UWE Bristol | University of the West of England

Presentation by

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MSc Cyber Security Programme Leader

Light bulbs and race cars: Cyber security education using cyber-physical systems

UWE cyber Gold Award

in association with National Cyber Security Centre

Department for Digital, Culture, Media & Sport

Academic Centre of Excellence in **Cyber Security Education**

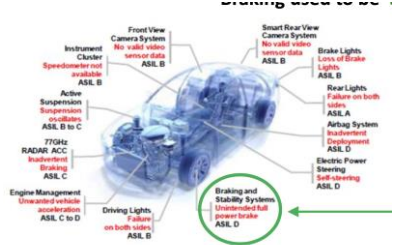
10th March 2021

About Me

- Associate Professor in Cyber Security
- Programme Leader for NCSC-certified MSc Cyber Security
- Co-Director of UWEcyber (NCSC ACE-CSE)

- Research interests:
  - Cyber security, Machine Learning, Data Visualisation
- Research domains:
  - Insider threat detection, cyber situational awareness, adversarial AI, privacy-preserving AI, visualisation for explainable AI, cyber resilience

About Me - Recent Projects



Centre for Connected and Autonomous Vehicles

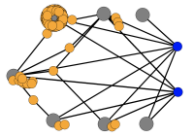
Fusion Processing

CAVFORTH

South Gloucestershire Council

TOSHIBA

UMBRELLA

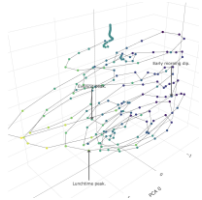


AVON & SOMERSET CONSTABULARY

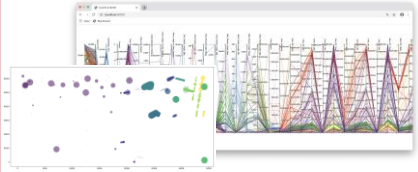
SYNALOGiK

CYBER CRIME CSCV
Cyber Specials Cyber Volunteers

SCOUT

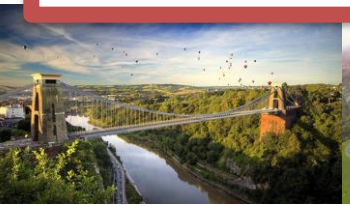


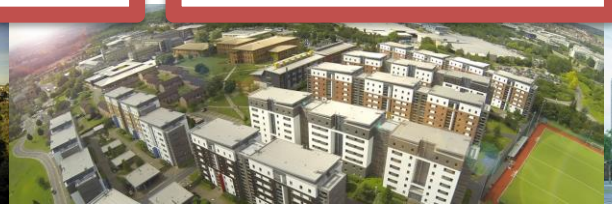
MONTVIEUX
Simplicity from Complexity



TECHMODAL

AI SEC





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… my other hat ☺ …

Cyber Security Education

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unlock cyber

OPENING FUTURES IN CYBER SECURITY

CISSE UK

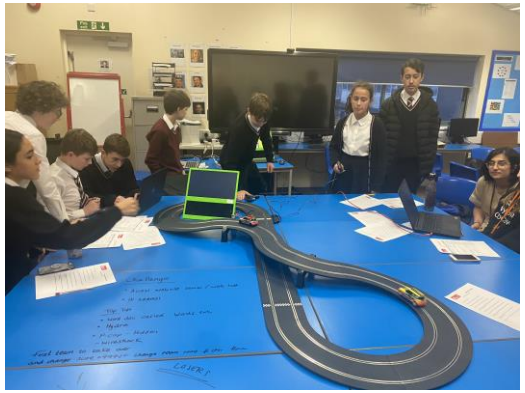
Sphero Workshop

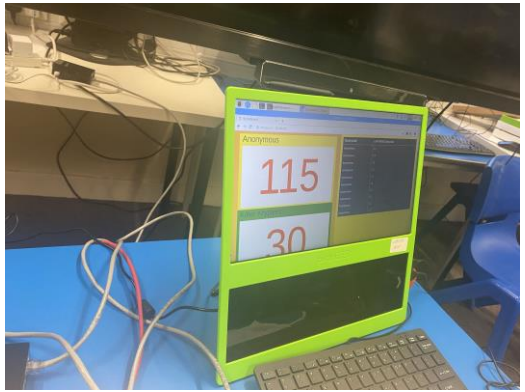
- November 2019
- 800 girls NCSC EmPowerCyber

- 3 students ran a **sphero hacking** activity –
  - One student controls the device normally around a maze using an iPad
  - Can another user issue commands using a Python API to cause it to crash?

Scalextric Workshop

- January 2020-February 2020
- 4 workshops, across 3 schools
- Two teams play Scalextric ☺
  - Each team has a laptop… can then hack into the scoreboard to throw the race?
  - Kali setup, worksheet using tools like nmap and hydra to brute force web server.
  - Python script to change scoring mechanism and to reset opponent score.

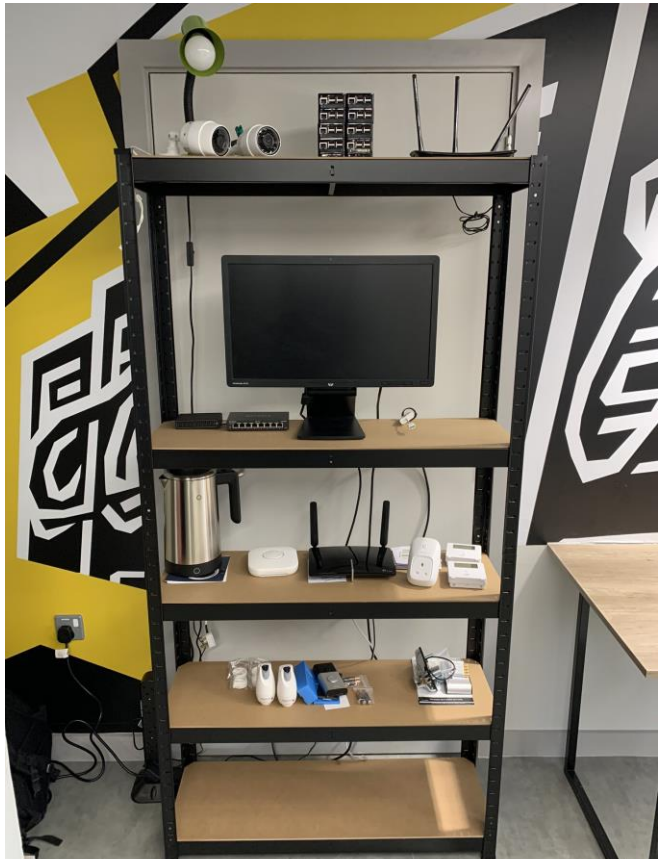




Cyber Foundry

- Physical space at Frenchay to link students on external cyber security projects

- IoT Workbench for smart home security
  - Cameras, doorbells, light bulbs, kettles, temperature sensors, door locks
  - CTF server, SOC setup, Factory simulator, lots of toys to play with…



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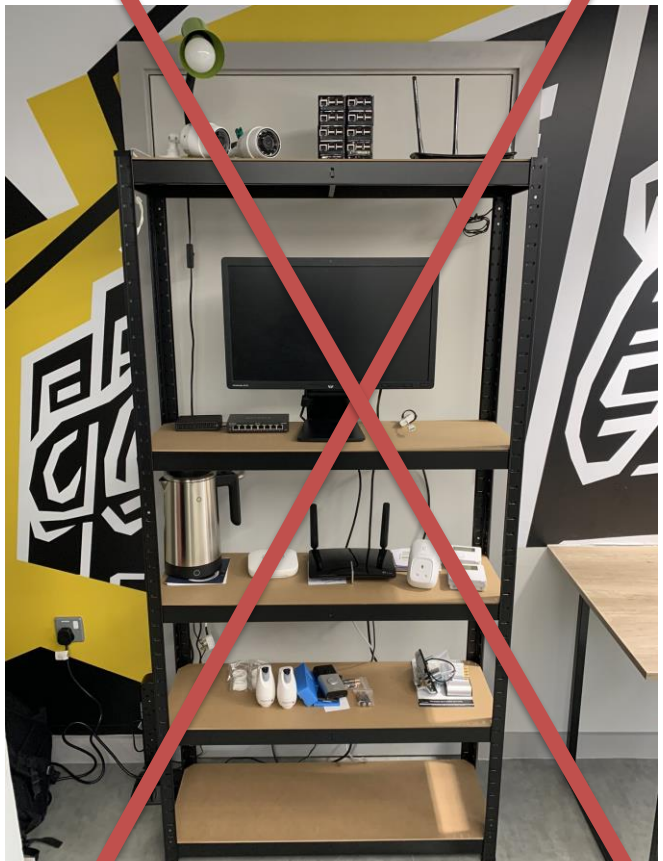
COVID-19 ☹

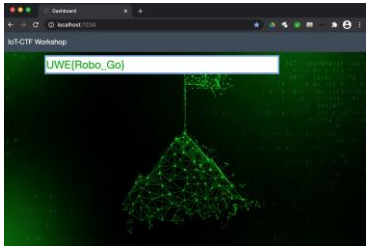
Outreach

- How can we deliver outreach under social distancing restrictions?
- What are the new ways of working that we need to think about?
- We don’t have physical access to our kit ☹ and students are also working from home.



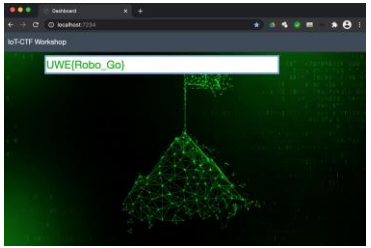
IoT Home Hacking

- We developed a "**Hacking the IoT home**" workshop, that can be delivered remotely.
- Based on a CTF-style meaning that challenges could be suited to all levels.
- CTF flags link to IoT device control - remote control of physical devices observed via online video
- CTF-IoT Server can be deployed on a Raspberry Pi – cheap (and separate!)



IoT Home Hacking

- Requires:
  - Raspberry Pi IoT-CTF server
  - Webcams (I have lots of cheap ones!)
  - IoT devices (running on Tuya network)
  - A (little) bit of home networking knowledge to set up port forwarding



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DEMO

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DEMO

Play along in your Browser

http://80.235.143.15:9999

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Play along in your Browser

http://80.235.143.15:9999

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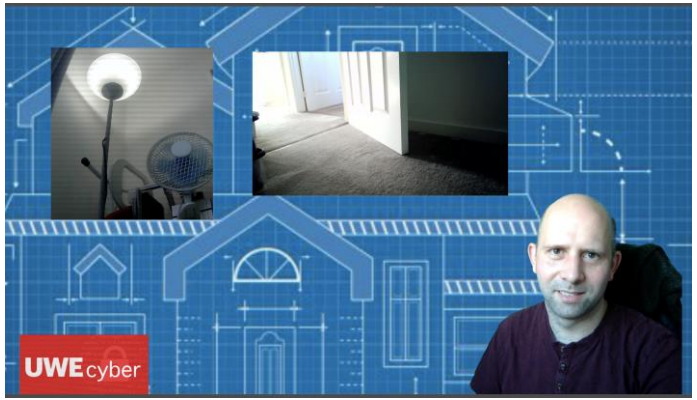
Play along in your Browser

http://80.235.143.15:9999

IoT Home Hack

- We hosted a small pilot study of online outreach in Summer 2020.
- Initial response from students was that it was "cool" to control devices remotely, and to see things happening in someone else's home!
- Turns WFH into an advantage – we actually have an IoT home to "hack".
- Increases online engagement for students, a different kind of session, and may encourage further exploration.



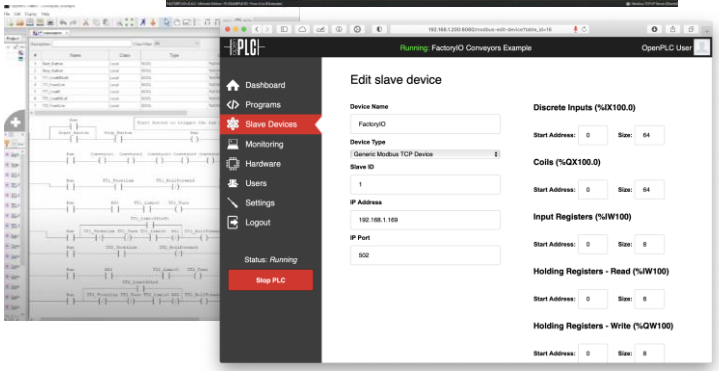
Post-Covid Cyber Security

- How has COVID-19 changed how we think about cyber security education?
- Cyber Security has been at the core of how we have continued to work remotely – *imagine a lockdown 20 years ago…*
- How will we continue to use online collaboration tools post-covid?

- *A key part of cyber security is about gaining remote access of systems – so how do we keep that 'remote' aspect in the future?*

Post-Covid Cyber Security

Are there aspects of HE cyber education that should continue to adopt remote learning?

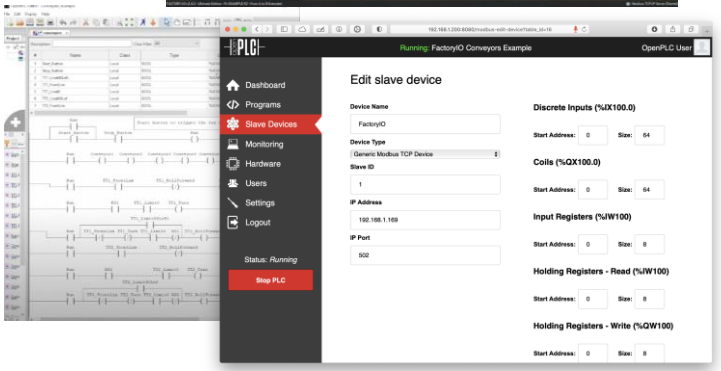


Cyber Physical Systems Security Example

- FactoryIO virtual simulation – can be observedand accessed remotely
- OpenPLC instance can be deployed by students on their RaspberryPi as Programmable Logic Controller to control factory
- Students can link their own device, observe behaviour, and then inject or spoof activity.
- CyBOK-funded project on CPSS to develop community resources – also to be used on our MSc Cyber Security CSS module.

Take Away

- Cyber Security at the heart of remote learning and teaching – how do we emphasise this?
- Can online meeting platforms be used for better educational experiences compared to how we traditionally approach teaching?
- WFH has allowed us to innovate our teaching in different ways, try new ways of working – we need to build on this rather than go back to old less-effective methods.



Thank you for listening

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Thank you to:
Pennie Spruhan,
Thomas Higgs,
Avin Karim,
Abbey Russell-Jeffery,
Jonathan White,
and Ian Johnson

Light bulbs and race cars: Cyber security education using remote cyber-physical systems

Abstract: What does a modern-day computer look like? With the rise of IoT, connected vehicles, and other Internet-enabled processes, understanding the security implications of these systems that are embedded within our everyday society becomes even more critical. In this talk, I will present some recent projects on this theme. As well as research on CAVs and IIoT, I will discuss our recent outreach projects for teaching cyber security and cyber-physical systems, including how this has evolved in the wake of remote working, and what this may mean for the future of cyber security education.

Bio: Dr Phil Legg is an Associate Professor in Cyber Security at the University of the West of England. He is Co-Director of the NCSC Academic Centre for Excellence in Cyber Security Education, and he is the Programme Leader for the NCSC-Certified MSc Cyber Security. His primary research interests cut across machine learning, data visualisation, and cyber security, and how these relate to new technologies such as IoT and CAVs, including how ML can both aid security as well as introduce security vulnerabilities, and how visualisation can support greater human-machine interaction for improved cyber situational awareness. He is a Co-Founder of CISSEUK, working with academics and government to improve sharing and collaboration in cyber security education. He completed his PhD in Computer Science at Cardiff University in 2010 and held post-doctoral roles at Swansea University (2010-2013) and the University of Oxford (2013-2015), before joining UWE in 2015.

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