Safety Management of Small-scale Marketing Operations Based on Intelligent Head Mounted Devices

Xueying Song*, Zheng Liu, Zhiqiang Sheng, Lu Li
Peipei Tian, Jianan Zhou, Dandan Song, Yining Wei

Beijing Fibrlink Communications Co., Ltd., Beijing, 100071, China

*Corresponding author: songxueying945@163.com

Abstract. Artificial intelligence is an important driving force for the transition of the power grid from digitalization to intelligence and intelligence. This article focuses on small-scale marketing operations such as emergency repair, meter installation and power connection in the power grid. Using head mounted terminals as carriers and artificial intelligence algorithms as the core, it achieves one-on-one, full coverage and real-time inspection of the operation site. By designing a standardized process for safety management of small-scale marketing operations based on intelligent head mounted devices, personnel safety control is achieved, To nip safety risks in the bud stage, solve the problem of traditional on-site inspections not being able to supervise in real time, achieve comprehensive and digital safety supervision of work processes, and improve the level of on-site operation safety management.

Keywords: Head mounted equipment, small marketing assignments, security management.

1 Introduction

There are various types of work locations for small-scale marketing operations such as emergency repair, meter installation and power connection, including substations, switching stations, user side distribution rooms, transformers on transformer columns, and indoor household meters[1]. Due to the tight working hours and the involvement of multiple risks such as safety, service, and public opinion, safety inspectors find it difficult to conduct comprehensive and real-time inspections of small-scale work sites, resulting in extremely high difficulty in safety management of marketing small-scale work sites[2]. On the other hand, due to the current focus on on-site safety inspections and manual management of on-site work videos, with the continuous increase in business volume and accumulation of video data, the analysis and application of on-site video data for small-scale marketing operations are also facing new challenges[3-4].

This article proposes a safety management method for small-scale marketing operations based on intelligent head worn devices. By using lightweight and portable head worn devices to collect real-time video of the operation site and upload it to the cloud management system, the method can "move the site home". Equipped with artificial

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intelligence recognition algorithms, it can identify violations in real time and provide timely reminders to reduce safety risks and improve the level of on-site safety management.

2 Current Situation of Small-scale Marketing Homework Sites

The small-scale marketing operation site presents the characteristics of "multiple points and wide areas, short and complex, and multiple new businesses", requiring safety inspectors to achieve full coverage and real-time inspection of safety assessment indicators for electric energy metering operation site[5]. The video review process still adopts manual review methods, which require reviewing and centralized inspection of each video. The labor cost is high and the efficiency is low[6]. It is urgent to build an intelligent security management method to achieve intelligent review of homework videos and reminders of risks and hidden dangers, thereby reducing repetitive manual labor and improving review efficiency, and building data analysis application capabilities for security protection, cost reduction and efficiency improvement, and management enhancement[7].

The challenges faced by small-scale marketing operations are specifically reflected in the following aspects:

(1) The workload of auditing continues to increase

With the increasing volume of various business activities such as fault repair, data collection and operation, and device replacement, the investment in video auditing has also increased. The investment in manpower has shown a linear growth trend with the increase of business volume. The auditing work involves a lot of repetitive labor, consumes time, and has a low input-output ratio[8].

(2) After the fact analysis, safety management is not real-time

The manual review of on-site operation videos is not real-time, and the analysis of non-standard behavior lags behind, which is not conducive to the control of on-site risk points and the reduction of on-site safety risks.

3 Design of Intelligent Headwear Devices

The intelligent head wearing device proposed in this article adopts an external design of a safety helmet, which is lightweight, portable, and detachable, without affecting the safety performance of the safety helmet. The intelligent head mounted terminal consists of a camera, fill light, buttons, and battery, with an integrated microphone and artificial intelligence recognition algorithm[9-10]. It is equipped with an IoT card slot and supports 4G/5G communication.

For each marketing task site, the business process is shown in Fig. 1.

After the homework starts, the intelligent head mounted device collects images, audio and video data of the workers, automatically detects signals, and when the signal is good, it uploads the real-time alarm module of the platform side intelligent recognition management system in real time; When the signal is not good, the device is pre

stored, and when the signal is good, it can be uploaded to the platform with just one click;

Real time monitoring and identification of violations such as work scenarios and personnel identities, and pushing abnormal alarms to the terminal APP to remind workers; For objects with unclear identification, platform management personnel make manual judgments and interventions, and then push abnormal results to the terminal APP to remind operators;

After the homework is completed, the platform side intelligent recognition system will analyze and analyze the data of this homework, including time, location, personnel, homework scenario, number of alarms, alarm type, etc.

The intelligent head mounted device proposed in this article supports voice recognition function, enabling voice to turn on and off lights. Through ID matching, it realizes real-time transmission of homework videos back to the cloud security management system. Supports automatic detection of on-site communication signals. If the signal is good, the device will start synchronizing and enabling video recording and uploading to the cloud. If the signal is poor, the device will start synchronizing and enabling video recording and local storage. After the device is turned on, the intelligent decision support module of the cloud security management system is launched synchronously, remind the corresponding precautions in the work process, and provide alarm sound prompts for non-standard or irregular behaviors.

4 Safety Management of Small-scale Marketing Operations Based on Intelligent Head Mounted Devices

(1) The homework personnel turn on the intelligent headset device through the power button, activate the fill light function as needed, and the headset device sends a prompt "Please obtain customer consent and pay attention to civilized language";

(2) The homework personnel inform the user of the homework items according to the standardized operation process. After obtaining the user's consent, they verbally state "the user agrees to change the meter". After the speech recognition intelligent algorithm integrated in the intelligent head worn device successfully recognizes it, they enter the next step. The head worn device sends a prompt "Please perform three power tests";

(3) The homework personnel follow the prompts to perform box experience electricity, meter back switch electricity, and meter front switch electricity in sequence. After the recognition algorithm of the electricity verification action is successful, they enter the next step. The head mounted equipment sends a "Please replace the meter" prompt;

(4) The homework personnel follow the prompts to replace the meter. During the replacement process, the artificial intelligence recognition algorithm integrated inside the head worn equipment will recognize the safety attire, safety tools, and insulation packages in real time. If any violations are detected, the equipment will emit an alarm sound. At the end of the meter replacement process, the homework personnel will power on the user and confirm that there is electricity in their home. At the same time,

the homework personnel will verbally state "electricity in the user's home". After the speech recognition algorithm successfully recognizes it, the head worn equipment will enter the next step and issue a "please seal the meter" prompt;

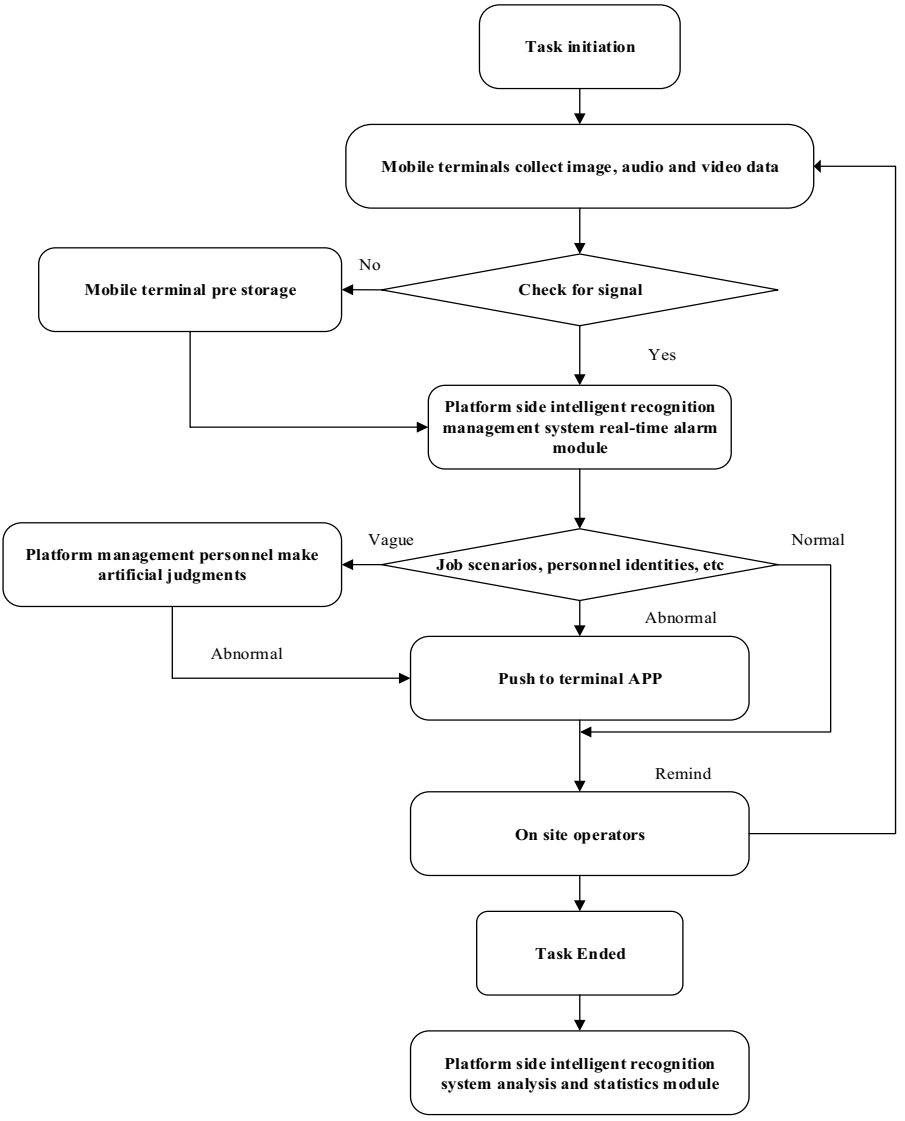

Fig. 1. Safety management process for small-scale marketing operations on site

(5) The homework personnel follow the prompts to seal the meter. After the artificial intelligence recognition algorithm integrated inside the head mounted equipment recognizes the sealing action, it enters the next step. The head mounted equipment sends a prompt "Please clean up the site, pay attention to the absence of meters, seals, and other remaining objects";

(6) The homework personnel follow the instructions to clean the site. After a fixed time interval, they enter the next step. The head mounted equipment sends a prompt "Please sign the user and pay attention to civilized language";

(7) The homework personnel follow the prompts to sign the customer. After the artificial intelligence recognition algorithm integrated inside the head mounted device recognizes the signature action, it enters the next step. The head mounted device sends a prompt "This table change has ended, ready to start the next table change process";

(8) If the algorithm recognition is unsuccessful due to issues such as signal and shooting angle during the homework process, the equipment cannot automatically enter the next process. The operator can manually end the current phase and enter the next phase by pressing the button, achieving uninterrupted work.

The artificial intelligence algorithms involved in the intelligent decision support module of the cloud security management system are as follows:

The insulated glove detection algorithm is used to automatically identify whether the staff at the small-scale marketing operation site are wearing insulated gloves as required. This algorithm uses a real-time multi person 2D pose estimation algorithm based on Part Affinity Fields (PAF) for human pose recognition, which can achieve pose estimation of human actions, facial expressions, finger movements, etc. Extract hand regions in complex scenes, then use SSD models to identify insulated gloves and further improve detection speed. Using a detection algorithm based on SSD MobileNet, replace the feature extraction network VGG16 of SSD algorithm with MobileNet network to enhance the real-time detection of insulated gloves.

Safety tool recognition is used to detect the presence of safety tools such as screwdrivers, test pens, pliers, etc. in the screen. This algorithm is implemented through object detection algorithms. Considering that safety tools have obvious features under standardized placement, the YOLOR model, which emphasizes speed, is adopted to quickly identify the coordinate positions of various tools.

Speech recognition is used to automatically redirect the workflow during the homework phase, and the system can automatically move the workflow to the next phase by recognizing the voice instructions of the workers. This algorithm adopts a parameter model-based Hidden Markov Model (HMM), which abstracts speech signals into an observation sequence and models the speech signal through state transition probability and transmission probability.

Identify and detect personnel in the monitoring image of the electrical inspection action, and determine whether personnel have electrical inspection behavior. This algorithm uses the YOLOv5 model to quickly identify whether there is a person and a test pen in the picture. Through the key point detection algorithm, the coordinates of key points such as the head, hands, body, and test pen of the human body are identified. The positional relationship of these key point coordinates is analyzed to determine whether there is a test action by the personnel.

Insulation package recognition is used for real-time monitoring and detection of the operation of workers, and to determine whether they are wiring insulation packages according to the prescribed standards. This algorithm uses the Faster R-CNN deep learning model to quickly identify insulation packages in the image. Through object detection algorithms, the position and shape of insulation packages can be detected, and

whether they meet the specified standards can be determined. At the same time, the algorithm can also identify key information in the insulation package, such as packaging material, color, etc., as well as whether the staff carried out the insulation package according to regulations.

The meter sealing recognition algorithm is used to automatically identify whether the staff at the small-scale marketing operation site have carried out meter sealing as required. Due to the small size of the sealed targets in the table, this algorithm uses a TPH-YOLOv5 based object detection model to improve the feature extraction effect on small targets through the TPH header, in order to achieve better detection results.

Customer signature action recognition detects personnel in the monitoring image screen and determines whether personnel have signed actions. This algorithm uses the YOLOv5 model to quickly identify the presence of people and pens in the image. Through the key point detection algorithm, the coordinates of key points such as the head, hands, and pen of the human body are identified. The positional relationship of these key point coordinates is analyzed to determine whether there is signature behavior among personnel.

1000 images were selected as the test set, the selection method was random, and the results of each recognition algorithm were as shown in Table.1:

Table 1. The algorithm recognizes the results

Identify the object	Accuracy	Recall rate	Identify the object	Accuracy	Recall rate
Gloves are not worn	0.913	0.896	Electrical inspection	0.825	0.865
Screwdriver	0.967	0.936	Insulated wrapping	0.878	0.852
Electrometer	0.825	0.865	The meter is sealed	0.886	0.901
Pincers	0.972	0.905	Signed by the customer	0.923	0.866
Voice	0.983	0.912			

After testing, the performance of the head mounted device is as follows. After applying the intelligent head mounted device to the safety management of small-scale marketing operations, it has been put into trial operation in more than 10 basic power supply units, assisting in regulating more than 1000 meter replacement operations and helping the provincial power company to meet peak summer power supply needs. The performance of the head mounted device is shown in Table 2.

Table 2. Performance Test Table

Index	Parameter
Recognition Accuracy	96%
Identify latency	<2s

5 Conclusion

This article analyzes the current situation of small-scale marketing operations such as emergency repair, meter installation and power connection. Based on the pain points of grassroots business, an intelligent head wearing device is designed and developed, and a safety management process for small-scale marketing operations is proposed. Using intelligent head wearing devices as carriers and artificial intelligence algorithms as the core, safety management for small-scale marketing operations based on intelligent head wearing devices is implemented, standardizing the entire process of operations and achieving efficiency improvement, Assist in improving safety level, reducing accident losses, and provide important driving force for the transformation of the power grid from digitalization to intelligence and intelligence.

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