netidee STIPENDIEN

Abstract der fertigen Arbeit

The Internet of Things (IoT) is becoming increasingly prevalent in our daily lives, with sensor devices providing the ability to sense and act on the environment. However, these sensor nodes are often resource-constrained, relying on batteries as an energy source, and constrained by wireless communication, which results in higher energy consumption and network congestion. Reducing required network communication in these devices increases their lifetime, reduces maintenance costs, and preserves network resources.

To tackle this challenge, we propose SenseReduce, an open-source framework for prediction-based data reduction with continual learning and continuous deployment of prediction models in IoT environments. The framework enables using neural networks as multivariate prediction models, which can significantly reduce the required communication by predicting future sensor measurements with high accuracy.

To evaluate the performance of the proposed framework, we conduct a parameter study based on the use case of air temperature monitoring. We design three neural networks with varying architectural and computational complexities using hyperparameter optimization and run multiple simulation scenarios using different training datasets and parameter configurations. The quantitative evaluation of the simulation results demonstrates the effectiveness of SenseReduce in reducing the required messages by up to 38% and the amount of transferred data by up to 22% compared to a baseline using trend extrapolation. Continuous model updates reduce the total data transferred in scenarios with sparse training data and improve model performance over time. Additionally, our simulations show that the effectiveness of prediction-based data reduction highly depends on the context, including measurement frequency, threshold metric, and model architecture. Overall, we provide several recommendations for future applications, particularly for air temperature monitoring.