SaTC: EDU: Collaborative: Building a Low-cost and State-of-the-art IoT Security Hands-on Laboratory
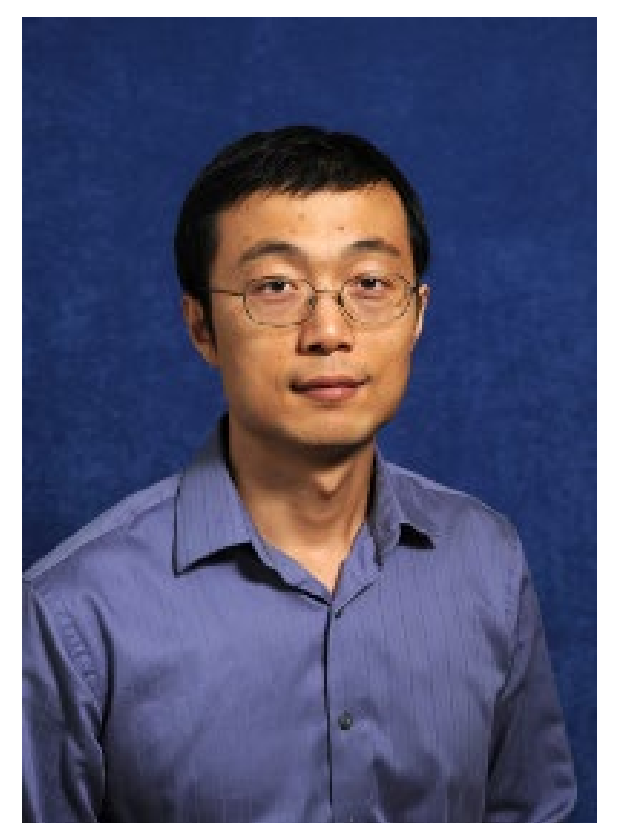
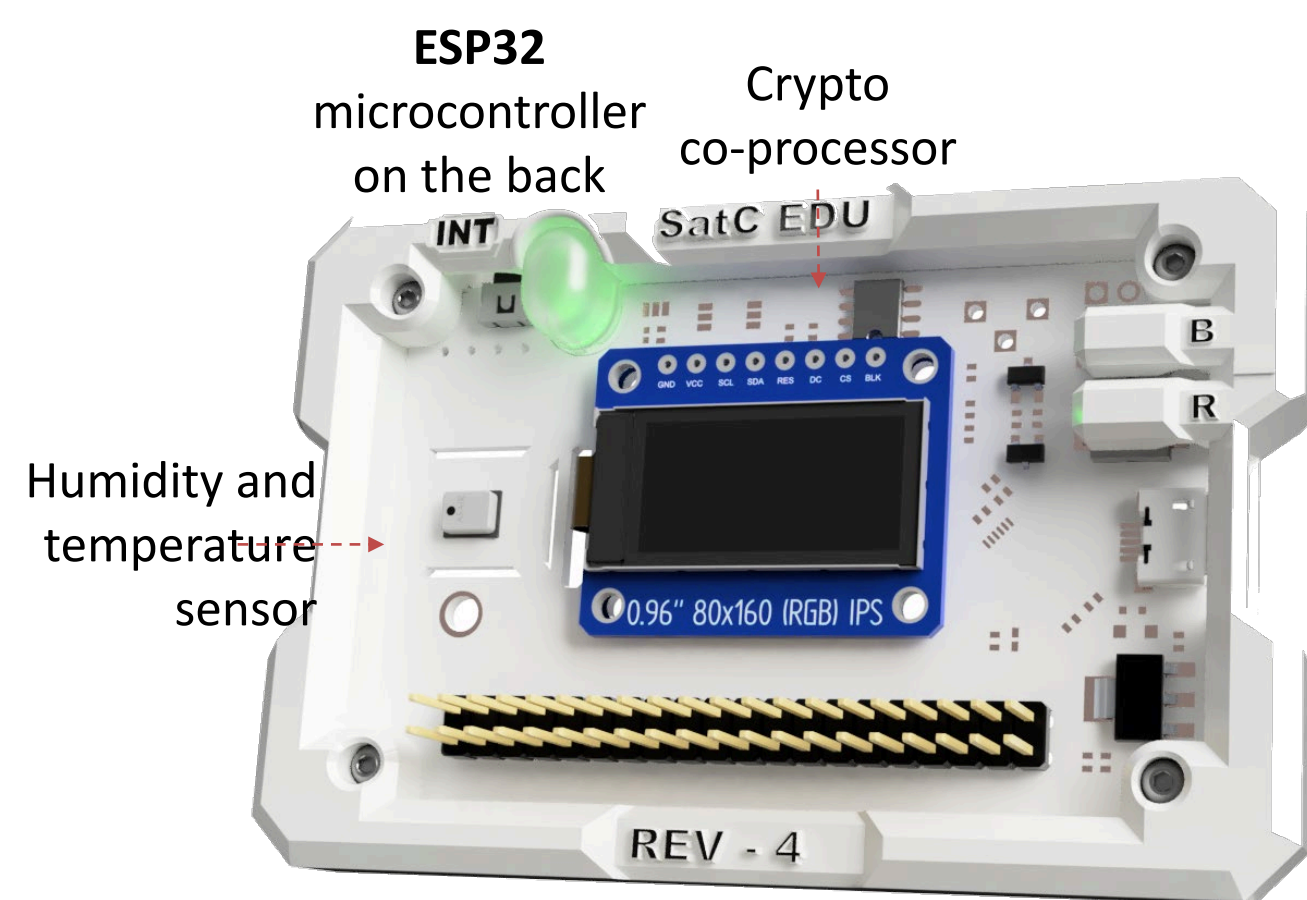**Cliff Zou**@UCF   **Xinwen Fu**@UML   **Shuo Wang**@UF

https://github.com/xinwenfu/IoT

PCB version

Mean and Standard Deviation of Participant's Understanding or Skill(s) Related to Mutual Authentication Lab
None (0)   Minimal (1)   Moderate (2)   Advanced (3)

| Item	Before		After		Mean Change
	Mean	**SD**	**Mean**	**SD**	
Experience generating the ECC key pair and burning the ECC private key into an ATECC608A chip.	0.174	0.564	2.043	0.624	
Knowledge that even if flash encryption is used, malware that gets into the device will be able to read the private key.	1.043	0.806	2.217	0.507	
Experience connecting an ATECC608A enabled device to a MQTT server or AWS IoT through SSL/TLS.	0.304	0.621	2.174	0.636	

Note. n = 23

Challenges

- The popularity of IoT has raised grave concerns about security and privacy
- Our research and related work disclosed various vulnerabilities of IoT products
- IoT security should be addressed from five aspects: *hardware*, *operating system/firmware*, *software application*, *secure networking protocols* and *data*
- There is an urgent need of promoting education in IoT security and privacy given that IoT will be ubiquitous and its security should be systematically addressed

Scientific impact

- We develop effective, engaging and novel teaching materials on IoT hardware, operating system/firmware/software, network, and data security with the low-cost IoT kit and integrated development environment (IDE)
- The transferable teaching materials are mapped to the NICE Cybersecurity Workforce Framework (NCWF), and knowledge, skills, and abilities (KSAs)
- The proposed faculty development workshop will advance IoT security and privacy expertise of other researchers and educators

Developed labs and modules

- Hardware Security
  - JTAG hacking lab
  - JTAG defense lab
  - UART hacking lab
  - UART defense lab
  - Flash ethical hacking lab
- Network Security
  - Network attack (MITM) lab
  - Network defense (AWS IoT) lab
  - Secure key storage (eFuse) lab
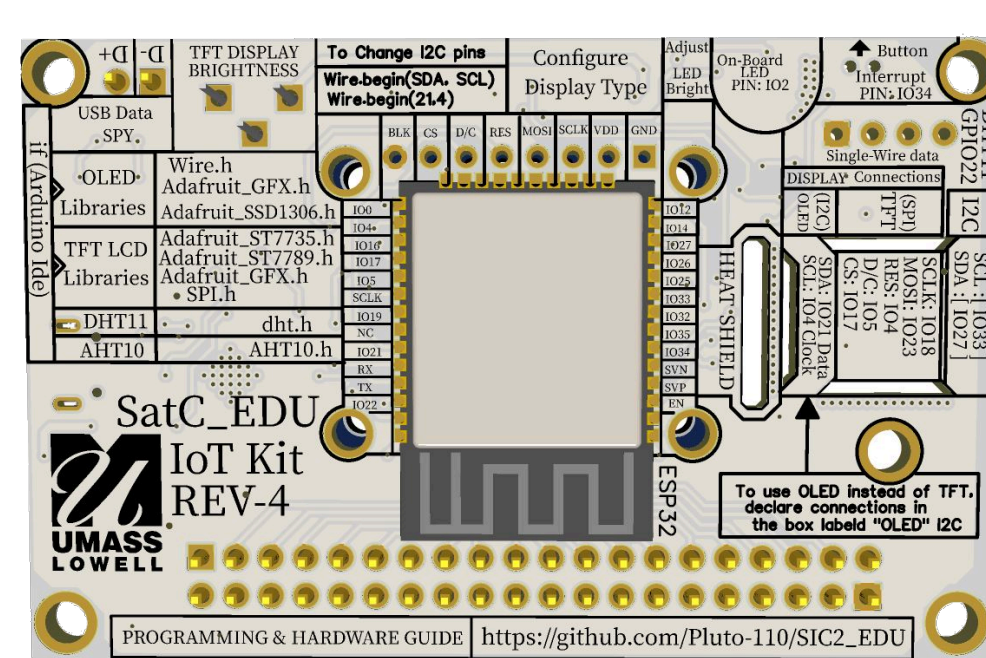
Back of PCB version

- Crypto co-processor, mutual authentication lab with ATECC608A
- Secure Firmware
  - OTA (WiFi) attack lab
  - Secure OTA lab
  - Secure boot lab
- Data Security
  - Flash encryption Lab
- Software Security
  - Format string attack on memory
  - Control flow hijack lab
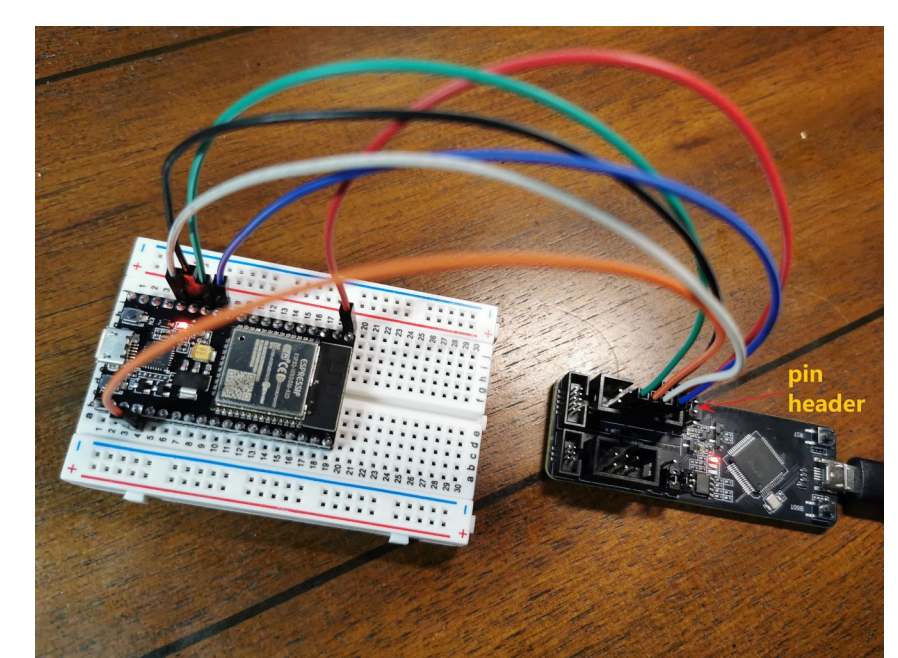
Breadboard version

Impact on society

- Disseminating the developed teaching materials to institutions across the country
- Contributing to the Cybersecurity Workforce Development Initiative

Education and outreach

- Improving curricula, student learning, and faculty collaboration and development at the three participating institutes
- Advancing faculty expertise on IoT security and privacy

BPC

- Broadening participation of underrepresented groups in cybersecurity training
- UCF is a Hispanic Serving Institution and its student body is 25 percent Hispanic/Latino students