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An Automatic Generation Method of Augmented-reality Contents by Image Annotating for Supporting Inspection of Power-Distribution Facilities

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1. Introduction

It is important for power-distribution departments to improve efficiency of maintenance works. Conventionally, high reliability is ensured by inspecting distribution facilities. Inspection workers should inspect the facilities while referring to related information such as inspection history, facility attributes, and past pictures to judge a facility's condition accurately. It is, however, difficult to identify the facilities and to retrieve the information from a database because an enormous number of facilities are scattered widely.

In light of the above-described issues, therefore, an augmented-reality (AR) system for supporting inspection has been proposed, implemented, and tested in our previous work [1]. By means of the proposed system, the facilities viewed through a camera mounted on a tablet are identified by the proposed robust identification algorithm, and related information is overlaid on a live camera view.

In this work, an automatic generation method of AR contents by image annotating is proposed to enhance our proposed system. By means of the proposed method, a worker records inspection results by taking picture of a target and annotating defect icons to the corresponding part of the picture. Location of each annotated icon on the picture is automatically linked to the location of real facilities and saved in database. When the worker inspects the target through a camera mounted on a tablet, alerts about defects found in previous inspections are automatically displayed by AR based on previous annotated pictures. As a result, the system can improve efficiency and reliability of inspection works because the workers can inspect target while referring to check points.

2. Robust Location-based AR system

In our previous work [1], an AR inspection-support system has been proposed. The system consists of server system and tablet application The server system holds databases of facility data and GIS data. This facility database stores inspection history, facility attributes, and facility's time-series pictures. The locations of the facilities are managed in the GIS database. The tablet-side application consists of a map view, an AR view, a photo album, and some functions for supporting facility inspections. The map view displays the facility's locations on a map. In the AR view, the target facility is identified by the proposed robust identification algorithm, and related information is overlaid on a live camera view. Furthermore, taken pictures can be browsed in the photo album. Finally, the pictures and inspection results are uploaded to the server and accumulated in the database.

The robust identification algorithm is an advanced approach for conventional location-based methods. The algorithm only uses GPS data as well as data from acceleration and geomagnetic sensors. Concretely, the facilities are identified on the basis of not only a tablet's current location and heading obtained from these sensors but also object distance (i.e., the distance between the user and the object being inspected) by triangulation method using acceleration and geomagnetic sensors. The facilities can be identified robustly without being influenced by measurement errors of these sensors and difference between utilization conditions of the AR system.

3. An Automatic Generation Method of AR Contents by Image Annotating

The proposed method consists of two steps: an input step, and a reference step. In the input step, an inspection worker records inspection results by taking picture of a target and annotating defect icons to the corresponding part of the picture. In the reference step, the worker can refer alerts about defects found in previous inspections by AR on previous annotated pictures when the worker inspects the target. A summary of both steps is explained as follows.

Fig.1 and Fig.2 show a summary of the input step. At first, a target facility is identified using the robust identification algorithm as explained in Section 2. After identification of the target, location of the target in the screen can be calculated and tracked. When the worker finds some defects, he/she takes target's

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picture to record found defects. He/she drags and drops defect icons to corresponding part of the picture as shown in Fig.1. After annotating defect icons, location of each annotated icon on the picture is automatically linked to the location of real facilities as shown in Fig.2. The defect's location is expressed in a set of height and angle. Finally, the annotated picture (defect's height and angle) is saved in database as inspection result.

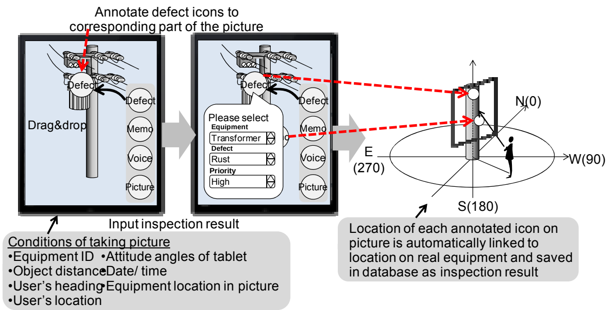

Fig.1 Summary of input step

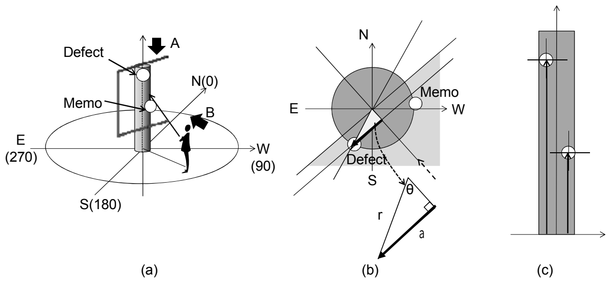

Fig.2 Calculation of defect location in input step

Fig.3 and Fig.4 show a summary of the reference step. For explanation of the proposed method, it is assumed that a different worker inspects the same target in several years after the inspection explained above. In Fig.3, the worker's location is different from one in Fig.1. At first, the target facility is identified using the robust identification algorithm. After identification of the target, previous inspection results (annotated pictures) are retrieved from database using facility ID. When the worker inspects the target through a camera, previous defect's locations on the live camera view are automatically calculated based on previous annotated pictures (defect's height and angle) and tablet's attitude angles as shown in Fig.4. On the basis of the calculated defect's locations, alerts about previous defects are displayed by AR in real-time. In the case of Fig.3, only memo annotation is displayed on the screen because the worker checks the lower side of the target. Therefore, the system shows a caution to prevent overlooking the defect annotation.

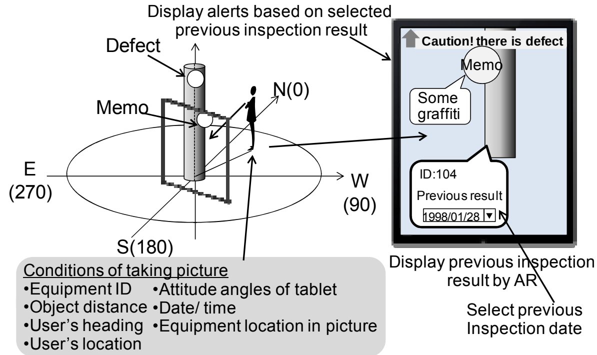

Fig.3 Summary of reference step

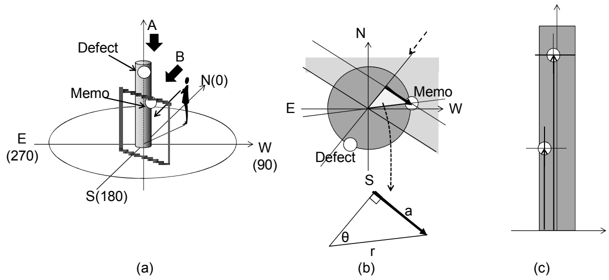

Fig.4 Calculation of defect location in reference step

4. Conclusion

An automatic generation method of augmented-reality (AR) Contents by image annotating for supporting inspection of power-distribution facilities was proposed. By means of the proposed method, a worker records inspection results by taking picture of a target and annotating defect icons to the corresponding part of the picture. Location of each annotated icon on the picture is automatically linked to the location of real facilities and saved in database. When the worker inspects the target through a camera mounted on a tablet, alerts about defects found in previous inspections are automatically displayed by AR based on previous annotated pictures. As a result, the system can improve efficiency and reliability of inspection works because the workers can inspect target while referring to check points which should be inspected with extreme caution.

In future work, practicability of the proposed method will be evaluated through prototyping.

References

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