

# Pervasive Computing

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COMP5047 – Lecture 01

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What do you think  
computers would like in  
10 years?



# Pervasive or Ubiquitous computing

*Pervasive/Ubiquitous computing (or "ubicom") is a concept in software engineering, hardware engineering and computer science where computing is made to appear anytime and everywhere*

Adapted from Wikipedia

***The general idea is that computing disappears into the environment and becomes a natural part of our surroundings with a seamless user interface.***

# Pervasive or Ubiquitous computing

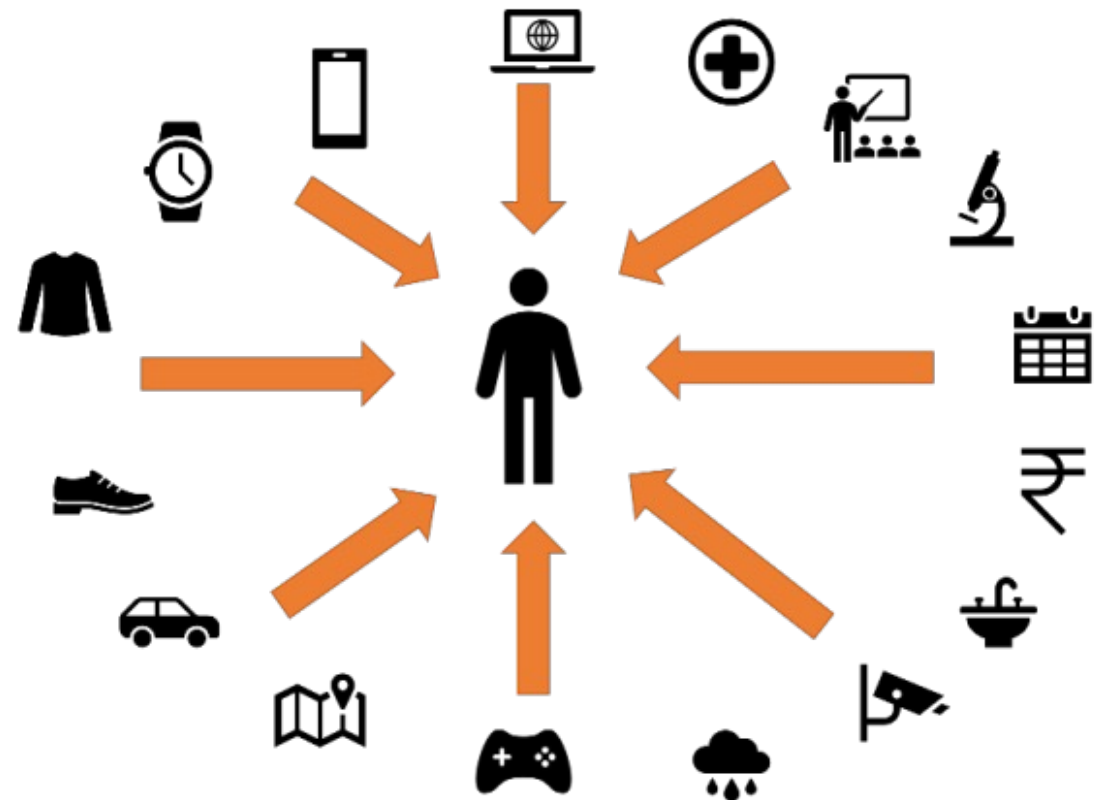
- Also known as: ambient computing, ambient intelligence

# Characteristics of Pervasive Computing

- **Embedded**: networked devices integrated into the environment
- **Context aware**: these devices can recognize you and your situational context
- **Personalised**: they can be tailored to your needs
- **Adaptive**: they can change in response to you
- **Anticipatory**: they can anticipate your desires without conscious mediation.
- **Natural User Interface (NUI)**: voice, gestures

# Examples of Pervasive Computing

- Mobile phones.
- Fitness trackers.
- Automated lighting/heating systems in modern buildings.
- Smart fridge/washing machines.
- Home automation, voice assistants (amazon, google etc)
- More examples?



<https://www.nic.in/blogs/pervasive-computing/>

# Personalized Interfaces



Narjes Pourjafarian, Anusha Withana, Joseph A. Paradiso, and Jürgen Steimle. 2019. *Multi-Touch Kit: A Do-It-Yourself Technique for Capacitive Multi-Touch Sensing Using a Commodity Microcontroller*. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology (UIST '19)*. Association for Computing Machinery, New York, NY, USA, 1071–1083. <https://doi.org/10.1145/3332165.3347895>



# Tangible Interfaces



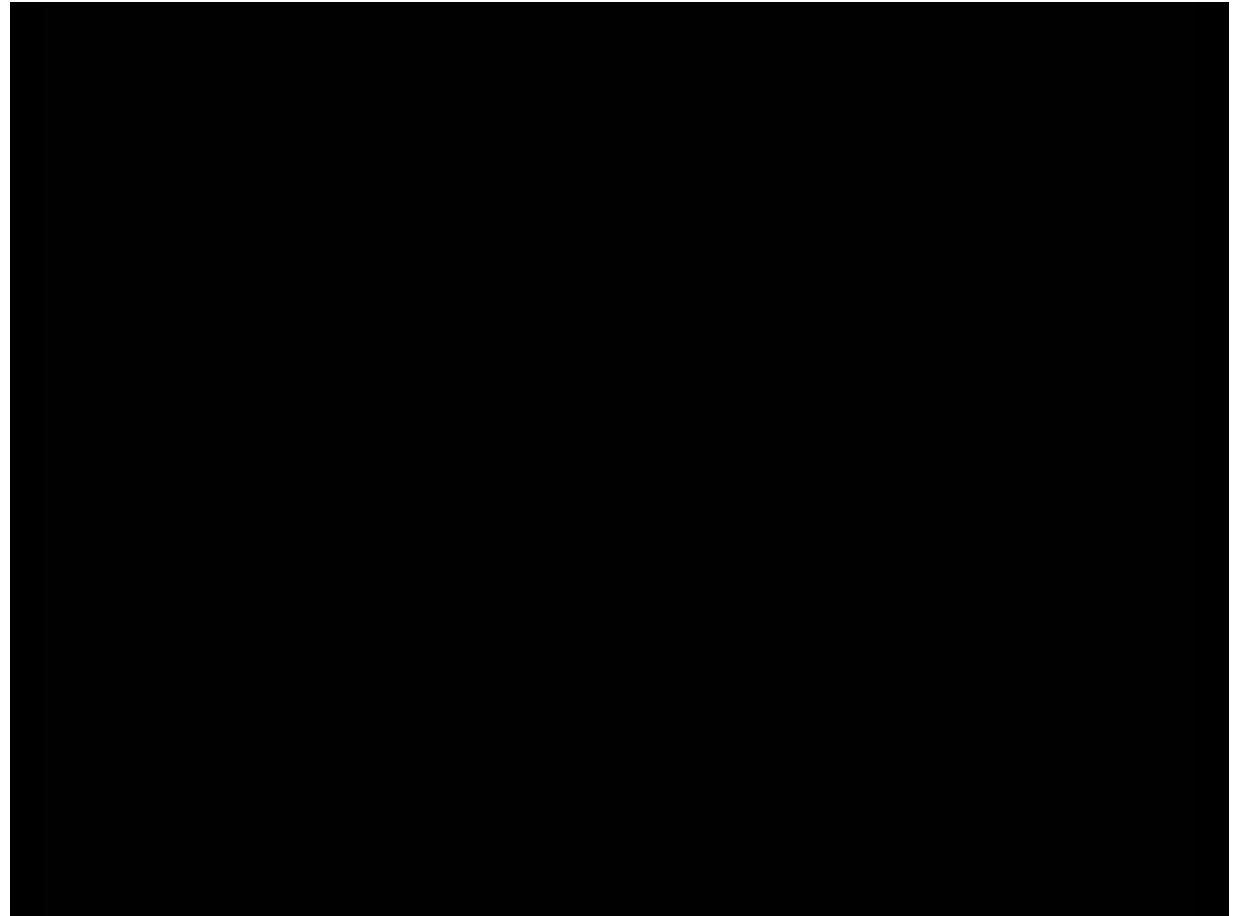
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# Ambient intelligence

- Another popular term for the area
- Example of ambient information display:
  - A lamp in your lounge room that usually behaves normally but will change colour in order to convey some information. For example, to warn of bad weather, to remind you to take some medication...
- Usually refers to a normal, everyday device that has been enhanced to interact in some way

# Ambient intelligence

Ali Mazalek, Ali Wood, and Prof. Hiroshi Ishii of MIT created these interactive "genie bottles." The "conversation" is actually triggered by the opening and closing of the bottles. In other words, this is not a scripted project; the bottles are actually "reacting" to the presence of their neighbors. This video was furnished by Ali Mazalek.



CHI Full Paper

# Slow Robots for Unobtrusive Posture Correction

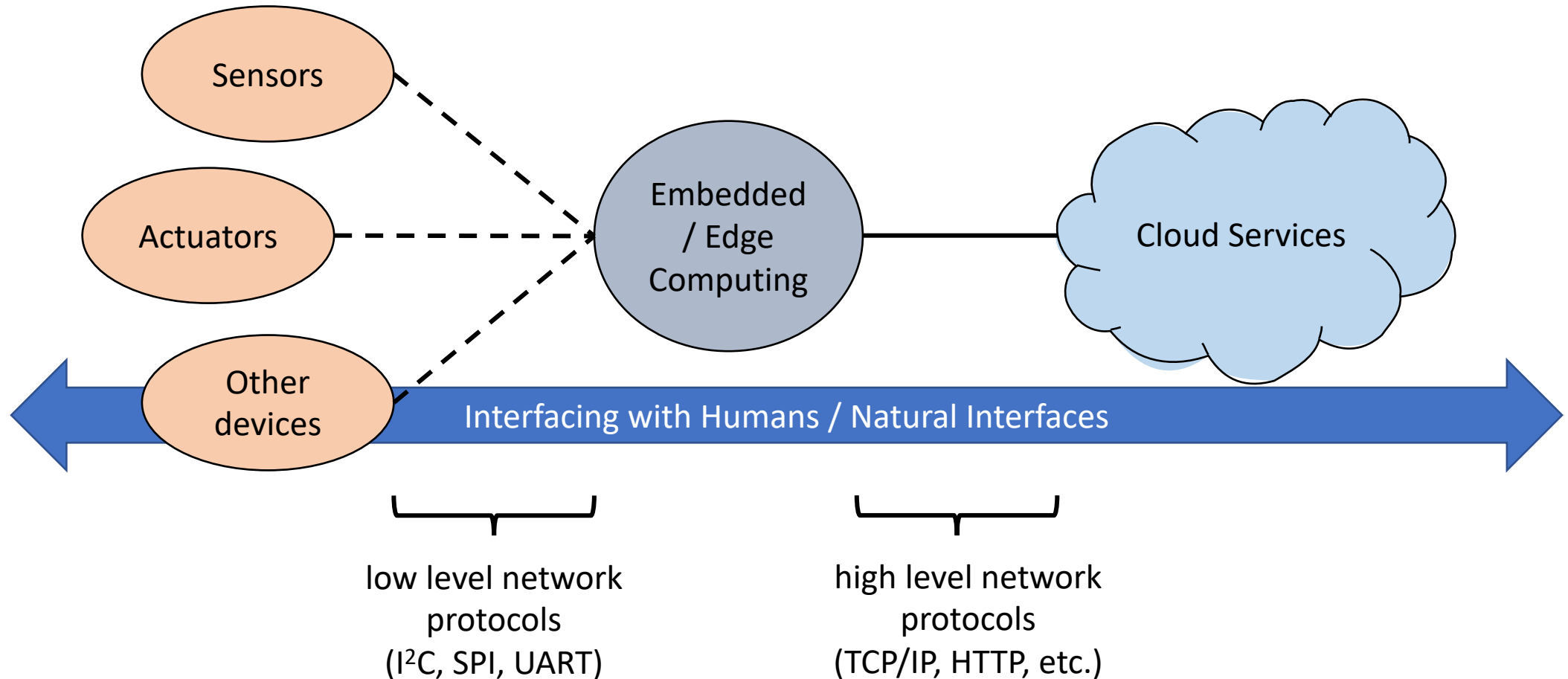
Joon-Gi Shin, Eiji Onchi, Maria Jose Reyes, Junbong Song, Uichin Lee, Seung-Hee Lee & Daniel Saakes

[Slow Robots for Unobtrusive Posture Correction](#), Joon-Gi Shin, Eiji Onchi, Maria Jose Reyes, Junbong Song, Uichin Lee, Seung-Hee Lee and Daniel Saakes. In CHI '19, 2019. [\[doi\]](#) [\[bib\]](#)

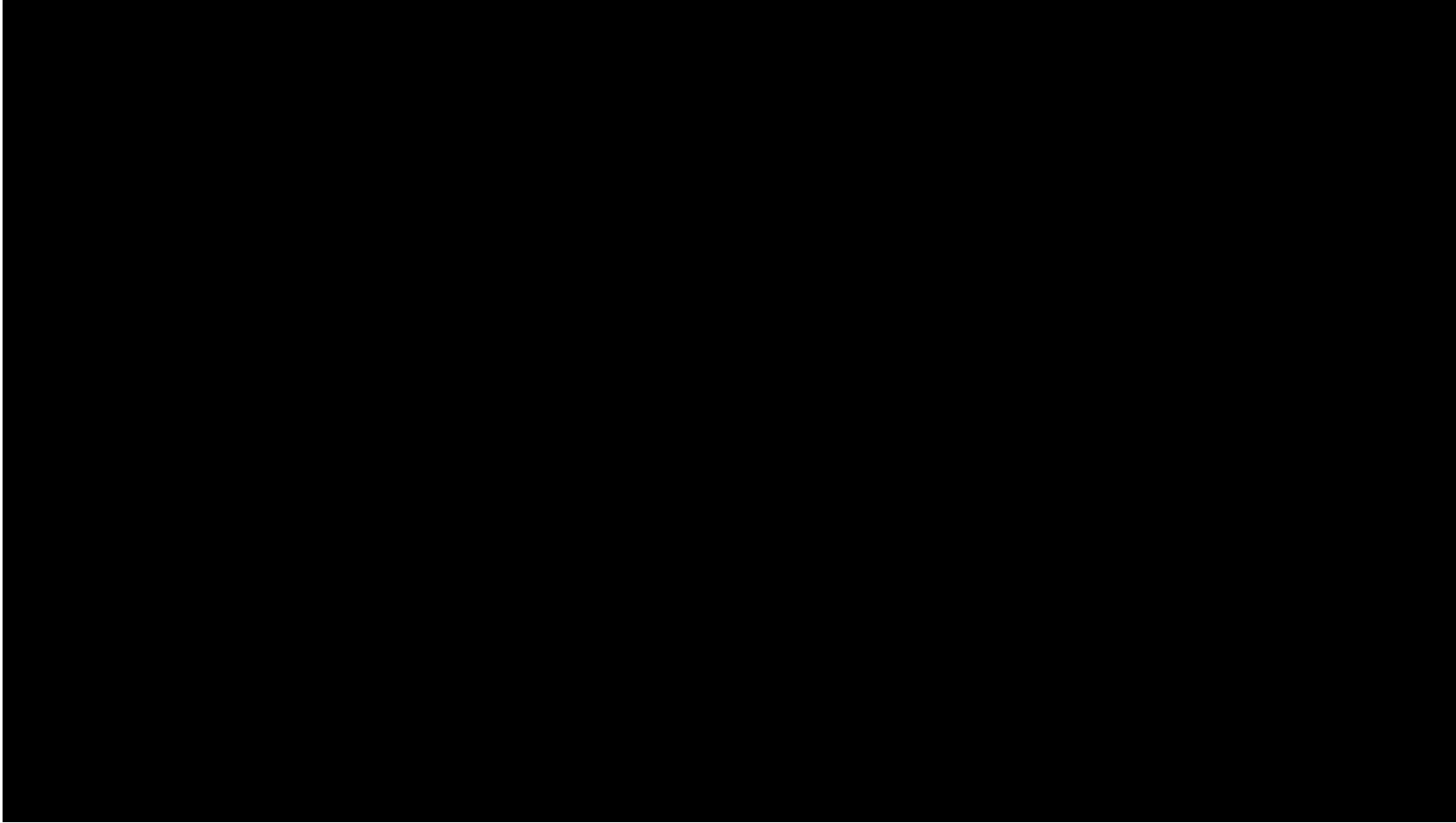
# Pervasive Computing Technology

- **Hardware:** microcontrollers, small systems, cloud systems
- **Sensors and actuators:** Digital/analogue, wearable
- **Interfaces:** parallel, serial, media
- **Software:** programming languages, IDEs, cloud based dev environments, platforms
- **Networks:** hardware/software/protocols, wifi, Bluetooth, ethernet, mobile networks, NFC...
- **Packaging:** materials, 3D printing, design....

# A Simple Overview



# Correctly and safely



<https://www.youtube.com/@ElectroBOOM>. (Mehdi Sadaghar)

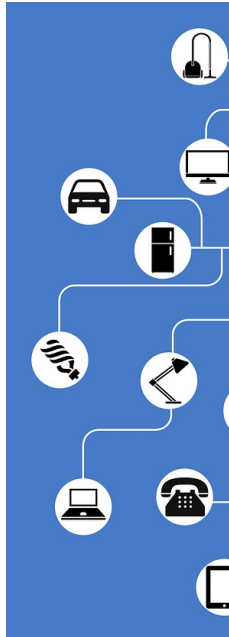
# Internet of Things

The **Internet of things (IoT)** describes physical objects (or groups of such objects) with [sensors](#), processing ability, [software](#), and other technologies that connect and exchange data with other devices and systems over the [Internet](#) or other communications networks.

Adapted from Wikipedia



# Internet of Things

- IoT is changing the world in many ways:
    - health
    - energy
    - food
    - travel
    - security
    - .. and many others
  - General IoT capability:
    - tracking
    - sensing
    - control
    - AI
- 



<https://www.rtsrl.eu/blog/what-is-internet-of-things-iot/>

# What are we going to do?

- Learn how to
  - Understand the **requirements** for a pervasive computing system
  - Make **design decisions** and identify appropriate technology
  - **develop** and build a pervasive system
  - **evaluate** a given system

# What are we going to do?

- Everyone: Learn about IoT platforms
  - Hardware:
    - Learn about embedded systems (microcontrollers)
    - Programming an embedded system (firmware)
    - Interfacing with transducers
  - Software:
    - Develop a connected system
- Group: design a system, build a prototype and demo it!

# What are we going to do?



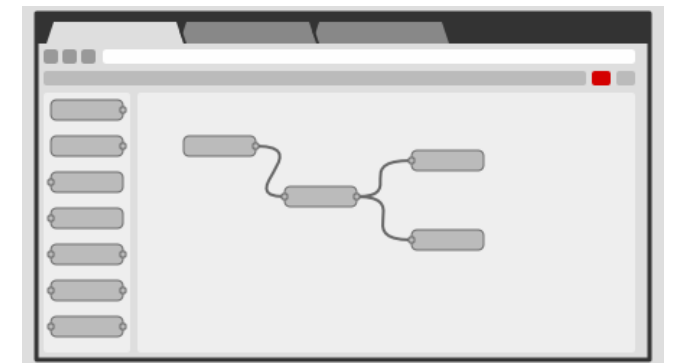
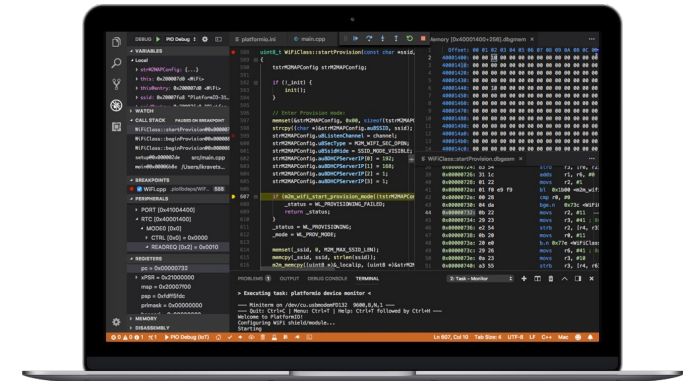
<https://core-electronics.com.au/kitronik-inventor-s-kit-for-the-arduino.html>



<https://core-electronics.com.au/firebeetle-esp32-e-iot-microcontroller-with-header-supports-wi-fi-bluetooth.html>

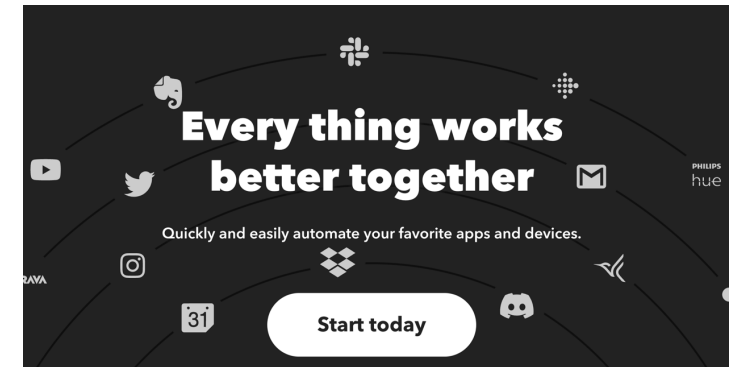
# Tools we are going to use

- Arduino Platform
  - We will use Visual Studio Code with PlatformIO plugin
    - <https://code.visualstudio.com/>
    - <https://platformio.org/>
- Node-red: graphical data flow programming
  - <https://nodered.org/>
- MQTT: pub/sub programming
  - <https://mqtt.org/>



# Tools we are going to use

- IFTTT: rule based end-user programming
  - <https://ifttt.com/>
- Linux
- Voice assistants: Alexa and Google home



# You can get started now

- Install the tools
- Follow getting started tutorials
- For your group work
  - We may use other hardware depending on requirements
  - Other software tools as well
  - May use 3D printing/laser cutting etc.

# Reading for Week 2:

- Weiser (1991) The Computer for the 21st Century
  - Must read before week 2!!
  - Professors Kay and Kummerfeld will discuss this in week 2.
  - [https://sydney.leganto.exlibrisgroup.com/leganto/public/61USYD\\_INST/citation/25081072190005106?auth=SAML](https://sydney.leganto.exlibrisgroup.com/leganto/public/61USYD_INST/citation/25081072190005106?auth=SAML)
- Identify the **5 most important ideas in the paper** (in your opinion)



# Next steps

- Form groups
  - 4 students is ideal
  - 3 when it is impossible
- Read the paper (homework)
- Install and do tutorials on tools
  - Arduino/PlatformIO, Node-red, MQTT
- I hope we can have a lot of fun learning this unit!

# Summary

