Parameter Acquisition System of High Voltage Electrical Equipment Based on Field Operation Standardization Platform

Li Zhang, Dening Zhang, Yushen Jia

College of Mechanical & Electrical Engineering, Agricultural University of Hebei, Baoding, Hebei province 071001,China

Abstract

There are many kinds of products in the existing domestic intelligent high-voltage electrical equipment, which are in low degree of Standardization and Serialization, so there are a lot of problems: the communication interface and protocol are not standardized, the exchange and interoperability between devices are poor and data is lost in original experiment and so on. This paper studies the parameters acquisition system of high voltage electrical equipment based on field operation platform. Parameters of field collection will be uploaded to the cloud platform for data management center through Bluetooth data link and finally complete the accumulation of large amount of raw data samples, which is completed under the unified communication protocol specification. The accumulation of the original data sample provides a training sample for the development of intelligent detection and expert detection, which can accelerate the development cycle of the expert diagnosis system.

Key words: HIGH VOLTAGE ELECTRICAL EQUIPMENT, FIELD OPERATION STANDARDIZATION PLATFORM, COMMUNICATION PROTOCOL, CLOUD PLATFORM FOR DATA MANAGEMENT, THE ACCUMULATION OF ORIGINAL DATA SAMPLE.

1. Introduction

The reliability of power supply system is an important problem in the electric power sector, and the safe operation of high voltage equipment is the foundation of the whole system. So it is necessary to detect the parameters of high voltage electrical equipment regularly[1].

With the rapid development of embedded computer technology and communication technology, substation automation technology has been. Many intelligent electronic devices (IED) have been developed in the domestic and foreign country. At the same time, these intelligent electronic devices have been widely used in the field of electric power automation system. However, from the overall view, many kinds of intelligent electronic equipment products are in low degree of standardization and serialization. Because of the lack of uniform standards in the communication interface and protocol, the exchange and interoperability between devices of the different manufacturers are poor and even can't communicate, which will directly affect the development speed of China's smart grid.

The communication interface and protocol are not standardized, especially the test data format is not uniform, which will lead to the inconsistent state criterion of the electrical equipment and is not conducive to improving the standard of the evaluation of the operation state of the electrical equipment[2,3,4]. In addition, different manufacturers transmit and store the experimental data according to their own specifications, which is not conducive to the accumulation of a large number of original test data. The original experimental data have an important role in

judging the operation state of the equipment. Firstly, without a large number of original experimental data to do the reference, the experts probably have deviation or even error on the judge of the status of the device operation. Secondly, a large amount of raw experimental data can be used as training sample of expert system, and it is the essential resource for the development of the expert system. Thirdly, a large number of original experimental data is the basis of the mathematical model of the establishment of the equipment, especially the experimental data of the equipment running problem is very important for the modification of model identification.

This paper studies the parameters acquisition system of high voltage electrical equipment based on field operation platform. Parameters of field collection will be uploaded to the cloud platform for data management center through Bluetooth data link and finally complete the accumulation of large amount of raw data samples, which are completed under the unified communication protocol specification. The accumulation of the original data sample provides a precious training sample for the development of intelligent detection and expert detection. It has important theoretical and practical significance for accelerating the development cycle of the expert diagnosis system.

2. The hardware of acquisition system

The communication interfaces used by the intelligent electronic devices mainly are RS-232 bus, RS-485 bus, CAN bus, Ethernet interface and Bluetooth[5,6]. As a standard for short distance wireless communication, the substance content of Bluetooth is to establish a kind of public standard for low power, low cost radio air interface and its control software and make the communication connect with the computer[7,8]. So the portable device for different manufacturers in the absence of wires or cables can connect with each other and conduct mutual use and mutual operation function in close range. In this paper, we use the Bluetooth interface mode and select the HC-05 blue serial port module to configure and upgrade the existing test device. The overall block diagram of the system is shown in figure 1.

3. The communication protocol of field operation standardization platform

The communication protocol of field operation standardization platform for experimental data acquisition is in accordance with GB/T 18657.1, GB/T 18657.2 and GB/T 18657.1 standard. It defines the data exchange format and communication mode for the experiment instrument to the intelligent terminal, the function of data communication, data frame structure, packet content, transmission rule, check algorithm, frame type, and message type, etc.[9]. Intelligent terminal will be resolved after the data upload the analytic data to the cloud platform of data management center and complete storage and processing of the experiment data.

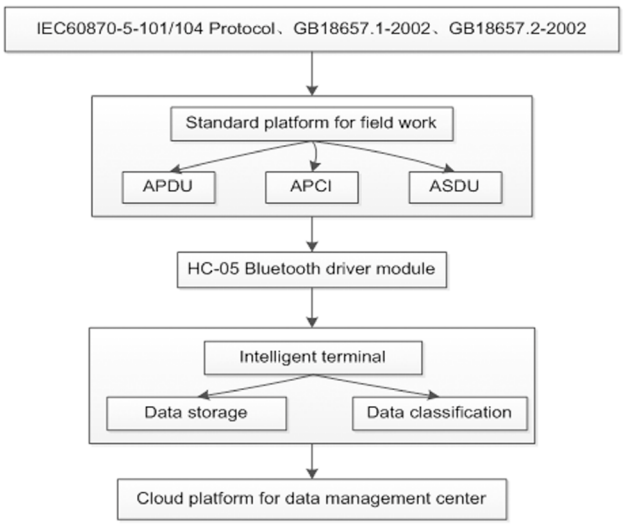

Figure 1. Overall block diagram of the system

3.1 Application protocol structure

The application protocol data unit (APDU) is composed of a plurality of application service data units (ASDU) and a plurality of Application Protocol Control Information (APCI). The number of the ASDU and APCI is defined by the user, at the same time the experiment number in APCI is also defined by user. Application protocol structure is shown in table 1.

3.2 Application service data units (ASDU)

ASDU is composed of a data unit identifier and a unique information body. The data unit identifier is composed of 4 bytes, which is the type identification, the structure limit word, the transmission reason and the application service data unit public address. Information body is composed of an information body identifier and a set of information elements, which can be selected with time scale information. The application data unit is analyzed In the application layer, the data content is obtained, and the corresponding processing is carried out. Its structure diagram is shown in Figure 2, and the structure of the information object is shown in figure 3.

4. Data transmission

4.1 Data object format

High voltage equipments are different, such as GIS, capacitive voltage transformer, oil immersed current transformers, dry-type power transformer, isolating switch, and so on. In this paper, the process of data transmission is described by the GIS partial discharge test. The data detected by partial discharge detector will be stored in the PC C:\data folder, then

the PC program reads the measurement data, and upload data through HC-05 Bluetooth module installed in the PC according to the communication protocol.

Intelligent terminal receive data and resolve the storage through the field operation standard platform. Data object format for GIS partial discharge test is shown in table 2

Table1. Application protocol structure

	Start character 68H	APCI	APDU
	ASDU LEN(MAX 253)		
LEN	Experiment number 1		
	Experiment number 2		
	Experiment number 3		
	Experiment number 4		
	ASDU defied by IEC 60870-5-101 and IEC 60870-5-101	ASDU	

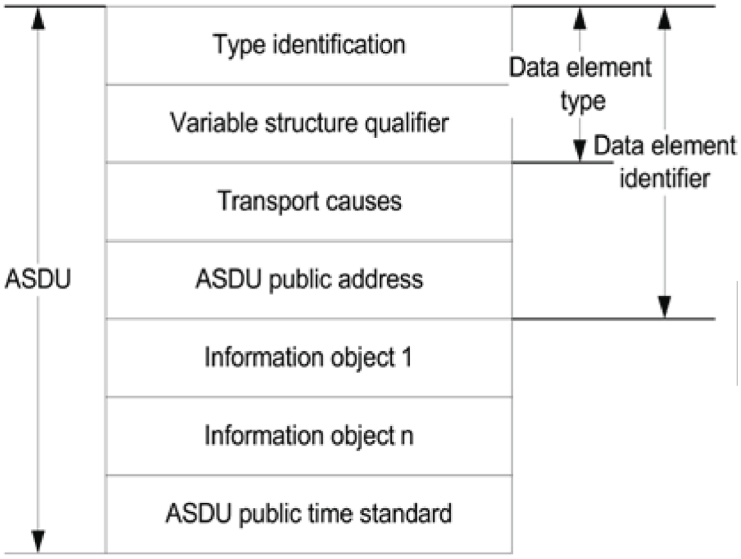

Figure 2. ASDU structure

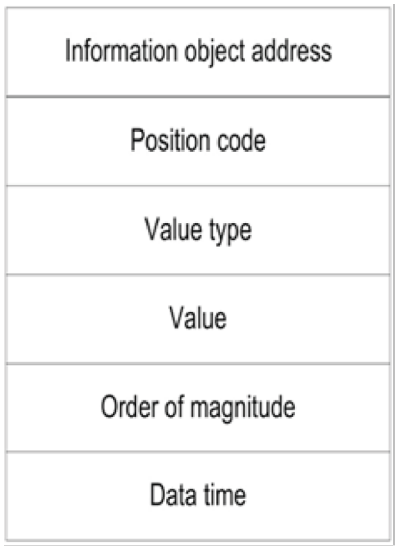

Figure 3. Information object structure

Table 2. GIS partial discharge experiment—3513

Information object	Information object address	Type	Optional value	Position code	Necessary item
Phase	1041	Integer	0~4	0	√
Test result	1038	Integer	0~1	0	
Test frequency (Hz)	108	other	other	0	
Partial discharge (pC)	110	other	other	0	
Test voltage (kV)	101	other	other	0	

4.2 Experiment test

The device using this specification to transmit data must implement the serial linear simulation protocol (RFCOMM) to regulate the basic mode of data transmission, and must provide a complete SDP service based on Bluetooth technology to establish a wireless data link based on Bluetooth technology from two directions. The detection device installed the Bluetooth transmission module HC-05 transmit the code of data object format of the GIS partial discharge experiment. The code is transmitted by upper computer program, and received by the intelligent terminal installed with the standard platform soft. Sending program interface is shown in figure 4.

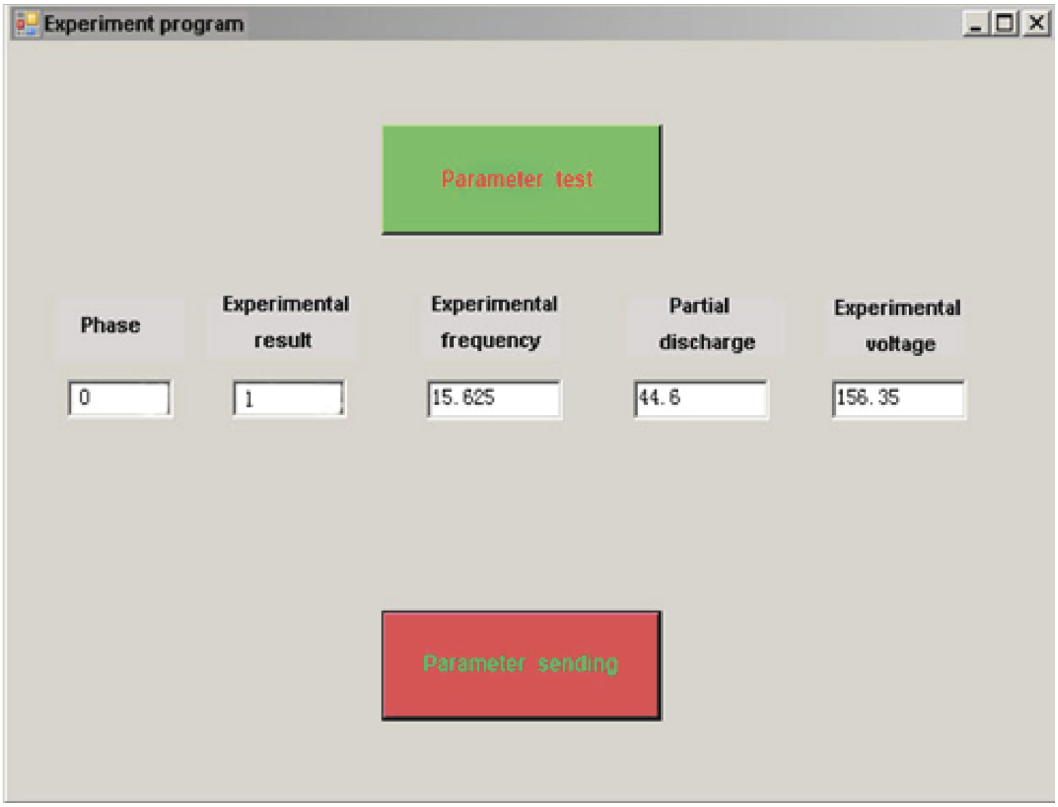

Figure 4. Sending program interface

4.3 Bluetooth module

Any Bluetooth device must comply with the Bluetooth specification in order to achieve the interconnection between the various manufacturers of products. Bluetooth specification is divided into core protocol and application profile. Core protocol provides for the implementation of the protocol layer of the Bluetooth device, and the application protocol provides the specific implementation of the Bluetooth device in different application scenarios. Bluetooth core protocol stack include RF, baseband, HCI, SDP, L2CAP,RFCOMM and other protocols. The Bluetooth radio frequency band is usually realized by the chip. The logical link control and adaptation layer protocol (L2CAP) work with the link management unit (LMP), L2CAP provides the data service of connection-oriented and connectionless. Service discovery protocol (SDP) is used to find services provided by Bluetooth device. RFCOMM with the method of multiplex, provide more transparent data channel, and each data link connection identifier is decided by server channel number and the direction. The HC - 05 module choosed in the article works from the machine model, and Bluetooth module upper application algorithm flow chart is shown in figure 5.

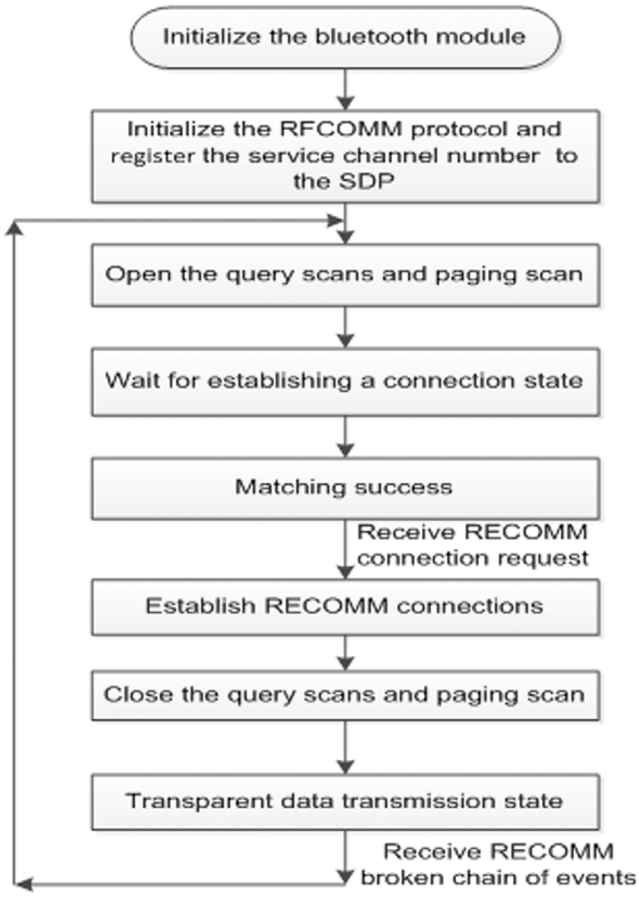

Figure 5. Bluetooth module upper application algorithm flow chart

4.4 Intelligent terminal

The partial discharge detection apparatus equipped with Bluetooth module HC-05 send detection data according to the format of the communication protocol. The field test personnel installed with the standard platform software receive and parse data after successfully connected with Bluetooth module. The receiving interface is shown in figure 6.

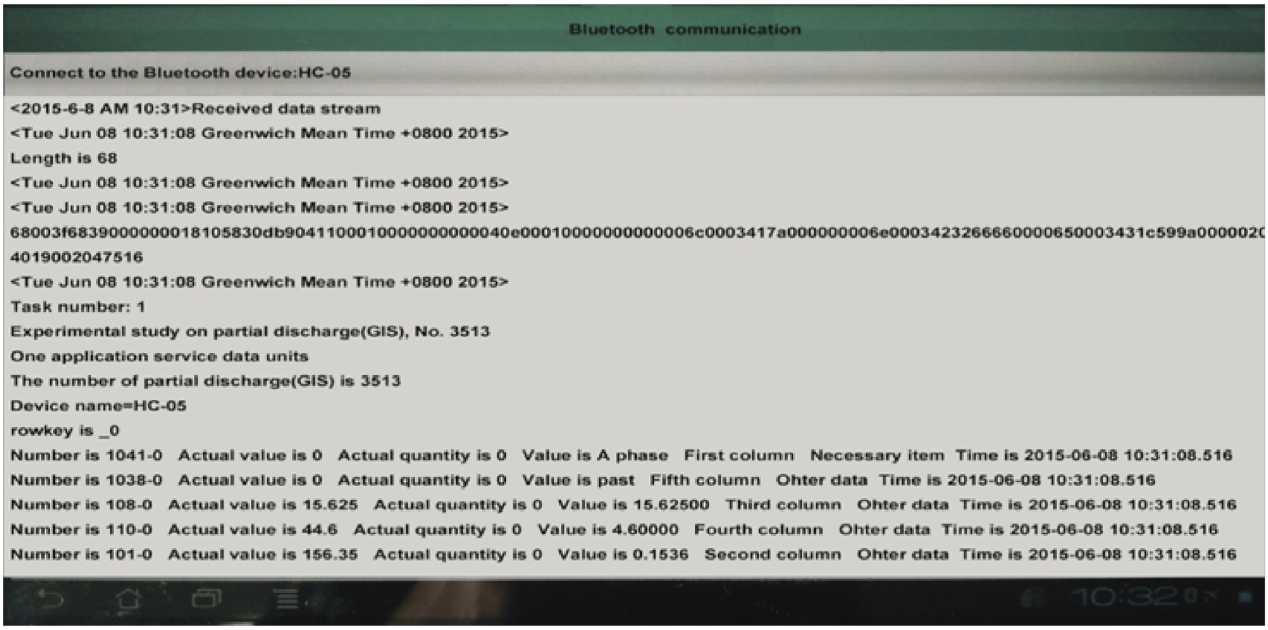

Figure 6. Receiving interface of the intelligent terminal

From above we can know that intelligent terminal parse five information objects, which are phase, test result, test frequency (Hz), partial discharge (pC), test voltage (kV), after received 16 band code. The parsed information objects are just shown as table 2.

5. Conclusions

With the continuous development from routine testing status of power failure to the live detection, detection methods, such as live detection, on-line monitoring and professional inspection, are used more and more widely. This requires a reliable data platform to effectively collect and manage the test data.

From the experiment test we can see that this system realized the seamless connection of the field data and PMS system; canceled the data manually transcribing and PMS manual entry, and reduce human error; realized the interchange and interoperability between devices; achieved the unity of the test data format, completed the accumulation of the original experimental data, and accumulated valuable sample for the follow-up intelligent diagnosis and development of expert diagnostic system.

Acknowledgements

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BCI-based Electric Cars Controlling System

Yin Jinghai, Hu Jianfeng, Mu Zhendong

Institute of Information Technology, Jiangxi University of Technology, Nanchang, China

Abstract
The so-called brain machine interface (BCI) is a use of peripheral nerves and muscles the brain's normal output channels of communication system. People hope that this new communication technology can be used for auxiliary control of vehicle, weapons and other systems, especially for those people with damaged nerves and muscles, providing another way to communicate with the outside world because disabled patients cannot use conventional means of communication. In this paper, we use the BCI technology to build a control system to assist the electric vehicle operation. The control system is based on BCI and vehicle control technology research and development. The system can make the disabled persons control the electric vehicle operation after training, so as to improve the life quality of the handicapped.
Keywords: BRAIN-COMPUTER INTERFACE (BCI); ELECTRIC CARS; ELECTROENCEPHALOGRAPH (EEG).

1. Introduction

In 1929, Hans Berger, firstly recorded electroencephalograph (EEG) brain activity of human, then, people began to use EEG, analysis brain activity, and the brain computer interface (BCI) technology emerge as the times require[1]. People gradually found that this dream is slowly become a reality.

Brain computer interface (BCI) is a new way of human-computer interaction, it is through the EEG acquisition equipment collecting corresponding EEG signals, feature extraction, and classifying different brain activities and different emotions (such as the mouse moves up and down etc.), then realizing the communication of human brain and the external equipment, such as computer, lights, wheelchair, mobile phone, vehicle etc.

In 1991, JR Wolpaw and DJ McFarland began using EEG to study brain computer interface system[2], at this time the brain computer interface system is mainly to control the cursor moving 1D.