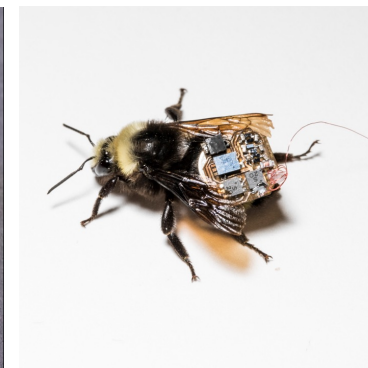
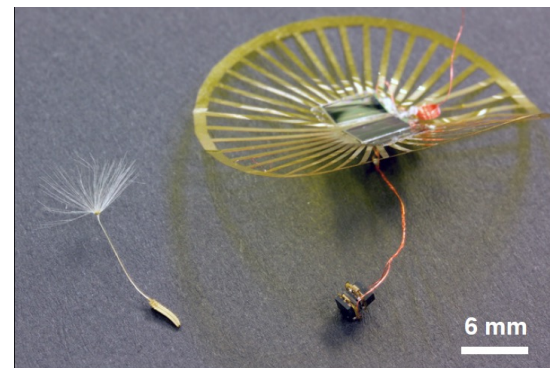
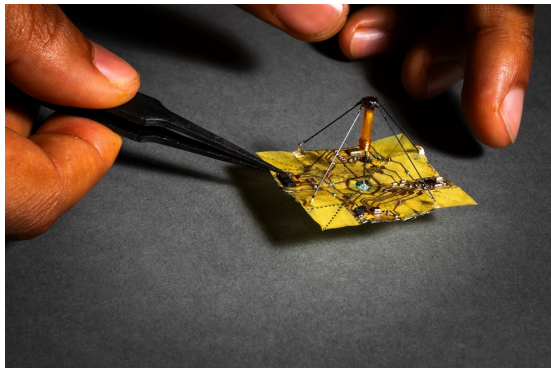
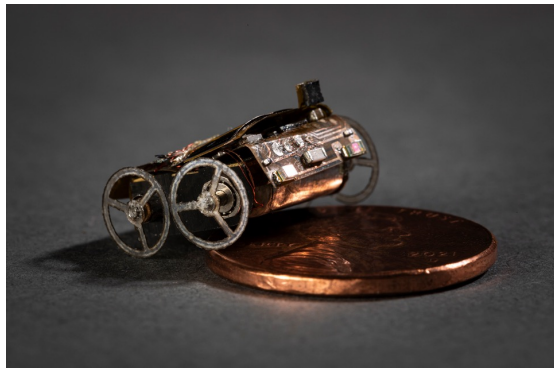


# Lecture 1: Course Overview

Vikram Iyer

# Plan for today

- Logistics
  - Intro to course staff
  - What are embedded systems?
  - Canvas and resources
  - Class format
  - Labs
  - Grading
- Examples of embedded systems



- Intro to C programming (if we have time)

# Course staff

**Instructor:** Vikram Iyer, [vsier@uw.edu](mailto:vsier@uw.edu)

**TAs:**

- Alex Ching
- Zachary Englhardt
- Deeksha Prabhu

# What are embedded systems?

# What are embedded systems?

Tiny computers that are *embedded* or hidden inside something else.

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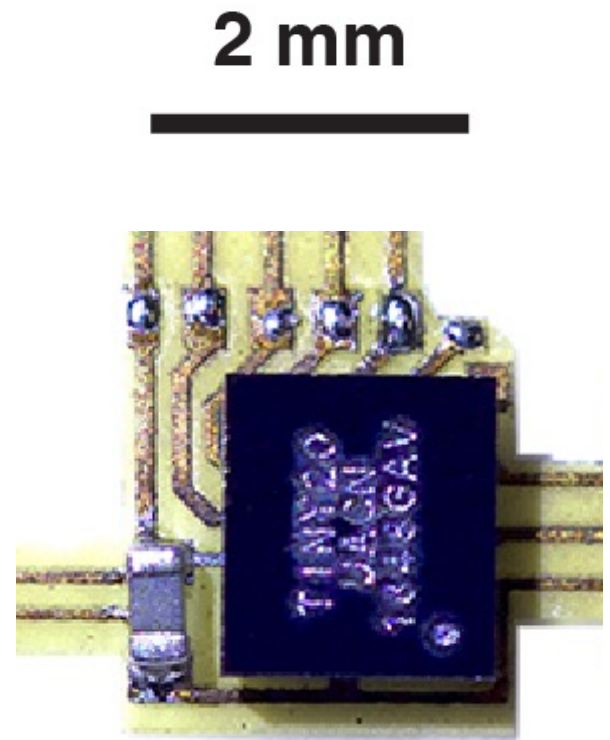
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# What are embedded systems?

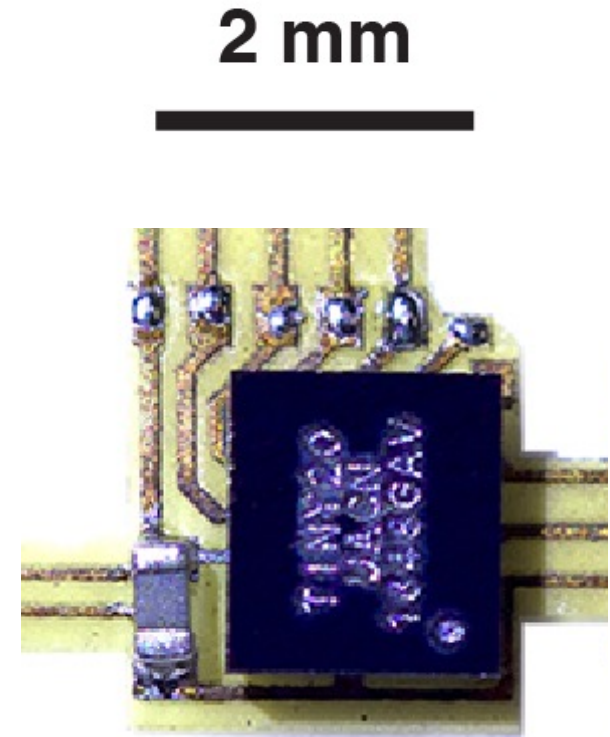
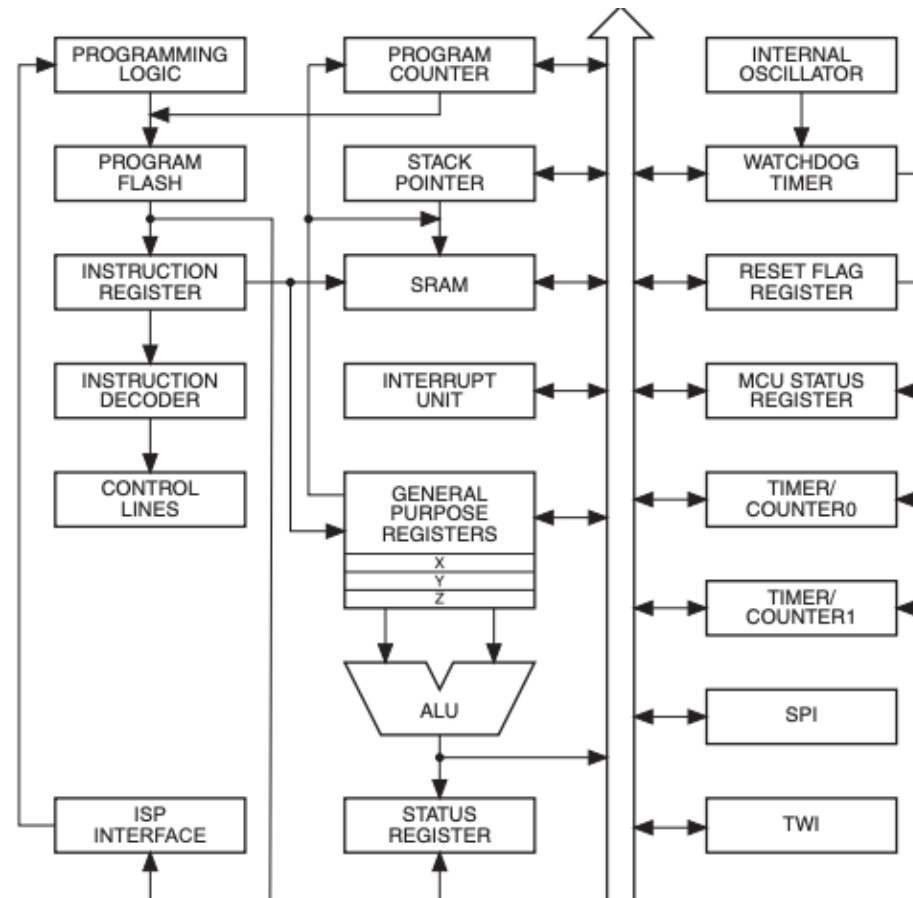
Tiny computers that are *embedded* or hidden inside something else.



**Microcontroller**

# What are embedded systems?

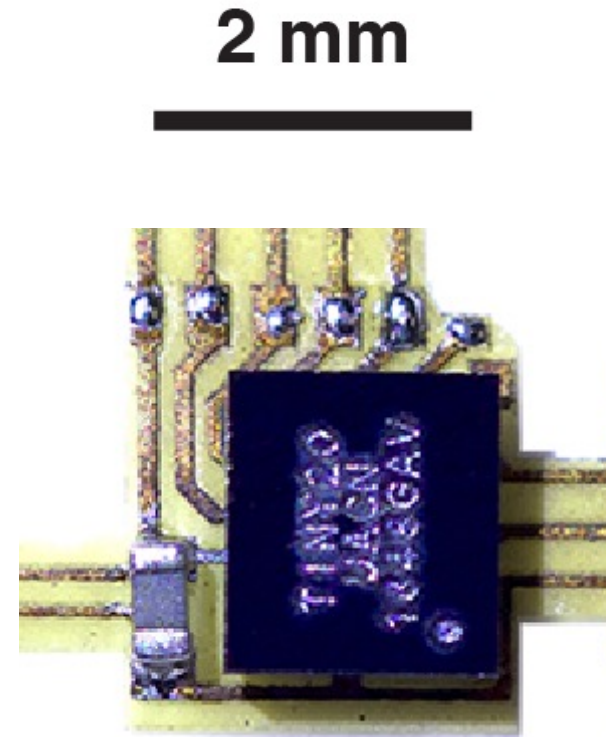
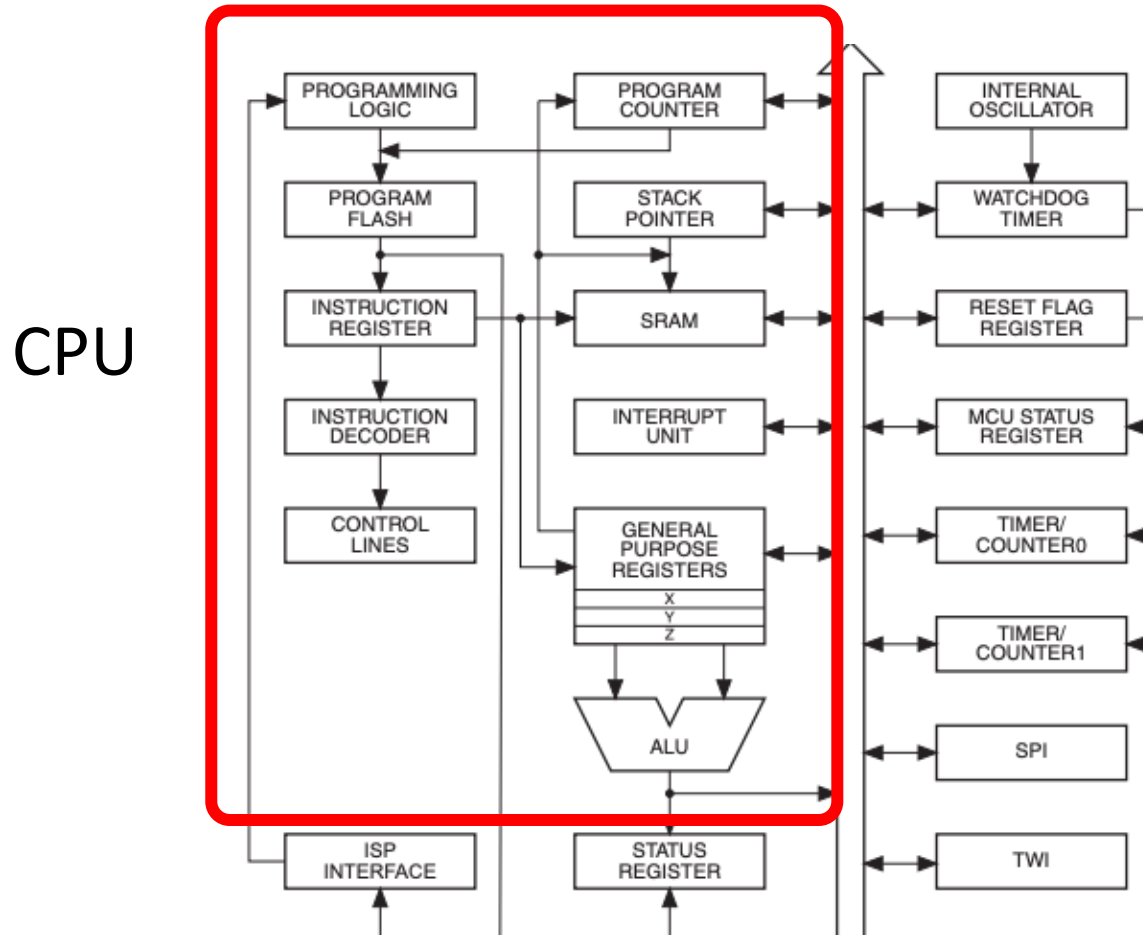
Tiny computers that are *embedded* or hidden inside something else.



**Microcontroller**

# What are embedded systems?

Tiny computers that are *embedded* or hidden inside something else.



Microcontroller



# Examples of embedded systems?

Tiny computers that are *embedded* or hidden inside something else.

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# CSE/ECE 474 Key Ideas:

- C programming intro for Java programmers
- Advanced C programming (void pointers etc.)
- Process Context, Multi-tasking, Basic schedulers
- Meeting real-time performance constraints, scheduling algorithms.
- Coordination of resources shared between multiple tasks.
- Interrupt service routines
- Bit-level I/O to hardware devices.
- Use of a minimalist real-time kernel.

# Prerequisites

- You must have completed two quarters programming in Java or C
- Basic understanding of computer organization and architecture
- Helpful: Understanding and use of electronic laboratory instrumentation


  
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Spring 2024

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Poll Everywhere

Ed Discussion

# CSE 474 A Sp 24: Introduction To Embedded Systems <sup>AD</sup>

Welcome to CSE/ECE 474!

The detailed weekly schedule and syllabus is [HERE](#).

The primary usage of Canvas this quarter will be

- Central place with links
- Turning in assignments
- Posting of grades

**Lecture time:** 12:30-1:50, Wed & Fri in MOR 230

**Lab room:** EEB 345

## Course Staff

Vikram Iyer (instructor), email: [vsiyer@uw.edu](mailto:vsiyer@uw.edu)

Alex Ching (TA)

Zachary Englhardt (TA)



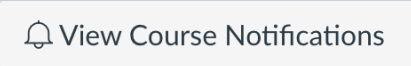
Deeksha Prabhu (TA)

**Office Hours will be in EEB 345, schedule:**

<https://courses.cs.washington.edu/courses/cse474/24sp/schedule/> 

**EE store hours for lab kit pickup (EEB 137):**

- Mon-Fri: 9am-12pm and 1pm-5pm

## To Do

Nothing for now

New Thread

Search

Filter

This Week

Welcome to CSE/ECE474  
General Vikram Iyer STAFF now

CATEGORIES

- General
- Lectures
- Labs
- Assignments
- Social

0 others online

# Welcome to CSE/ECE474 #1



Vikram Iyer STAFF

Now in General

PIN

STAR

WATCHING

1 VIEW



Hi everyone,

We're using Ed Discussion for class Q&A.

This is the best place to ask questions about the course, whether curricular or administrative. You will get faster answers here from staff and peers than through email.

Here are some tips:

- Search before you post
- Heart questions and answers you find useful
- Answer questions you feel confident answering
- Share interesting course related content with staff and peers

For more information on Ed Discussion, you can refer to the [Quick Start Guide](#).

All the best this semester!

Vikram

Comment Edit Delete Endorse ...

Add comment

# CSE/ECE 474: Introduction to Embedded Systems- Spring 2024

**Instructor:** Vikram Iyer (vsiyer [at] cs.washington.edu)

**Teaching Assistants:** Alex Ching, Zachary Enghardt, Deeksha Prabhu

**Lectures:** 12:30-1:50, Wed/Fri in [MOR 230](#), [Recordings \(UW Login required\)](#)

**Lab and Office Hours:** EEB 345

**Assignment Submission and Grades:** [Canvas \(UW Login required\)](#)

**Contact Info:** Please use [Ed Discussion](#) whenever possible. This is the fastest way to get an answer to your question from the course staff or even others who have had the same issue. The answer to your question is likely to be helpful to others in the class. Feel free to use private messages on the discussion board for questions that contain detailed code or should not be shared with the rest of the class. For other questions, including unexpected emergencies or other personal circumstances, email the instructor directly.

**Lab kit pickup (EE Store- EEB 137):**

- Mon-Fri: 9am-12pm and 1pm-5pm

## Lecture Topics

Date	Description
March 27	<i>Lecture 1: Course overview</i>
March 29	<i>Lecture 2: Intro to C Programming</i>
April 3	<i>Lecture 3: Pointers in C</i>
April 5	<i>Lecture 4: Number Representation and Bitwise Operators</i>
April 10	<i>Lecture 5: Hardware and Machine Organization</i>
April 12	<i>Lecture 6: Working with Registers and IMU Demo</i>
April 17	<i>Lecture 7: ATmega 2560 Datasheet and Timers</i>
April 19	<i>Lecture 8: Tasks, Threads, Scheduling I, Interrupts</i>

# Schedule

[Subscribe to this calendar \(google, iCal, etc.\)](#)

March				
Monday	Tuesday	Wednesday	Thursday	Friday
25	26	27 12:30-14:20 Lecture MOR 230 <i>Lecture 1: Course overview</i> 14:00-15:00 OH (Vikram) ECE 345	28	29 12:30-14:20 Lecture MOR 230 <i>Lecture 2: Intro to C Programming</i>
April				
Monday	Tuesday	Wednesday	Thursday	Friday
01	02	03 12:30-14:20 Lecture MOR 230 <i>Lecture 3: Pointers in C</i> 14:00-15:00 OH (Vikram) ECE 345	04	05 12:30-14:20 Lecture MOR 230 <i>Lecture 4: Number Representation and Bitwise Operators</i>
08	09	10 12:30-14:20 Lecture MOR 230 <i>Lecture 5: Hardware and Machine Organization</i> 14:00-15:00 OH (Vikram) ECE 345	11	12 12:30-14:20 Lecture MOR 230 <i>Lecture 6: Working with Registers and IMU Demo</i>
15	16	17 12:30-14:20 Lecture MOR 230 <i>Lecture 7: ATmega 2560 Datasheet and Timers</i>	18	19 12:30-14:20 Lecture MOR 230 <i>Lecture 8: Tasks, Threads, Scheduling I, Interrupts</i>

**\*Office hours and assignment due dates coming soon**

# Labs

- Four lab exercises using the Arduino Mega Board (ATMEGA 2560ARM-based CPU).
- Lab kits will be signed out from ECE store.
- **Lab kits to be returned at the end of the quarter**
- Lab are in a two-person team.



## Grading

- Each lab exercise will require a report to be turned in and also an in-person, in-lab demo with TA or instructor.
- Both team members must be able to answer questions about the entire lab project.

# Lab kit pickup times

- **Location: EE Store- EEB 137**
- Mon-Fri: 9am-12pm and 1pm-5pm
- Note: these extended times are for Week 1 and Week 2, the schedule for the rest of the quarter will be updated on the website

# Lab location: EEB 345



# Labs build on each other

- All ECE474 labs build on each other to create a software prototype.
- We will implement more and more tasks, building the complexity and efficiency of the real-time code.
- Lab 1 Getting Started with the Arduino Mega
- Lab 2 Digital I/O and timing of outputs
- Lab 3 Round Robin Scheduling and multitasking
- Lab 4 FreeRTOS and Project

**Advice:** When you get stuck, try hard to fix the problem, but then come to us. We will get you going again even if we don't know all answers right away.

# Labs Teams

- 2-person Lab team
- Team work is critical to success. “Friction,” “tension,” “miscommunication,” happen to some groups. (5% — 10% of teams).
- When these occur, take individual initiative to come to TA or Prof. immediately.
- Example problems:
  - Partner not showing up for meetings
  - One person is doing all the work
- You are responsible for bringing these problems to attention of TAs or Prof.

# Labs Grading

- In-person sessions in which you demonstrate correct operation of your system and answer questions from a member of the staff
- Both team members must be present for the demo
  - Both team members must be able to answer a question about any part the project.
  - We will expect in-depth answers from the person who coded/debugged specific parts, and specific though less detailed answers from the other team member.

# Lab Reports

- You must follow the Detailed Report Format for Spring 2024.
- Reports must be turned in (PDF only) according to the Canvas due date.
- Late work- One late day per homework (2x), one late day per lab (4x). You can use a max of 2 late days per assignment. After this, any late assignments will be subject to a penalty of 25% per day.
- Assignment-specific requirements for the reports may be given in the Lab Assignment.

# Grading system

- “Flat” point system.
- 400 total points
- Grade will be obtained by dividing your total by 100
- Final adjustment at the end of the course

Assignment	Points
C prog 1	20
C prog 2	20
Quiz	15
Lab 1	70
Lab 2	70
Lab 3	70
Lab 4 / Project	90
Midterm	45
No Final	
<b>TOTAL</b>	<b>400</b>

Example	
Student Points	370
Multiplier (x0.01)	3.700
Class adjustment	+0.100
Final Grade	3.800
Official Grade	3.8

# Grading system

- Team members receive same Lab grade
- Each lab's grade is computed based on Demo and Report.
- In exceptional cases a student's lab grade may be adjusted up or down relative to their teammates.
- Individual final grades still vary because of performance on individual performance on C-coding assignments, quizzes, and exams

# Academic Integrity and Cheating

We expect students to follow the relevant UW policies on Cheating (working collaboratively on quizzes/exams and homework submissions, sharing answers and previewing quizzes/exams).

Plagiarism (representing the work of others as your own without giving appropriate credit to the original author(s))

Using AI tools- working on a policy for this, will announce soon

# Other Important Policies and Inclusion

- Our goal is to create a comfortable, welcoming and safe environment for all enrolled students
- Disability and religious accommodations
  - Have already gotten notifications from DRS
  - Reach out early (first two weeks)
- Illness (COVID, etc)
  - For things affecting the whole class we'll announce updated policies (e.g. zoom lectures, remote lab check offs, etc)
  - If you get sick, etc let us know (sooner the better)

# Examples of embedded systems

# Example: Wireless headphones

# Example: Wireless headphones



# Embedded systems research: computers on insects

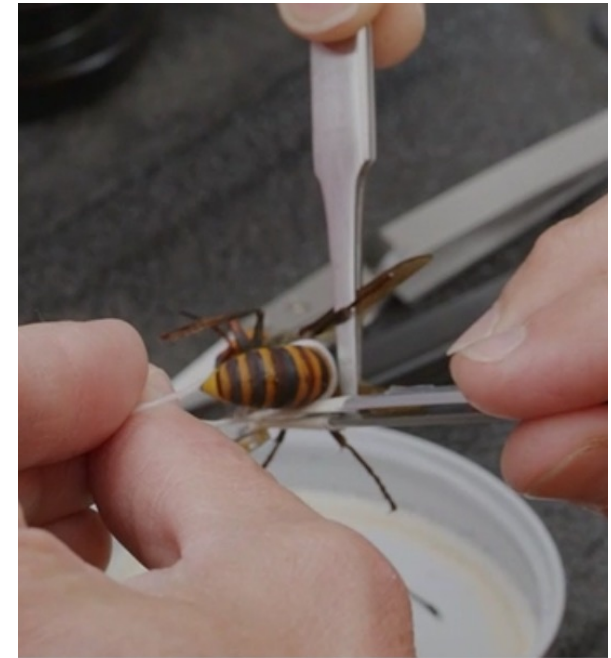
**Bumblebees +  
wireless temperature**



**Beetle + wireless  
steerable camera**



**Tracking murder hornets  
with Dept of Agriculture**



**Useful for understanding wildlife behavior of insects and small animals in the wild**

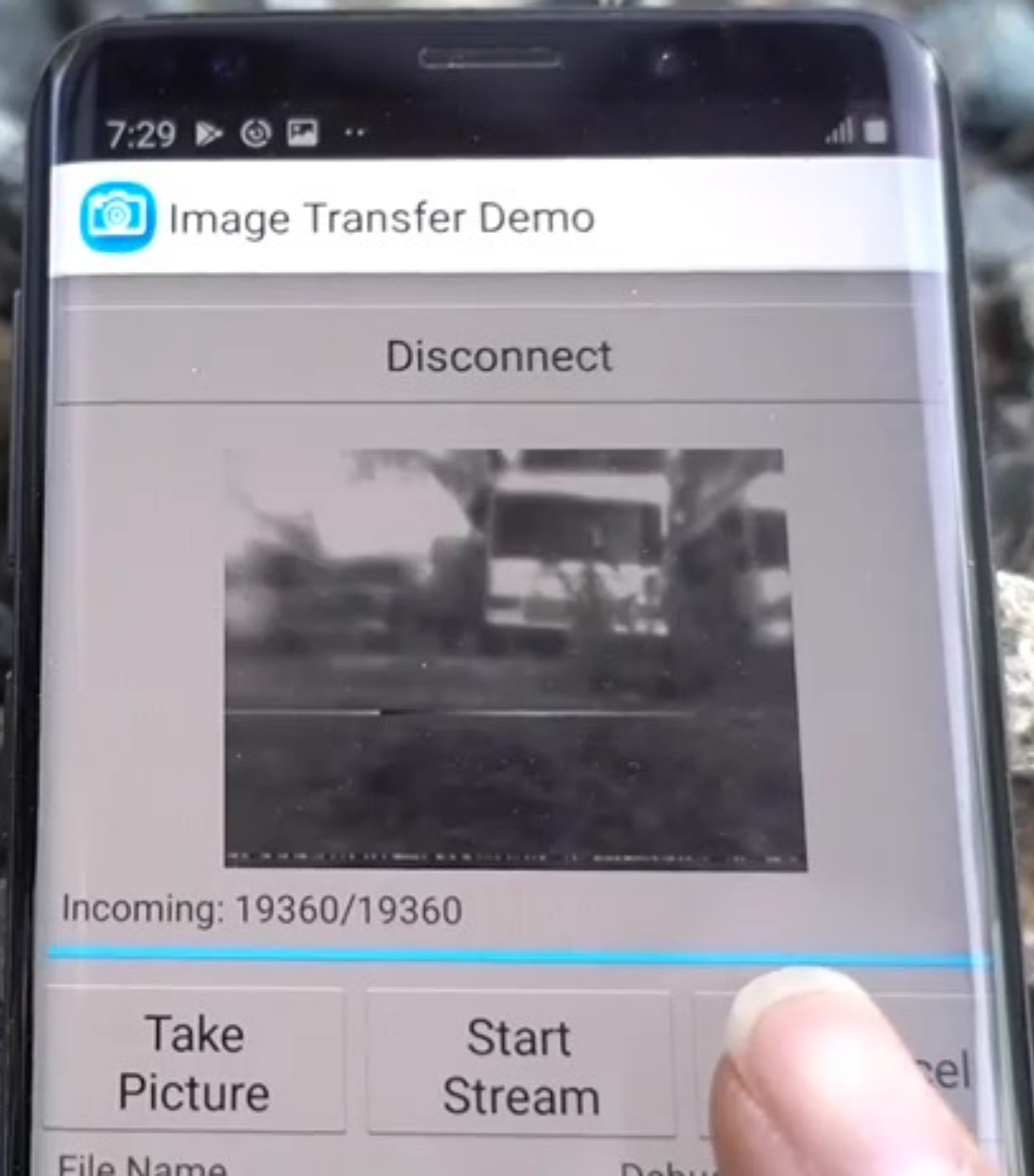


Live bumblebee carrying our sensors and electronics

# Tagging "Murder" Hornets with WA DoA

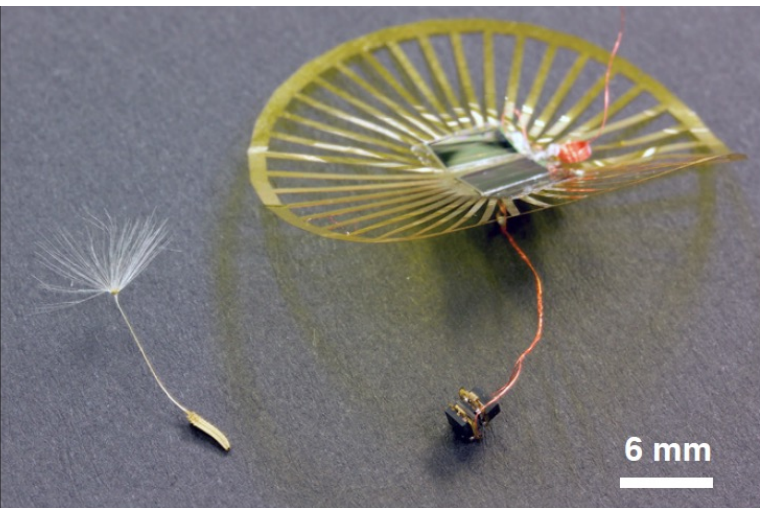


*Video credit: WSDA/Karla Salp*

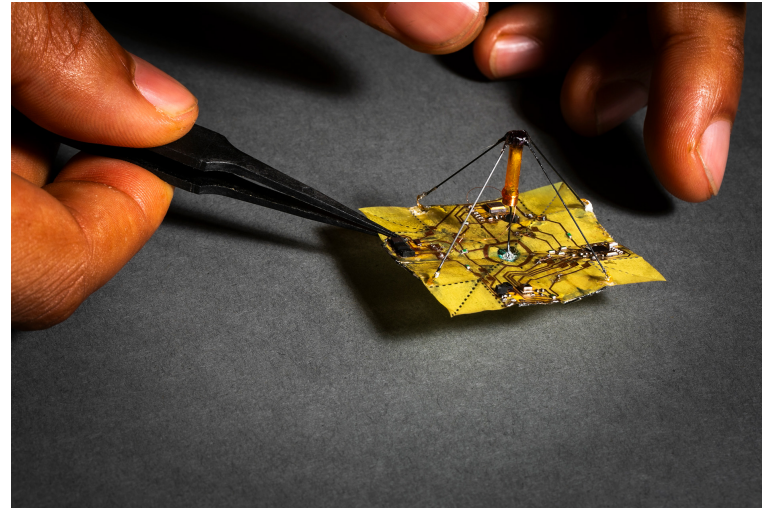


# Embedded systems research: robots and sensors

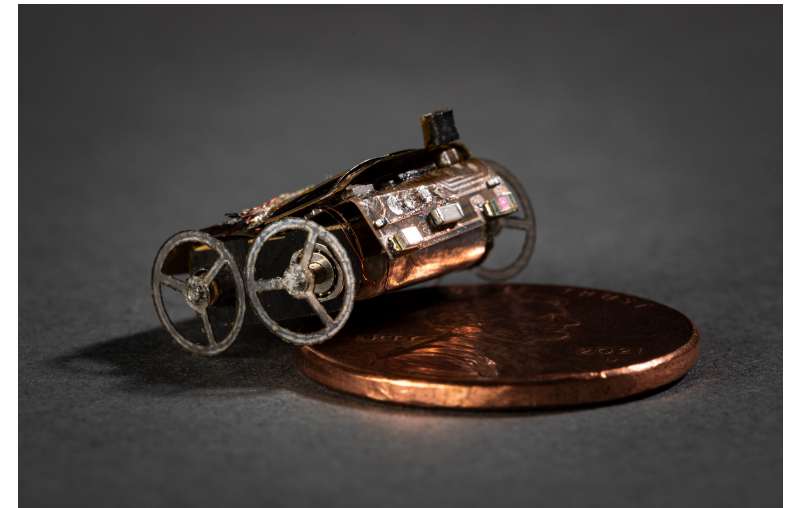
**Dandelion inspired sensors fly in the wind**



**Shape changing origami microfliers**



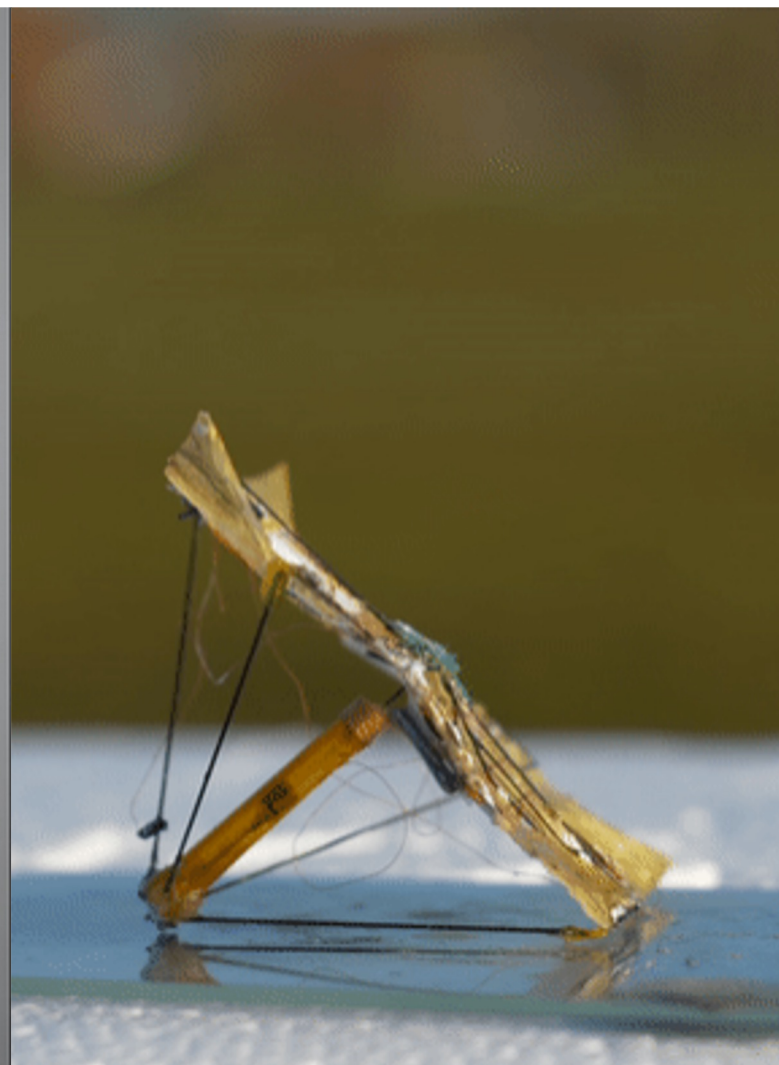
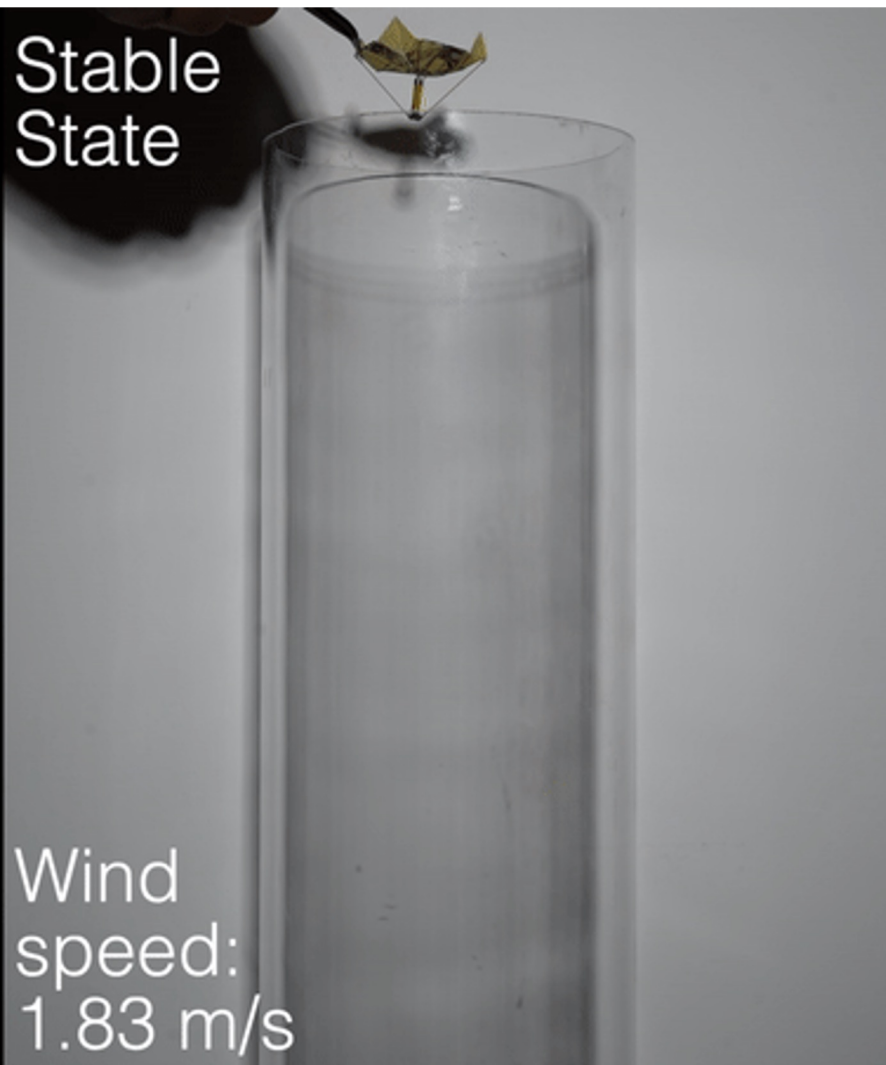
**Battery-free microrobots**



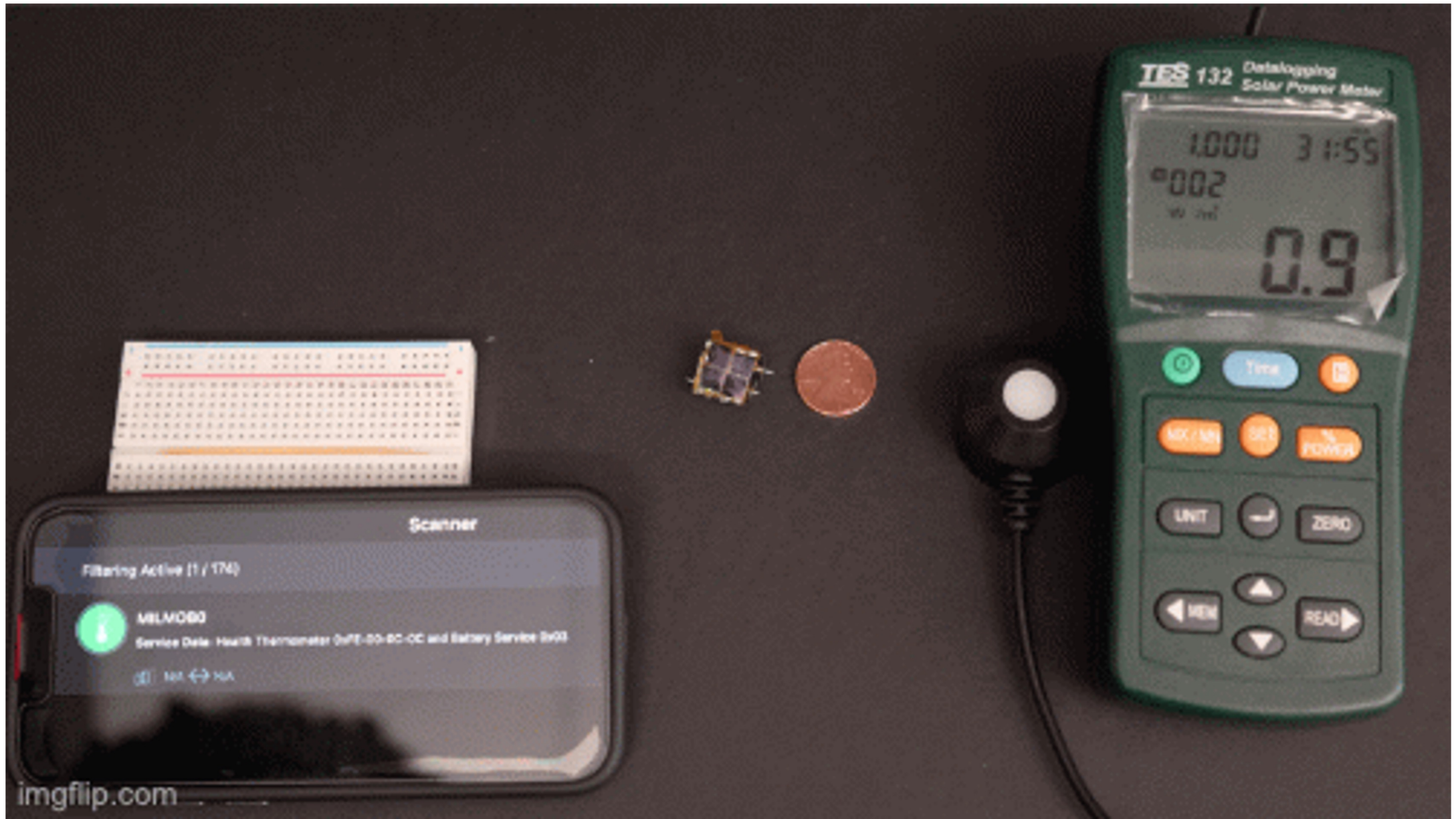
**Useful for sensing over large areas (agriculture/environmental monitoring), exploring confined spaces like pipes or under industrial equipment, or space applications**



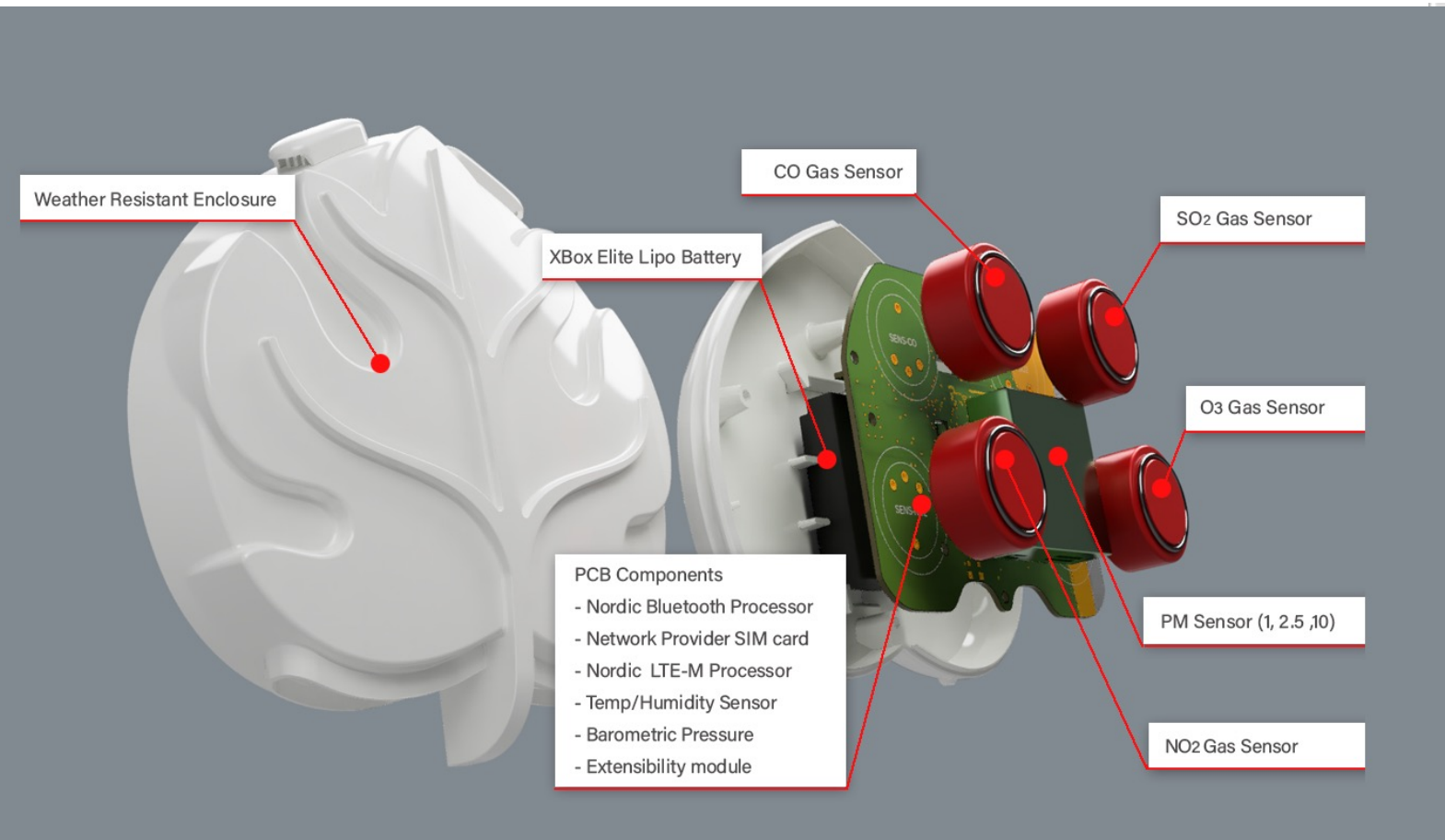
# Solar powered origami microfliers



# Battery-free robots



# Internet of Things: Low cost, cloud connected air quality sensors

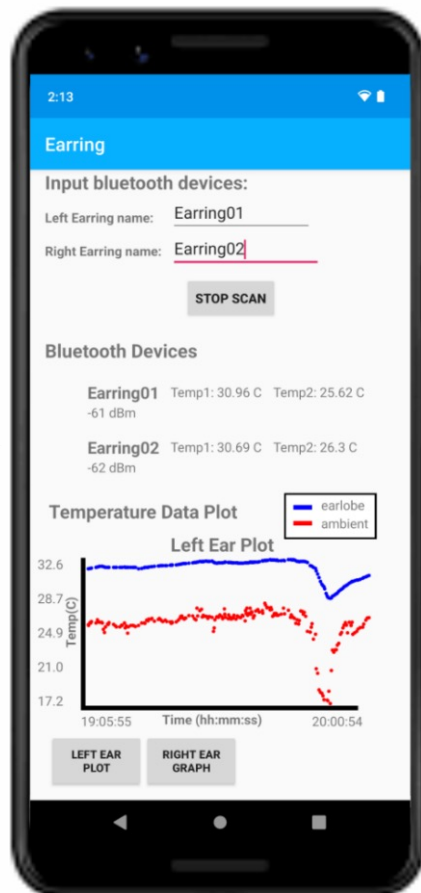


More info: [www.microsoft.com/en-us/research/project/project-eclipse/](http://www.microsoft.com/en-us/research/project/project-eclipse/)

# Smart jewelry, wearables, and medical devices

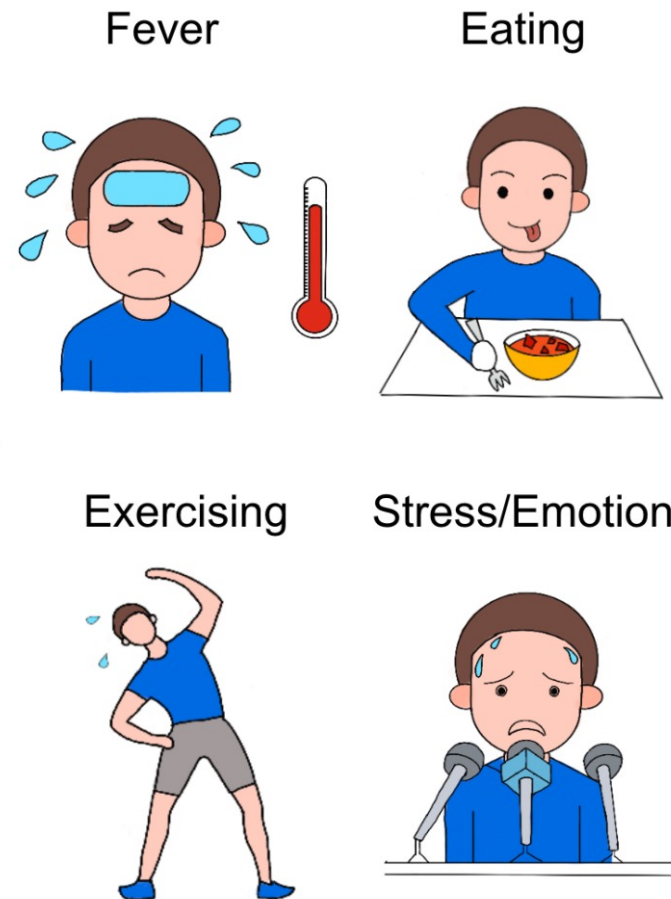


Thermal Earring with temperature sensing



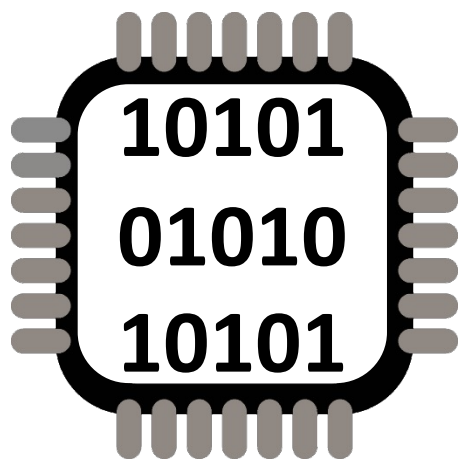
Phone App to log temperature data

Enables



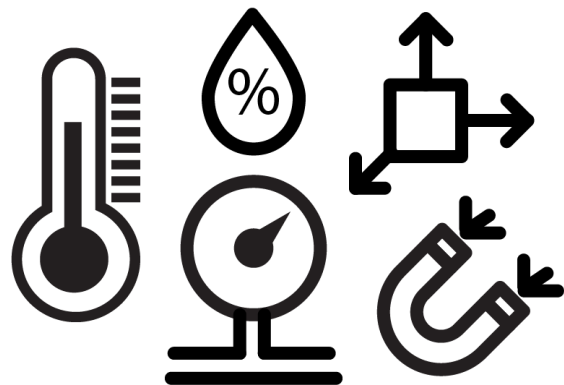
Longitudinal passive sensing

# What are the major parts of these systems?



**Computing**

+



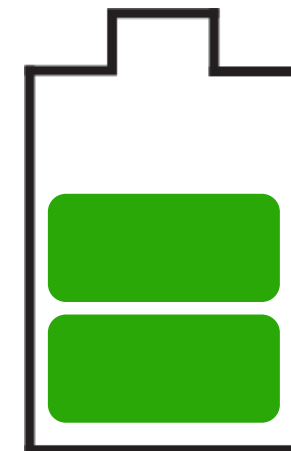
**Sensors and  
actuators**

+



**Wireless  
Link**

+



**Power  
Source**

