Remote Maintenance and Communication System for Wind Turbines

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ABSTRACT

This article describes how a shared vision systems support people to solve a problem from different places. The advantages of the system are, reduction in time to diagnose and resolve maintenance issues, reduction in diagnosis errors, reduced travel costs for experts, and increased reliability in service. The aim of this article is to analyze the benefits of a shared vision system for maintenance and repair tasks for wind turbines as well as to improve the occupational safety and health. The entire process for wind turbines, from installation to operation and maintenance deals with very large components and maintenance operations are actually quite complicated. Therefore, instead of wind turbine, a substitute system is used for the experiment to analyze the advantages of a shared vision system for maintenance operations. The substitute system and the wind turbine have similar mechanical and electrical failures that need to be solved. As a part of this article, a substitute system is used and implemented by using a shared vision system for maintenance operation.

KEYWORDS

Communication Support, Maintenance and Inspection Tasks, Occupational Health, Safety, Shared Vision System

INTRODUCTION

The renewable energy sector is increasing in size and wind farms technology has improved. With the development of internet technology maintenance efficiency has improved. However still there are some challenges that must be overcome about technological, usability and finding proper applications. Maintenance is a core activity of the production lifecycle since it accounts for 60 to 70% of its total costs. This has led to increased need for maintenance planning and the implementation of new technologies. Unexpected breakdown requires a time-consuming process which has a negative impact on machine availability. Shared vision system (SVS) is another enabling technology used for dealing with the increasingly complex maintenance procedures. In order to define the influences of a remote user support, the use of a SVS has been shown in the way many operations are performed, such as maintenance and training. By using a SVS number of solutions has emerged, testing various ways of SVS user interaction. Towards that end, the main objective of this study is to develop a SVS technology for remote maintenance by enabling cooperation between the technician and the expert. The system represents a solution within the intersection of the areas of problem solving and remote

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support in the context of collaborative work. As a test case application to show the potential of a SVS considering the following targets: improve time taken to complete maintenance tasks, minimize maintenance costs, and improve the communication between the technician and the expert. The proposed system includes the methods for fixing the failures by the end user, the actions required by the expert so as to provide instructions in a SVS application for maintenance. In order to define the influences, participants used different conditions for fixing the failures. According to four cases (SVS, audio communication, smartphone, by yourself) duration of the maintenance and the success times are defined in this research.

Research Questions
The SVS is designed to solve the problems from far distances. SVS transmits information in various ways. When the operator is on site, the expert could see the working field of the operator at a remote location. The motivation for the research effort described in this study can be summarized in the following research questions:

- What kind of methods is available for maintenance operations for wind turbines?
- Why SVS is used and is it feasible for the maintenance operations?
- How do the characteristics of a shared vision system need to be set to obtain comprehensiveness?

RESEARCH APPROACH FOR WIND ENERGY SECTOR

Renewable Energy
Renewable energy is obtained from natural sources. Basically, there are seven common types of renewable energy; wind, solar, hydroelectric, tidal, wave, geothermal and bio-fuels and each of these sources can produce electricity from their original form (Andrawus, 2008). Global primary energy consumption increased by 1% in 2016, 0.90% in 2015 and 1% in 2014. This means increased by 1.8% in a year in 10 years average. Renewable power grew by 14.1% in 2016 and wind provided more than half of renewables growth (BP Statistical Review of World Energy, 2017).

Wind Energy
Wind energy is played a crucial role in the future energy supply of the European Union (EU) and of the world. By 2020, around 180 GW of onshore and offshore wind power could be installed in the EU (estimates from the European Commission and the European Wind Energy Association); meaning between 10% and 15% of the total EU electricity demand. According to Global Wind Energy Council (GWEC) report, more than 54 GW of clean renewable wind power is installed in the global market in 2016 with more than 10.000 MW installed. Wind power penetration levels continue to increase, led by Denmark pushing 40%, followed by Uruguay, Portugal, and Ireland with over 20%, Germany at 16%. The big markets of China 4%, the US 5.5% and Canada 6% gets their power from wind. GWEC’s five-year forecast sees 60 GW of new wind installations in 2017 and rising about 75 GW by 2021 (GWEC, 2017). Figure 1 shows the global annual installed wind capacity.

Basic Definitions of Wind Turbine Parts
Wind turbines are large mechanical devices that convert wind energy into electricity. They are located in areas where there is consistent wind. The turbine is made up of three major components: a tower, three blades, and a nacelle, which is composed of an outer case, generator, gearbox, and brakes (Bureau of Labor Statistics, U.S. Department of Labor, 2018). Wind turbine gearboxes convert low speed and high torque to low torque and high speed. This is accomplished with gear and bearing sizes. Wind turbine includes mechanical, electrical and hydraulic components and these components are the replacement parts for the wind turbines. Components come together with the different ratios,
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