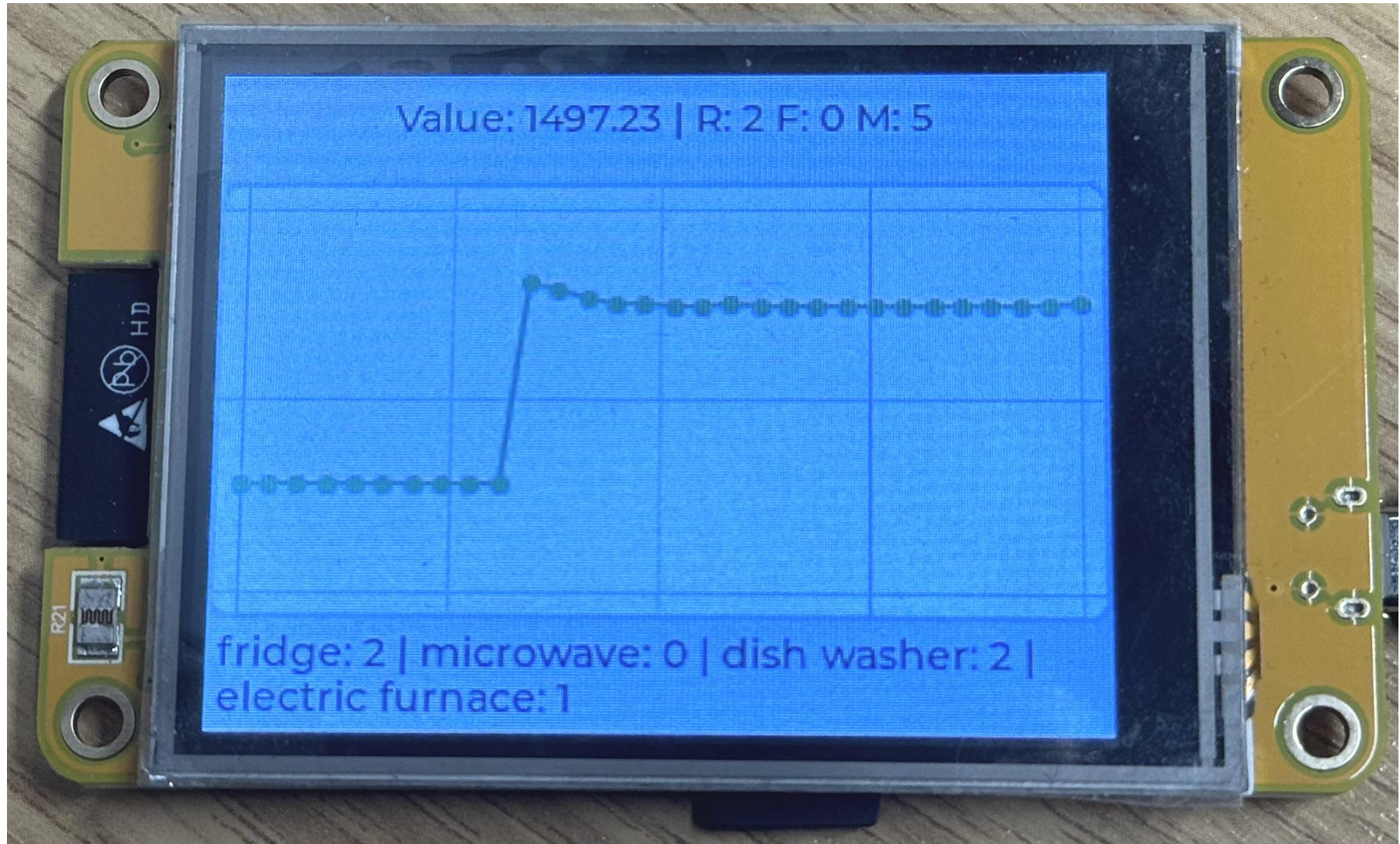


A Real-time Tsetlin Machine-based Non-intrusive Load Monitoring System on MCUs

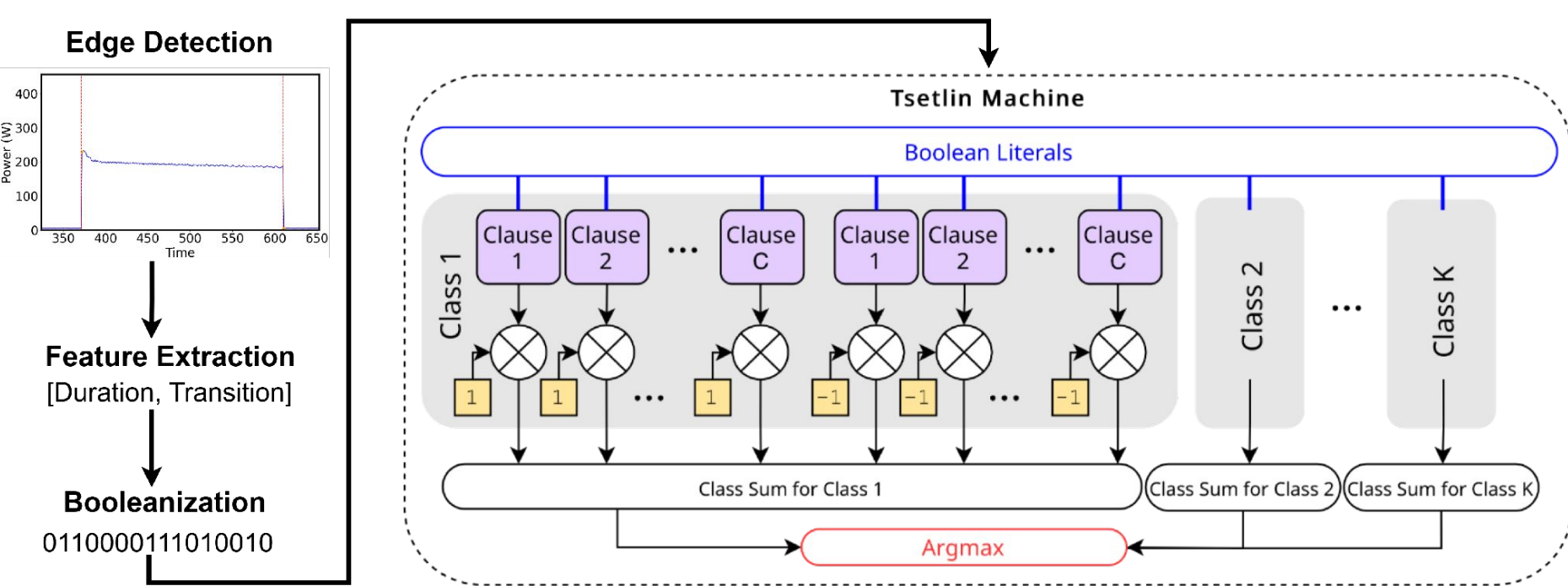
Han Wu, Tianhang Tan, Shengyu Duan, Alex Yakovlev, Rishad Shafik and Tousif Rahman



Real-time TM Inference on MCU



Tsetlin Machine Inference



Features for Tsetlin Machine

TABLE I: Features extracted from each paired appliance activity window.

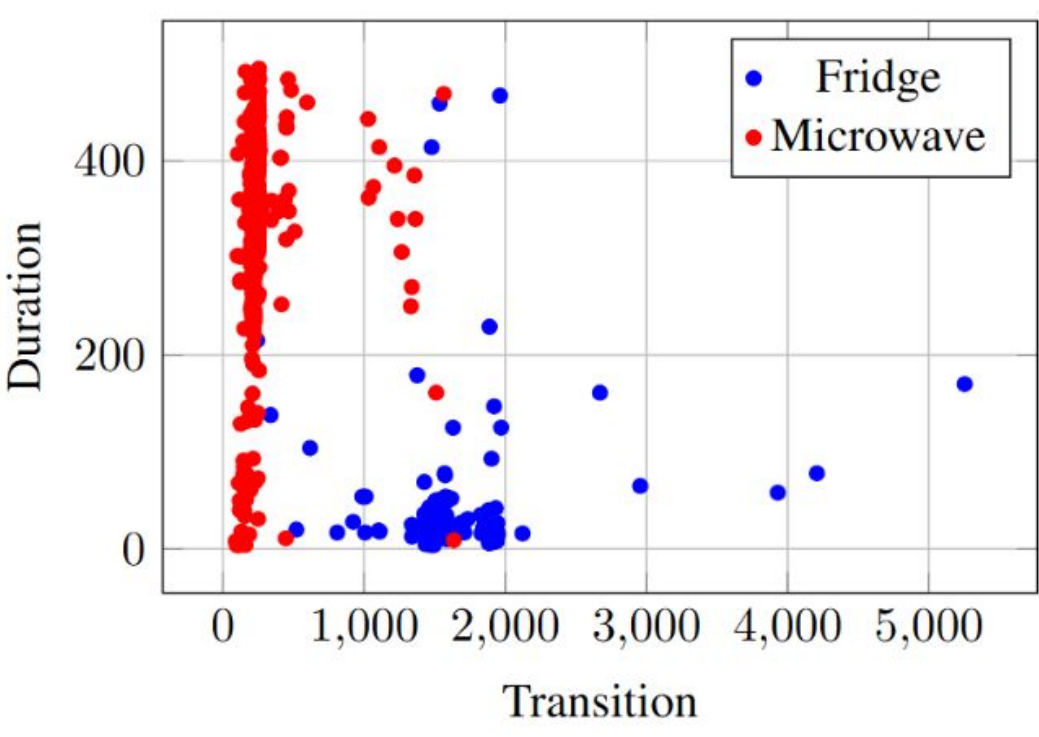
Category	Feature
Transition	Positive transition magnitude
	Negative transition magnitude
	Average absolute transition magnitude
	Logarithm of absolute transition magnitude
	Episode duration
	Logarithm of episode duration
	Transition-duration product
	Transition-duration ratio
Steady-state statistics	Mean power
	Standard deviation of power
	Minimum power
	Maximum power
Internal dynamics	Power range
	Mean absolute consecutive-sample difference
	Maximum absolute consecutive-sample difference
	Number of significant internal power transitions
Energy & context	Estimated number of operating subcycles
	Active-state fraction
	Episode energy estimate
	Post-event minus pre-event mean power
	Number of large internal power transitions



Evaluation Results

Appliance	Precision	Recall
Fridge	0.99	0.97
Microwave	0.80	0.95

Appliance	Precision	Recall
Fridge	0.84	0.94
Microwave	0.75	0.95
Dish Washer	0.10	0.08
Electric Furnace	0.50	0.15



Method	Fridge (F1)	Microwave (F1)	Model Size
Our Method	0.89	0.84	17 KB
LSTM	0.92	0.38	1.9 MB
BERT	0.76	0.48	8.4 MB
EdgeNILM	0.74	-	41.5 MB

GitHub Code

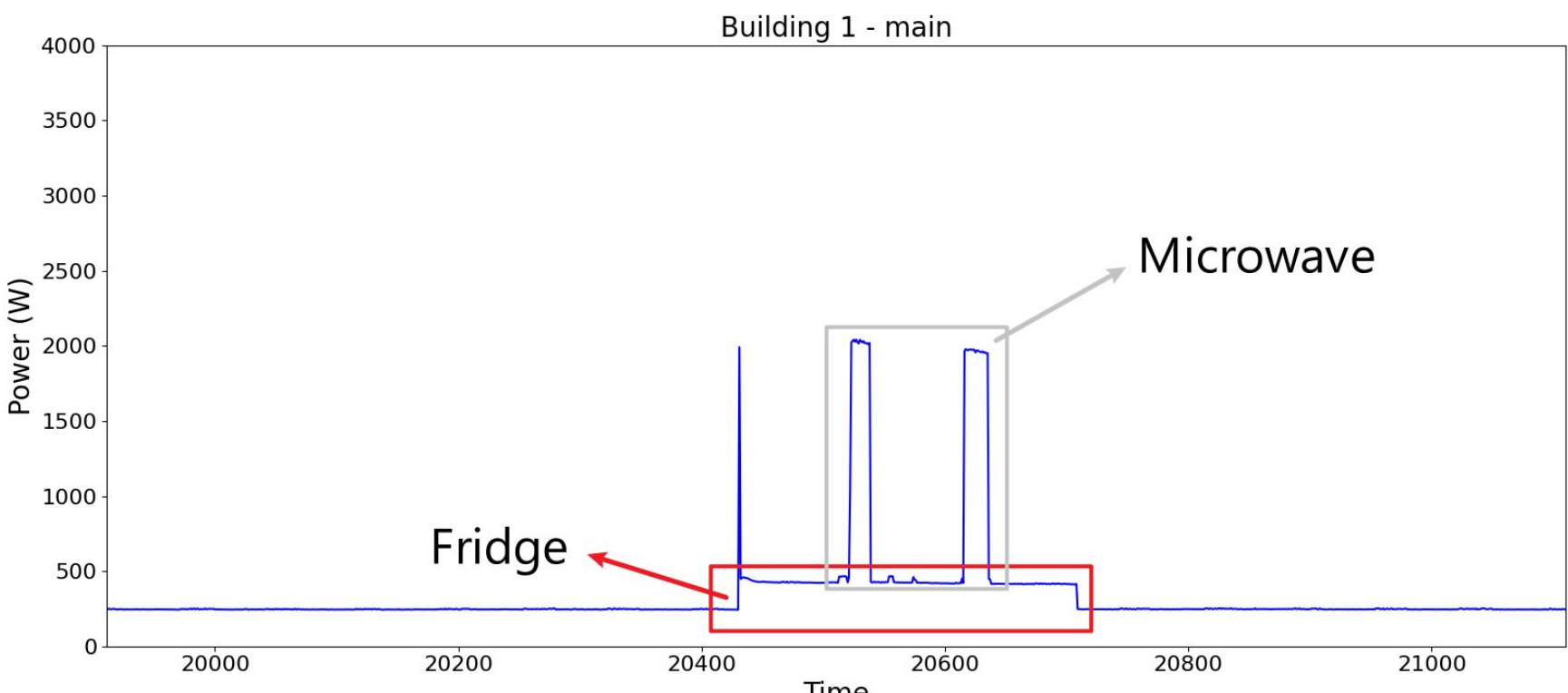


Scan for more details!



What is Non-Intrusive Load Monitoring (NILM)

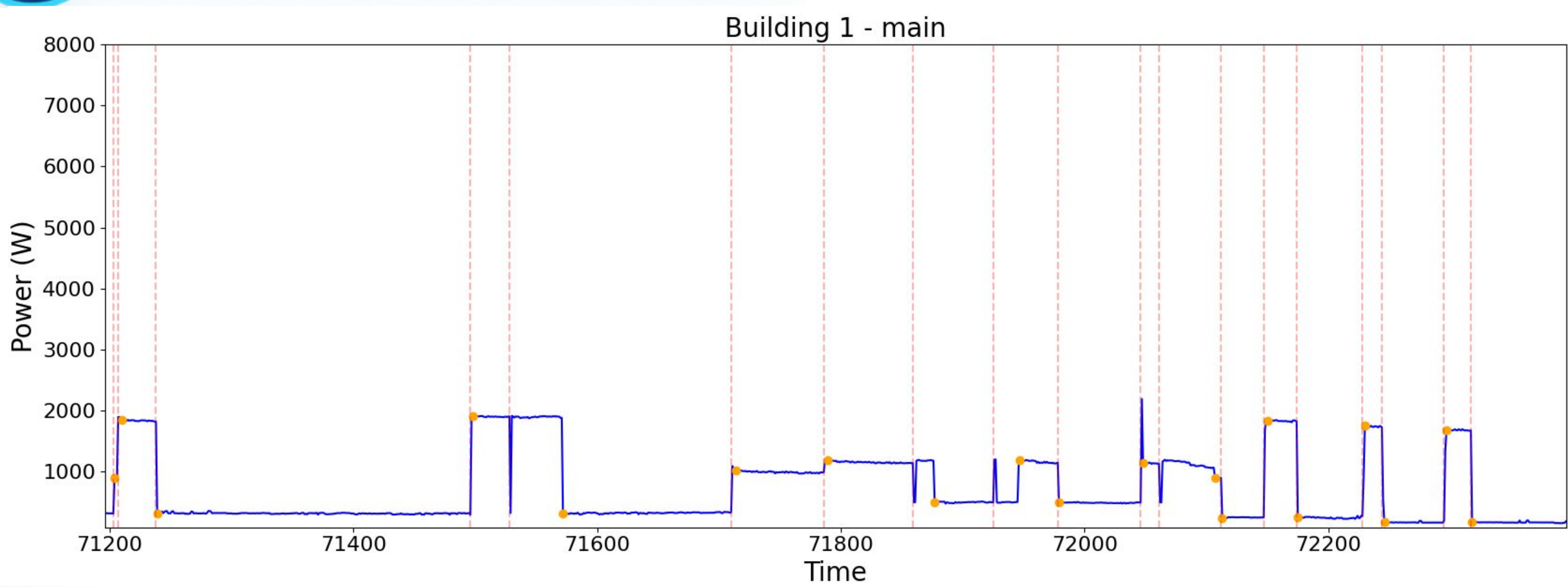
- Estimates the **energy consumption** of individual appliances
- Uses **only one sensor** at the main electricity meter



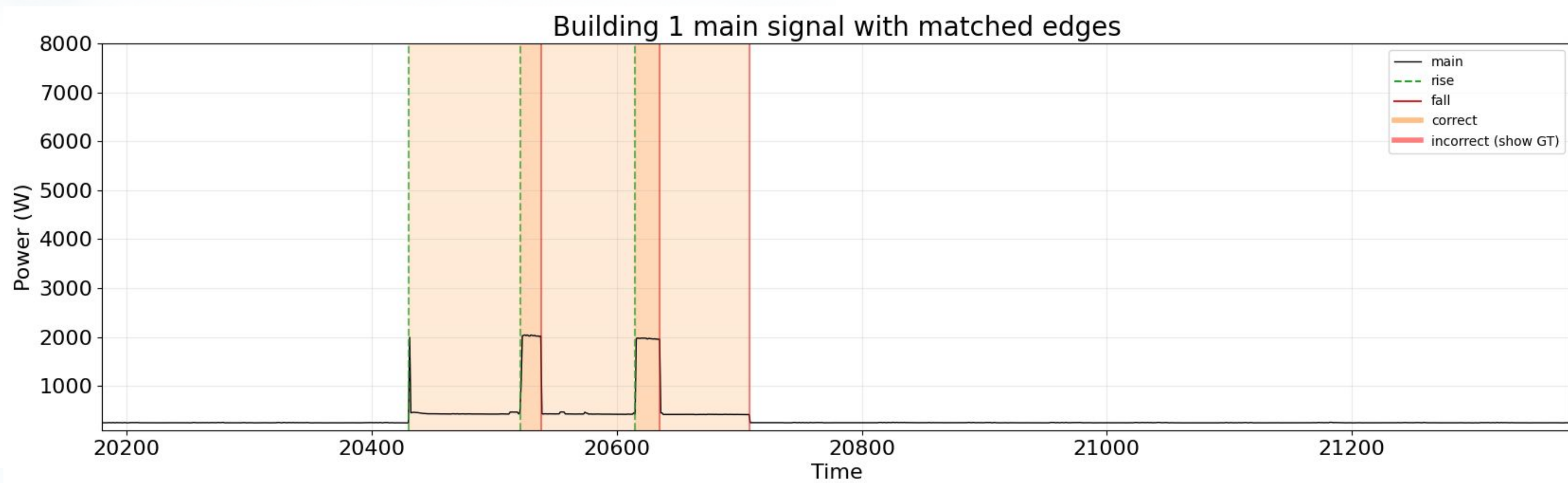
- a.k.a. **Energy Disaggregation**



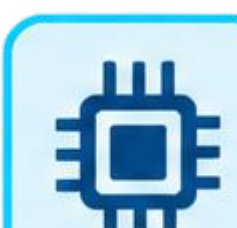
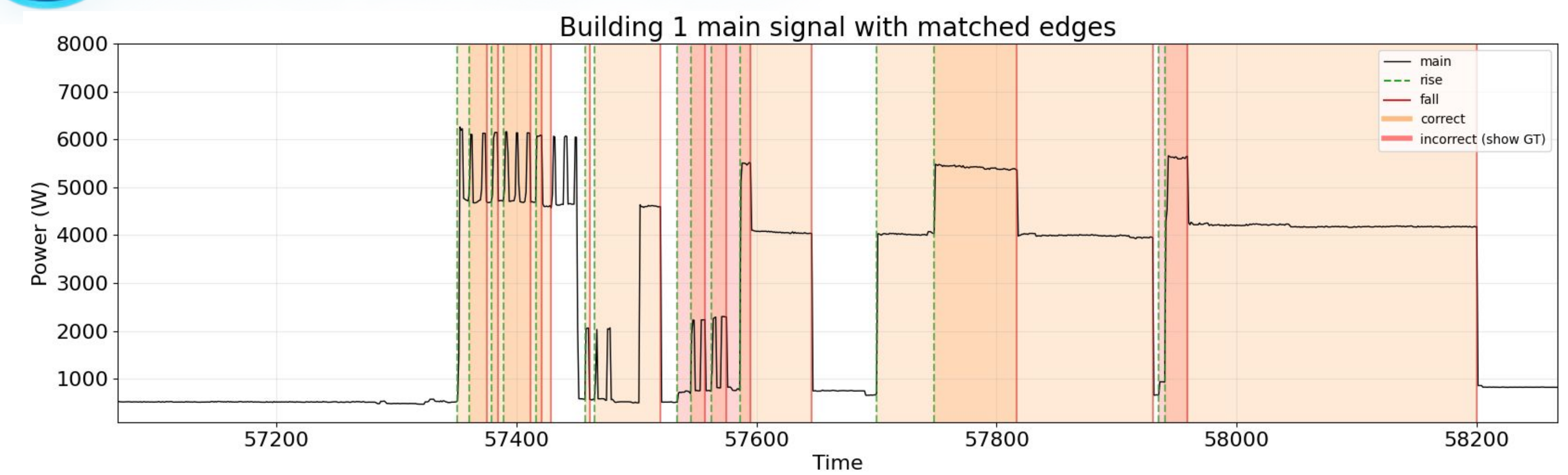
Edge Detection



Easy to Predict Scenario



Hard to Predict Scenario



Real-time on MCU



Low-Memory 17KB



Energy Efficient



Towards Smart Home