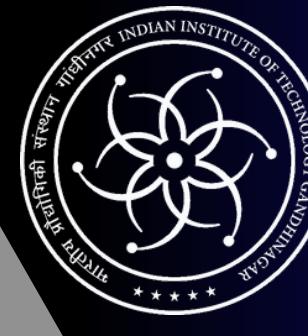


SUSTAINABILITY LAB

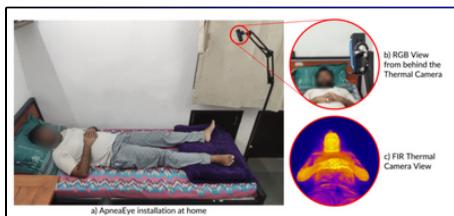


Professor Nipun Batra

sustainability-lab.github.io

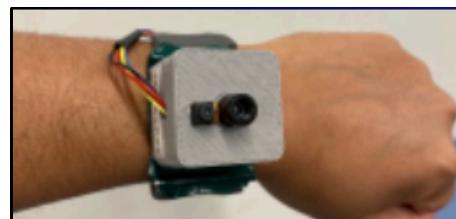
**Indian Institute of Technology
Gandhinagar**

Health



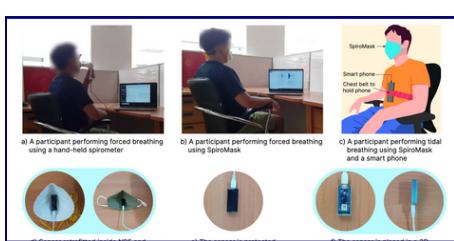
ApneaEye

A thermal camera-based, non-intrusive system to monitor Respiration signals during sleep.



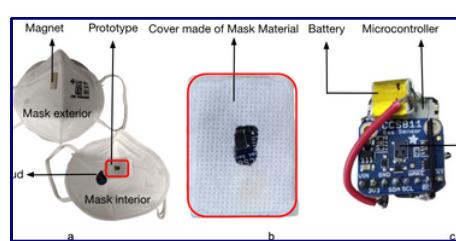
JoulesEye

A Thermal camera system that accurately estimates calorie expenditure during exercise by monitoring respiration rate.



SpiroMask

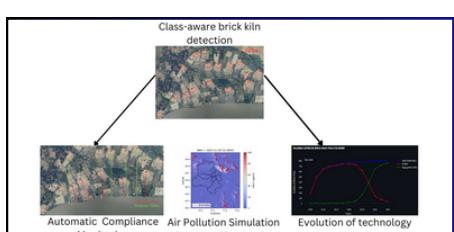
A smart mask with integrated microphones for accurate, non-invasive lung health monitoring.



Continuous Respiration Rate

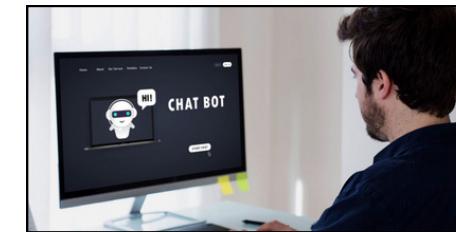
A CO₂ sensor in an N95 mask enables continuous respiration rate monitoring during walking and rest.

Air Quality



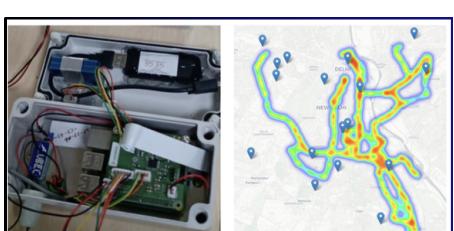
Space to Policy

A Scalable system that Automates Brick Kiln Detection with Geospatial Data



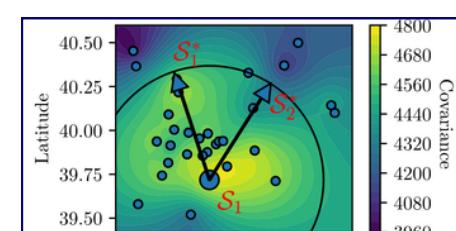
VayuBuddy

LLM-Powered Chatbot to Democratize Air Quality Insights for the masses.



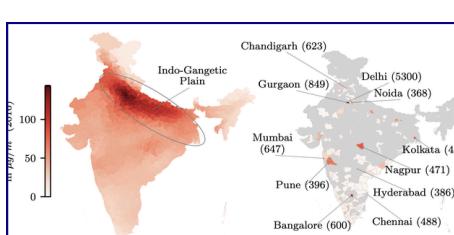
AIRDELHI

A novel mobile sensor based dataset for Delhi, enabling air pollution analysis and benchmarking.



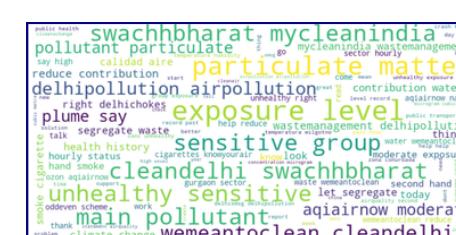
Scalable AQ Inference

Gaussian processes method with advanced kernels for accurate air quality estimation



Samachar

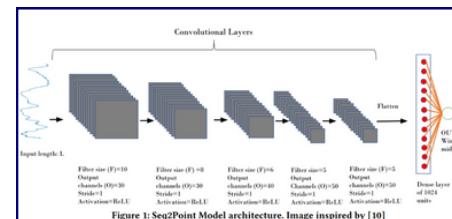
Reveals temporal and geographical biases in Indian media's air pollution coverage



Vartalaap

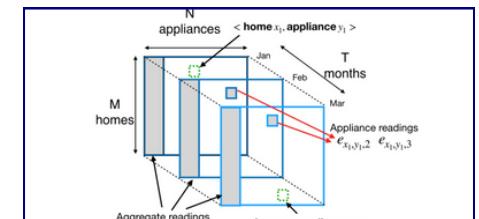
Analyzing public perception of air pollution in Delhi using Twitter data and NLP techniques.

Energy Analytics



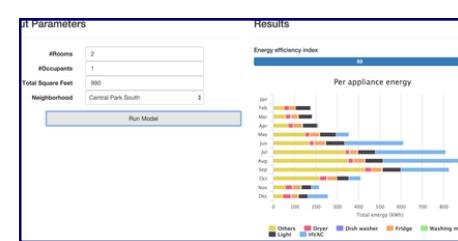
EdgeNILM

A multi-task learning approach to compress neural networks for efficient Non-Intrusive Load Monitoring (NILM).



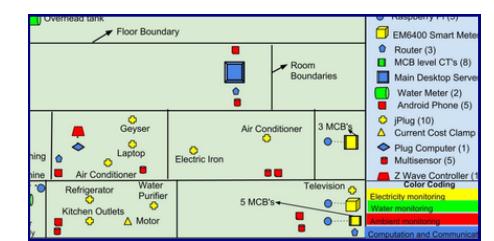
Active Collaborative Sensing

A cost-efficient approach for accurate appliance-level energy breakdown with minimal sensor deployment.



Scalable Energy Breakdown

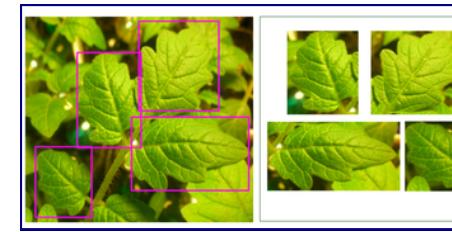
Matrix factorization method for energy breakdown in homes without requiring additional hardware installation



It's Different

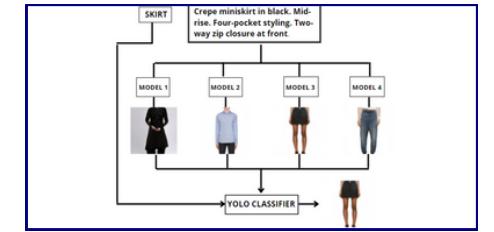
A sensor network deployment for monitoring energy, water, and ambient parameters in a Delhi home

Expositions



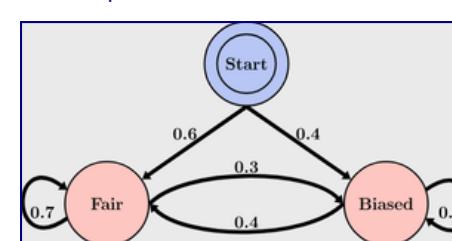
PlantDoc:

PlantDoc enables early plant disease detection using a curated dataset for computer vision models.



Vastra-GAN

A GAN-based model generates intricate Indian apparel designs from text, enhancing customization.



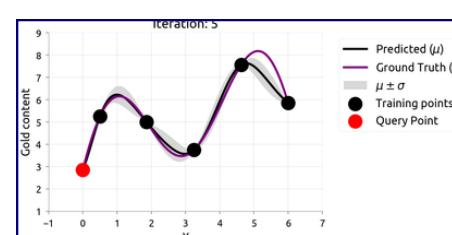
Exploring HMM

Explaining Hidden Markov Models, Markov Chains, with interactive visualizations



Active Learning: Visual Tour

Visualizing Active Learning for selecting most informative data point for machine learning models.



Exploring Bayesian Optimization

Visualizing Bayesian Optimization, its principles, techniques, and applications to simplify complex concepts.

LAB COMPUTATIONAL RESOURCES

The Lab features modern computational servers with up to **512GB RAM, 64 CPUs and Intel Xeon processors** for intensive computational tasks. The following are the high-end GPUs: **4xNVIDIA A100 (4x80 GB), 2xNVIDIA RTX A5000 (24GB), 2xRTX A4000 (2x16GB), 1xNVIDIA RTX A2000 and Titan XP**.



Lab Webpage
sustainability-lab.github.io



Youtube Channel
Sustainability Lab IITGN



Nipun Batra is an Associate Professor of Computer Science at IIT Gandhinagar. He completed his postdoctoral research at the University of Virginia and earned his PhD from IIIT Delhi. His research group focuses on utilizing machine learning and sensing technologies to address computational sustainability challenges, particularly in smart buildings, air quality, and healthcare.

Prof. Nipun Batra

Awards won by Prof. Nipun Batra:

- ACM SIGEnergy Rising Star 2025 Award
- Excellence in Teaching Award by IIT Gandhinagar 2024
- Young Alumni Award from IIIT Delhi 2023
- Keynote talk at ACM COMPASS 2024 Doctoral Colloquium
- Best Graduate Presentation at ACM Sensys 2015 [A*] (first and only winner from India)
- Best demo award at ACM Buildsys 2014 [A]

Awards won by the lab students:

- PhD student Zeel Patel awarded Microsoft PhD fellowship 2024 (one in ten in India)
- PhD student Rishiraj Adhikary is a finalist in the ACM Ubicomp (A*) graduate award
- PhD student Rishiraj Adhikary selected for prestigious Lindau Laureate Program 2024
- PhD student Rishiraj Adhikary won the Fullbright Nehru visitationn fellowship (1 in 3 in STEM that year)
- MTech Student Ankita Jain won Gold Medal in Research in 2023 convocation (awarded to 1 MTech student in a batch across all departments)

Alumni Across the Globe

Caltech



ORACLE



Microsoft Research



Carnegie Mellon University



Sponsors



CoE in AI (MHRD)

MEDIA COVERAGE

Research scholar at IITGN develops device to overcome fitness monitoring limitations

The trial study was conducted in the SMASH lab of Carnegie Mellon University (CMU) in Pittsburgh, the United States, during Adhikary's stint as a Fulbright scholar between August 2022 and May 2023 where Prof Mayank Goel from the CMU and Prof Nipun Batra from IIT Gandhinagar were his advisors for this project.



IIT-Gn chatbot eases air pollution data

Chatbot developed by IIT-Gn leverages artificial intelligence to answer queries about air quality

Ahmedabad Mirror Bureau
feedback@ahmedabadmirror.com

Posts @ahmedabadmirror

A chatbot developed by the Indian Institute of Technology, Gandhinagar (IIT-Gn), Vayubuddy, is designed to make air-quality data accessible to the largest number of people. Model-powered tool to simplify complex datasets into comprehensible insights.

IIT-Gn officials said that

Vayubuddy leverages artificial intelligence to respond to natural language queries about air quality. For example,

users can ask questions like, "What

was the PM2.5 in Ahmedabad in my

last month?" or "Which cities are the

cleanest in winter?" The chatbot pro-

cesses the query, analyses data from

India's Central Pollution Control

Board (CPCB) and delivers answers in

plain language through visualiza-

tions like graphs and heatmaps.

"Our aim was to reduce the gap

between raw data and public under-

standing," says Prof Nipun Batra, a

lead researcher on the project. He

adds, "Vayubuddy gives people a way

to interact with air quality data in a

user-friendly manner, empowering

them to make informed decisions."



the broader implications: "Air pollution is a shared challenge, and tools like Vayubuddy can foster collective awareness and action. When people see clear, localized data, they're more likely to advocate for cleaner policies."²

Vayubuddy matters

Adhikary points out that for its users, it is important as pollution affects not just health but all aspects of human life. Dr Sarah Guttikunda, air quality expert and collaborator, highlights

children's exposure, and researchers

can report trends using ready-to-publish charts.

Zeev Patel, a researcher on the project, underscores the versatility of the tool, "By combining data analysis with AI-powered conversational AI, Vayubuddy opens up new possibilities for engaging with air quality data. It's designed to work for everyone, not just experts."

Extending its capabilities to cover more pollutants like NO₂ and ozone, integrating multilingual features, and incorporating datasets from other countries are all on the horizon.

Vayubuddy gives
people a way to
interact with air qual-
ity data in user-friendly
manner, empower-
ing them to make
informed decisions

-Prof Nipun Batra,
Lead Researcher

children's exposure, and researchers

can report trends using ready-to-publish

charts.

the broader implications: "Air pollu-

tion is a shared challenge, and tools

like Vayubuddy can foster collective

awareness and action. When people

IIT-Gn researchers devise mask to measure lung health

SpiroMask assesses lung health parameters using microphone, derives vital statistics and monitors rate of respiration to spot and treat disease in its early stages

Niyati.Ram
[ahmedabadmirror.in](https://repaper.ahmedabadmirror.com/c/70530029)

Tweets @Niyati_Ram

An one get to know algo-

rithm in lung function

or diagnose lung health by

just wearing a mask? A team

of Indian Institute of Tech-

nology (IIT-Gn) along with

institutes from US has deve-

loped SpiroMask, a novel mask

that can detect forced and

tidal breathing using a micro-

phone. The device can de-

termine vital lung parameters and

continually track respiration rate to

monitor lung health.

SpiroMask measures respiratory

health indicators such as lung vol-

ume and peak expiratory flow

rate, etc., rates approved by

American Thoracic Society (ATS)

using commonly available fac-

ilities. It is made of a small

microphone and a signal pro-

cessing and machine learn-

ing unit.

Participants running on an ex-

ercise bike were asked to

wear SpiroMask, of which 14 par-

ticipants were healthy and 10 had

asthma. SpiroMask is also

important as late diagnosis of the

disease can lead to serious com-

lications.

Currently, the team analyzes the

data collected by SpiroMask to

train the machine learning al-

gorithm.

"Our aim is to

catch and treat the disease in

its early stages via regular moni-

itoring," he said adding a

SpiroMask costs Rs 2000

against a Rs 40,000 Spiremeter.

The researchers said that

SpiroMask can help them from

visiting a clinic.

A 4th year PhD, Computer

Science student at IIT-Gn, Rishiraj

Adhikary, who is the lead re-

sponsible for the project, said

that SpiroMask can help them

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