Introduction to Embedded Interface Design

Embedded Interface Design

with **Bruce Montgomery**

Learning Objectives

Students will be able to…

- Clarify the class focus and relevance
- Determine the class fit to the student's learning goals, experience, and skills

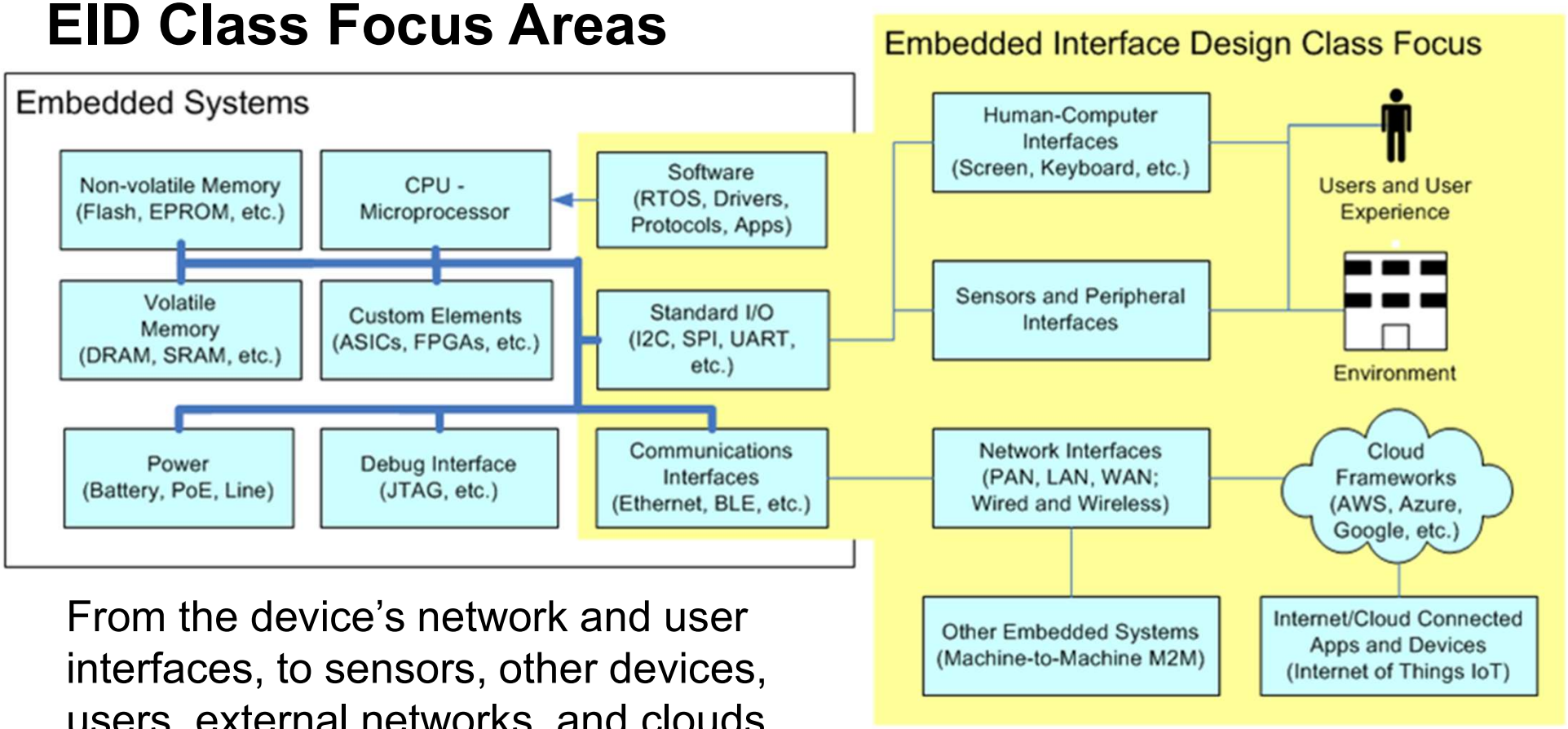
Welcome!

- Welcome to Embedded Interface Design (aka EID)
  - I'm looking forward to working with you!
- This is not a typical Embedded Systems course
  - Unlike low level EE design classes, a mix of technical and softer topics
  - A lot of usable content from several topic areas
- Very broad coverage, not always deep
  - Definitely a class where you will get out of it what you put in
  - I will introduce you to topics, but you'll have to dig into them

Prerequisites

- Basic programming skill in C or other languages
  - No prior experience in Python or Node.JS required, but you will be largely learning the languages on your own as we use them
- Basic understanding of computer architectures
- Basic knowledge of IP networking
  - e.g. the difference between TCP and UDP, or basic IP message structure and communication flows
- Small gaps in these areas will not prevent you from taking the course, but may require more effort…

EID Class Focus Areas



From the device's network and user interfaces, to sensors, other devices, users, external networks, and clouds

1 – User Experience and Interface Design

- HCI (Human Computer Interaction) for embedded devices
- Usability and user experience (UX) design
- Embedded device human interface elements
- UX design tools and methods
- Understanding users (people)

HCI/UX Topics

- Discount vs. formal UX/usability processes
- UX analysis and planning methods, work breakdowns
- UX research, user personas, use cases, UML
- UX design, wireframes, sketches, and other design methods
- UX Laws, usability heuristics, cognitive psychology, human factors
- UX verification and validation, methods, surveys, statistics and data
- All considering embedded device and system design

2 - Embedded Device Interfaces & Protocols

- Exploring embedded device machine interfaces
- Embedded system HCI elements
- Machine to Machine (M2M) interfaces and protocols
- Internet of Things (IoT) and
  cloud interfaces and protocols
- Message queueing, API design,
  and more

Interfaces and Protocols

- Low level protocols: SPI, I2C, UART, etc.
- M2M wired/wireless protocols: BLE, Zigbee, Z-Wave, USB, etc.
- IoT application protocols: MQTT, CoAP, HTTP, WebSockets, etc.
- LPWAN protocols: LoRa, NB-IoT, LTE-M, etc.
- Amazon Web Service (AWS) & the IoT framework, other AWS services
- Other cloud/IoT architectures and services
- Message queuing (ZeroMQ, RabbitMQ)
- APIs (Swagger, AWS)

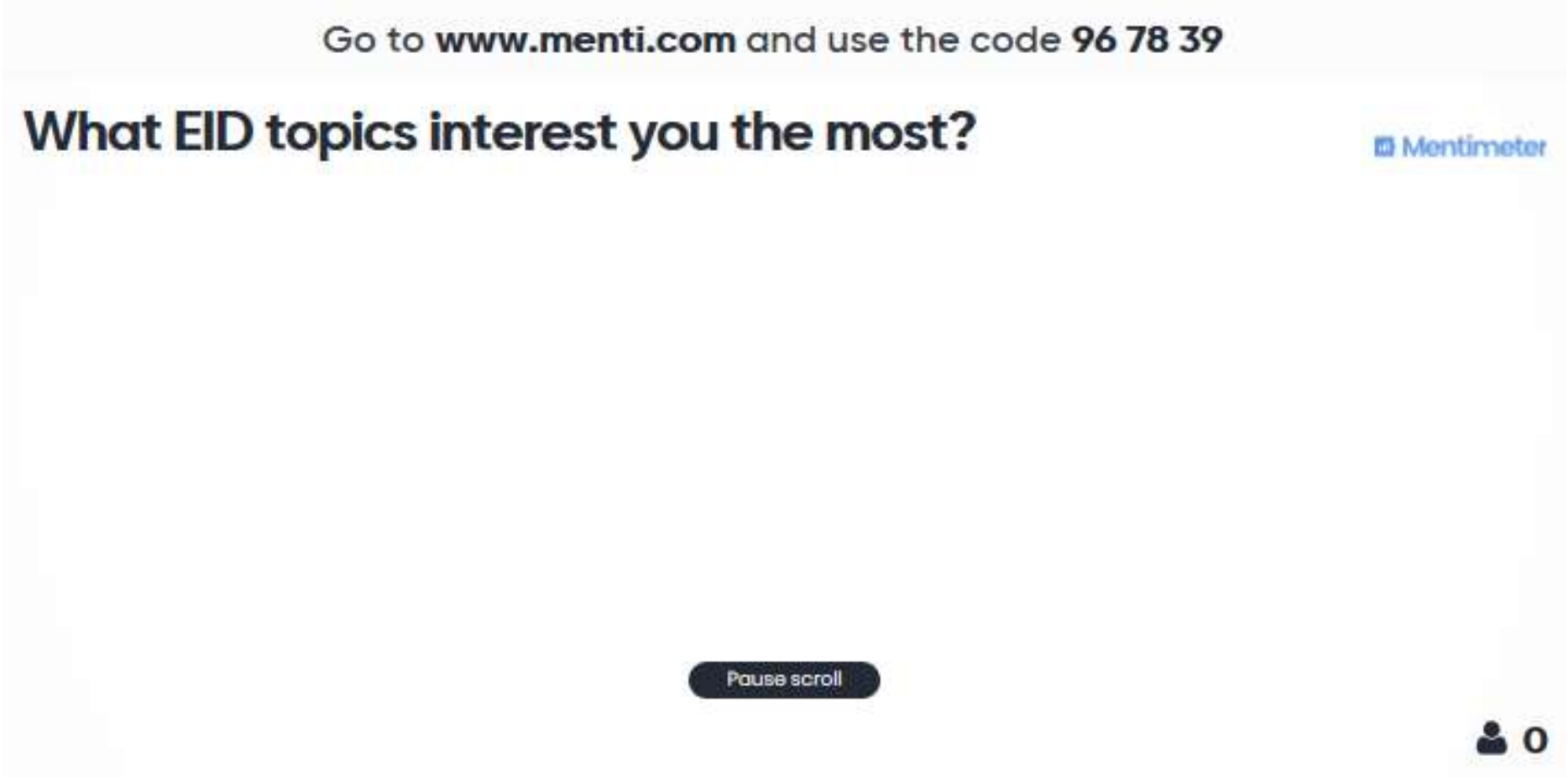
3 - Rapid Prototyping of Embedded Devices

- Exploring rapid prototyping for embedded devices and systems
- Proof-of-concepts for devices, interfaces, communications, systems
- Leveraging other platforms (single board computers (SBCs), cloud services, etc.)
- Design considerations for specific types of embedded devices

Rapid Prototyping Topics (& Projects)

- Languages: Python, Node.js (not C, why?)
- UI tools: QT, HTML, etc.
- Other tools: Git, databases (SQL/NoSQL)
- SBCs (Single Board Computers) and other prototyping alternatives
- Lean design methods, Pugh matrices
- Leveraging the cloud and cloud-based services
- Prototyping and production
- Specific embedded design concerns: RF, data, wearables, VUIs

Mentimeter - Interactive Presentations



Relevance?

- Every embedded device has an interface to something
  - Do you disagree?
- Becoming an effective embedded device engineer
  - How to develop a useful and usable device
  - How and why to select communications protocols
  - How to demonstrate functionality and device feasibility
  - How to narrow a design down for a product
  - Knowing best practices for device designs

Relevance?

- The growth of connected devices and the IoT…
- Looking for a job?
  - Thousands of companies involved in the development of IoT connected embedded systems, devices, components, or infrastructure [1]
- Billions of dollars in investments in technologies and startups… [2]
  - Agriculture, automotive, smart cities, industry, retail, security, etc.
- Many more billions in sales of IoT devices and related revenue opportunities [3]

References

[1] https://www.quora.com/What-are-the-top-IoT-companies
[2] http://www.networkworld.com/article/3053552/internet-of-things/10-internet-of-things-companies-to-watch.html
[3] http://fitbit55.rssing.com/chan-7066908/all_p4.html