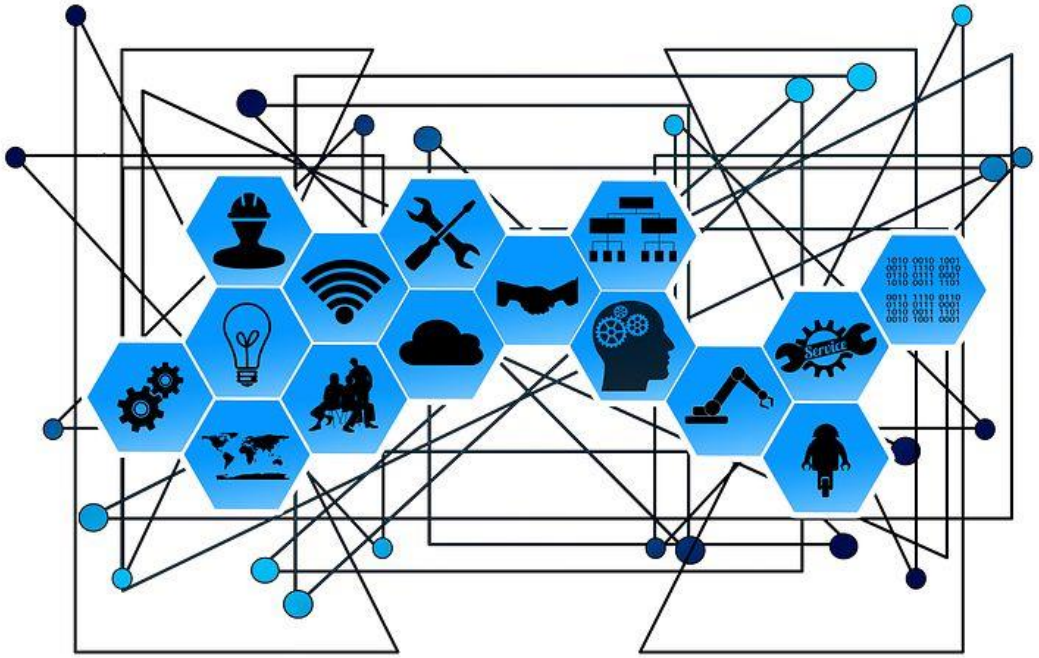
CS60055: Ubiquitous Computing

Department of Computer Science and Engineering

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Welcome!



Sandip Chakraborty
sandipc@cse.iitkgp.ac.in

What is Ubiquitous Computing?

- Let's ask it to ChatGPT …
  - Ubiquitous computing, also known as pervasive computing, refers to the **concept of embedding computational capabilities** into **everyday objects and environments** to enable **seamless interaction and integration** with technology. This paradigm envisions a world where computers and sensors are integrated into various devices and systems, often operating invisibly and continuously in the background to enhance user experience and provide useful services.

Text generated by ChatGPT 4o

I then asked ChatGPT to generate a representation image …

Image generated by ChatGPT 4o

I then asked ChatGPT to generate a representation image …

Salient factors in this image:

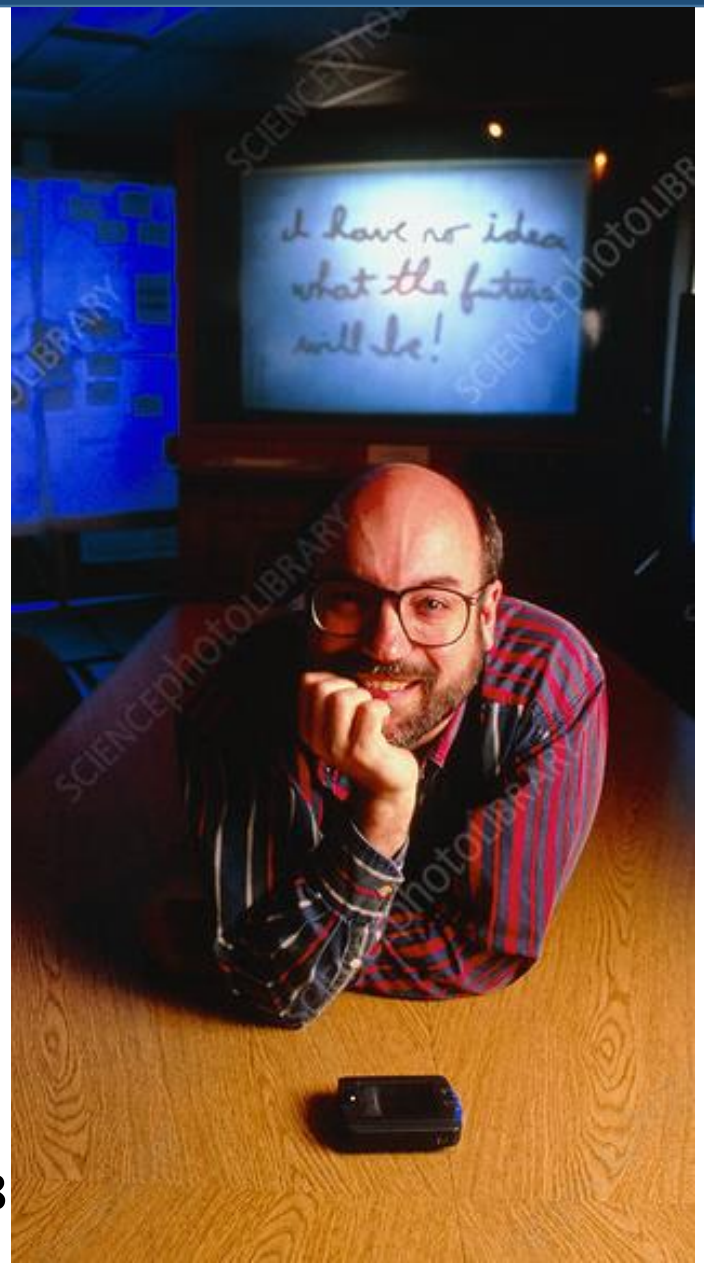
1) Human
2) Sensors
3) Objects (static and mobile)
4) Connectivity
5) Context and Control
6) Interactions

Let's see a video from a top research group on Ubiquitous Computing

Ubiquitous Computing and Interaction Group, Aarhus University, Denmark

From the Father …

"Ubiquitous computing names the third wave in computing, just now beginning. First were mainframes, each shared by lots of people. Now we are in the personal computing era, person and machine staring uneasily at each other across the desktop. Next comes ubiquitous computing, or the age of calm technology, when technology recedes into the background of our lives."



Mark Weiser, 1952 - 1999

CTO of Xerox PARC

Coined the term "Ubiquitous Computing" in 1988

And his article that triggered the topic "Ubiquitous Computing"

The Computer for the 21st Century

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."

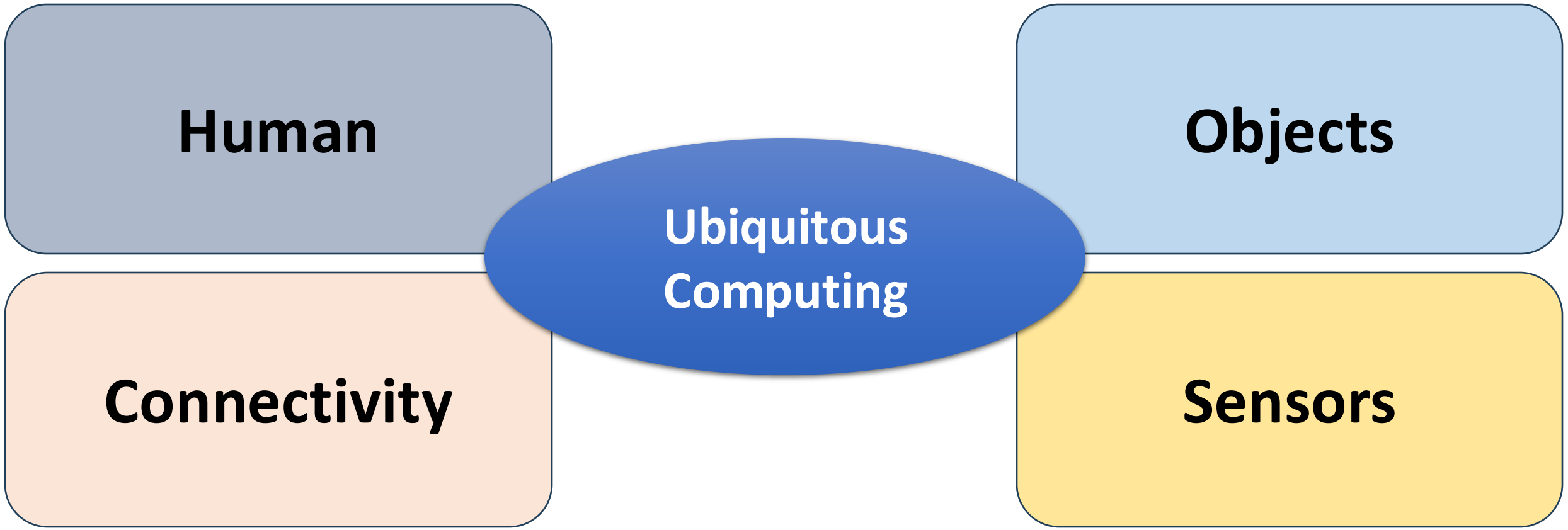
""*Ubiquitous computing*" in this context does not just mean computers that can be carried to the beach, jungle or airport. "

"ubiquitous computers must know where they are."

"ubiquitous computers will help overcome the problem of information overload"

Link: https://web.archive.org/web/20141022035044/http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html

So, What Does Ubiquitous Computing Look Like?



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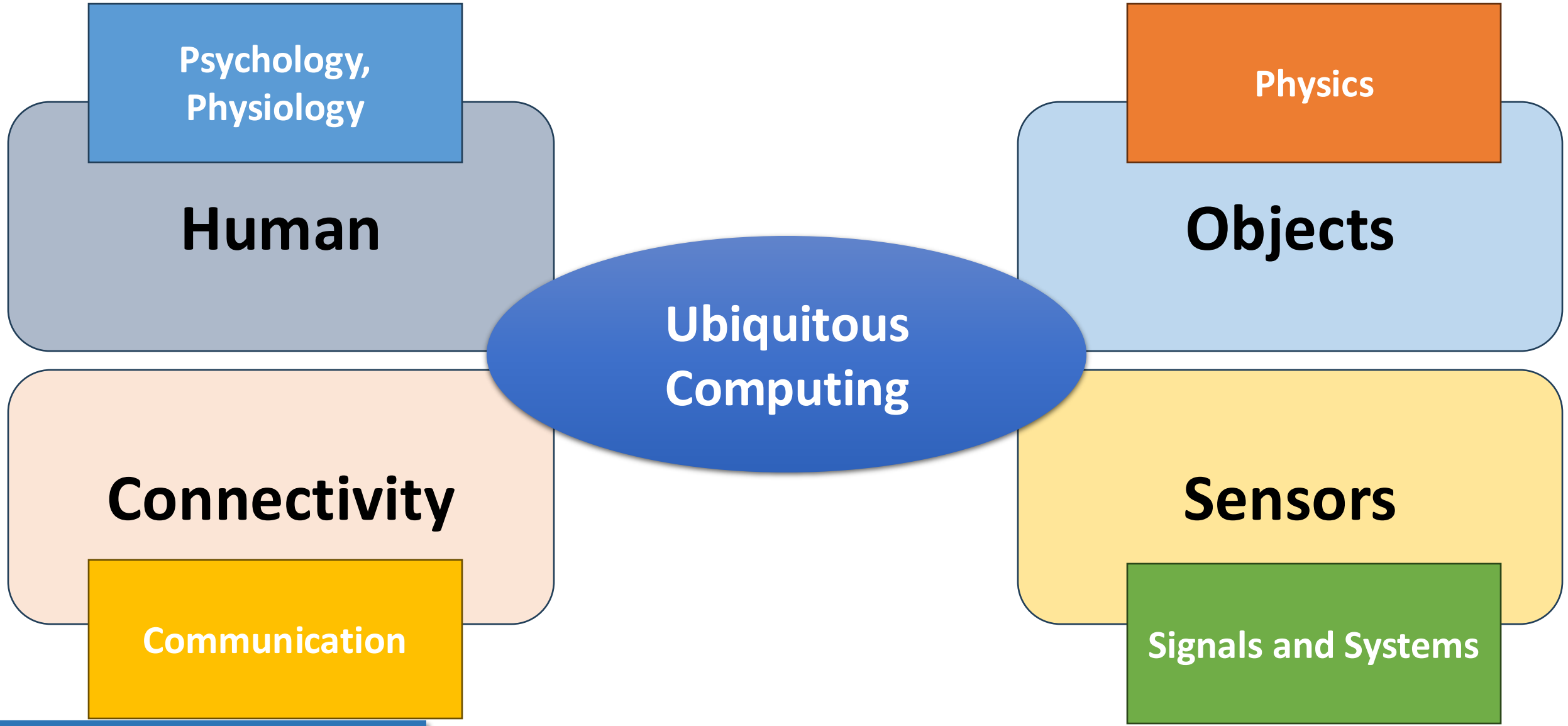

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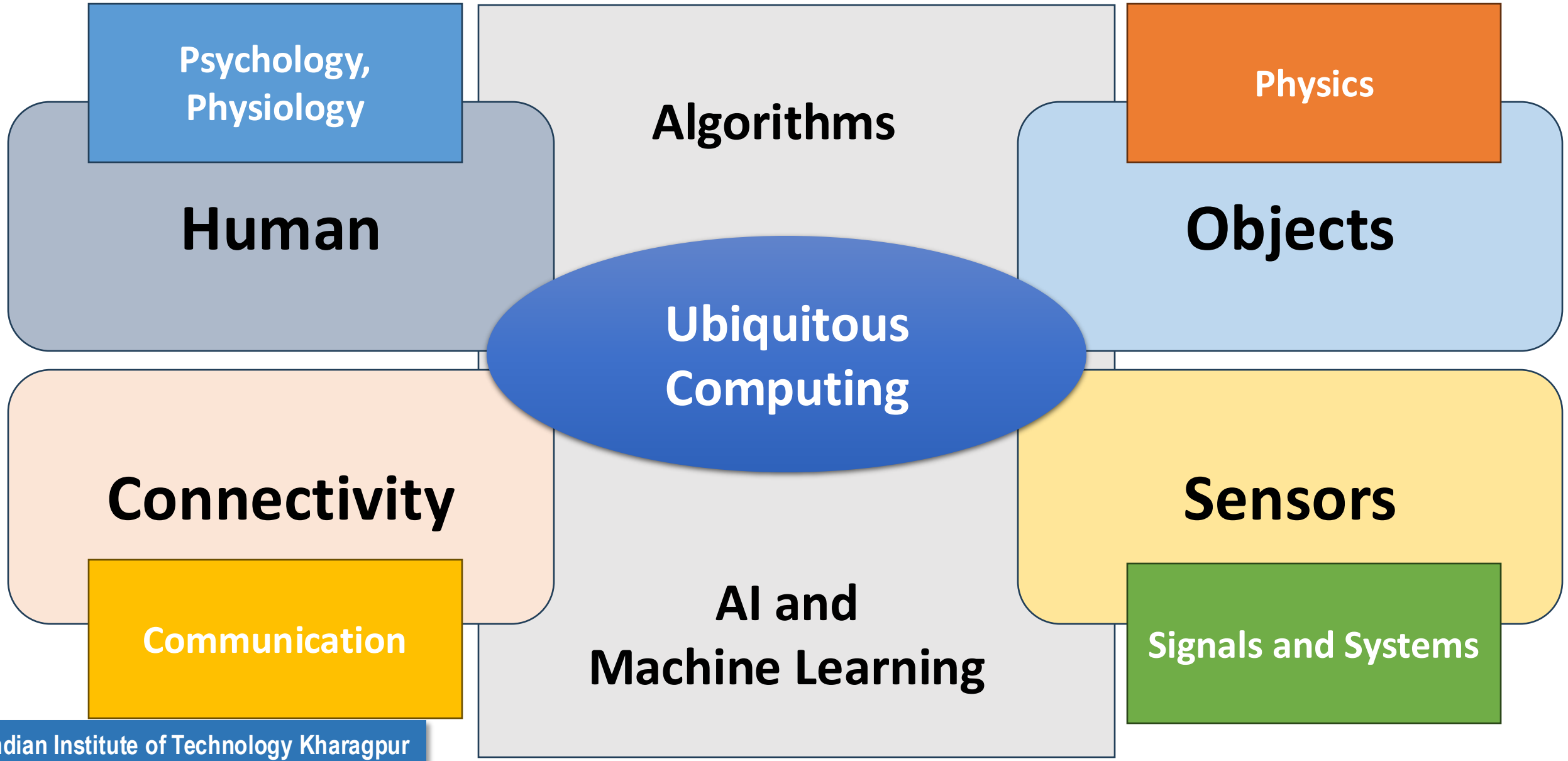
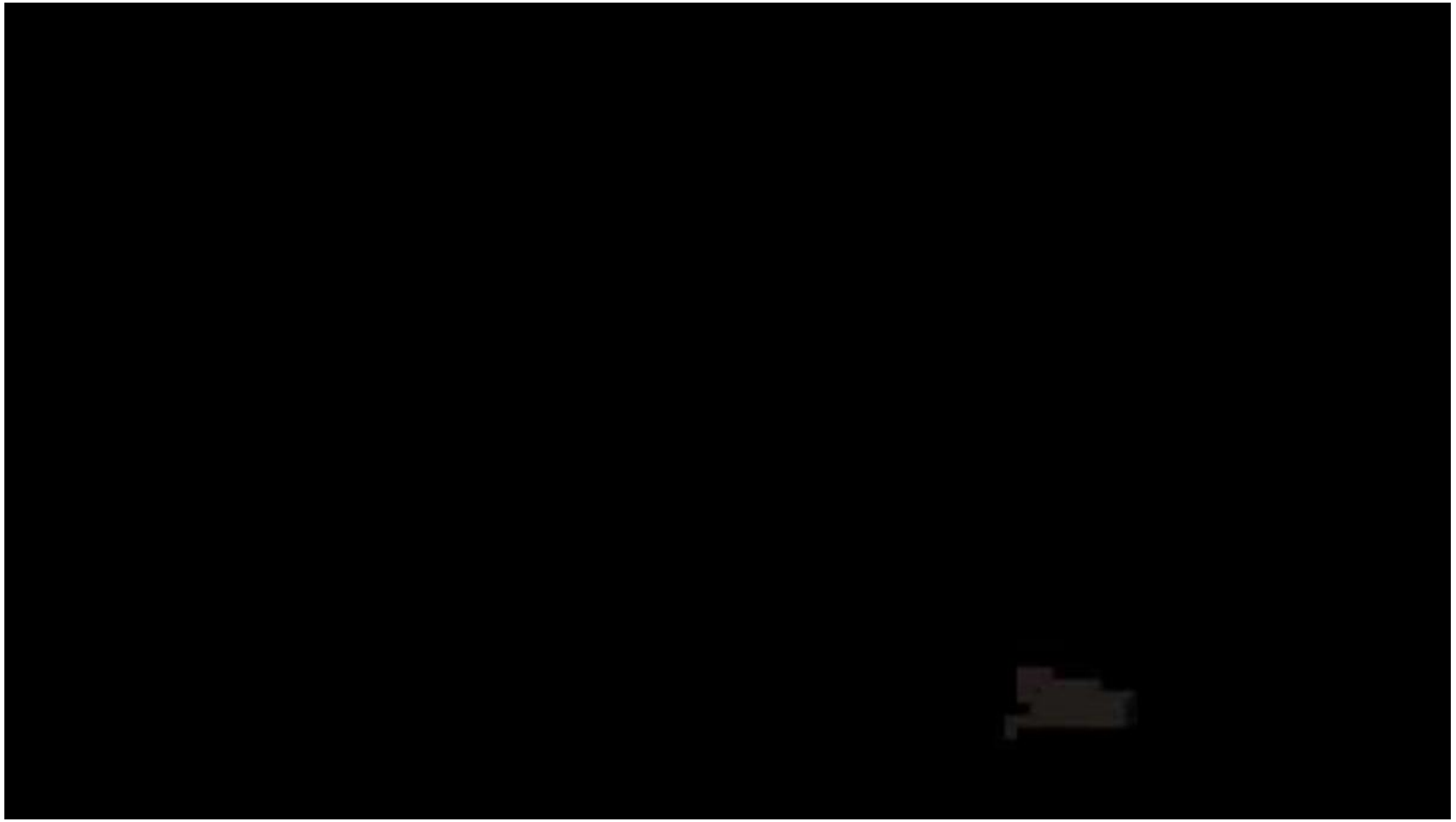


Some Interesting Ubiquitous Computing Projects



Core Idea: Picking up objects generate ubique vibration patterns

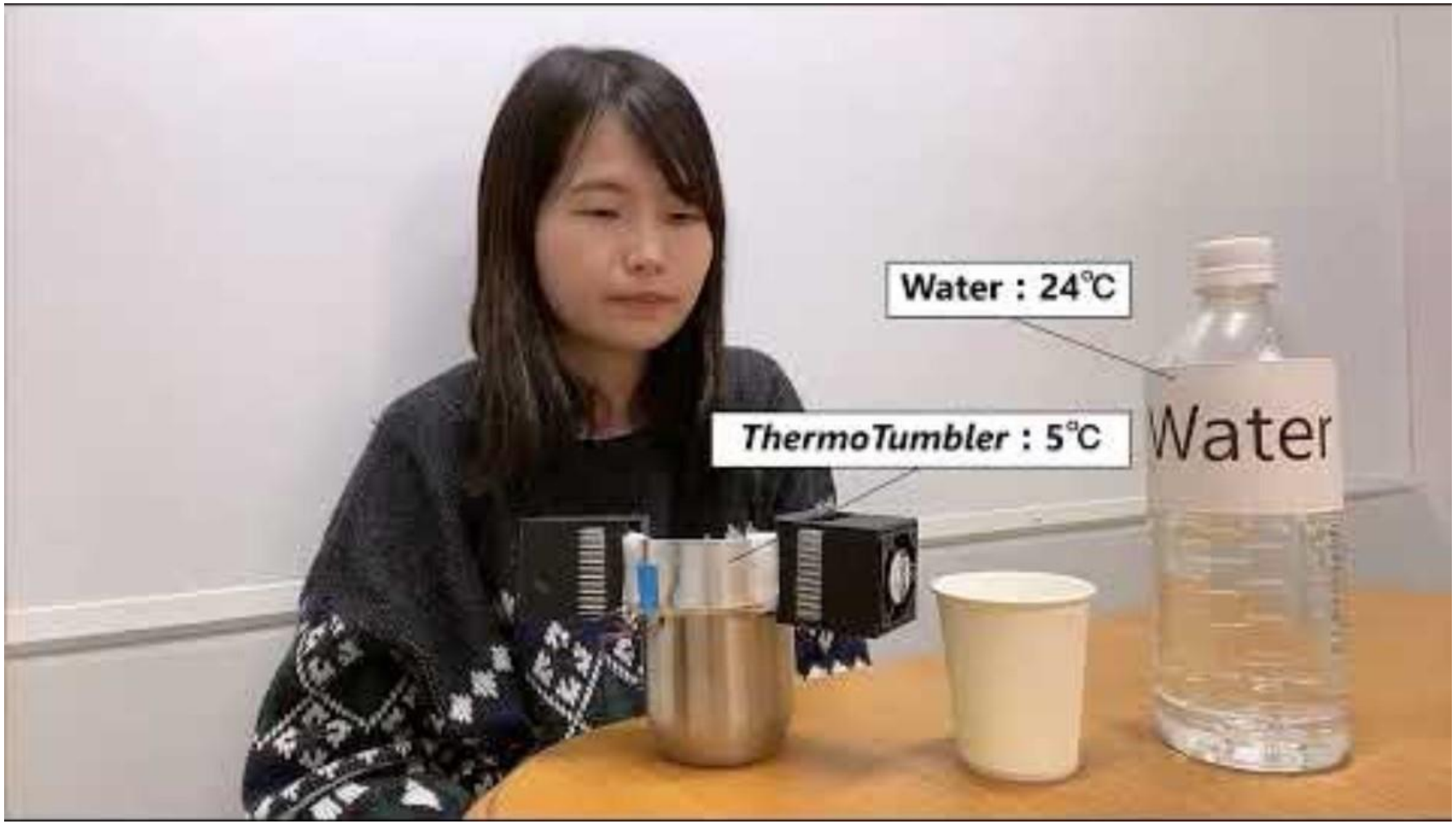
Acknowledgement: ACM SIGCHI YouTube Channel

Some Interesting Ubiquitous Computing Projects

Core Idea: Room lighting and surrounding sound can stimulate lucid dreams

Acknowledgement: ACM SIGCHI YouTube Channel

Some Interesting Ubiquitous Computing Projects



Core Idea: The temperature of the cup influences our sense of taste

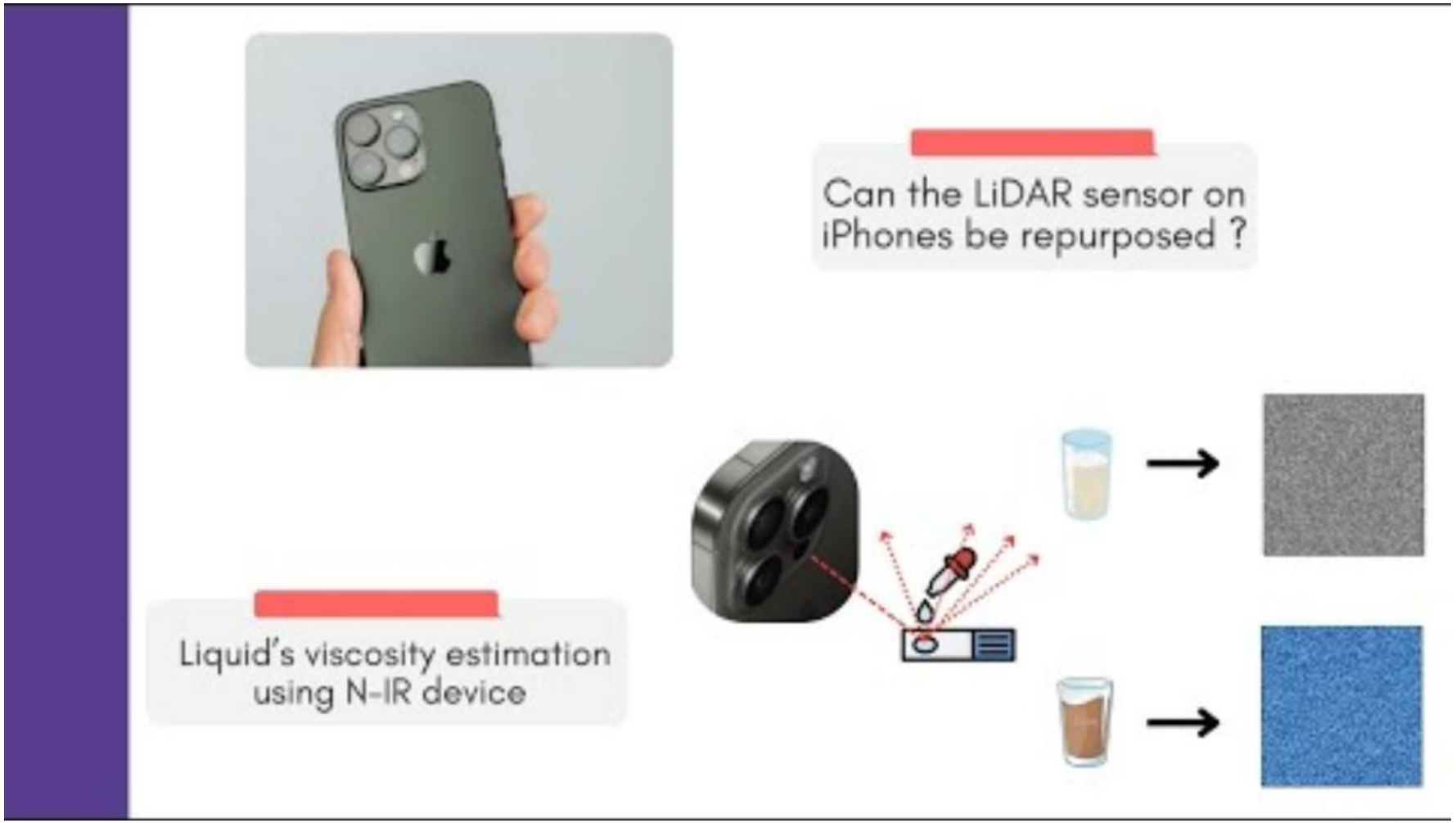
Acknowledgement: ACM SIGCHI YouTube Channel

Some Interesting Ubiquitous Computing Projects

Core Idea: The right temperature and humidity levels are crucial for plants

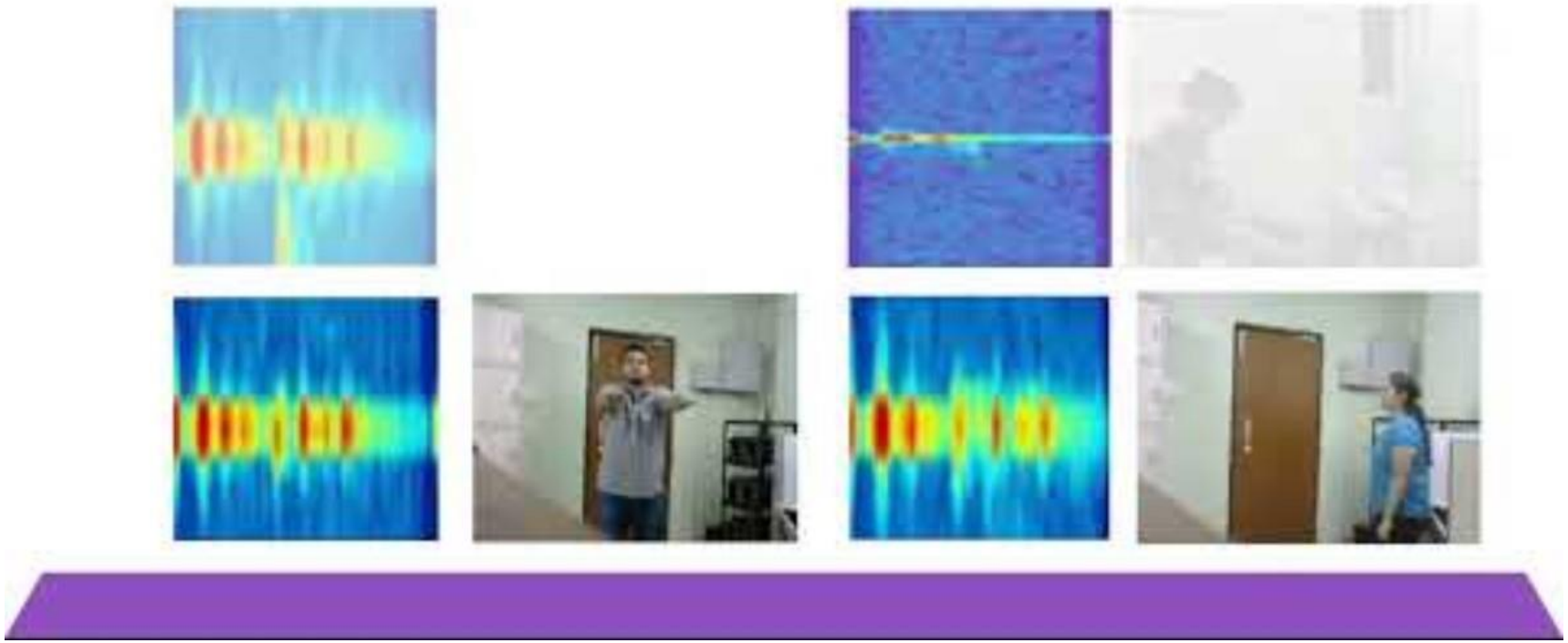
Acknowledgement: ACM SIGCHI YouTube Channel

Some Interesting Ubiquitous Computing Projects



Core Idea: The viscosity of the liquid is decided by the Brownian motion of the particles

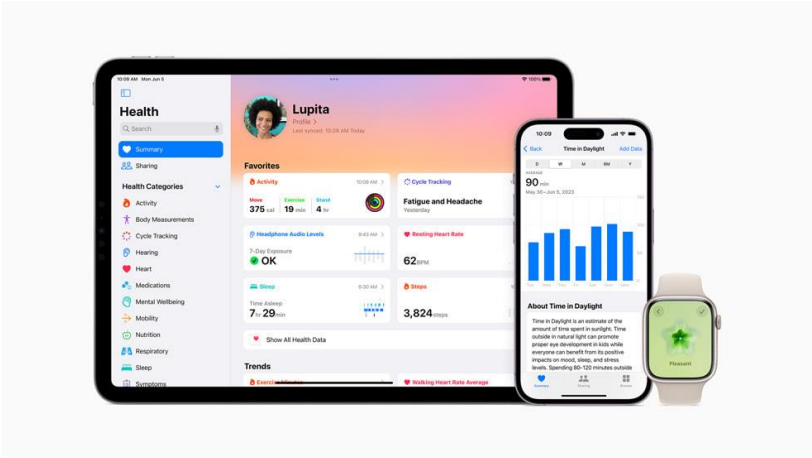
Some Interesting Ubiquitous Computing Projects

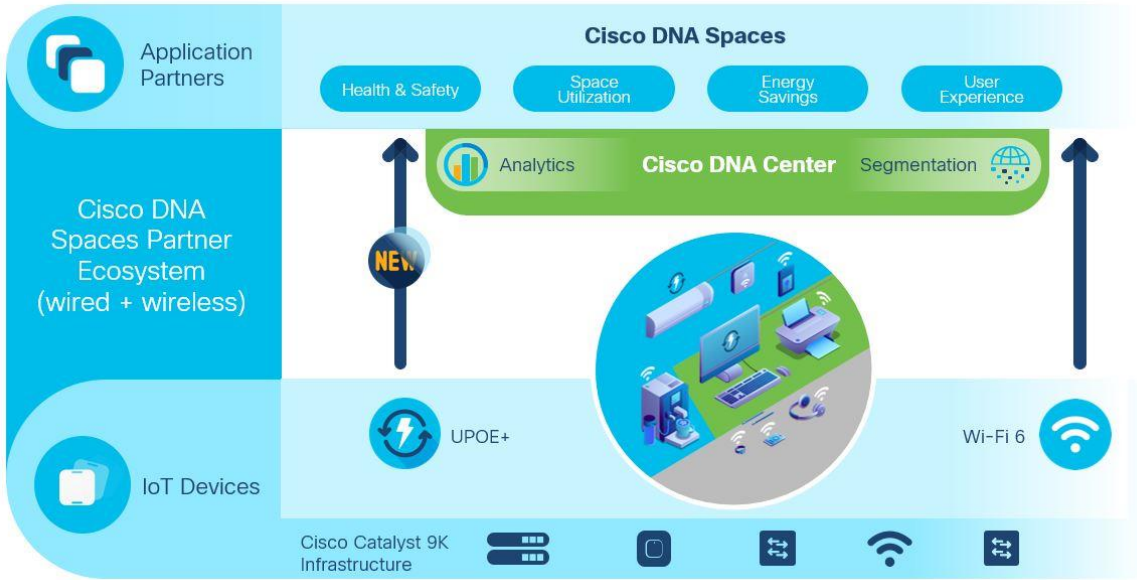


Core Idea: Human activities cause unique reflection patterns for RF signals

UbiComp in the Industry

- There are several products that we use now a days
  - Apple Health
  - Google Fit
  - Cisco Smart+Connected Residential
  - Samsung Connected Living
  - …





What we are going to cover

- The fundamentals of physical sensing
  - Sensing human: Motion, gesture and activities
  - Sensing objects: Understanding the structure, materials and properties
- The notion of context and contextual sensing
  - What does context mean and how it impact the decisions
  - Decision problems based on contextual sensing – How ML/DL can help
- Interactions
  - How do human and objects interact
  - How can we apply logical reasoning to understand interactions
- Ethics, fairness, and bias
  - The privacy-accuracy tradeoff and how do we live with that

Class and Grading Policies

- Try to attend the classes; the classroom discussions will help you to understand the topics better
  - We have 5% marks for attendance
- Mid and end-semester exams will carry 25% and 35% marks, respectively
- Term project will carry 35% marks
  - Prepare a group of three
  - Check the available term projects: https://docs.google.com/spreadsheets/d/1f0PXk0M1LXl-rdplANo24gn4cGPN3WkfTd6ZbB0TcRc/edit?usp=sharing (**Please do not share the list outside the class**)
  - Submit your choices through this Google form by 3rd August (you need to rank the projects based on your choices; the allocation will be based on FCFS): https://forms.gle/eM5duVe5Gpqh4Xv88
  - You'll be informed about the allocation on 4th August
  - Meet your mentor and start working upfront without delay
  - Maintain a github repo to update your data, code, documents and findings. Please keep on updating the repo regularly. Share the github repo with your mentor.

Policy on the Use of AI Tools like ChatGPT

- You can use ChatGPT (or any other AI tools) for learning purposes, understanding codes, generating code snippets, etc.
- However, you must acknowledge ChatGPT (or any other AI tools that you have used) within your code snippets under comments, whenever you have generated and used the same within your implementation.
  - No worries; we'll not deduct any marks for the same :-)
  - However, acknowledging it is important from the ethical perspectives
- Nevertheless, you should prepare the final project report yourselves. Use of any AI tools there may lead to heavy penalty. The texts in the report should not be generated through AI tools.
  - You can use tools like Grammarly to check the grammars and the overall writing styles, although.

Ethical Issues Regarding Data Collection during the Projects

- You might have to collect human data during the experiments, which might have ethical concerns
  - Discuss with your mentor about the ethical considerations before you start data collection; you must follow the required ethical norms
  - In your project report, you should mention about the ethical considerations and how you have addressed the same
  - Whenever you have any doubt about ethical issues, please follow up with your mentor or the course instructor, immediately
- We have some ethical clearances from the institute to perform the human experiments
  - The term projects are mostly covered by those
  - You can obtain a copy of the approval and keep it with you, in case you need to show the same during the experiments

Happy Learning!

Scan the QR to check the course website!

Teaching Assistants

Argha Sen
arghasen10@gmail.com

Prasenjit Karmakar
prasenjitkarmakar52282@gmail.com