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A REVIEW ON MICROGRID PROTECTION TECHNIQUE

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Abstract- In order to analyze the challenges and solutions provided in the microgrid protection, this paper presents the review of protection algorithms proposed in the literature. The present review work has been oriented to provide the idea of protection strategies adopted in the past and their effectiveness in providing the protection to microgrid with reliability. Various efficient protection approaches have been discussed and compared to examine the effectiveness of them in providing the suitable protection against the common issues and challenges. Furthermore, the review is also oriented to describe the various challenges associated in the development of appropriate protection technique related to the mode of operation, nature of DERs and their dynamic profile. The comparison results showed the effectiveness of the schemes to detect, locate, classify, and isolate various types of short-circuit faults in both the grid-operated and islanded modes of the microgrid.

Keywords: Microgrid; protection; Machine learning; Feature extraction; Distributed generation

I. INTRODUCTION

The use of distributed energy resources (DERs) to meet the electric power demand all around the globe is rising owing to the increasing awareness about the green energy and gradual depletion of fossil fuels, with the concern of greenhouse gas emission reduction [1, 2]. This emerging need of distributed energy resources has come up with the solution called as micro grid. The microgrid is causing customary mass force age frameworks to quickly change into appropriated age frameworks [3, 4]. It has the ability to give ecological and financial advantages by providing power locally, shaving top burdens, diminishing line misfortunes, and providing nonstop vitality gracefully with improved dependability and vitality productivity. In order to meet the power demand and sustainable needs, the application of distributed energy resources, especially wind turbine (WT) and photovoltaic (PV) systems, have become more widespread at the distribution level [5, 6]. While the application of these resources can definitely help with the needs, the control strategy of a large number of distributed generators (DGs) creates a new challenge for operating and controlling networks. This challenge can be partially addressed by microgrids (MGs), which are entities that coordinate the distributed energy resources in a more decentralized way [7]. In both low and medium-voltage age frameworks, the bidirectional force emerging from the generators and burdens moves through the defensive gadgets in a microgrid. The main benefit from the network point of view is that MGs are treated as a controlled entity and may be considered as an aggregated load. Under such changing working conditions, the issue examples of the microgrid are not as evident as in customary insurance frameworks. In this manner, the standard overcurrent relays makes the protection task more challenging [10-16]. As one of the aforementioned challenges, protection has the crucial task of isolating, as fast as possible, any element of the system when it is subjected to a short-circuit, or abnormal operation that can cause damage to it and/or to the rest of the system.

In order to impart efficient and reliable operation of a micro-grid, it is highly important to detect and locate faults to restore power with a minimum outage, and to limit damage- and protection-related problems. Therefore, to maintain a high level of continuity of services and satisfaction of customers under both operating modes, fast and intelligent protection strategies have to be designed through advanced signal processing techniques, which can overcome the aforementioned protection challenges. To thisend, a protection scheme

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designed for a micro grid should consider the following aspects:

(a) Bidirectional power flow,

(b) Looped configuration, and

(c) Relatively Low short-circuit current during islanded operation [10,11]

Considering the importance of reliable protection for supporting the widespread implementation of MGs, various scientists and researchers across the globe have been involved in developing studies that address the above-mentioned issues.

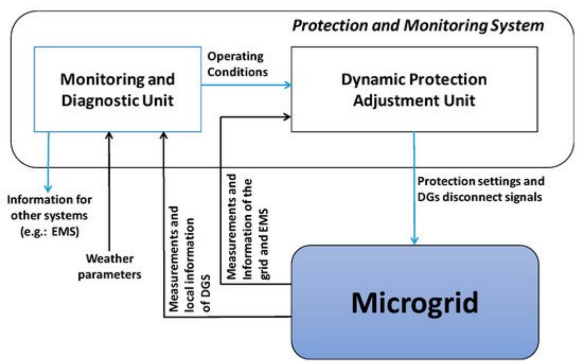

Figure 1: Microgrid protection strategy.

II. LITERATURE SURVEY

In this section the comparison of the techniques which are proposed by several authors in order to perform fault detection as well as the classification is performed.

In this paper [1] author explained Fault detection is essential in microgrid control and operation, as it enables the system to perform fast fault isolation and recovery. The adoption of inverter-interfaced distributed generation in microgrids makes traditional fault detection schemes inappropriate due to their dependence on significant fault currents. In this paper, we devise an intelligent fault detection scheme for microgrid based on wavelet transform and deep neural networks. The proposed scheme aims to provide fast fault type, phase, and location information for microgrid protection and service recovery. In the scheme, branch current measurements sampled by protective relays are pre-processed by discrete wavelet transform to extract statistical features. Then all available data is input into deep neural networks to develop fault information. Compared with previous work, the proposed scheme can provide significantly better fault type classification accuracy. Moreover, the scheme can also detect the locations of faults, which are unavailable in previous work. To evaluate the performance of the proposed fault detection scheme, we conduct a comprehensive evaluation study on the CERTS microgrid and IEEE 34-bus system. The simulation results demonstrate the efficacy of the proposed scheme in terms of detection accuracy, computation time, and robustness against measurement uncertainty. In this paper [2] author presents an intelligent protection scheme for microgrid using combined wavelet transform and decision tree. The procedure begins at recovering current signs at the transferring point and preprocessing through wavelet change to infer compelling highlights, for example, change in vitality, entropy, and standard deviation utilizing wavelet coefficients. When the highlights are extricated against blamed and unfaulted circumstances for each-stage, the informational collection is worked to prepare the decision tree (DT), which is approved on the inconspicuous informational collection for shortcoming recognition in the microgrid. Further, the shortcoming characterization task is done by including the wavelet based highlights got from succession segments alongside the highlights got from the current signs. The new informational index is utilized to fabricate the DT for deficiency identification and arrangement. Both the DTs are broadly tried on an enormous informational collection of 3860 examples and the test outcomes demonstrate that the proposed handing-off plan can adequately secure the microgrid against defective circumstances, remembering wide varieties for working conditions. In this paper [3] author disclosed To determine the security issues brought about by high entrance of dispersed vitality assets, this paper proposes a proficient insurance plot for microgrids dependent on the autocorrelation of three-stage current envelopes. The proposed procedure utilizes a squaring and low-pass sifting approach for assessing the envelope of the current sign. At that point, the change of the autocorrelation work is utilized to extricate the shrouded data of the mutilated envelope to identify the deficiency marks in the microgrid. Moreover, the receptive force is utilized for deciding the fault heading. The exhibition of the proposed security plot was checked on a standard medium-voltage microgrid by performing recreations in the MATLAB/Simulink condition (Version: R2017b). The proposed conspire was demonstrated to be anything but difficult to actualize and have great execution under circled and outspread design for both framework associated and islanded activity modes. The recreation results indicated that the plan couldn't just identify, find, arrange, and seclude different kinds of short out issues adequately yet additionally give reinforcement security if there should arise an occurrence of essential insurance disappointment. In this paper [4] author clarified Microgrids have accumulated a lot of consideration inside the previous decade and turning into a fundamental resource in the vitality business. The capacity to coordinate manageable vitality age techniques into the dispersion arrange is one of the principle explanations behind microgrids ubiquity. A wide assortment of Distributed Generation (DG) including wind and other smaller scale turbine age, photovoltaic age alongside vitality stockpiling, makes the microgrid suitable in both lattice associated and islanded modes while diminishing the force misfortunes. There are different specialized difficulties to be handled so as to collect the maximum capacity of microgrids, and insurance is one of them. Different arrangements were presented, driven by the advancement of insurance strategies. One of the most encouraging methodologies for microgrid insurance is versatile assurance. This paper contains an efficient audit on versatile insurance of microgrids, including a wide scope of materialness variations, their qualities, and disadvantages. It likewise investigates the best in class explores that use computational insight to accomplish versatile insurance. These arrangements are right now at the skirt of thoroughly reclassifying insurance arrangements with an increasingly adaptable and solid framework that will be applied all inclusive. In this paper [5] author clarified the deficiency current degree of microgrid is distinctive between islanded mode and matrix associated mode. This circumstance corrupts the presentation of conventional overcurrent assurance plans.

Consequently, this paper proposes a security strategy dependent on highlight cosine and differential plan. Initially, highlight cosine is proposed; it utilizes circle condition and least squares to evaluate the unified conduct about voltage and current. Furthermore, shortcoming current heading and highlight cosine are examined when deficiency happens at various areas of a run of the mill microgrid, and afterward the distinction of highlight cosine among defective and solid segment areas is acquired. Thirdly, in view of highlight cosine and differential plan, the differential heading is characterized and used to identify broken segment area. Ultimately, different time area reproduction contextual analyses, including diverse microgrid activity modes, establishing protections, faulted sorts, defective segment areas, and clamor impact, are directed and exhibit that the proposed assurance has high precision.

In the above table 1, the comparative analysis of previously reported microgrid protection algorithms is presented. The literature review as summarized in the Table 1 clearly indicates that most of the proposed approaches are based on determining suitable features and the detection and classification of faults is performed by some classifier which consider the feature set as input. The machine learning based classifier has the ability to predict the fault and discriminate among the fault types for suitable relaying decision.

III. KEY FEATURES OF MICROGRID SYSTEM

1. Benefits the earth through the absence of ozone depleting substance emanation through low/zero-discharge age advances

2. Separate control plans are required to work inside both specialized and efficient cutoff points

3. Through Islanding, microgrids can work in any event, during utility disappointments expanding the unwavering quality levels

4. Use of battery-based vitality stockpiling frameworks can be costly in both commencement and support

5. Can add to top shaving of the framework arrange by appropriated age during top hours

6. Intermittent nature of the sustainable power sources

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Authors	Methods	Tasks performed	Summary
James J. Q. Yu , Member [1]	Wavelet Transform and Deep Neural Networks.	Fault Diagnosis	The simulation results demonstrate the efficacy of the proposed scheme in terms of detection accuracy, computation time, and robustness against measurement uncertainty.
Debi Prasad Mishra [2]	Decision Tree (DT),	Diagnosis	The new data set is used to build the DT for fault detection and classification.
ShaziaBaloch 1 , SaeedZamanJamali 2 [3]	The proposed strategy uses a squaring and low-pass filtering approach for evaluating the envelope of the current signal.	Diagnosis & Identification	The simulation results showed that the scheme could not only detect, locate, classify, and isolate various types of short-circuit faults effectively
T S SSenarathna [4]	Integrated and data-driven fault detection and diagnosis scheme	Diagnosis Strategy	Normal and fault conditions
Lai Lei,1,2 Cong Wang [5]	Distributed Generation (DG)	Detection & identification Detection algorithm	These solutions are currently at the verge of totally redefining protection solutions with a more flexible and reliable system that will be applied globally.
Susmita Kar and S.R.Samantaray [18]	S-transform and Decision tree	Fault detection and classification	The differential features determined using the S-transform are used to train the three decision trees based classifier to perform the tasks of fault detection and classification.
S.R.Samantaray , Geza Joos [19]	S-transform and differential energy	Fault detection and classification	The presented scheme is based on Spectral energy content of the time- frequency contours of fault current signals and the differential energy is computed to register the fault patterns in the microgrid at grid-connected and islanded mode.

7. Used to jolt remote regions which experience issues in interfacing with the essential framework

8. Protection Challenges because of the circulated age

9. An perfect answer for the CHP prerequisites of clients by expanded in general vitality effectiveness

10. The monetary preferred position of creating own power for a lower cost than from the principle utility and even by trading the vitality back to the matrix

IV. PROBLEM DEFINITION

The Protection tasks gets complicated when the microgrid switches between mesh and radial topologies.

A protection scheme for the microgrid must address the problems related to bidirectional power flow and different levels of fault current in islanded and grid-connected mode.

Based on the review carried out in this paper, the proposed work is planned in the following manner to meet the mentioned objectives:

- To develop an efficient protection strategy for microgrid which can identify the healthy and faulty scenario.
- To discriminate the fault type among the various shunt faults occurring in in the distribution line of microgrid.
- To implement the protection algorithm using Discrete wavelet transform to extract useful features utilized by machine learning based technique to perform the protection tasks under both Grid-connected and islanded operation.

V. CONCLUSION

The literature review conducted in this paper is to analyze the protection techniques reported in the literature. The proposed research develops a new motivation to carry the research in this direction and meet the important objectives. In most of the techniques, initially the current is preprocessed to extract most effective statistical features which contain the transient information. Further, the features are extracted which are further used to build the data-mining models for final relaying decision. The proposed protection models provides significantly improved performance over the existing over current relays. Even though another data-mining model RF provides similar performance like the DT, however, being a black-box solution, the RF faces implementation difficulty as compared to the transparent datamining model DT. The most important issue is the use of time–frequency information for constructing the machine learning models which enhance the performance with high dependability and reliability of the protection devices.

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