ToRDIS

Trustworthy And Resilient Decentralised Intelligence For Edge Systems

Collaborative Intelligence Sharing in Energy Communities via Federated Learning

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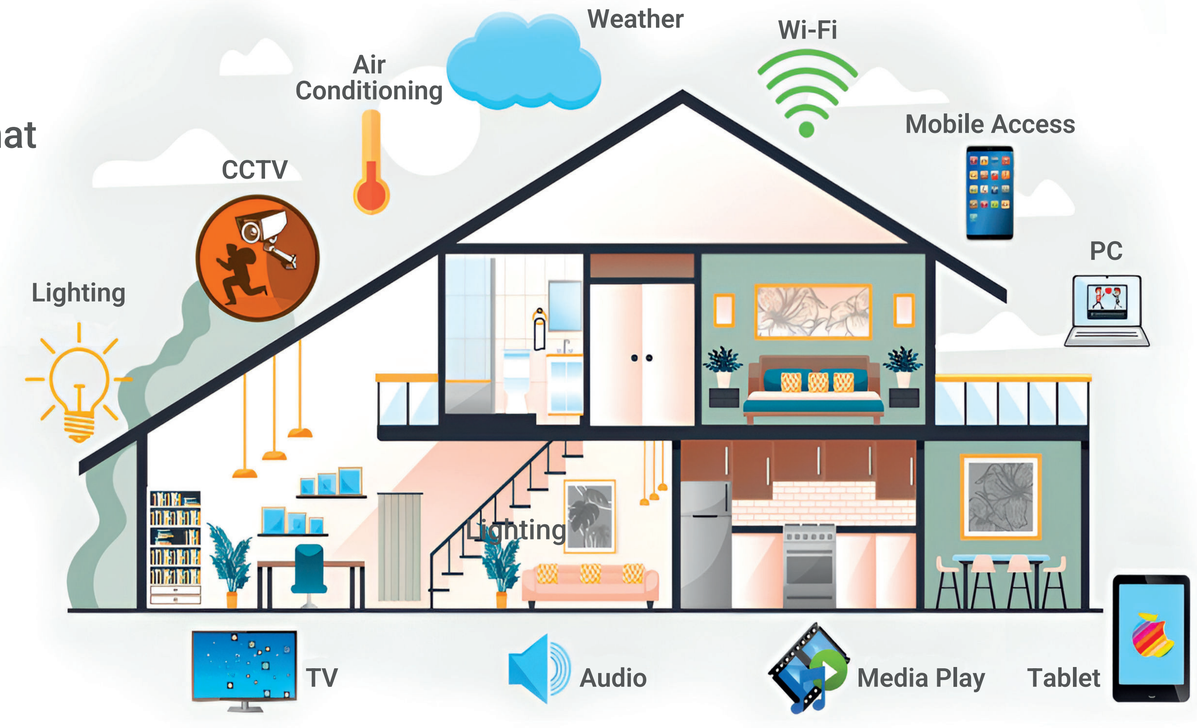
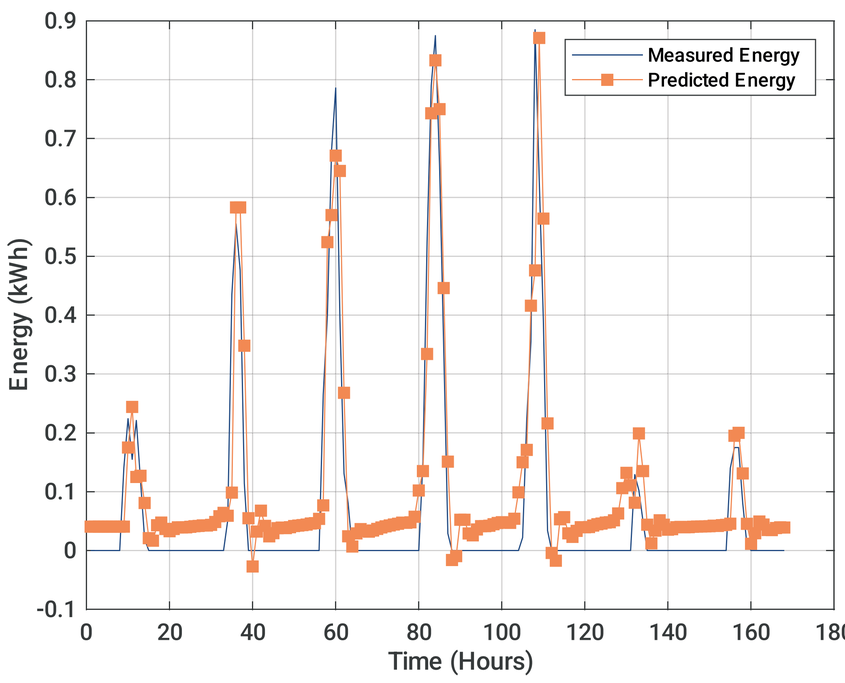
Smart Home

Smart homes are equipped with Internet of Things (IoT) devices that provide the user with a lot of **flexibility** and **comfort**. **Coordinating** these devices and their **energy demands** needs careful planning.



Energy Demands in a Smart Home can be

- **Non-shiftable** loads (lights, television, computer)
- **Shiftable** and **non-interruptible** loads (washing machine)
- **Controllable** loads (HVAC system, heat pumps)



Applications of Machine Learning

Time Series Prediction

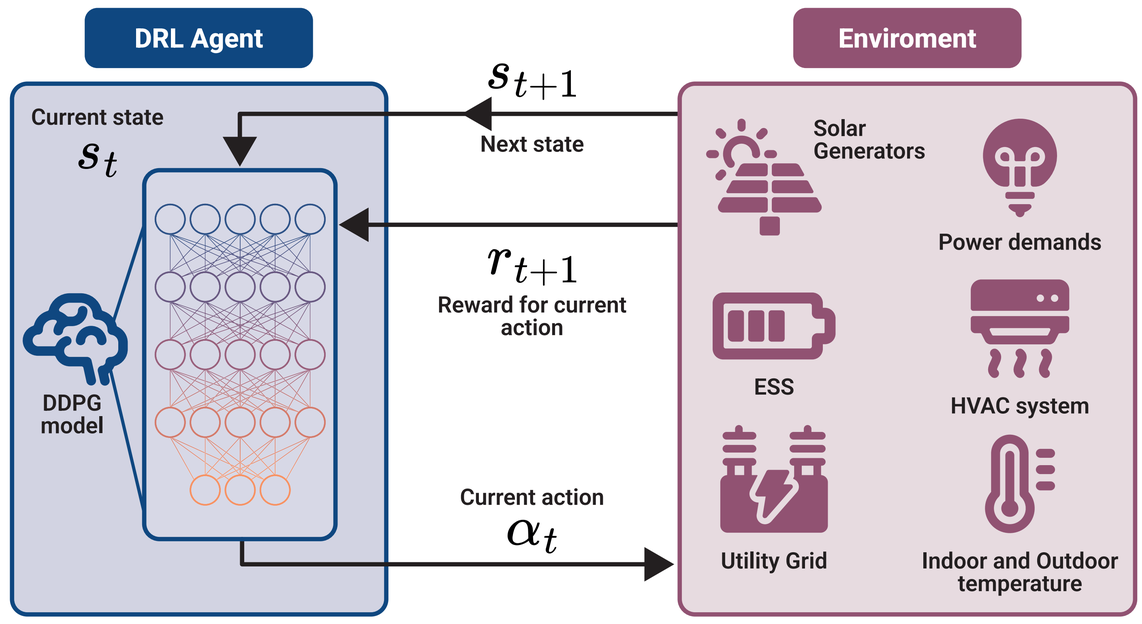
The energy **Consumption** and **Production** of an energy community fluctuate but tend to have **periodicity** and **seasonality**. **Predicting** the values for the next time slot can determine the energy management strategy.

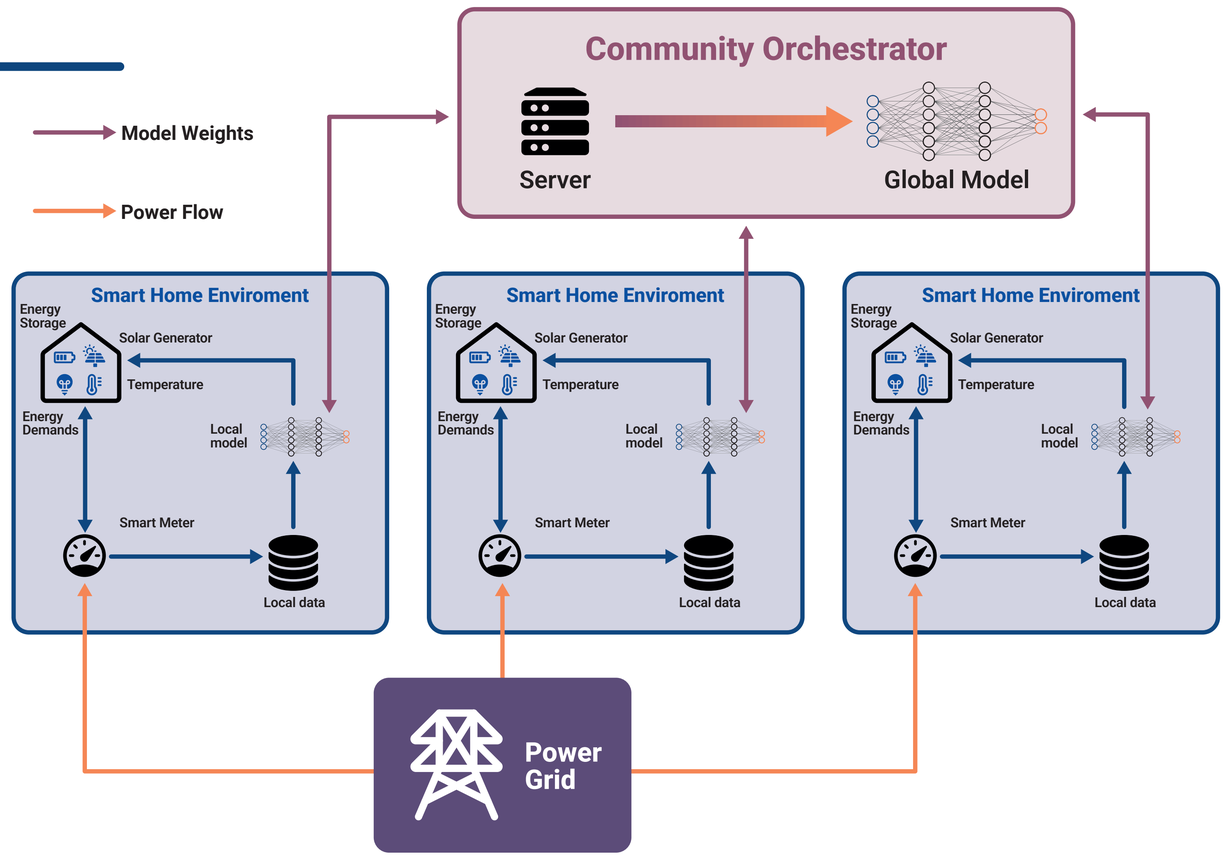
This time series prediction can be done using a **Long-Short Term Memory Neural Network**, if the appropriate data are available.

Energy Management Using Deep Reinforcement Learning

DRL can be used to schedule the **Shiftable** and **Controllable** loads appropriately, as to maximize the utilization of **renewable energy** produced through solar panels, as well minimize the **cost** of buying power from the grid.

Additionally, it can be trained to achieve other goals, such as preserving the temperature inside a comfortable range, set by the user.





Federated Learning

FL can be applied either on the **LSTM** or the **DRL** models inside an energy community consisting of multiple smart homes, with the Community Orchestrator acting as the global model aggregator.

Advantages of FL

- **Privacy.** FL keeps data localized on devices or edge servers, reducing the risk of data breaches.
- **Reduced Bandwidth Usage.** FL transmits smaller updates, instead of sending large datasets
- **Fairness.** No node is responsible for training the global model, rather, all of them contribute.
- **Personalization.** Models can learn locally from specific user data, enabling personalized services without exposing private information.

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