Study Committee D2

Information Systems and Telecommunication

Paper 10532_2022

THE ADVANCED APPLICATIONS FOR EQUIPMENT MAINTENANCE UTILIZING THE LATEST INFORMATION AND COMMUNICATION TECHNOLOGIES OF JAPANESE ELECTRIC POWER UTILITIES

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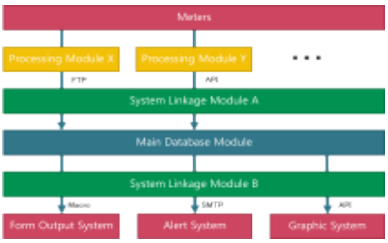
Motivation

- Japan is one of the most rapidly aging counties in the world. This is leading to rising worker costs.
- Energy liberalization in Japan was finalized in April 2016. The rate of renewable energy in the market is growing and fuel prices are soaring. These factors have a significant impact on the predictability of future market prices.
- It is necessary to improve the efficiency of workers using ICT to reduce costs.

Method/Approach

- We introduce two cases of utilizing the latest ICT to solve the problem.

Automatic meter posting system (AMPS)



- Measuring instruments read and recorded by humans.
- AMPS can read gauges of meters which are already installed.
- Image recognition can be used to create a generic system that is independent of the meter manufacturer.
- In the future, it can be combined with image acquisition equipment such as industrial robots.
- No need to run cables

Objects of investigation

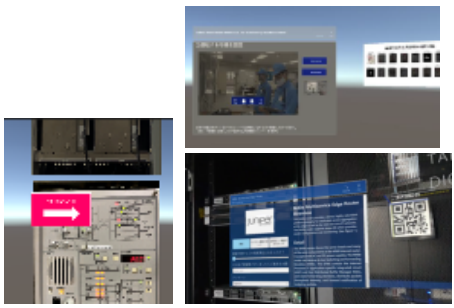
- We need to know how accurate was studied.
- We actually built AMPS and multiple recognition engines were combined to exchange data.
- We tested the system in the two different environments.

Discussion

- Outdoor meters are difficult to read in some cases due to light and other factors.
- The accuracy of the system is enough to be operated, but it depends on the environment, so it is necessary to be creative when installing the system, such as retrieving information at specific times of the day.
- Adjust the angle of the camera, taking into account the direction of light.

Support for facility and maintenance operation using mixed reality(MR)

- The MR HMD can display the manual of the device by reading the QR code attached to it.
- The worker can intuitively understand the work by using this application displayed on the HMD.
- HMDs allow the user to experience MR without connecting to other devices.



- MR can give more information to the worker than talking.
- The HMD displays images so workers can intuitively understand the system.
- MR can be used to improve technical skills without the need for conventional group training.
- In the future, efforts will need to be made to introduce more innovative applications to meet the changing environment of Japanese electric power utilities.

Discussion

- In order to increase the effectiveness of the tools developed in this study, it is necessary to enhance the tools used to collect needs.
- Acceleration of efforts in this area is needed to address the current situation of workers

Conclusion

- We show two cases for achieving more efficient workloads in Japan.
- Deep learning and MR are the latest ICT products, and useful for the maintenance work and education.
- We will have to make an effort to install more innovative applications for changing environments in the Japanese power industry.
- Our study serves as a window of opportunity to the application of ICT.

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continued

Experimental Setup & Results of AMPS

- We built AMPS and two recognition engines were combined to exchange data.
- The system was tested in two different environments.
- One tested four types of meters from various angles. (Table 1)
- A 10% margin of error was allowed for with average of three different settings calculated4 meters were used for testing. (Fig. 1-4)
- AMPS is efficient for reading meters in laboratory circumstance.

Table 1.

setting	angle	Distance
1	Front	50 cm
2	Front	100 cm
3	Front	300 cm
4	20 degrees left	50 cm
5	20 degrees under	50 cm

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Table 2.

Setting No.	Fig. 1	Fig. 2	Fig. 3	Fig. 4
1	3/3	2/2	3/4	10/10
2	3/3	2/2	4/4	10/10
3	3/3	1/2	1/4	0/10
4	3/3	2/2	4/4	8/10
5	3/3	2/2	2/4	8/10
Overall	100%	90%	70%	72%

- Another is a three-month installation test at same angle.
- Six types round analog meters were read every hour.
- A 10% margin of error was allowed.
- Every meter has network failure of about 5 %.
- Fig. 5 is too far to take with enough resolution and daily fluctuations occurred in angle of view, possibly due to heat.
- Fig. 6 is failed to config the light of camera. Whiteout occurs at night, and the accuracy is 91.4 % only at daytime.

Table 3.

Fig.	Accuracy	Outdoor/Indoor
5	89.3%	Indoor
6	94.9%	Outdoor
7	94.9%	Indoor
8	95.5%	Indoor
9	47.6%	Outdoor
10	45.7%	Outdoor

Fig. 5

Fig. 6

Fig. 7

Fig. 8

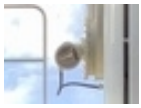

Fig. 9

Fig. 10

What is Mixed Reality?

- Mixed Reality (MR) is a technology that allows the projection and manipulation of virtual objects that do not actually exist in the real world space in real time. The MR Head Mounted Display (HMD) is not a closed type like a Virtual Reality (VR) HMD, but a transparent type that allows the wearer to see the virtual 3D image and the surrounding real world scenery at the same time. And, even if the wearer changes the direction of his or her gaze or moves, the virtual reality can be seen as if it were "there".
- In addition, the holograms can be grabbed, pulled, and manipulated. MR, a fusion of the real world and holograms, supports more realistic examinations and discussions.