Local Detection of Distribution Level Faults in a Distributed Sensor Monitoring Network using HMM

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***Abstract*— The Smart distribution system initiative requires an increased usage of the distribution feeder-level communication infrastructure to improve automation. Using a distributed sensor network for monitoring the distribution system is proposed by various researchers. Such distributed sensor communication architecture requires information to be received within an allowable delay and a minimum processing time at the control center. Increasing the number of sensors in the network also increases the data flow in the communication medium. Therefore, to reduce the burden in the communication medium, an event driven communication protocol could be utilized. This communication architecture assumed that the sensors used a local fault detection system to detect the abnormal event before communicating with the control center. This work focusses on local detection of faults in a distributed sensor network using a Hidden Markov Model considering a minimum processing time.**

Keywords*— *distribtuion system; distrubted sensor network; fault detection; Hidden Markov Model.

I. INTRODUCTION (*HEADING 1*)

The Smart grid initiative requires the future distribution systems to enable automation, which in return will improve its performance. Automation is expected to decrease the downtime and increase the real-time controllability of the distribution system [2]. Automation requires improved feeder level communication. This initiative requires investment in the communication infrastructure at the feeder level that will not only improve the operating condition of the distribution system but also increase the life time of the assets. [3].

Recent literature [4-8] shows an increased interest in using distributed sensor networks for distribution system monitoring. Based on operating needs, the communication system should provide quick decision–making tools for distribution system operations. This becomes critical for the dynamic management of the distribution system during both normal and abnormal conditions. This requires remotely accessible distributed sensors along feeders [4].

Technical advancements in low cost current and voltage sensors allow utilities to deploy these devices within the distributed network on a massive scale [5]. These sensors can measure load currents from 0A to 600A. These have long-range wireless communication capabilities. The sensors are also compact in size and weight and therefore ideal for distribution feeder level application.

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Wang et. al conducted a survey on wireless sensor networks for smart grid application and they identified that the placement of wireless distributed sensors along distribution feeder to be an attractive future trend [6]. Wireless communication is one of the better options because of its capability of being more flexible and cost effective, while offering adequate long-range performance [7].

Furthermore, Wang et. al. discussed that a self-healing power system is possible through multiple sensors placed along the feeders [6]. Adrabou proposes a pole mounted communication infrastructure along with the utilization of low cost massively deployed sensors for monitoring the distribution system [8]. Fig. 1 shows the distributed current sensors installed on overhead line similar to [8] where distributed sensors communicate with its Access Point wirelessly.

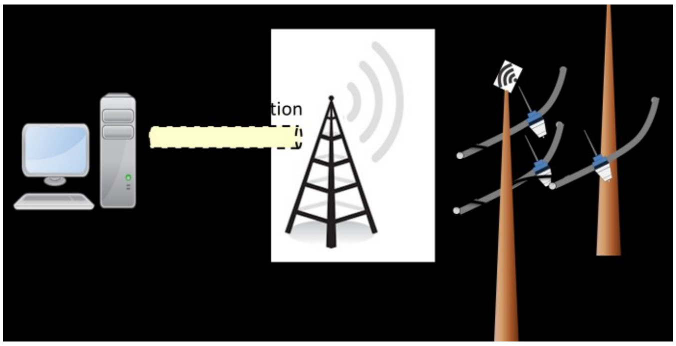

Fig. 1: Wireless overhead power line sensors similar to [7]

The objective of this work is to develop an effective event detection tool for local sensors. This work proposes a Hidden Markov Model (HMM) based decision tool for the distributed sensors for event detection applications. Each sensor will be equipped with this decision making tool to detect the events locally. Upon an abnormal event is detected the proposed decision tool will share the information with the hierarchical decision tools via wireless communication. Rest of the sections describe the modeling of the decision tool and evaluation of the

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