EPRI ELECTRIC POWER RESEARCH INSTITUTE

REMOTESPARK SUBJECT-MATTER EXPERT TOOL

Incubatenergy Labs 2020 Pilot Project Report

KOGNITIV SPARK

Startup

Kognitiv Spark

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Technology Solution

Today's utilities are looking for new and innovative ways to enhance knowledge transfer. Workforce attrition and reduced staffing levels have resulted in a loss of institutional knowledge, while incoming workers are inexperienced but tech savvy. Innovations that seamlessly connect field workers with remote subject-matter experts (SME) have great potential for facilitating knowledge transfer when needed and ensuring that critical activities may be performed safely and effectively. Learning necessary skills and resolving questions and uncertainties at the point of work can provide hands-on guidance and reduce errors. Sharing of documents, images and drawings, and animated equipment models in real time can add additional value by allowing work to continue without interruption.

The RemoteSpark pilot project was established to demonstrate the feasibility and value of implementing the remote SME solution developed by Kognitiv Spark (KS) using a commercially available augmented reality (AR) product, the Microsoft HoloLens2. The RemoteSpark application offers capabilities uniquely suited for industrial environments and isolated work sites. Importantly, no third-party software is required. This ensures a high level of security and, where necessary, the ability to deploy completely "on premise" with no need to connect to the internet or to other outside systems. As a result, RemoteSpark is able to optimize efficiency and facilitate fully enabled video calls, to include sharing of 3D holographic models, using bandwidth as low as 256Kb.

Challenge: Workforce of the Future

AR image of 3D hologram of SEL relay

Project Overview

In designing this project, the KS-EPRI team sought to demonstrate the core functionality of the RemoteSpark application for utilities while addressing the following questions:

1. Can the technology be evaluated in simulated work scenarios directly applicable to those encountered by utility field workers?
2. Can the technology enable field workers to troubleshoot and complete tasks in a manner that leads to significant positive impacts in workflow and error reduction?

Specific use cases related to power generation and transmission were developed with reference to original equipment manufacturer (OEM) literature and to actual utility procedures. Interested utilities serving on

a project steering committee, as well as technicians at the EPRI High Voltage Lab in Lenox, Massachusetts, were instrumental to this process. The scenarios included the following:

- SF6 high-voltage breaker
  - o Routine inspection to check condition and function
  - o Field verification of proper breaker isolation and clearance for maintenance
- SEL751 relay
  - o Connection to the relay to upload settings or download data
  - o Investigation of relay-initiated trip to determine cause and review captured data

EPRI's Lenox lab houses fully functional versions of each of these components. KS team members created animated 3D holograms of the components and tasks based on photos and OEM operational data. The animated holograms were designed to support and/or replace written documentation of the procedures. An EPRI technician not involved in developing the use cases was provided with a HoloLens2 headset to gain familiarity with wearing and using the device.

Results & Learnings

To mimic a real-world application, the EPRI technician used the AR headset before going to the work site to become familiar with each task before execution, viewing the stepped animations of the 3D holograms detailing the inspection steps and showing the specific components referenced. Once in the field at the Lenox lab in Massachusetts, the technician used RemoteSpark to initiate video communication calls through the head-mounted device to an EPRI counterpart, acting as the remote SME and located in Florida.

While performing the agreed-upon procedures on the breaker and the relay, the technician was in full video/audio contact with the remote SME, who could ask them to stop and inspect a specific component more closely or guide them through additional steps. The stepped animations were viewed and referenced during task execution as both a guide and a validation tool. The remote expert was able to capture screen shots and video, make annotations on the technician's field of view, and send additional reference documents and holographic models.

The technician was able to successfully complete all procedures using the HoloLens2 and RemoteSpark application. Test scenarios highlighted the value of using head-mounted devices with the KS solution, as technicians can keep hands free for work tasks. The new flip-up feature of the HoloLens2 headset allowed the field technician to move the lens up and out of the way, leaving an unobstructed view of the work area and also improving situational awareness of their surroundings.

EPRI technician using Hololens2 with RemoteSpark at the Lenox High Voltage Lab

After each test case, discussions were held to determine ease of use, efficiencies gained, confidence in task completion, improvement opportunities, and overall perceptions. Initial feedback indicated that the headset and holograms made the procedures

TESTIMONIAL: EPRI Technician

The goggles – the HoloLens2 operating RemoteSpark – proved to be a wonderful learning and support tool for someone not very familiar with either the relay or breaker. Having information in my view and on hand, along with an expert in the background, was absolutely amazing. In this time of social distancing and limited travel, the next best thing to having experts with you in the field is to have them essentially in your head, while you are working hands free.

significantly easier to perform. The Lenox technician especially liked that the remote SME was able to capture photos and videos without requiring specific action by the user, which allowed uninterrupted focus on the task. Significant error reduction is anticipated as a result of using the guided hologram for visual identification of components and verification of steps.

While the pilot demonstrated the capabilities and potential benefits of RemoteSpark, a couple of challenges were encountered relating to the HoloLens2. The technician was unable to use the headset with a hardhat. This is a recognized need for utility and other industrial uses, and solutions are in development by several vendors. Also, bright sunlight tends to wash out the headset display. Shading the work area or applying window tint to the lens (https://www.youtube.com/watch?v=cw11KQSe9Tk) have been shown to be effective.

Additionally, the 3D holographic models used in this pilot were created by the KS team, but these models may be created at the customer level by remote experts following a few suggested guidelines provided by KS, as follows: Using modeling and rendering software such as 3DS Max, the first step is to convert a standard 3D CAD file to a glTF 2.0 file. This can also be achieved directly from many industry-standard CAD programs using a built-in or plugin glTF exporter. Node animations (for transformation, rotation, and scaling) can also be generated by the modeler and embedded directly in the glTF file. These animations can contain a single sequence or a stepped (multiple track) animation. The file is zipped by the modeler, a thumbnail is added, and then they can be sent to the HoloLens headset by drag and drop during a RemoteSpark video call.

Implications & Next Steps

In this pilot demonstration, RemoteSpark used with the HoloLens2 provided a unique, high-value, hands-free tool for assisting an inexperienced field worker and showed broad applicability for on-the-job training and for expert support during critical or seldom-performed tasks.

The ability to walk through a job task using the holographic animation, refer to the virtual model and other resources as needed during execution, and maintain direct, real-time voice and video contact with remote SMEs is expected to translate into a range of benefits. These include greatly decreasing the likelihood of error, improving knowledge transfer to less experienced colleagues, and increasing the confidence of the field worker. Cost savings, in the form of improved task efficiency, reduced equipment downtime, and less technical support travel, are also anticipated.

Several utilities have expressed interest to EPRI in conducting field trials of the RemoteSpark solution for specific worker-job-task scenarios. As partnerships develop and lead to demonstrations, EPRI plans to monitor progress and publish results to facilitate broader industry adoption.

TESTIMONIAL: Kognitiv Spark

This engagement sharpened our focus on fundamental questions surrounding the introduction of augmented reality capabilities to power industry settings. Will our product work where utilities need it to work? Will it help the workforce operate with less cognitive burden whilst achieving higher levels of safety and accurate task completion? Even during the limited course of this project, we found our focus rewarded by seeing a growing appetite for these capabilities among participating EPRI members.

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