Application of Augmented Reality Technology and Artificial Intelligence Satellite Communication Equipment in Power Grid Emergency Training

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Abstract. In recent years, more and more fast-developing high and new technologies have gradually penetrated into the power grid emergency of satellite communication equipment training, and Augmented Reality (AR) technology and Artificial Intelligence (AI) are one of them. The power communication network is an important means to ensure the safety, stability, and economic operation of the power grid, and it is also an important infrastructure for the entire power grid. Power grid emergency training is particularly important for improving the ability to respond to emergencies. The purpose of this article is to study the application of AR technology and AI satellite communication equipment in power grid emergency training. This article first analyzes the demand for training content of power grid emergency training for satellite communication equipment training. Through questionnaire surveys and interviews with relevant experts and emergency rescue teams, it summarizes the training content suitable for the application of AR technology and AI technology for power grid emergency. Then, by introducing the key technologies of the power grid emergency training of satellite communication equipment training, the application of AR technology and AI in the power grid emergency training of satellite communication equipment training is completed. The training effect data shows that 68% think that the training can improve the motivation of training by using this technology, 74% think that the overall effect of the training is good, and 66.3% think that the skill improvement effect is good, which verifies that the technology is used in power grid emergency training. It is worth promoting.

Key words: Augmented Reality, Artificial Intelligence, Satellite Communications, Power Grid Emergency

1. Introduction
In order to improve the rescue capabilities, command capabilities, and safety awareness of emergency paramedics in the power grid, a large amount of training is required. However, limited by natural factors, the traditional training scope is limited and the training effect is not ideal [1-2]. Satellite...
communication equipment training based on AR technology and AI. Power grid emergency training is a training method that matches the team’s functional tasks, technical means, and rescue environment. It can improve the level of informatization of training and has the ability to perform various tasks in an AR environment [3-4].

Many scholars at home and abroad have conducted in-depth discussions on the application of AR technology and AI satellite communication equipment in power grid emergency training, and have achieved good research results. For example, they proposed the intelligent construction of power grids. The scheme, through modern communication and computer technology, realizes the monitoring of the operation status of the distribution network from time to time, and at the same time realizes the automation and informationization of the management of the distribution network [5]; several schemes of shortwave communication in the emergency communication of the power system are proposed [6].

Based on the demand analysis of emergency rescue team's rescue capability, this article summarizes the training content of power grid emergency rescue team, and selects the most suitable training method according to the characteristics of different training methods. Based on the overview of AR technology and AI technology, the key technologies that have been trained in the power grid are discussed. Finally, with the emergency rescue team of the city A power grid as the experimental object, the traditional training method and the training method using AR technology and AI technology are tested and compared to analyze the training effect to verify the scientificity and feasibility of this research.

2. Application of AR Technology and AI Satellite Communication Equipment Training in Power Grid Emergency Training

2.1. Demand Analysis of Power Grid Emergency Training Capabilities for Satellite Communication Equipment Training

Basic ability, Learning and summarizing ability, social interaction ability, communication and coordination ability, political discrimination ability, organization and management ability, language expression ability, time management ability, leadership ability, power grid system mastering ability, power grid equipment mastering ability, power grid rescue equipment mastering ability, strategic thinking and Planning ability and psychological endurance.

In terms of business capabilities, Disaster and accident mastery ability, hazard source identification ability, hidden danger investigation ability, observation ability, accident investigation ability, emergency plan preparation and management ability, monitoring ability, occupational hazard mastering ability, ability to avoid injuries and deaths of the rescue team, medical first aid ability, theoretical teaching ability, Formulate rescue exercise capabilities, actual combat simulation rescue exercise capabilities, computer simulation exercise capabilities, and joint operations capabilities on the map.

Accident rescue command ability, Information collection ability, accident decision-making ability, accident research and judgment ability, flexible response ability, coordination control ability, decisive decision-making ability, overall planning ability, rescue organization implementation ability, accident handling new technology application ability.

2.2. Key Technologies of Satellite Communication Equipment Training in Power Grid Emergency Training

Display technology. Display technology is one of the most basic key technologies in AR. It can realize the seamless integration of fictional objects and the real world on any terminal device [7-8]. A light path is formed between the user's visual range and the objects in the real scene, and an image is formed on this light path, so that the virtual and the real are seamlessly integrated. The AR system mainly superimposes virtual information on the real scene through the display terminal. According to the technical characteristics, the commonly used display technologies are: Optical-Based-based head-mounted or wearable display technology, which can be divided into optical perspective and video
perspective according to the working principle. Two types, with high degree of realism and no need to hold the device in the experience process, it is currently the best user experience [10]; based on Video-Based flexible and convenient handheld mobile display technology such as mobile phones, etc. The role of the screen is a playback window to display virtual and real fusion information, which is used to display virtual objects superimposed on the real scene. Projection display technology with a wide field of view requires additional projection equipment to pass computer-generated virtual objects through. The projection equipment is directly integrated with the real scene.

Technical equipment monitoring technology. The equipment management function of the satellite network control center software and remote satellite station control software adopts XML-based equipment model technology to realize the monitoring and management of the satellite system equipment. Through the use of modeling modeling technology, a special monitoring management model is designed for each type of equipment, and the corresponding XML description file is generated through equipment modeling and packaging technology. The equipment model packaging technology abstracts each type of equipment into a model, transforms and encapsulates the equipment monitoring protocol into the model, and encapsulates the equipment parameter interface into the model after modeling, that is, encapsulates the device panel view display logic, the communication interface information, parameter information, and status quantities can be obtained through the monitoring model of a type of equipment to obtain all the monitoring information of that type of equipment.

Satellite resource dynamic allocation technology. The satellite IP access controller requests frequency resources from the network control agent, and the network control agent sends the IP access controller request to the network control center through the control channel. The network control center calculates the allocation plan according to a certain strategy according to the satellite frequency usage. The network control center issues the allocation plan to the network control agent requesting resources. The network control agent sends the call processing result (including routing information) to the satellite IP access controller, and the IP access controller configures the route according to the call processing result, and conduct a continuity test, the link is successfully established, and end-to-end communication begins.

Network control signaling transmission optimization technology. Network control signaling transmission optimization technology. Customizable priority queue scheduling does not mean that low-level control signaling waits indefinitely. In the application, the length of the buffer queue should be reasonably controlled. When the buffered data exceeds the threshold, the priority will be temporarily changed according to the priority rule. Level processing method to solve the problem of excessively high delay that may be faced by low-level control signaling transmission.

Virtual and real fusion technology. Virtual and real fusion technology is one of the expansion directions of AR, and it is also a breakthrough point for further research on AR. AR is the fusion of virtual information in the real scene, bringing a different visual impact to the experriencer, and a new experience of fusion of virtual and real, allowing users to enhance their understanding of the real environment [11-12]. The virtual and real fusion is based on tracking and registration, and the image information obtained by the real camera is transmitted to the computer. The computer performs data processing and technically synthesizes the lighting, shadow and texture of the virtual object to solve the problem of seamless fusion of virtual and real.

User interaction technology. The AR system uses acquisition equipment to obtain real-world data. By tracking the feature points of the registration technology, the user issues behavior commands, and the interactive technology feeds back this command to the system and gives feedback on the output results, so that the user can be present in the real world. The natural interaction between the virtual elements.

2.3. Artificial Spider Web Routing Algorithm for Smart Grid

Hub node selection. The shortest distance rule: The value of the maximum distance from the hub node to the rest of the nodes reaches the minimum value. This is an optimal location problem. We define the following formula for node x distance degree D(x):
According to the experimental investigation on the rescue team of City A Power Grid Center.

### 3. Application Environment

The use of this research is located in the power grid center of City A. The laboratory environment construction of the city's power grid center meets the "laboratory construction environmental requirements" and basically meets the needs of small-scale experiments.

### 3.3. Application Mode

This research mainly adopts an experiential training mode for teaching, allowing rescue team members to practice and experience personally, and further internalize and construct their own knowledge system on the basis of knowledge.

### 3.4. Experiment Development

In this study, the unequal experimental group was used to measure the accuracy before and after control. The independent variable of the experiment was the emergency training method, the dependent variable was the training effect, and the others were constant. The specific plan is as follows:

- The control team still uses traditional emergency training methods. In the training, the training commander teaches relevant training content to the rescue team members, and uses real objects to demonstrate the operation skills to inspire the rescue team members to think about problems and complete the learning of relevant theoretical knowledge and operational skills.

- The experimental group adopts the experiential training method based on the training demonstration platform of AR and AI. According to the experiential training principles and the characteristics of the power grid emergency training courses for satellite communication equipment training, the following training tasks were designed for the experimental group: power grid emergency theory knowledge training tasks, power grid emergency operation skills training tasks, and power grid emergency application training tasks. This training task is highly comprehensive and complex.

- The specific training steps of the experimental group. In the experimental group, according to the experiential training method based on the AR and AI training demonstration platform, the following arrangements were made for the training procedure during the experiment: creating a situation to stimulate the trainer’s interest in training; training the commander with the aid of the AR-based experimental demonstration platform training; the trainer conducts independent experiments to practice operational skills; completes training tasks and conducts training effects testing.

### 4. Application Data Analysis of AR Technology and AI Satellite Communication Equipment Training in Power Grid Emergency Training

#### 4.1. Grid Emergency Training Accident Rescue Capability Demand Survey

According to the statistical analysis of the professional analysis software SPSS, more than 90% of people consider the "very important or important" abilities in terms of accident rescue command:
accident decision-making ability, accident research and judgment ability, flexible response ability, coordination control ability, decisive decision-making ability capacity, overall planning capacity, rescue organization implementation capacity, accident handling new technology application capacity, specific data are shown in Table 1:

**Table 1.** Survey results of requirements for accident rescue capabilities

| Serial number | Accident rescue capability                          | Important (%) | General (%) |
|---------------|-----------------------------------------------------|---------------|-------------|
| 1             | Information gathering ability                       | 87.5%         | 13.5%       |
| 2             | Accident decision-making ability                    | 93.0%         | 7.0%        |
| 3             | Accident Research and Judgment Ability              | 91.7%         | 8.3%        |
| 4             | Coordination and control ability                    | 94.4%         | 4.6%        |
| 5             | Decisive decision-making ability                    | 90.3%         | 9.7%        |
| 6             | Overall ability                                    | 91.7%         | 8.3%        |
| 7             | Rescue organization implementation capability        | 93.7%         | 6.3%        |
| 8             | New technology capability for accident handling     | 90.3%         | 8.7%        |

**Figure 2.** Survey results of requirements for accident rescue capabilities

It can be seen from Figure 1 that not all abilities are very important or very important for power grid emergency commanders, and not all abilities have to be strengthened through training. Because, when arriving at the accident rescue site, the accident information is often already collected by other people, and the commander is more important to study and judge the collected information and make decisions.

4.2. Analysis of Training Effect

The training effect feedback is mainly carried out on the basis of the training effect evaluation, mainly including the enthusiasm of the rescue team to participate, the consistency of the training content and goals, the learning effect, and whether the rescue team’s skills can be improved after the training. It also includes the rescue team. Team members’ evaluation and feedback on the training system and its
content.

In this questionnaire survey, 90 questionnaires were sent out and 86 were returned. According to the survey data on the training effect, 68% think that the training can improve the motivation of training by using this technology, 74% think that the overall effect of training is good, and 66.3% think that the skill improvement effect is good. The specific survey results are shown in Table 2:

**Table 2.** Training effect feedback form

| Serial number | investigate subject              | Well     | General | Bad  |
|---------------|----------------------------------|----------|---------|------|
| 1             | Improve training motivation      | 68.0%    | 21.7%   | 10.3%|
| 2             | Conformity of training content   | 54.3%    | 32.7%   | 13%  |
| 3             | Theoretical effect               | 69.7%    | 18.3%   | 22%  |
| 4             | Skill improvement effect         | 66.3%    | 22.0%   | 11.7%|
| 5             | Overall training effect          | 70.0%    | 17.3%   | 8.7% |

**Figure 2.** Training effect feedback form

It can be seen from Figure 2 that AR technology and AI training methods have a significant effect on improving the training enthusiasm of rescue team members; based on the fact that AR technology and AI satellite communication equipment grid emergency training content and rescue related regulations training content are generally in line with the traditional training content; compared with the training methods, the teaching effect of this study has been affirmed by most rescue team members; after the relevant module training, the rescue team’s skill improvement effect is also obvious; finally, the overall situation of the training using AR technology and AI technology is good. In summary, AR technology and AI satellite communication equipment training methods for power grid emergency training are worth promoting in emergency rescue training.

5. Conclusion

As a new way of experience, AR technology and AI have a wide range of research foundations and application prospects. They have attracted people's attention and will be more and more widely used in the power grid industry of satellite communication equipment. Introducing AR technology and AI technology into power grid emergency training, creating a training environment and providing a platform for training commanders and learners, not only improves learners’ interest in learning, but also helps to master knowledge and improves training efficiency. For training commanders, the training process has been optimized and the training quality has been improved. Only through continuous improvement of the training system, strengthening of training demand planning analysis,
improving the vividness of the training process, paying attention to the improvement of theoretical and practical abilities, and ensuring the enthusiasm of rescue team members, can the training effect be improved and the rescue team’s emergency rescue ability can be improved, provide a strong guarantee for the emergency rescue of the State Grid.

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