Study of Short-term Load Forecasting Techniques

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***Abstract*— Electric demand forecasting is increasingly challenging in the modern grid system, with emerging technologies like rooftop solar photovoltaics and vehicle electrification. Multiple utilities generate load forecasting independently, leading to suboptimal resource allocation and inefficiency. The challenge lies in capturing non-linear power system characteristics associated with emerging technologies. This study has investigated several load forecasting techniques for short-term forecasting in the context of dynamic conditions and consolidates the essential components to devising an alternative solutions. This study presents a novel approach that utilizes an ensemble model as an alternative technique for short-term demand forecasting, which offers the advantage of least complicated and best-performing forecasting models. The data from the Sabah state power utility company and the Red Eléctrica de España were used as case studies to analyze the effectiveness of these techniques. The accuracy of univariate and multivariate methods is evaluated in terms of their ability to accurately forecast recent patterns of demand. The proposed alternative method using weighted ensemble model which employs Multilayer Perceptron (MLP), Decision Tree Regression and Gradient Boosting has produced an average mean absolute percentage error (MAPE) performance of 0.83% for the Sabah Grid dataset and 4.47% for the Spanish dataset.**

Keywords*— *Short-term Load Forecasting, Load Forecasting Technique, Statistical Method, Machine Learning, Deep Learning

I. INTRODUCTION

Short-term load forecasting is crucial for managing and planning energy resources effectively. It involves anticipating electricity use within a specific timeframe, ensuring adequate generation capacity to meet demand. Accurate load forecasts help optimize power systems, reduce expenses, and maintain grid stability. Influenced by various factors like weather, time, and special events, short-term demand forecasts are crucial for mitigating power outages and blackouts. They also aid in strategizing for grid infrastructure maintenance and enhancement, ensuring reliability and robustness. By forecasting demand patterns, utility companies can make informed decisions about renewable energy sources and energy storage technologies, promoting a more sustainable power system. This study aims to identify forecasting models and methodologies that can accurately predict electric demand and anticipate peak periods, enabling grid operators to efficiently manage and optimize power systems. The study analyses historical data on electricity consumption, identifies key elements influencing load patterns, formulates forecasting models using statistical and machine learning techniques, and evaluates the effectiveness of these models. The goal is to enable grid operators to efficiently manage and optimize their power systems.

II. LITERATURE REVIEW

There are several modeling approaches for load forecasting, including statistical models, machine learning models, deep learning models, and ensemble models. Table I provides a summary of the existing research literature and highlights the gaps that have been identified in previous studies on the forecasting technique.

TABLE I: SUMMARY OF PREVIOUS RESEARCH WORKS AND RESEARCH GAPS RELATED TO FORECASTING TECHNIQUE

Forecasting Method(s)	Author(s)	Research Gaps
Time series regression, exponential smoothing seasonal, Box-Jenkins, the decomposition method, and Naïve model, ARIMA, GARCH, SMA, WMA, SES, HL, HW, and CMA	[1], [2], and [3]	The study found that these models perform better on simple and low-complex datasets, but their effectiveness is debated compared to other multivariate models like MLR and MLP. It also lacks the capacity to evaluate their effectiveness on a larger dataset like electric demand for power grid systems.
Multiple Linear Regression (MLR)	[4]	The experimental model's effectiveness is limited by its inability to account for uncommon days like public holidays and the growing non-linear nature of modern power systems.
Multilayer Perceptron (MLP)	[5], [6], and [7]	This study's limitation is its inability to address short-term load forecasting in modern power systems, which

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