

Spatiotemporal Video Data Acquisition and Application for Intelligent Manufacturing

Zheng Shikui, Cheng Bo, Du Feifei

Weichai Power Co., Ltd., Weifang, Shandong, 261061, China

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Abstract: There are gaps in the basic data collection of engine production line, such as the lack of intuitive and efficient quality tracking methods, the lack of effective evaluation means for the consistency of product assembly process, and the difficulty in supporting further fine management requirements. This paper provides data acquisition and storage application and big data analysis application based on "UWB positioning + video +AI". The UWB high-precision positioning management system is adopted to integrate the UWB high-precision positioning technology with video acquisition technology, and combine with advanced deep learning algorithm to realize the application of production process positioning and video data. The consistency and quality of products are greatly improved, and the level of fine management is also promoted.

The concept of fine management plays a vital role in the development of enterprises. It is a management means that makes the organization and management units accurate, efficient, coordinated and continuous operation through institutionalization, procedure, standardization, meticulous and data, so as to achieve the specific and clear management responsibility [1]. It requires enterprises to accurately refine the work of each link.

At present, the engine production line engine assembly, processing in the process of video information storage is incomplete and unable to quickly obtained, artificial cannot find the complete assembly process, lead to product quality problems, unable to fully trace the production process, the product consistency and quality of major obstacles, difficult to support further fine management requirements. It is necessary to introduce positioning equipment to locate the engine assembly process, and use the video linkage function to assemble the video of the engine in the assembly process, so as to realize the historical track of the engine at each station and the video linkage image traceable, and realize the visual traceability of the whole process of product production.

At present, the positioning technology based on indoor environment mainly includes Wi-Fi technology, Bluetooth technology, infrared technology, R FID technology, Z igB ee technology, ultrasonic technology, ultra-wideband (UWB) and other technologies [2]. Among them, Wi-Fi technology, Bluetooth technology and infrared technology are vulnerable to signal interference in complex environment, and the system stability is poor[3]; R FID Technology has large transmission range and low cost, but it is not easy to integrate into mobile devices, which limits its application scope; Z igB ee technology is suitable for fields with short transmission range and low transmission rate; ultrasonic technology has high positioning accuracy and simple system structure, but high

overall cost [4]. Compared with the aforementioned positioning technologies, UWB technology is a carrier-free communication technology, which uses nanosecond non-sine wave narrow pulse for communication, and has the advantages of high bandwidth, high transmission rate, high low power consumption, high positioning accuracy and strong anti-interference ability, so UWB technology is widely used in the field of indoor positioning[5].

In conclusion, this paper provides the data acquisition and storage based on "positioning + video + AI" UWB application and big data analysis application comprehensive solutions, using UWB high precision positioning management system, the UWB high precision positioning technology and video acquisition technology fusion, combined with advanced deep learning algorithm, realize the application of production process positioning and video data, provide accurate, efficient and intuitive means, makes product consistency and quality, and promote the improvement of fine management level.

1. The UWB localization principle

The UWB is positioned based on the time of flight (ToF). The positioning label periodically emits the UWB signal. When the UWB positioning base station scans the UWB uplink signal, it can measure the UWB signal ToF, and then solve the method of multiple positioning circles or sphere intersection, and accurately locate the precise position of the positioning card, as shown in Figure 1.

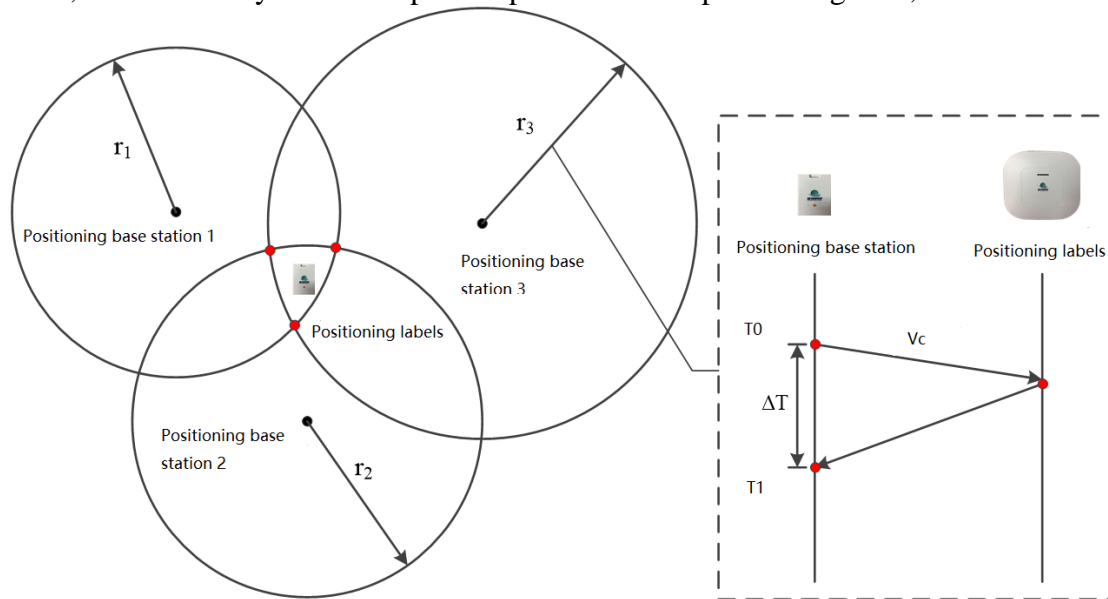


Figure 1 UWB positioning principle

2. Technology roadmap

UWB high precision positioning management system, by the real-time positioning, historical trajectory, product management, electronic fence, electronic inspection, alarm management, data analysis, map management, user management, vehicle management, system management, is used to achieve "UWB positioning + video + AI" data collection and storage application and large data analysis application of important carrier. Through the integration of UWB positioning technology and video acquisition technology, combined with advanced deep learning algorithm, the application of production process positioning and video data is realized. The specific technical route is shown in Figure 2.

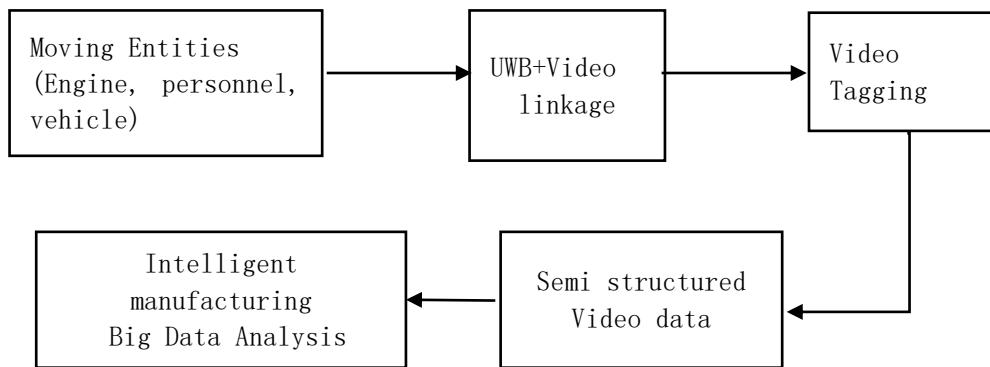


Figure 2. Technical route

2.1 Accurate positioning and acquisition process residence time are realized through UWB positioning technology

The project deploys the positioning base station and the camera in the production line, connects the surveillance video with the engine number and the process name through the hardware and software, and realizes the automatic video storage. The positioning adopts a two-dimensional positioning mode, which can accurately locate the position of the label on the two axes, reflecting the plane motion trajectory of the label, and smoothing the motion trajectory. Positioning labels are divided into industrial plate positioning labels and vehicle-mounted positioning labels. The plate positioning label is worn by personnel, and the on-mounted positioning label is placed on the engine for binding. FIG. 3 is a schematic diagram of UWB positioning. Within the coverage of the base station, the tag is transmitted to the server in real time to obtain the position and track of the personnel and engine. When the tag enters the divided process area, the relevant camera receives the signal to record video; when the tag leaves the divided process area, the relevant camera accepts the signal to stop recording video to accurately collect the process residence time.

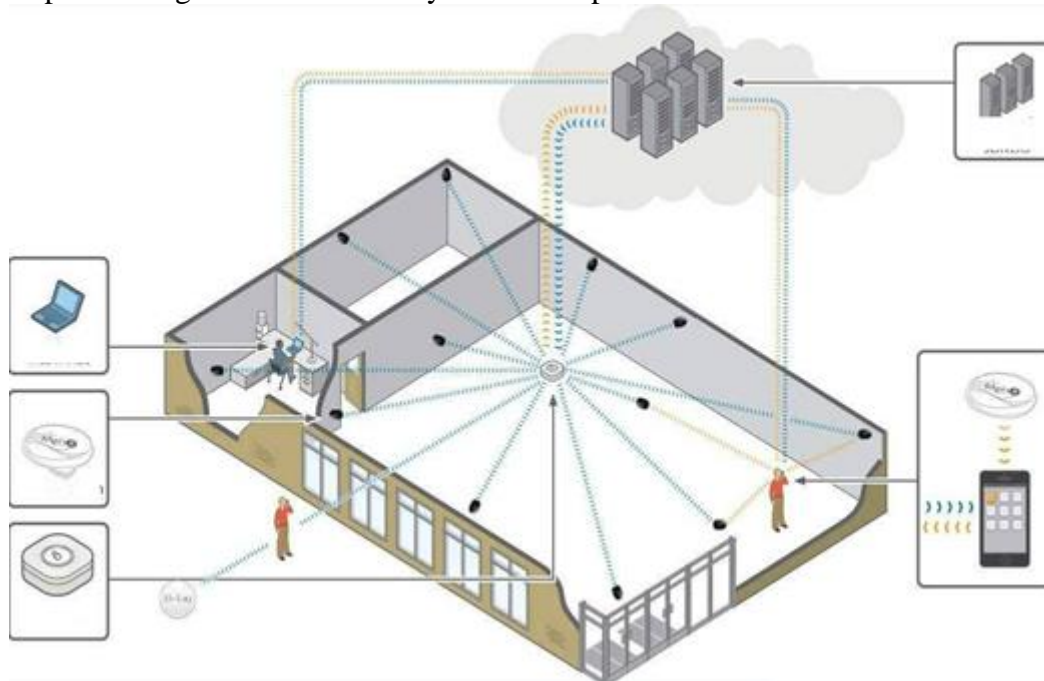


Figure 3: Schematic diagram of the UWB localization

2.2. Check each process of the engine through video acquisition to achieve production quality traceability

The 233-channel camera in the scene records the production video in real time, and the untreated video will temporarily exist in the NVR (network video recorder) server. Through the product resume information collected by the positioning system, the video in the NVR server is intercepted and stored in the big data platform server, so as to realize the data association of "engine number-process-process cycle time-process video". By logging in to the UWB high-precision positioning platform, users can view and track the target object in real time. As shown in Figure 4, they can strictly check every process of the engine, trace the video resume, and realize the traceability of production quality.

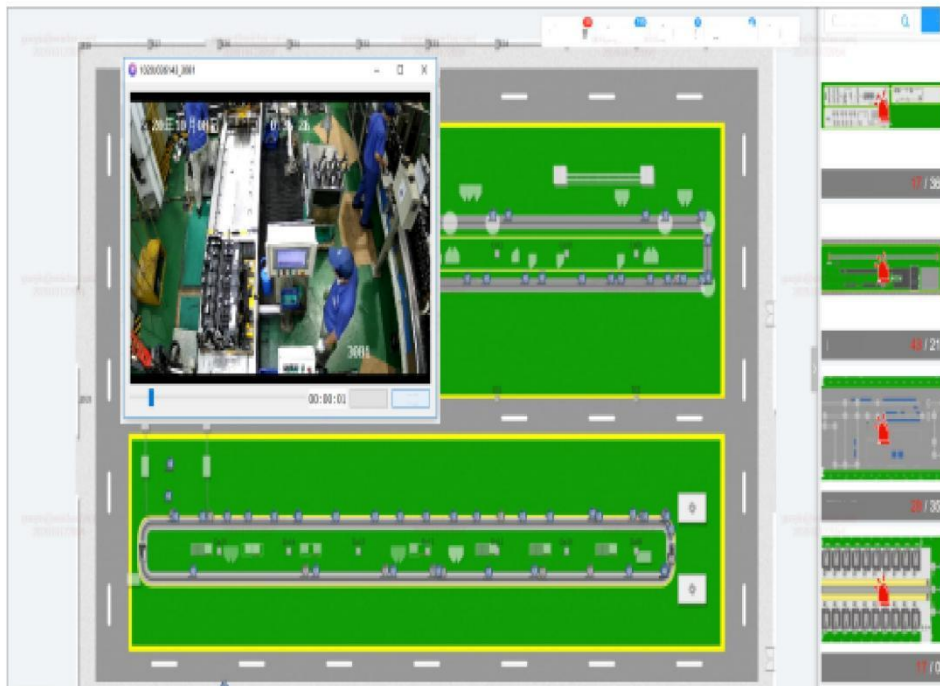


Figure 4: Video real-time query diagram

2.3 Second-level query of video is realized through semi-structured storage of video data

Based on the storage of the big data platform, you can build the CEPH object storage cluster by yourself, which has the advantages of high expansion and high availability, and realizes the semi-structured storage and second-level query of video data. Users can retrieve the video by entering the engine number or the process number on the front-end page. At present, 240TB of storage space has been invested to store about 18,000 engine videos for two months.

2.4 Improve the scope of process confirmation and new employee training efficiency through video storage and playback

According to the process requirements, the positioning system strictly divides the entry and exit range of each process, and improves the process confirmation range. The video storage time collected by the positioning system is more than one year. Through the video recording of each process and each model, combined with the action standard, we can provide better materials for the new staff training, visual teaching, let the new staff capture the action details, and establish a rich

video library of each model and each process assembly. The new employees change from theoretical learning to operational video learning, which shortens the independent working time of the new employees, and realizes the training method and efficiency upgrade of the new employees. Provide employees with operation video of different shifts, further improve the consistency of engine, and realize the standardization of employee action.

2.5 Intelligent manufacturing big data analysis is realized through the deep learning algorithm

Through the deep learning algorithm, the extraction of human bone node flow, multi-person information separation, multi-video operation key coordinate judgment, operation key coordinate coding and coding consistency judgment in the assembly process are realized, and then realize the analysis and evaluation of action consistency.

3. Conclusion

This paper provides a comprehensive solution based on "UWB positioning + video +AI" application collection and storage data and big data analysis application. By using the integration of UWB high-precision positioning management system, UWB high-precision positioning technology and video acquisition technology, combined with advanced deep learning algorithm, the application of production process positioning and video data is realized. We should provide accurate, efficient and intuitive means for quality traceability, make product consistency and quality, and promote the improvement of fine management level.

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