long as there are wires, there is no need to reframe the wires.

The operating principle of the power line communication is: that the single is sent from the message source and converted to the digital sequence available for transmission through the coding of the encoder and the modulation of the modulator, coupling to power line, and the digital sequence will be sent to the receiver through demodulation and decoding.

Signal source: means the person or equipment (such as control machine, PC machine, DSP and single chip microcomputer) to produce and give out message. The messages sent can be continuous waveforms or discrete digital signals, of which the main function is to convert the messages to the electric signal, convenient for subsequent processing and transmission.

Receiver: refers to the person or machine to receive the message sent from signal source.

Encoder: source encoder is to convert the signal to the digital sequence, and the channel encoder is to add the check code in the digital sequence to make the receiving end find or correct valid message, so as to improve the reliability of message transmitted in the communication.

Modulator: to convert the output digital sequence to high-frequency radio frequency oscillation signal available for transmission, and the demodulator is just the opposite of the modulator, which is to match the digital sequence with communication protocol and communication method.

Channel: medium for transmitting signals. It can be either a physical signal line or an electromagnetic wave. The characteristics of medium are closely related to the reliability and effectiveness of the communication system and whole control system.

Decoder: decoding is the inverse process of encoding, which is to convert the digital sequence to the applicable message and is completed by the combination of digital circuits and analog circuits.

Sync system: it is mainly to ensure that both ends of the receiving and transmission are in step and work together, mainly applied on the occasions where content updates are frequent. Sync is an important component in communication system of power line carrier. There will be a lot of wrong code garbled in the absence of sync. The performance indicators of the carrier sync system include: efficiency, accuracy, synchronization setup time and synchronization hold time.

Noise source: can be caused by the human factors or possessed by equipment or system itself, but not what people want.

Simple applications of power line carrier technology

In some areas involving complex tasks, high reliability and real-time requirements, PLC technology has not been widely applied for the limitation of anti-interference capacity and anti-attenuation capability.

Next the applications of existing system of power line carrier technology are introduced briefly.

For example: as shown in Fig.1, it is a mature field that the power line carrier technology is applied in Europe and America. It can be clearly seen from the Figure that, all disease information of the patient can be transmitted to the hospital and the suggestions and diagnosis of the hospital can also be transmitted to the user by means of power line carrier technology to achieve efficient and timely medical testing system. The layout and size of this network are based on existing power line layouts.

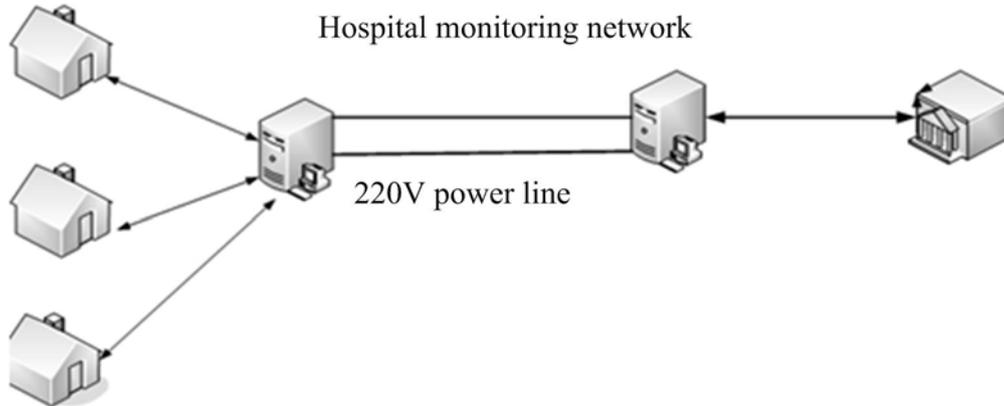


Fig.1. Hospital monitoring network

Compared to foreign mature applications, since China started late, although great progress has been made, the standard of PLC technology is not perfect and the devices to meet the new standards is not mature. Although entering into the actual use stage in the field of remote meter reading, the basic problems of stability, reliability and security have not been addressed, and the so-called intelligence and automation are not implemented. In view of the present situation in China, the research of power line carrier technology is of great significance to the modernization in China, which can improve our operating efficiency and change the outdated capacity. It is thus clear that the research of low-voltage PLC is of great significance to the development of economy and society in China.

FSK Modulation Mode

Status of development of PLC technology

Based on the understanding of communication system and power line carrier technology in the introduction and Chapter 1, we can know that, it is of great significance to select proper modulation mode for improving the reliability and effectiveness of the system. The selection of proper modulation mode shall begin with the development of PLC technology.

Even if the PLC technology has a long history, it is applied only in very few enclosed places for strong interference and serious signals pollution. Early PLC technology is different from modern PLC technology. In early stage, the power line carrier equipment was mainly used and the wave trappers were installed at the both ends of the communication (to reduce the consumption of energy).

Practical application reflects that there is a series of problems in the channel of power line carrier technology, such as violent change, strong interference and various sudden noises, etc. Under the serious influence of these problems, the reliability, security and effectiveness of communications are seriously threatened, and this limits its use to a large extent.

Therefore, it is important to explore a practical and operable modulation mode. The modulation modes in technology are divided into digital and analog modulation mode, of which the principle is the same. As shown in Fig. 2-2, the input baseband signals are passed through the modulator, channel, and demodulator until the final baseband signal is output, however, during the process of channel, there must be a lot of noise.

The realization of digital modulation signal by digital keying method is called keying method. Based on that FSK modulation mode is used in the KQ-130 module of the Paper, so here is a detailed introduction to FSK modulation technology. Other PSK technologies and ASK technologies will not be covered, without detailed introduction. Fig.2 obviously shows the basic diagram of the modulation mode. FSK modulation technology is also evolved on this basis.

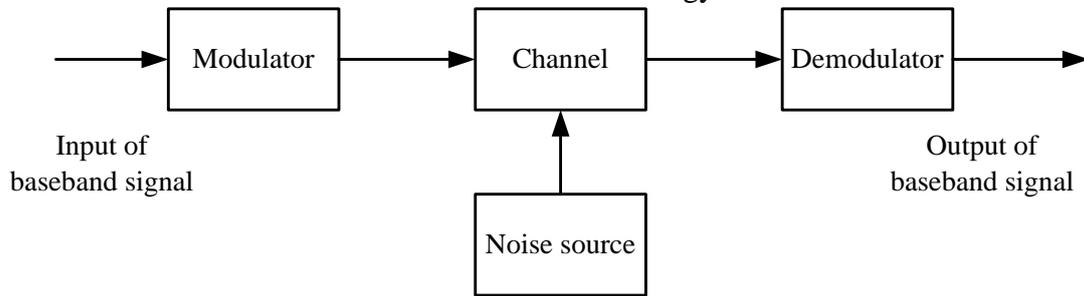


Fig.2. Structure chart of digital modulation system

FSK modulation technology

FSK (Frequency-shift keying) refers to the use of carrier frequency changes to transmit digital information. In the current field of communication technology, FSK technology accounts for the majority, which is common and widespread on account of its simplicity.

FSK modulation technology is a kind of common modulation technology with relatively mature application and strong anti-interference capacity in the daily communication, which has been widely applied on the communication of medium and low speed data transmission.

FSK is composed of continuous and discrete FSK. Both continuous and discrete are determined according to their output waveform. Moreover, with the development of digital technology, most of the discrete FSK are developing toward continuous FSK.

In 2 FSK, with the difference of input data, two frequency generators change so that the corresponding output is binary 1 and 0.

As shown in the Fig.3, two frequency generators f_1 and f_2 switch constantly through changing the switch according to the input binary data, amplify the signal through amplifying circuit and output the discrete FSK signals from the output end of the output circuit. Such kind of modulation mode of FSK is widely applied on the traditional communication equipment. At present, more and more of this modulation mode is developed toward continuous FSK.

As shown in Fig.3, the received FSK signals achieve waveform changes and signals modulation by band-pass filter, and the signals passed through band-pass filter complete the conversion and sampling from analog signal to data signal through envelope detection circuit to convert its waveform to the binary. Then these values shall be compared to determine whether the output data bits are 1 or 0 in accordance with comparator.

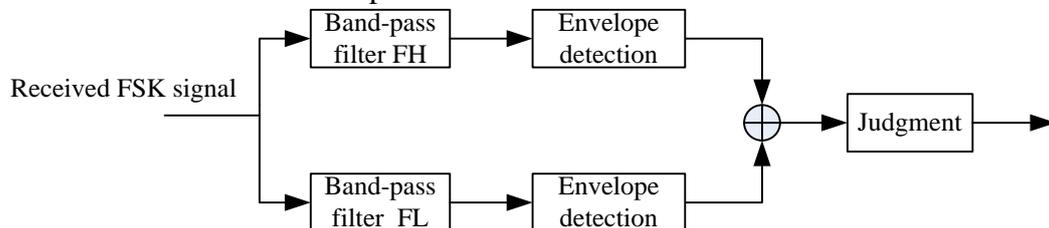


Fig.3. Block diagram of incoherent FSK receiver

Analysis of Channel of PLC

Even if the proper modulation technology is selected, there is still a series of problems in the channel of PLC technology, such as violent change, strong interference and various sudden noises, etc. Under the influence of these problems, the reliability, security and effectiveness of communications are seriously threatened, and this limits its use to a large extent. Therefore, it is necessary to analyze the channel of PLC and channel modeling based on this.

It is unavoidable that the signal encounters noise during transmission and these noises can be

artificial or can be inherent in the device itself. Therefore, the analysis on characteristics of communication channel and establishment of model is the foundation to research the communication problems. As the noise is closely related to the reliability and stability of the signal transmission, the analysis on channel and establishment of model is necessary.

At present, the communication of railway, rail transit, medical system and government system is achieved in most cities based on the physical medium, such as twisted pair, coaxial cable, optical fiber cable, etc. ^[12] Although the message capacity of these communication line is large, there still are a lot of disadvantages such as high cost, difficult maintenance, large attenuation, poor anti-interference ability and difficult repair, etc, especially the transformation of the old city is difficult. Based on the understanding of power line carrier technology, the data transmission by existing power lines can reduce investment and costs. Currently, since the street lamps are provided with 220V voltage in China, thus there is an existing channel with wide routing.

Channels include generalized channel and chivalrous channel. Chivalrous channel is just a mere medium. The generalized channels not only include medium but also include conversion devices related to communication, such as transmitting equipment, receiving equipment, modulator and demodulator, etc.

However, in the communication system, there are serious interference problems, especially in the low-voltage power carrier communication in the research stage, added additive noise and electromagnetic compatibility problems. It is difficult to achieve reliable and stable data communication on power line with serious interference and all kinds of sudden noise. The selection of modulation mode, system structure, and communication protocol and communication method shall be based on the understanding of characteristics of low-voltage power line channels. At present, China lacks research in this area and related papers. All in all, channel transmission interference is very complex.

Design of Monitoring Control System

On the basis of understanding of communication and power line carrier and the master of FSK modulation technology in KQ-130 module, we have also analyzed and modeled the PLC channel. With this knowledge reserve, I believe that we will be handier in the next system design.

The System, taking the electric power transmission line as the medium, completes the information conversion between main control station, general control station and slave control station by virtue of power line carrier technology to achieve time setting of street lamp switch, proportion setting of starting, inquiry of losses of street lamp and adjustment of street lamp voltage and other operations. To change the traditional control method achieves the remote centralized management for street lamp in city, improves the city wisdom level and saves a lot of manpower and material resources, with good prospects for development. Based on the understanding of power line carrier technology, the data transmission by virtue of existing routing can reduce the investment and costs. At present, since the street lamp is provided with 220V voltage in China, in this way there is a reliable channel.

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