CONNECTED EVERYTHING SUMMER SCHOOL

https://cesschool.github.io/

12-14 July, Online

This year ConnectedEverything II Summer school was jointly organized by the School of Electronic and Electrical Engineering at Leeds University, UK in collaboration with the School of Computing and Engineering at the University of Huddersfield, UK. The core theme was **"Industrial Internet-of-Things (IIoT) for Connected Factories"**.

The summer school was aimed at providing a platform for interdisciplinary discussions around recent advancements in IIoT. This year we had very exciting programme which involved a mix of industrial and academic talks around the thematic area. The program also included hands-on sessions and a Hackathon for participants.

Key Facts:

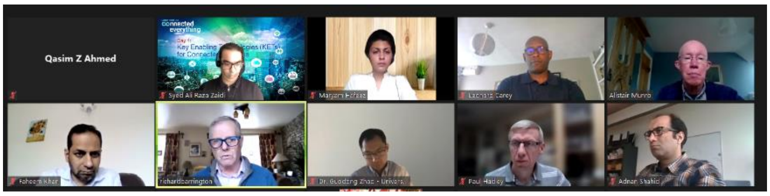
69 Participants

13 Disciplines

12 Countries

90% Early Career Researchers

The school was attended by over 69 participants from 12 different countries with majority of participant being early career researchers (ECRs). Over the course of three-days students participated in live, pre-recorded lectures, live demos, industrial panels, and hands-on activities. Each day had its own unique theme. Day 1 was focused on "[Key Enabling Technologies] for Connected Factories". Dr. Alistair Munro from **Digital Catapult** opened the day discussing recent advancements in Industrial 5G and its role in shaping Connected Factories. The talk was followed by Dr. Adnan Aijaz from **Toshiba Research Lab** who provided in depth overview of convergence between operations technology and 5G. Specifically, he focussed on convergence of Time Sensitive Networking (TSN) standard and how it can be supported over 5G air interface. The morning session culminated with a live demo from the **University of Glasgow and Scotland 5G Centre's** live demo presented by Dr. Guodong Zhao, Dr. Yusuf Sambo and Prof. Muhammad Ali Imran. The afternoon session presented the participants with an opportunity to engage with the industrial panel. The panellists included Richard Barrington from **Perform Green**, Leonard Carey from **Aware Technologies**, Paul



Hadley from **Ford UK**, Marc Funnel from **NCC**, Dr. Syed Zaidi from the **University of Leeds**, Dr. Adnan Shahid from the **University of Ghent**, Dr. Alistair Munro from Digital Catapult, Dr. Guodong Zhao from **University of Glasgow**, and Dr. Faheem Khan from the **University of Huddersfield**. The panellist introduced various ongoing national and international projects and key technical challenges they are facing. The discussion included everything from software architecture to security and DevOps of the Industrial IoT networks.

Hackathon: Over the course of three days participants were involved in a Hackathon around thematic area of "Safe, Agile and Reconfigurable Production Lines" which, inline with post-COVID operation, was a very timely topic. The participants organized themselves into four groups. Dr. Maryam Hafeez from **the University of Huddersfield** led the Hackathon.

Prizes for the Hackathon were distributed by industrial panellists on Day 3. The themes presented four different ideas:

Hackathon & Design Workshop: *Safe, Agile and Reconfigurable Production Lines*

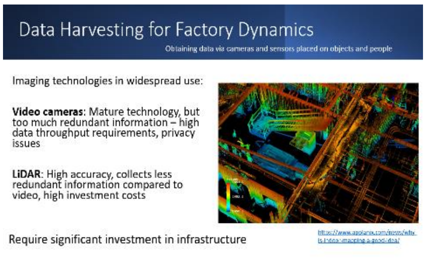
Table 1. Key digital technologies and their relevance to post-Covid recovery and diversification

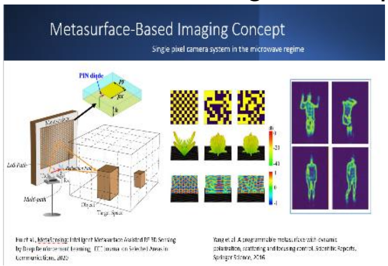
Example technologies	Driver 1 Supply chain transparency, predictability and flexibility	Driver 2 Efficient work space re-configuration and staff tracking	Driver 3 Increased remote working and training	Driver 4 Flexibility to repurpose production	How can it help recovery, diversification and resilience of manufacturing?
Artificial intelligence (AI) - AI describes a collection of techniques, including machine learning, that enable systems to interpret and learn from data in order to achieve flexible goals.	✓				AI can help to build more resilient supply chains through advanced supply forecasting to predict demand and accurately plan manufacturing activities.[13] Predictive analysis can help with revenue stability through dynamic pricing optimisation and identifying areas for diversification.[14]
Big data - handles high information density and uses mathematical analysis to measure trends, identify relationships and dependencies.	✓	✓	✓		Enables remote working solutions and better supply chain visibility.[15] Real-time data can be monitored against key performance indicators (KPIs) on people, assets, work in progress, finished goods.
Digital twins - integrate several digital technologies to create living digital replicas of physical entities. These simulations can include people, places, processes and systems.			✓	✓	Real-time modelling of production and assembly lines can support remote workforces to make informed decisions. End-to-end visibility of inventory, machines and processes supports seamless integration between increased digital and physical working.[12]
Internet of things (IoT) - refers to a system of connected devices that can collect, transfer, analyse and store data via sensors.	✓	✓			IoT-enabled inventory can help with waste reduction and maintenance improvements, further boosting productivity.[16] Workforce tracking can manage the risk of virus transmissions.[17]
Virtual reality (VR)/ Augmented reality (AR) - an artificial environment that presents itself as a real environment. AR is a hybrid of a real-artificial environment. The real environment is enhanced through computer-generated information to create an interactive experience.			✓		Upskilling and re-training the workforce helps to mitigate against skills shortages due to self-isolation or repurposing/diversification of manufacturing.
Automation and robotics - Autonomous robots can carry out tasks without any human interaction. Collaborative robots, or cobots, can work alongside human employees to boost production.		✓			Reduces the demands on workforce labour and helps compliance with social distancing.[14] Supports reshoring costs, advancing supply chain resilience. Increases machine operation hours, boosting productivity.[19]
Additive manufacturing - A set of technologies that enable the layer-by-layer production of a three-dimensional object from a digital 3D computer aided design				✓	Supports flexible production and agile response to demand fluctuations. Helps to build future crisis preparedness and solve supply chain gaps.[20]

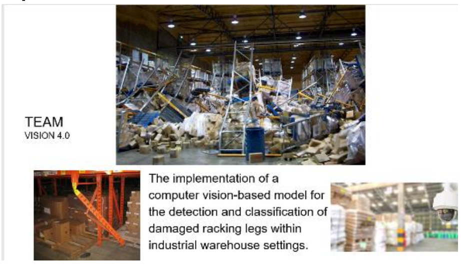
https://www.ciip.group.cam.ac.uk/reports-and-articles/role-industrial-digitalisation-post-covid-19-manuf/download/2020-10-08-DigitalER.pdf

1. **Localized Activity Tracking and Prediction in Post-COVID Production Lines** (Winner) by James Rains, Abdelaziz Salama, Daniel Povey and Tien Quach.
2. **Digitalizing Industrial Quality Control** by Ayub Ansari, Kenechi Omeke, Fuhu Che, Tochukwu Emma-Duru, Weixin Cui (Runner Up).
3. **IIoT aided Manufacturing System** by Mohammad Ahangar, Olaide Olabode, Vinu Pannackal and Zeyad Elsaraf (Joint Third).
4. **Vision 4.0: The implementation of a computer vision-based model for the detection and classification of damaged racking legs within industrial warehouse settings** by Muhammad Hussain, Mohammed B Aliyu, Ming Zhang, Yang Lu, Joshua Fasuyi (Joint Third).

All four projects presented incredible details on design of the proposed solutions.

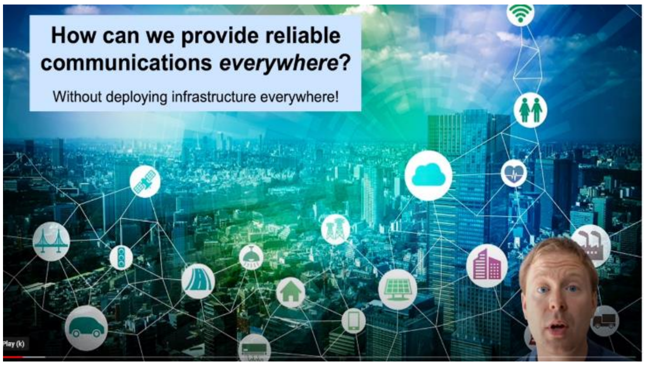






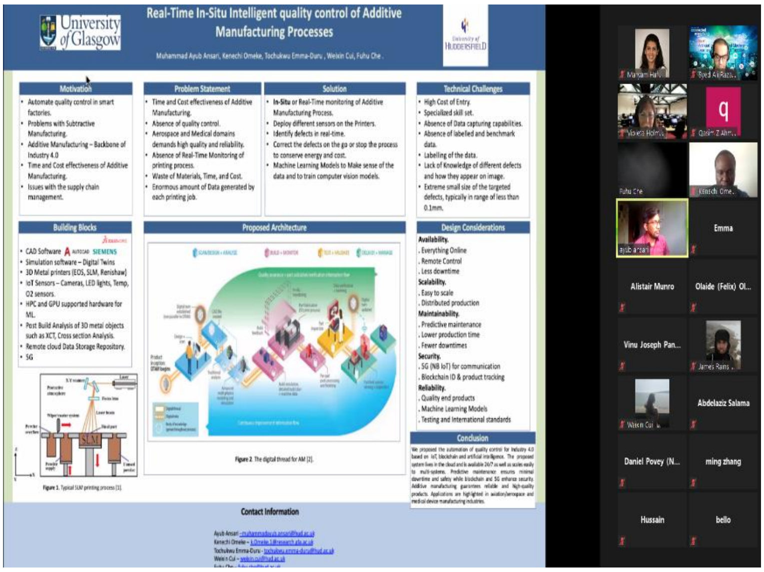
Prizes were shipped to participants after-conclusion of the Summer School. Members of the winner and the runner up teams received their own Raspberry Pi Starter Kit with a collection of several sensors to further promote their proposed ideas. Team members from the remaining two teams received their own Arduino Bluetooth Sensing Platform (Nano BLE Sense Devices).

Theme for the second day was specifically around the emerging connectivity paradigms for IIoT, which opened with a talk of Prof. Emil Bjornson from **KTH**. The recording can be accessed on the YouTube. The talked was followed by a practical demo from Dr. Danish Aziz from the **Analog Devices**. The morning session culminated with an interesting talk on Swarming for CPS design from Dr. Melanie Schranz from **Lakeside Labs**. The afternoon session was led by Dr. Violeta Holmes from the **University of Huddersfield** on behalf of **NVIDIA**. The session focused on hands on labs on developing Deep Learning models on NVIDIA GPUs. The hands-on lab covered both fundamentals of Machine Learning and advance topics e.g., Transfer Learning. All participants enjoyed and appreciated the amount of effort that was required to deliver this hands-on session. At the completion of the course, the participants were given an option of undertaking a hands-on assessment resulting in **NVIDIA Deep Learning Institute Certification for Competency** in Fundamentals of Deep Learning.



The theme for the third day was chosen as "Artificial Intelligence and Machine Learning for the Connected Factories". The first talk was from Dr. Ursula Challita from **Ericsson, Sweden**. She discussed how AI and ML are becoming pervasive and vital ingredient in managing, orchestrating and deployment of the next generation connectivity solutions. Her talk was followed by a very different application for AI and ML. Prof. Julia Bennell from **Leeds University Business School** (LUBS) presented an overview of cutting and packing problems and their relevance in supply chain. The morning session culminated with the talk from Prof. Ashiq Anjum from the **University of Leicester** which focused on research challenges around creating Digital Twins.

In the afternoon session, participants presented their proposed solution to Design Challenge and Hackathon followed by the Q&A session from Judges. The panel of judges convened to collate the results and subsequently announced the winners. In a very close-ran competition, the judges decided to award a joint third position to two teams. After the conclusion of the summer school prizes were posted to winning teams.



The Summer School was delivered with the help and support of several staff members across both the University of Leeds and the University of Huddersfield. Running hands-on session remotely required quite a lot of advance prepartion. All participants acknowledged that this summer school has been really informative and for some of them has also opened up new opportunities for collaborative research. This sure has been good learning experience for organizing teams and we look forward to organizing similar events in future to support early career researchers.