Task 3.1: A case study for AI solution

The use of Artificial Intelligence for electric power quality diagnostics has been a topic of discussion and importance for the researches of the respective industries. The AI tools such as expert systems (ES), artificial neural networks **(**ANN**),** fuzzy logic **(**FL), and the newer techniques of adaptive neuro-fuzzy systems (ANFS) are made use in power quality diagnostics.

Power quality has always been an issue for end-users, utility companies and equipment manufacturers. Some of the areas of concern include the sensitivity of end-user equipment, the complexity of industrial processes, sophisticated power electronics, complex interconnections and much more. This is where AI technologies can be useful for intelligent power quality diagnostics.

ANNs have been used in the classification of events into two categories: either PQ events (whose data should be recorded), or non-PQ events (whose data should be discarded). This system limits the amount of data stored in the monitoring system. Fuzzy-expert systems have been used for the diagnosis of power quality problems. The issues addressed by these systems include the lack of PQ experts due to the lack of information and experience. Also, tackled is the handling of large amounts of data involved in distributed mon-storing systems. Fuzzy logic is combined into these systems to cope with the imprecision of data. A PQ classifier using combined ANN and ES was reported. The main features of the classifier included the use of wavelet theory as a feature extracting mechanism. Another aspect was that the ES only classified the disturbances into respective classes while the cause of the disturbance was decided by individual neural networks each trained for only one class of disturbances. An ES for the analysis of electric power systems harmonics has also been introduced. The system was designed to perform a spectral analysis of the system currents and voltages upon which it would diagnose the source of the harmonic contamination and suggest a solution. The system's main features include its division into a Training module, a Harmonic Measurement module, and a Diagnostic module. From an interactive session with the engineer, the system obtained data about the site, equipment, and its location. CFs were used to deal with the fuzziness of the detains have been used for the estimation of the harmonic components and THD of power system waveforms. A fuzzy-expert system for PQ applications, with the main objective of utility personnel training and customer education, has been reported. This system can only acquire data from an interactive session with the user.

The advantage of using AI techniques for PQ applications is that using Distributed PQ monitoring systems that gather a huge amount of data, which is infeasible for a human expert to handle and A large amount of data that requires not only intelligent analysis but also intelligent data management also that Serious imprecision of data, making conventional programs fail to identify any PQ problem and PQ diagnosis requires expertise in a wide variety of power topics. AI tools combine multiple knowledge domains well and much more.

Artificial Intelligence (AI) technique is used to minimize the harmonics produced by nonlinear load. Thus, improving the power quality. Artificial intelligence tools have emerged as most suitable tools for power quality applications. The different paradigms of artificial intelligence were examined, and each possess its strength in some aspect related to power quality. The combination of two or more intelligent disciplines into one system for power quality analysis has proven even more effective. Artificial intelligence applications in power quality have been approached previously, and existing applications range from diagnostic systems, to classifier systems, to intelligent tutor systems. Artificial intelligence applications in power quality are certainly a very valid alternative, one that still holds a lot of potential for future investigation and research.

Some of the drawbacks of using AI techniques include the high computational power required, complexity of these systems require professional overview, cost of combining techniques for better efficiency, and accuracy of these techniques and much more

Reference:

- M. M. Marcos and W. R. A. Ibrahim, "Electric Power Quality and Artificial Intelligence: Overview and Applicability," in *IEEE Power Engineering Review*, vol. 19, no. 6, pp. 5-10, June 1999. **DOI:** 10.1109/MPER.1999.768508