An Energy-saving Approach to Anomaly Detection Using Federated Learning

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PROJECT PROPOSAL

When federative learning is used to detect anomalies, the energy consumption of the wireless sensor network is compromised?

Federated learning is a distributed machine learning technique for wireless sensor networks that allows multiple nodes to learn a shared model while keeping their training data separate. Using this technique, a global model is trained on data collected and stored at each node, then its weights are aggregated and shared globally. It allows each node to benefit from the knowledge of others while keeping the training data confidential. It requires lot of data transfer and computation. So, we will explore the usage of federated learning in anomaly detection, examining primarily its energy consumption. In this anomaly detection, energy will be consumed in a variety of forms, including Memory since the data is stored locally by the clients, Storage because the data is not only stored by the clients, but also by the server, Network bandwidth because the data needs to be transferred between the client and the server in a bidirectional manner, Processing power since the clients must continuously process the data, and also battery power since the devices running the federated learning mechanisms consume more power. These various ways of energy consumption will be investigated precisely.

Energy consumption can be minimized by using several research ideas in the implementation of anomaly detection using federated learning. An interesting research idea would be to examine how different federated learning architectures and communication protocols can be implemented. This would optimize energy consumption while maintaining high levels of accuracy. By using techniques such as data compression and aggregation we can reduce the amount of bandwidth required between nodes for communication. Additionally, research could be conducted to investigate how different data pre-processing techniques, such as data imputation, normalization, and feature selection, can be applied to lower the amount of energy required to train the anomaly detection model. Finally, research could be carried out to investigate how federated learning can be used to reduce the computational costs of anomaly detection and this could be done by reducing the number of parameters or reducing the number of layers in the model.

Below is the tentative schedule for our research:

1. In the first phase (2-3 weeks), we intend to implement the federated learning technique,
2. In the second phase (2-3 weeks), we will propose techniques to minimize energy consumption utilizing the research solutions we have,
3. In the third phase (3 weeks), we intend to test and evaluate these methods.

To implement the proposed techniques, we require the following:

- Sensor with WI-FI
- Software application for anomaly detection
- Software application for incorporating machine learning algorithms
- Data sets and few libraries to implement