Paper 3: Privacy and Security Threats from Smart Meters Technology

Key Topics : Consumer Privacy , NILM, Impacts of Misuse, Mitigation Strategies

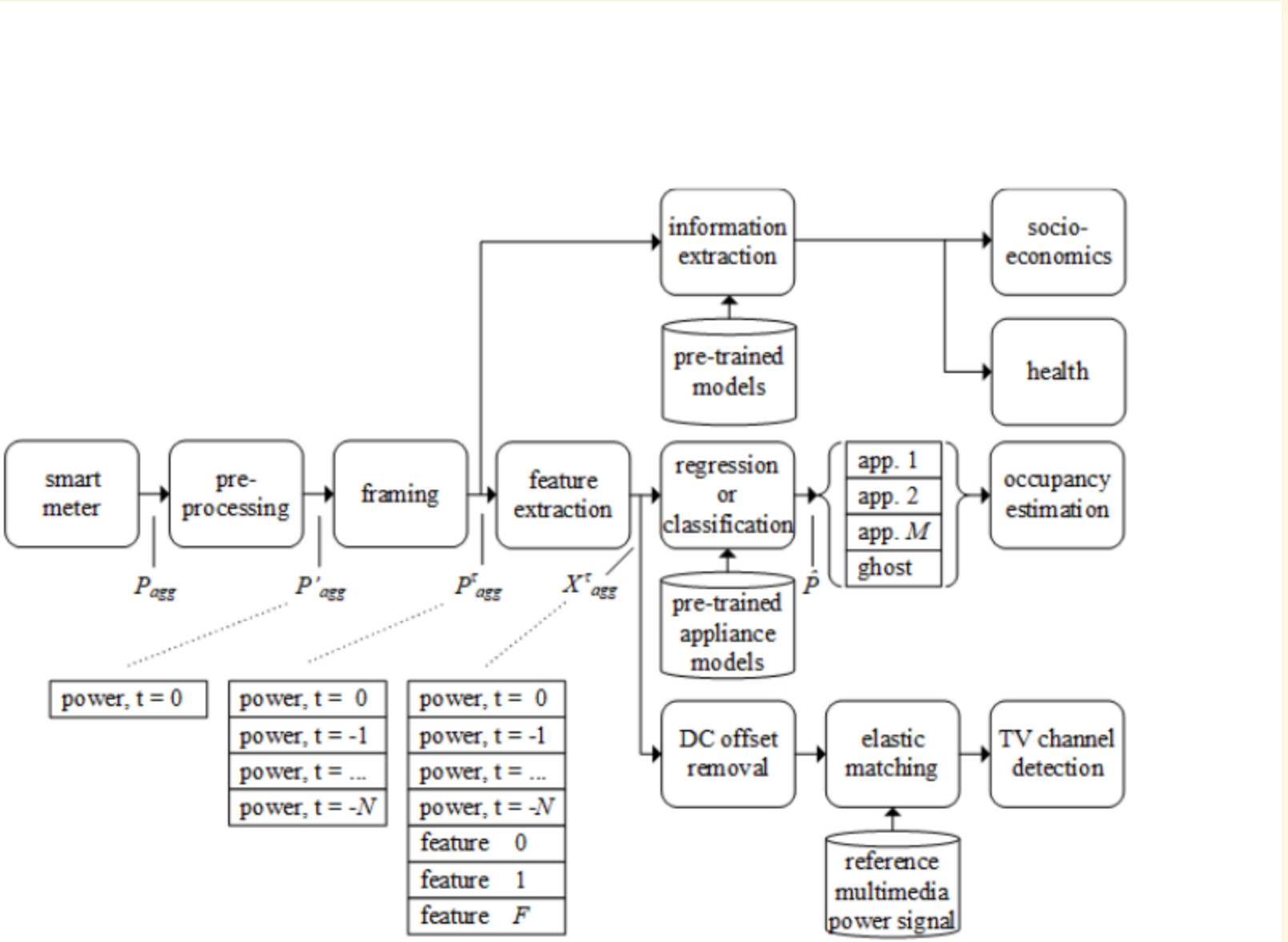
Introduction

- **Smart Meters**:
  - Measure and transmit household energy consumption data.
  - Benefits:
    - Accurate billing and energy management.
    - Supports grid optimization.
  - Risks:
    - Privacy and security vulnerabilities through data misuse.

Non Intrusive Load Monitoring(NILM)

Non-Intrusive Load Monitoring (NILM)

- **Definition**: Technique to disaggregate total energy usage into specific appliance-level data.
- **Inferred Data**:
  - Appliance usage.
  - Household occupancy patterns.
  - Socio-economic status and health-related habits.
  - Multimedia content consumption (e.g., TV channels).


smart meter
pre-processing
framing
feature extraction
information extraction
pre-trained models
socio-economics
health
regression or classification
pre-trained appliance models
app. 1
app. 2
app. M
ghost
occupancy estimation
DC offset removal
elastic matching
reference multimedia power signal
TV channel detection
P_{agg}
P'_{agg}
P^F_{agg}
X^τ_{agg}
$\hat{P}$
power, t = 0
power, t = 0
power, t = -1
power, t = ...
power, t = -N
power, t = 0
power, t = -1
power, t = ...
power, t = -N
feature 0
feature 1
feature F

Examples of Misuse:

1. **Consumer Profiling**:
    - Insurance premiums adjusted based on socio-economic data.
    - Targeted advertising based on multimedia habits.
2. **Criminal Activity**:
    - Burglary risks due to real-time occupancy tracking.
    - Targeting high-value homes based on socio-economic profiles.

Existing Policies:

- UK Smart Meters Act and Data Protection Act:
  - Limits data reporting to 30-minute intervals.
  - Mandates encryption, anonymization, and user consent.

Proposed Mitigations:

1. **Policy Interventions**:
   - Strict regulations on data access and usage.
   - Ensuring utility providers maintain secure systems.

2. **Technical Measures**:
    - Signal filters and battery-based networks to obscure data.
    - Secure hardware with tamper-proof designs.