

Autonomous Building Operations and Virtual Assistants Using Generative AI

Reachsak Ly¹, Dr. Alireza Shojaei²
Myers-Lawson School of Construction

Introduction

Traditional building automation systems rely on conventional AI system, lack contextual understanding and adaptabilities.

Feature of Generative AI/ Large Language Model

Creates human-like text for various applications, understand, text images, audio, and video.

Lack of Gen AI application in building automation systems

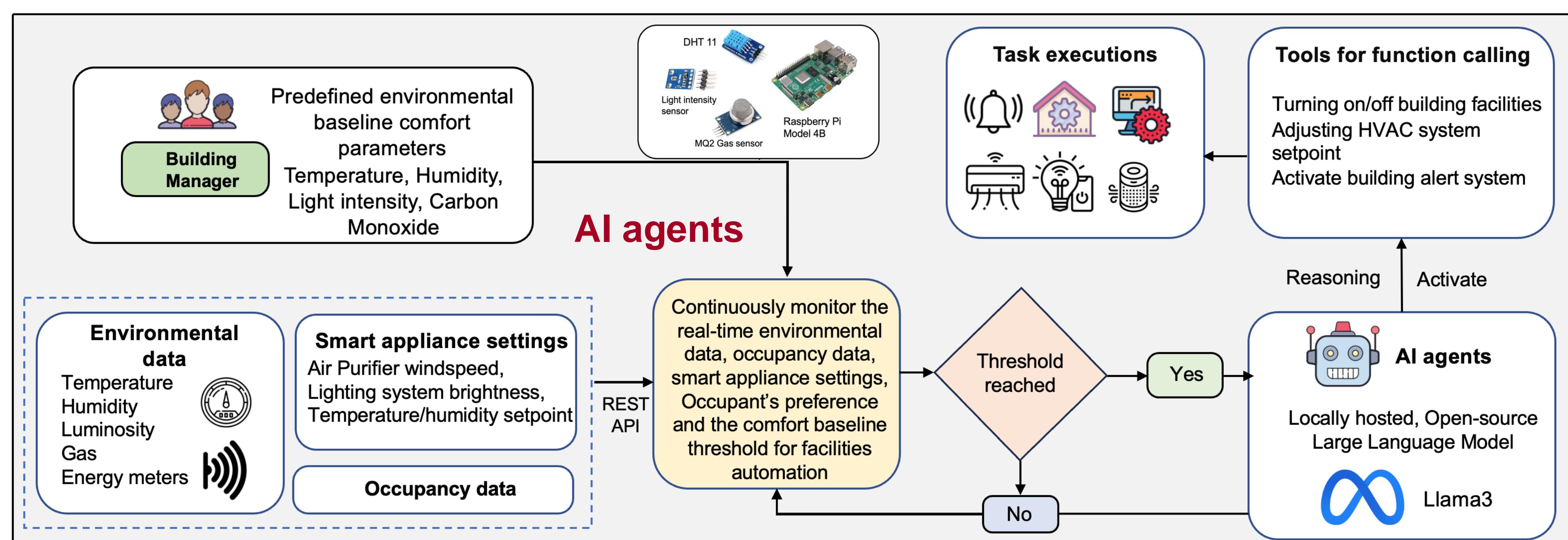
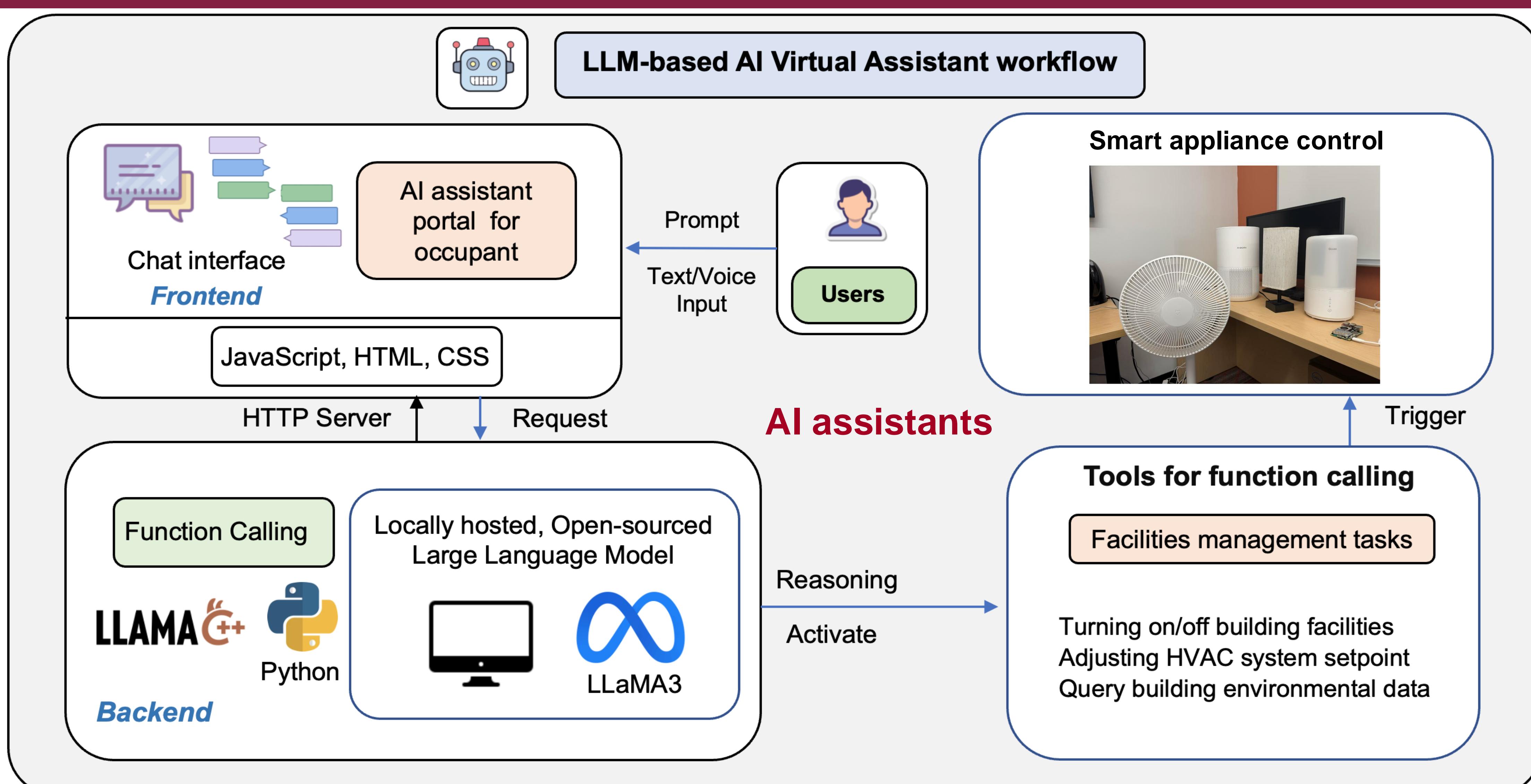


Lack of intuitive, human-like interaction in smart building control



Lack of open-sourced Gen AI/LLM application

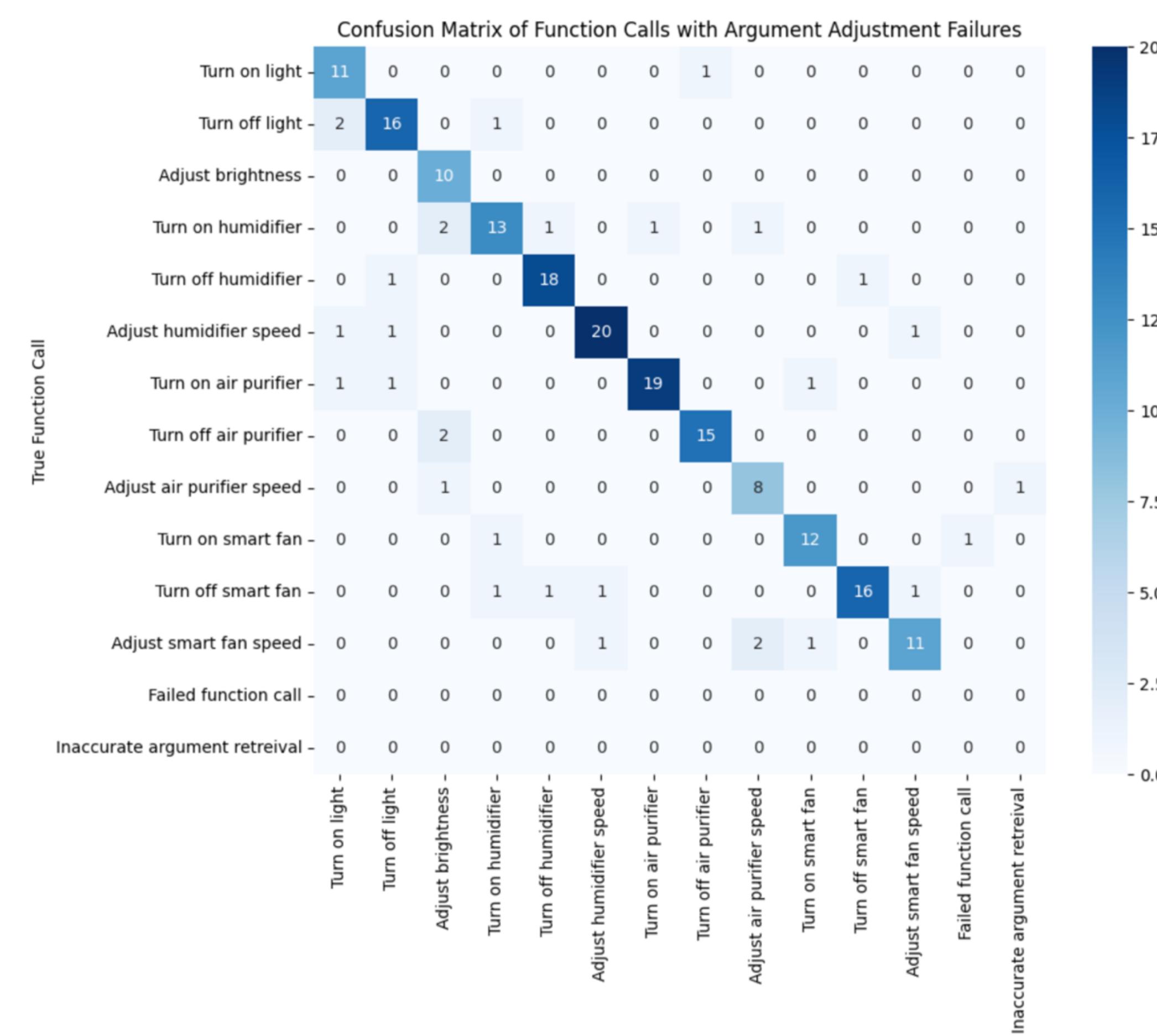
Methods



Evaluation, Result and Discussion

AI assistants

Virtual Assistant for appliance control



200 voice command for appliance control
Repeat each command 10 times for reliability test
e.g. Increase the room brightness to 60%

Scalability analysis

Throughput : 33.66 tokens / 20 words per second

Speed: 5 seconds per task

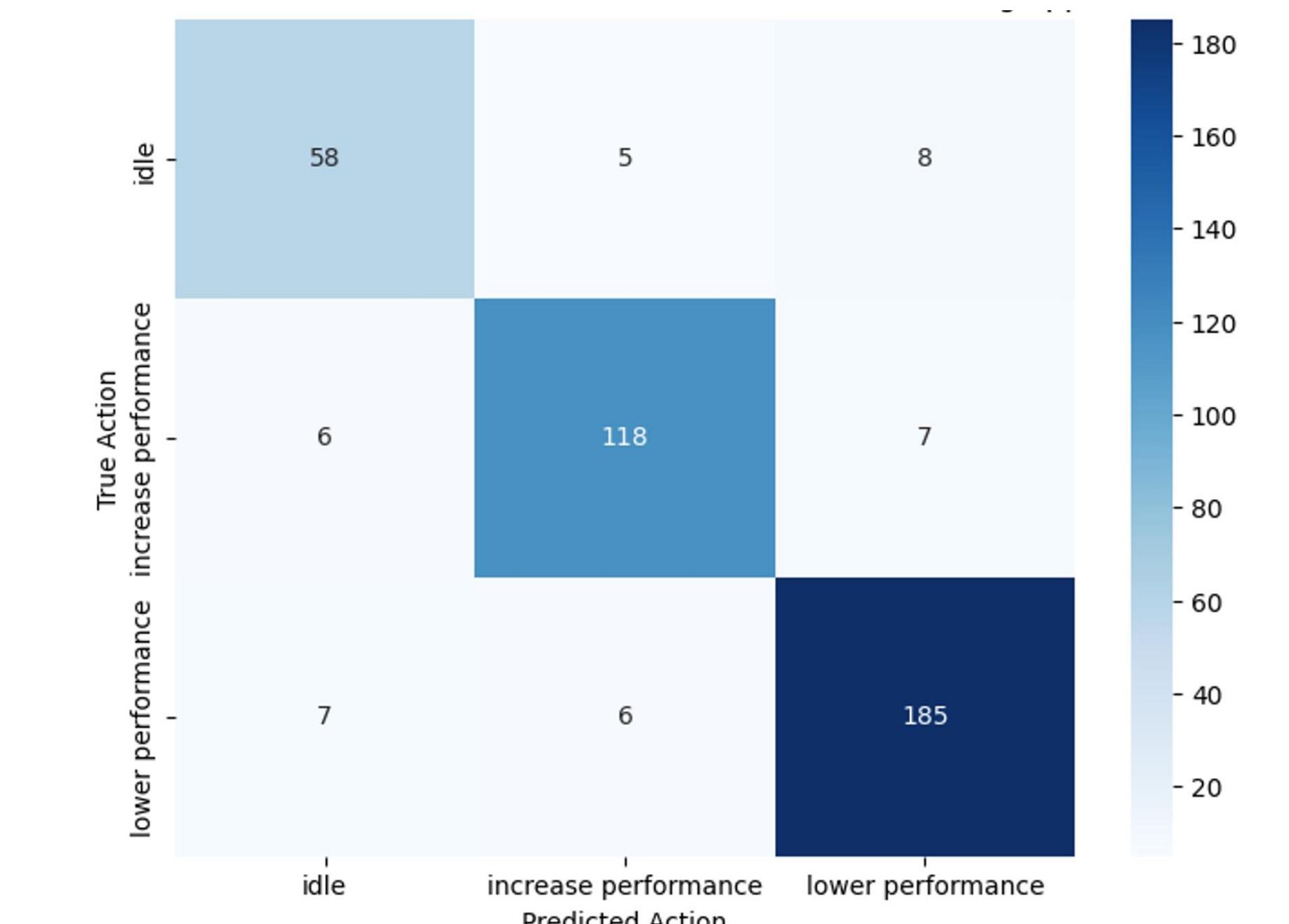
Concurrency: 16 parallel user requests

Workstation

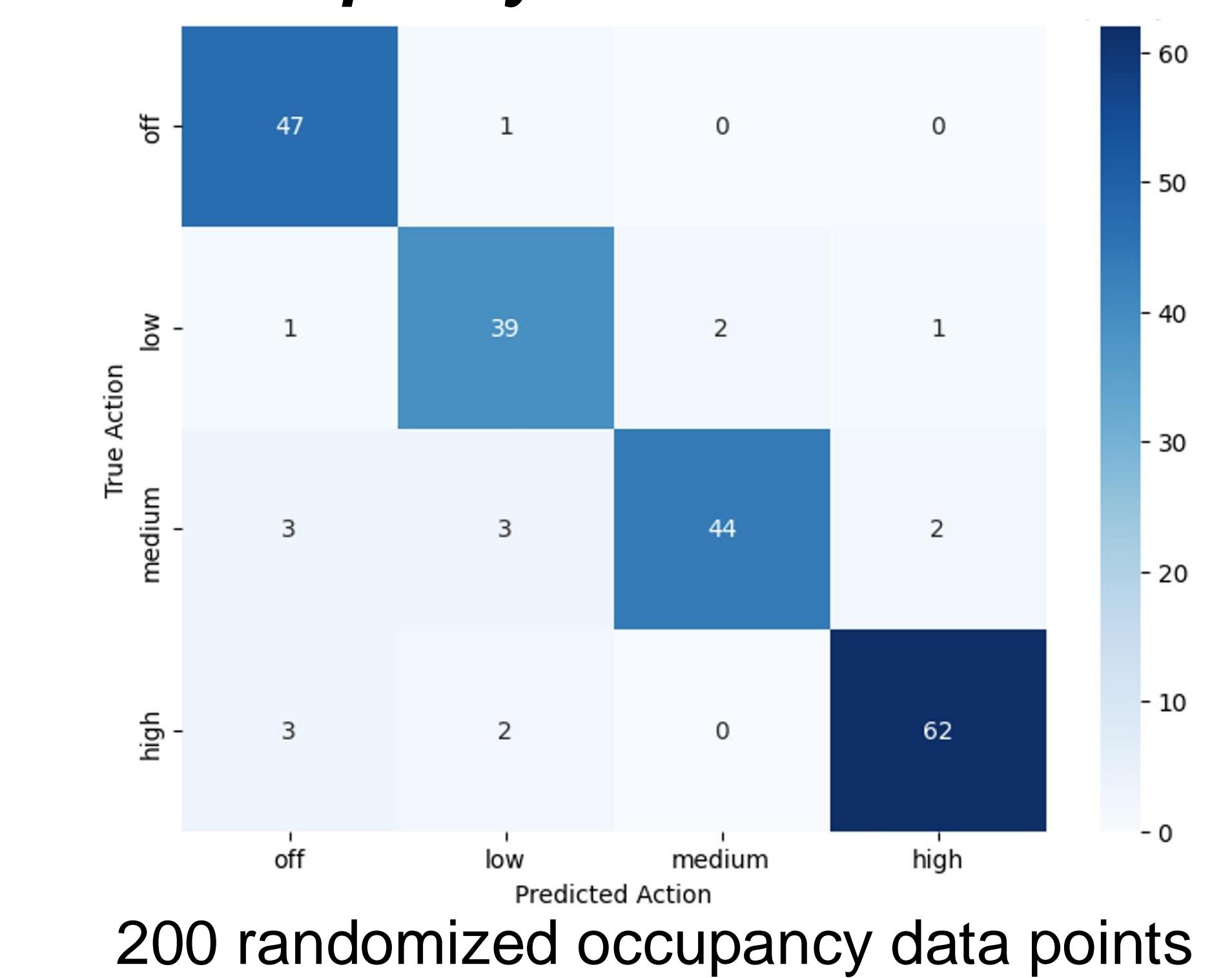
M1 MAX CPU/GPU / 32 GB RAM

AI agents

Threshold-based automation



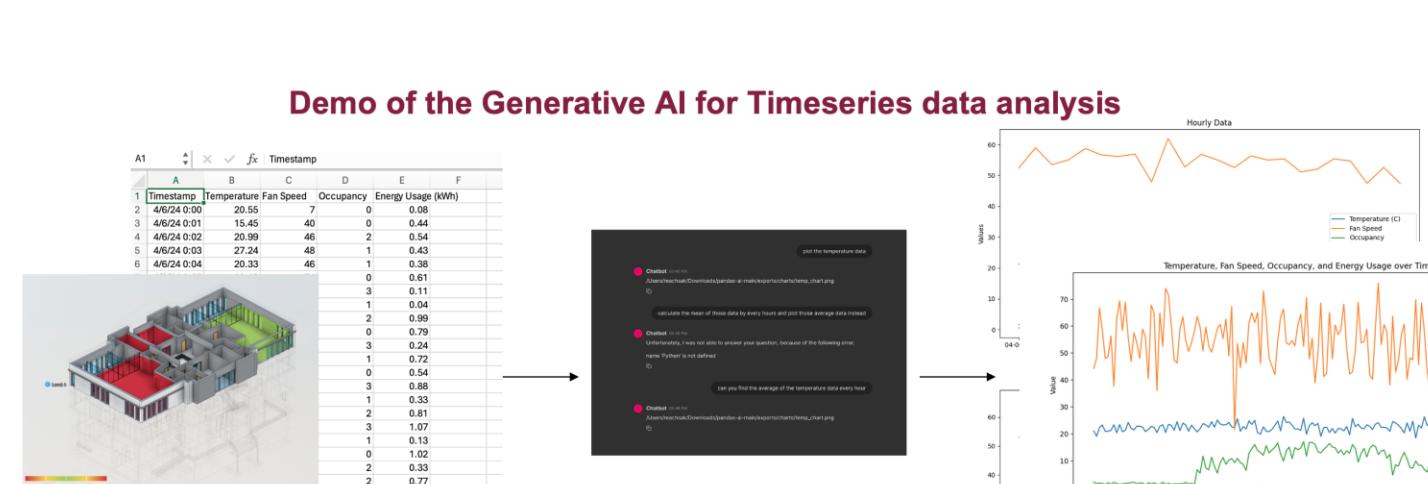
Occupancy-based automation



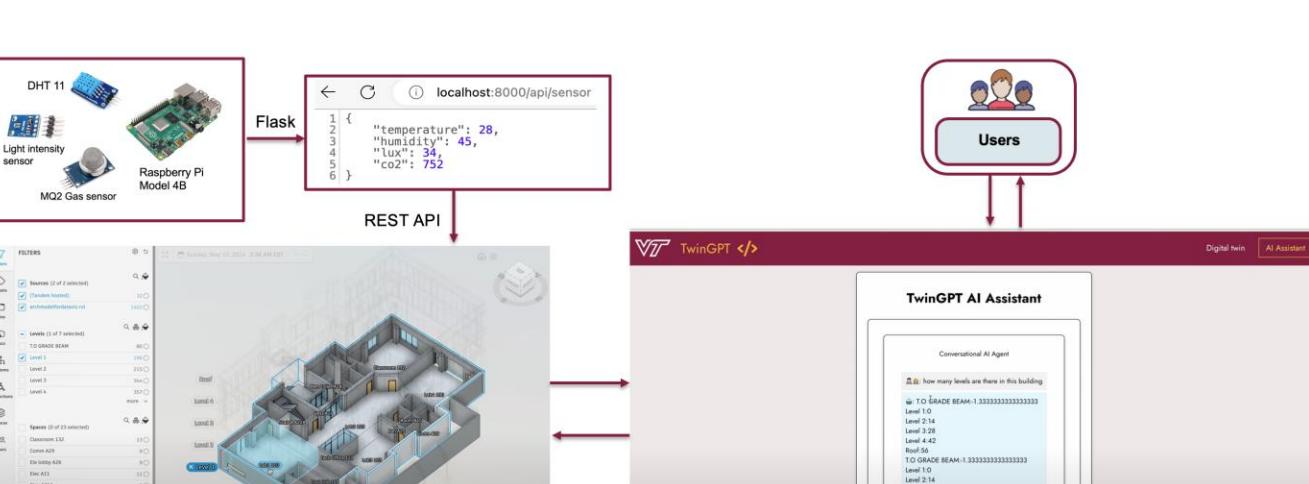
AI Systems	Task	Precision (%)	Recall (%)	F1 Score (%)	Accuracy (%)	Reliability (%)
AI Assistants	Smart appliance control task	95.91	92.75	94.17	92.75	95.45
AI Agents	Occupancy based automation	90.74	90.23	90.29	91	N/A
	Threshold based automation	88.58	88.16	88.25	90.25	N/A

Future work

Gen AI-assisted Facilities management using Virtual Assistant

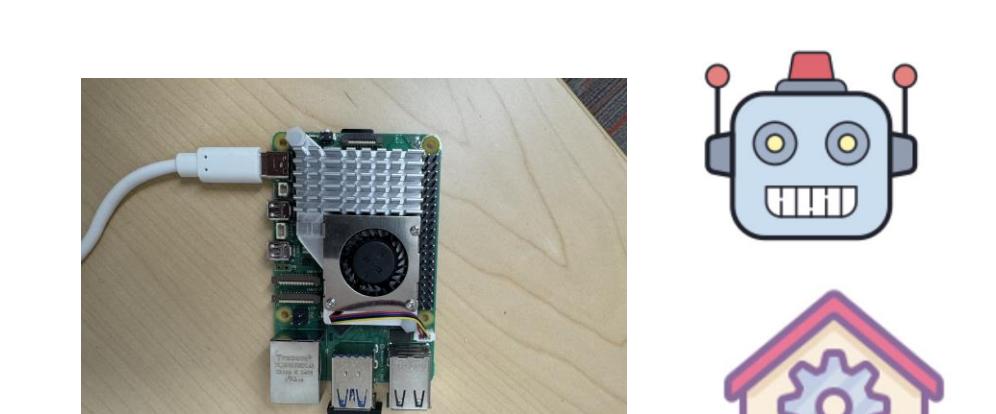


Query System for Digital Building Twin using LLM



- Building data analysis
- AI-driven insight/suggestion

AI on the Edge for Smart building and Smart cities using Small language model (SLM)



- Cost effective AI solution for building infrastructure