# ABSTRACT

**Energy consumption prediction using ML**

In recent years, the prediction of energy consumption has become a crucial component in the management and optimization of power systems. Accurate forecasting of energy usage is essential for balancing supply and demand, enhancing energy efficiency, and integrating renewable energy sources into the grid. This paper presents a comprehensive approach to energy consumption prediction using Machine Learning (ML) techniques. By leveraging historical data and various predictive models, we aim to develop robust algorithms that can accurately forecast energy usage patterns.

Our methodology involves the collection and preprocessing of data from multiple sources, including weather conditions, historical power consumption records, and socio-economic factors. We employ several ML algorithms, such as Linear Regression, Decision Trees, Random Forests, and Artificial Neural Networks (ANN), to build predictive models. The performance of these models is evaluated using metrics like Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared (R²).

The results demonstrate that ML-based models significantly outperform traditional statistical methods in terms of accuracy and reliability. Among the models tested, ANN and Random Forests exhibit the highest prediction accuracy, owing to their ability to capture complex, non-linear relationships in the data. Additionally, we explore the impact of feature selection and hyperparameter tuning on model performance, providing insights into the optimization of ML models for energy consumption prediction.

The findings of this study have significant implications for energy management systems, enabling utility companies to implement more effective demand response strategies, optimize grid operations, and enhance the integration of renewable energy. Furthermore, the predictive models developed can be adapted to various scales, from individual buildings to large urban areas, offering versatile solutions for diverse energy management challenges.

In conclusion, this research highlights the potential of ML techniques in revolutionizing energy consumption prediction, contributing to more sustainable and efficient power systems. Future work will focus on incorporating real-time data and exploring advanced ML methods, such as deep learning and reinforcement learning, to further enhance prediction capabilities.

**References:**

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