Identification of medical devices using machine learning on distribution feeder data for informing power outage response

NeurIPS 2022 Workshop: Tackling Climate Change with Machine Learning

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Problem and Motivation

> 4.4 million people in the US rely on electricity-dependent in-home medical devices*

Power outages pose severe health risks and stress to hospitals

2008
After Hurricane Gustav 20-40% of people in medical shelters were dependent on equipment

2017
>15% of deaths after Hurricane Irma due to worsening health conditions due to power outage

2003
22% of hospital admits after 2003 NY blackouts were people relying on medical devices

Climate change is driving more extreme weather events

+

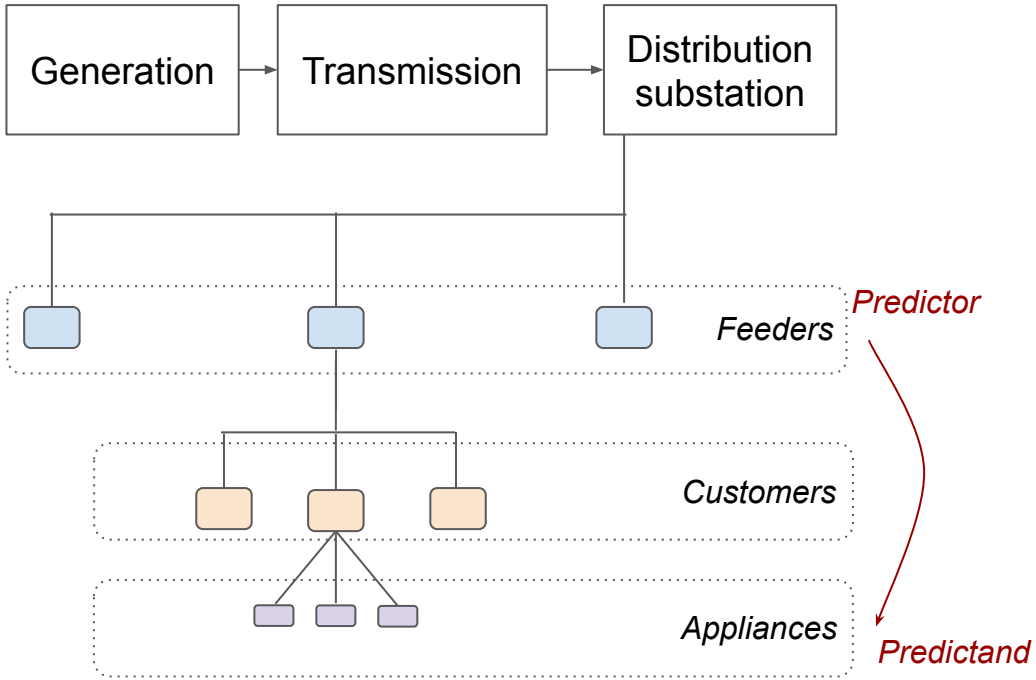
Aging power grid

+

Lack of complete & accurate data on in-home medical devices

**The set of in-home medical devices is vast and depends on the underlying condition. Some of the most commonly used are ventilators and oxygen concentrators.*

Related Approaches and Datasets



Datasets

PLAID - Plug Load Appliance Identification Dataset

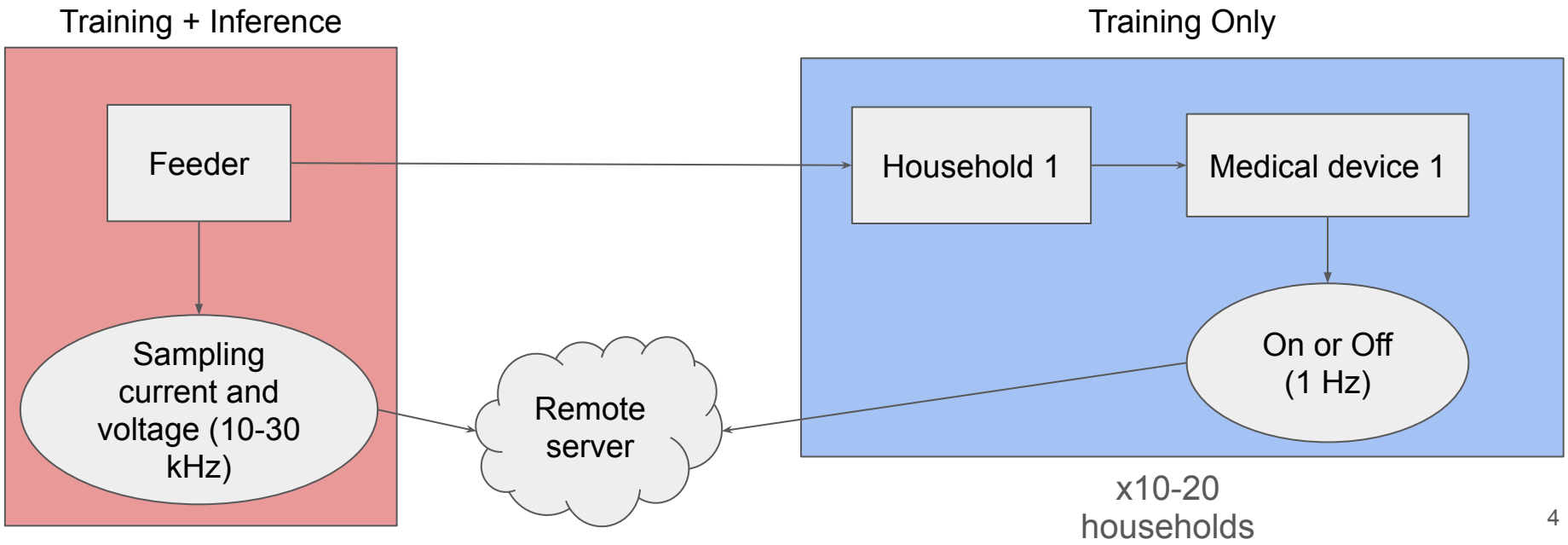
- voltage & current measurements
- 30kHz
- 11 appliances
- 60 households in Pittsburgh, USA

HHS emPOWER

- no. of people dependent on in-home medical devices
- on Medicare
- does not include those on other insurances

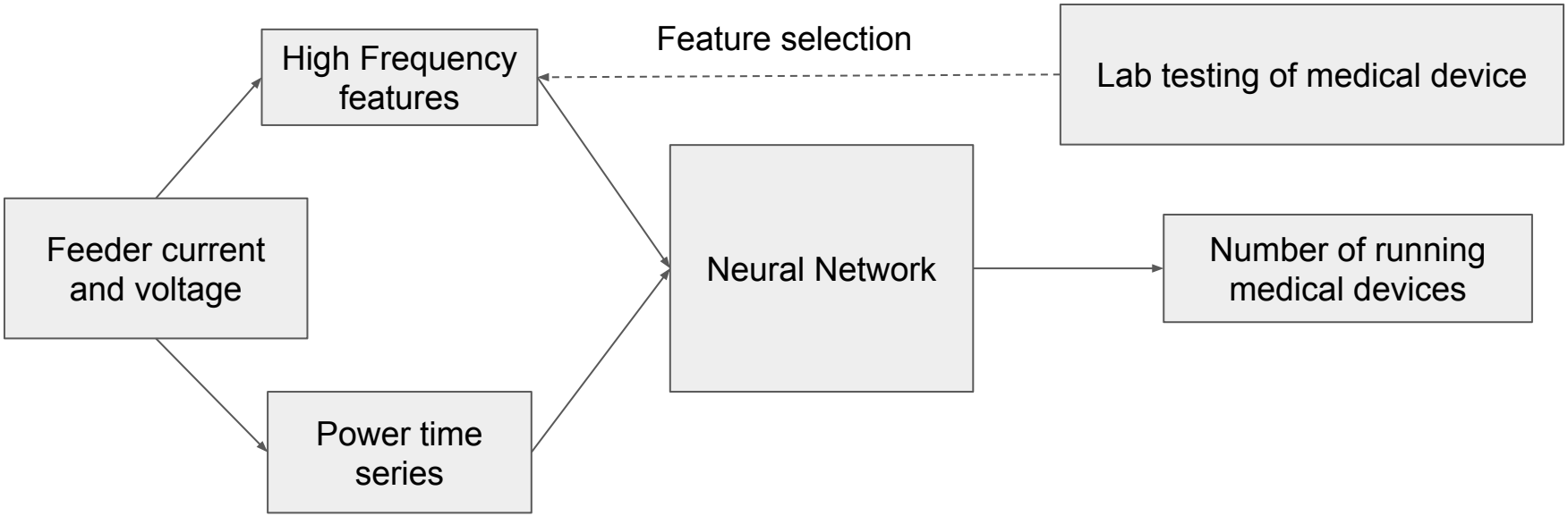
Proposed Methodology: Dataset generation

- Partner with households to monitor ventilator usage



Proposed Methodology: NN Model

- Train network to get number of devices running in a given time window



Ref: Marchesoni-Acland F, Mariño C, Masquil E, Masaferro P, Fernández A (2020) End-to-end NILM system using high frequency data and neural networks

Impact, Deployment, Limitations

Contributions and Impact

1. *load disaggregation model to predict number of medical devices downstream of a feeder*
2. *quantitative approach to estimate medically fragile population in an area while preserving location privacy*
3. *dataset of high frequency power data measurements for in-home medical devices*

emPOWER dataset has already proven useful to prepare and respond to:


wildfires


earthquakes


floods

Limitations

- Does not account for all at-risk individuals
- Extending house-level disaggregation approaches to feeder-level data
- Partnerships critical
- Privacy concerns

Deployment

Partnerships key for model formulation, training dataset generation, evaluation.


Medically fragile families, medical device experts, home healthcare agencies, hospitals


Electric utilities