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Effective IoT-based deep learning platform for online fault diagnosis of power transformers against cyberattacks and data uncertainties

Mahmoud Elsisi [a,b], Minh-Quang Tran [a,c,*], Karar Mahmoud [d,e], Diaa-Eldin A. Mansour [f,g], Matti Lehtonen [d], Mohamed M.F. Darwish [b,d]

[a] Industry 4.0 Implementation Center, Center for Cyber-physical System Innovation, National Taiwan University of Science and Technology, 10607 Taipei, Taiwan
[b] Department of Electrical Engineering, Faculty of Engineering at Shoubra, Benha University, 11629 Cairo, Egypt
[c] Department of Mechanical Engineering, Thai Nguyen University of Technology, 3/2 St., Tich Luong Ward0, 250000 Thai Nguyen, Vietnam
[d] Department of Electrical Engineering and Automation, School of Electrical Engineering, Aalto University, FI-00076 Espoo, Finland
[e] Department of Electrical Engineering, Faculty of Engineering, Aswan University, 81542 Aswan, Egypt
[f] Department of Electrical Power and Machines Engineering, Faculty of Engineering, Tanta University, 31511 Tanta, Egypt
[g] Faculty of Engineering, Galala University, Galala 43511, Egypt

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ABSTRACT

The distribution of the power transformers at a far distance from the electrical plants represents the main challenge against the diagnosis of the transformer status. This paper introduces a new integration of an Internet of Things (IoT) architecture with deep learning against cyberattacks for online monitoring of the power transformer status. A developed one dimension convolutional neural network (1D-CNN), which is characterized by robustness against uncertainties, is introduced for fault diagnosis of power transformers and cyberattacks. Further, experimental scenarios are performed to confirm the effectiveness of the proposed IoT architecture. While compared to previous approaches in the literature, the accuracy of the new deep 1D-CNN is greater with 94.36 percent in the usual scenario, 92.58 percent when considering cyberattacks, and ±5% uncertainty. The proposed integration between the IoT platform and the 1D-CNN can detect the cyberattacks properly and provide secure online monitoring for the transformer status via the internet network.

1. Introduction

Dissolved gas analysis is considered an efficient diagnostic means to the early discovery of diverse faults in the power transformer. Particularly, this analysis is considered the most vital test for isolating fluids inside the electrical components, including transformers [1]. In turn, transformers are a key item of electric power systems (i.e., transmission and distribution networks) [2–4]. To perform this analysis, a sample of

substations, that involve power transformers empowering smart sensors and infrastructure, will eliminate the need for maintenance as well as long traditional cabling and other electrical equipment [8,9]. Considering the rise of the Internet of Things (IoT) and cloud network systems, it has become a worldwide trend to link power network apparatus to the cloud. Its key advantage is that it recognizes value-added services through remote control, intelligent activity, and efficient diagnosis and maintenance ways [10,11].