

# Pitch-In IoT Student Placements Report

*Ramsay Taylor, Steve Jubb and Ceri Batchelder*

## Introduction

The University of Sheffield is setting up a LoRaWAN network beginning in Sheffield City but with the ambition of providing coverage across Sheffield City Region, supplementing the work already done in Barnsley. To help develop some prototypes and code that showcases the network's potential to our campus community and local business, Pitch-In supported a 10-week student placement programme for engineering undergraduates from 22 June to 28 August 2020.

The principle aim of these student projects was to provide both system designs, and documentation of some simple but extensible wireless IoT projects. A common and critical block to the adoption of IoT technologies and to the success of small and medium enterprise IoT ventures is the difficulty of producing a proof of concept prototype. Additionally, a thorough and well-grounded understanding of the complexity of different aspects of the (software and electronic) engineering can inform more successful project plans and budgets. By creating case studies with freely available software and hardware designs, as well as documented engineering experiences, the student projects give local and regional enterprises a measurable starting point for their own work.

Following a recruitment process, 11 undergraduate engineering students were selected from second, third, and fourth year of Undergraduate study in various Engineering disciplines (including Computer Science, Electronic Engineering, and Control Systems). The students created a range of project ideas, engaging with their mentors and external people/organisations to do so.

## Project Management and Mentoring team

- Ramsay Taylor – University Teacher in the Dept. of Computer Science and IoT expert
- Steve Jubb – University Technical Manager and IoT expert
- Mike Faulks – CTO loetec and IoT cybersecurity specialist
- Walter Bassage - Research Assistant at The University of Sheffield
- Ceri Batchelder – University Entrepreneur in Residence and regional IoT ecosystem experience
- Alex Kelly – IT Manager, Tinsley Bridge

## Student project topics

- Ahmed Haroun: Temperature Monitoring in Industrial applications
- Ammar Aboagwa: Energy management for the manufacturing sector
- Kennedy Dike/Onyeka Obidiegwu: RFID tag reader as a LoRaWAN application
- Mark Harris: Remote heart monitoring for the healthcare sector

- Mo-anna Tucker: Indoor and outdoor air quality monitoring
- Nathan Brown/Harrison Fretwell: Predictive maintenance of legacy equipment at AMRC
- Robert Bruce: Integrating Local and Wide Area Networks for Use by Smart Buildings
- Seth Roberts: Analysing the use of bicycles in a city environment
- Tom Edwards: Asset Security using Bluetooth Beacons and LoRaWAN

### **How did the projects go?**

When the project was conceived it was anticipated that we would operate in the Diamond, with access to the various lab facilities there. Due to the 2020 Covid pandemic, the students had to work remotely, from their residences either in Sheffield or at their family homes.

Whilst the remote delivery of the project wasn't ideal, we managed to create a sense of community through the regular standups, high level of availability of mentors and technical support and the Slack group.

Our biggest challenge was certainly the lack of hardware for the individual students. Due to various aspects of the students' remote working, we were not able to supply them with electronic components through the project. Some students had access to some components of their own, whilst others were able to pivot their projects to concentrate on the software elements.

The individual student work was collated into a GitHub repository which is publicly available. Additionally, each of the students has provided a report that documents their work and the accumulated experience in their particular sphere. These are all available from the links in the "Project Outcomes" section below.

### **Which external people/organisations were involved?**

**Alex Kelly**, *IT Manager, Tinsley Bridge* – Alex was hugely enthusiastic and involved, joining our weekly standups and mentoring several of the student projects [Ammar Aboagwa, Ahmed Haroun, Tom Edwards, Onyeka Obidiegwu and Kennedy Dike]

**Tracey Johnson**, *Barnsley Digital Media Centre* – Tracey enabled Mo-anna Tucker and Steve Jubb to work with Declan Kiely, ICT Engineer, to install a number of air quality sensors at the DMC.

**David King**, *Digital Design Manager, AMRC* – David was supportive of a project to install sensors at the AMRC, but this project had to pivot to look at network security issues due to the lack of hardware [Harrison Fretwell and Nathan Brown]

**Tracy Cook**, *Education and Training lead for Diagnostic Cardiology at Sheffield Teaching Hospitals NHS Foundation Trust* [Mark Harris]

**Chris Dymond**, *Unfolding Ltd and Smart Sheffield* – Chris was very helpful in talking to Robert Bruce about technology for smart cities.

**Russell's Bicycle Shed** – Russell and his colleague Theo showed some interest in supporting Seth, but the logistics were difficult with Seth being in Canada [Seth Roberts]

**Dr Andy Gilchrist**, *Business Development Manager in Oxford University* and part of Pitch-In [Ammar Aboagwa]

**Dr. Ben M Thomas**, *Research Associate, Dept. Materials Science & Engineering, University of Sheffield* - Sheffield Titanium Alloy Research (STAR)

**Victor Leh** *Missing Link*, a Finnish startup company specialising in wireless security solutions [Tom Edwards]

**Dyanda Salshabyll**, *isoenergy* - Dyanda is a University of Sheffield student carrying out a year placement as a design engineer [Ammar Aboagwa]

## **Project Outputs**

### [GitHub](#)

<https://github.com/ramsay-t/IoTInternships>

### [Student presentations](#)

<https://drive.google.com/drive/folders/1VEdakBzl9plrR-9NikR7Oz83btZ4Dqe4?usp=sharing>

### [Student reports](#)

<https://drive.google.com/drive/folders/1OHfeRVr3Vijmx9cO0gySalqFTpy7g-9T?usp=sharing>

## **Appendices**

### **APPENDIX 1**

#### **Development and Delivery of Campus Demonstrator pilot – Ceri Batchelder progress record**

##### **July 2019**

Proposal: To work with Steve Jubb, Technical Manager of the Urban Flows Observatory, to develop a plan for piloting the use of the IoT gateways/network on campus (due to be completed fairly soon), to prepare for a wider Campus Demonstrator programme. For example, in the pilot, 2-3 teams could address a local challenge to test use of the system. Include CiCS and Sheffield City Council in planning.

##### **August 2019**

I joined Steve Jubb (Technical Manager, Urban Flows Observatory) at a meeting with the University's network manager and faculty IT managers (CiCS) to discuss establishing a dedicated University IoT network. Steve has the green light to set up the IoT gateways/network on campus. I will discuss potential pilot projects to test use of the system with Steve and Ramsay Taylor, a University Teacher with a lot of IoT experience.

##### **September 2019**

I've discussed a potential source of pilot projects to test use of the Things Network infrastructure with Ramsay Taylor. Ramsay needs to first gauge interest levels from second and third year computer science and aerospace students, so we have a meeting booked in with Steve Jubb on 14 Oct. This should give those who are interested some time to develop prototype devices (say over 6-12 weeks) to be ready to test them on the network early in 2020.

##### **October 2019**

Through working with Ramsay Taylor and Steve Jubb, we have identified the key areas we need to progress to develop a practical demonstrator using sensors with the LoRaWAN network on campus. We have submitted a proposal and will discuss with Sarah Cullen.

##### **November 2019**

Ramsay Taylor, Steve Jubb and I developed a proposal for review by the Pitch-In Steering Group. We will run a 12-week programme in summer 2020 for 8 student projects, in which they develop prototype devices to test on the University LoRaWAN network. Where organisations are keen to get involved or help spread the word, I've had initial discussions with Sheffield Digital and the Sheffield Property Association.

##### **December 2019**

We had a catch-up about the project on 5 December and I've arranged a meeting for 13 January to start planning the project; for example, students may want to confirm their summer plans sooner rather than later.

##### **January 2020**

Some of the project/Pitch-In team – Ramsay Taylor, Mike Faulks, myself and Rosie and Sarah – met on 13 January for an early discussion on how we would run the project and encourage student recruitment. We are preparing some text to start promoting the student internships shortly (June-August).

##### **February 2020**

Ramsay, Rosie and I have prepared a flyer to start promoting the student summer internships. Ramsay suggested running it like the SURE scheme, so I contacted the SURE co-ordinator, Tracy Mayes at 301, the Academic Skills Centre. (We spoke on 6 March and I have circulated the information).

### **March 2020**

Despite the coronavirus situation, having liaised with John, Ramsay Taylor and Steve Jubb, the shared view is that we can go ahead with the student IoT projects in the summer. Steve has advised that if the students do not have access to Things Network, they can still apply if they have WiFi, and he will send them an indoor gateway.

### **April 2020**

The promotional flyer for the IoT internships and the Google registration form are being checked and tested before going live w/c 4 May. Students need to respond by 20 May, and the projects will start on 22 June, for 10 weeks. I am seeking guidance on the method of payment.

### **May 2020**

We received 33 applications for the student IoT internships. After reviewing the applications, we made 11 offers and all students accepted their place. The payment method is sorted out via the Dept of Computer Science finance team and we are currently organising the hardware delivery (Ramsay is aware of John's advice on this). We are starting to map out the schedule and shape regional challenges for the students to address.

### **June 2020**

- 11 internships were awarded and all 11 students accepted.
- We are now in week 3 of the 10 week programme, following the kick-off meeting on 22 June.
- We are having weekly 'stand-up' meetings for students to share progress and ask questions.
- In the meantime, the mentors and I are available to provide support.
- The students are starting to write initial code and make use of GitHub.
- They are shaping their projects through their own ideas and discussions with the mentors and external connections. I organised a number of expert sessions to help this.
- So far, links have been made/meetings facilitated with Pitch-In Oxford, AMRC (Design and Prototyping), Smart Sheffield, Sheffield Teaching Hospitals, Barnsley Digital Media Centre, the Healthy Lifespan Institute (TUoS), Tinsley Bridge, isoenergy and Russell's Bicycle Shed.
- Lastly, we have an issue with the approvals for hardware purchase and delivery which we are trying to address.

### **July 2020**

- All 11 students are making good progress on their IoT placements.
- They did an excellent job at presenting their projects at last night's Sheffield IoT meetup (30 July).
- We keep in touch through a Slack channel and weekly standup meetings.
- The mentors are all highly engaged and helping the students to troubleshoot any problems.
- Whilst waiting for hardware, the students have focused on the backend software systems including Grafana and InfluxDB.
- They are capturing their progress and things they've tried on GitHub.
- Steve Jubb has gained approval for three self-contained pieces of hardware to be shipped out which is ongoing.
- There are 4 more weeks, at the end of which the students will present again at the IoT meetup on 27 August.

## August 2020

- The students gave their final project updates on 21 August.
- Ramsay asked them to update their progress on GitHub, capturing as much learning as possible and to produce a short summary report in the following week, see [here](#)
- Ceri asked them to update their external mentors/organisations and invite them to the IoT meetup.
- Again, they did an excellent job of presenting at the Sheffield IoT meetup on 27 August.
- Several of them did very positive LinkedIn posts, see APPENDIX 2. As did mentor Alex Kelly, IT Manager at steel fabrication SME, Tinsley Bridge – see APPENDIX 3.

## APPENDIX 2

### Selection of Student LinkedIn posts

#### Nathan Brown

- 1st  
4th Year MComp Computer Science Student  
1mo • 1 month ago

Excited to take part in this [Sheffield IoT Meetup] presentation as an intern, the experience so far has been great and excited to show my projects progress and hear from others! [#Sheffield](#) [#IoT](#)

#### Harrison Fretwell

- 1st  
Final Year Artificial Intelligence and Computer Science Masters Student  
4d • 4 days ago

Really delighted to have been a part of the Pitch-in [#IoT](#) project. Being able to work with the other students to solve some interesting problems in developing solutions for the [#LoRaWAN](#) network has been an amazing opportunity, and even more so in the midst of a global pandemic. It's been a great experience and one I'm proud to have been a part of!

#### Onyeka Obidiegwu

- 2nd  
Vice president human capital at Sheffield consulting Society.  
2d • 2 days ago

Delighted to be able to complete a ten week, internet of things summer internship, sponsored by Pitch-in and in collaboration with the University of Sheffield.

The summer internship involved working on a project which makes use of LoRaWAN so as to be able to test the LoRaWAN network currently being set up in Sheffield.

I worked on this project alongside [Kennedy Dike](#) and in collaboration with [Alex Kelly](#) from Tinsley bridge. Elated to say that we were able to successfully build an RFID tag reader which sends information to the things network console using LoRaWAN. We were also given the opportunity to present in both Sheffield summer IOT meetups, hence improving my presentation skills.

I would like to thank [Ceri Batchelder](#) and [Ramsay Taylor](#) for helping organize the program and also [Steve Jubb](#), [Walter Bassage](#) and [Michael Faulks](#) for their assistance in various technical issues we came across. Lastly, I would like to thank Pitch-In for funding this internship and therefore giving me an opportunity to improve my understanding of LoRaWAN and it's applications. [#internetofthings](#) [#LoRaWAN](#) [#summerinternship](#) [#Engineering](#) [#university](#) [#opportunity](#) [#collaboration](#) [#network](#) [#innovation](#)

### [Mo-anna Tucker](#)

• 1st

Reliability Centered Maintenance Placement Engineer at Recycling Technologies Ltd

5h • 5 hours ago

On Friday I finished my Pitch-In summer placement with the University of Sheffield. I really enjoyed learning more about the hardware and software of LoRaWAN technology. As part of this placement I looked at how LoRaWAN and The Things Network can be used to monitor indoor air quality and used Node Red and Grafana to display data.

Thank you to [Tracey Johnson](#) for allowing me to work with the DMC in Barnsley to monitor indoor air quality.

Also, thank you [Steve Jubb](#), [Michael Faulks](#), [Walter Bassage](#), [Ramsay Taylor](#) and [Ceri Batchelder](#) for all of your help through these strange times.

[#lorawan](#) [#grafana](#) [#ttn](#)

### [Kennedy Dike](#)

• 1st

Student at The University of Sheffield

2h • 2 hours ago

Delighted to have completed the 10-week long Internet of Things Summer Placement organised by The University of Sheffield. This project has enabled me explore the huge potential of LoRaWAN network, which I never used before I started this placement.

The project was to design a system that sends information from an RFID tag reader to The Things Network using LoRaWAN. I worked with [Onyeka Obidiegwu](#) and also collaborated with [Alex Kelly](#), from Tinsley Bridge, for the full duration of the placement. Fortunately for us, we were able to achieve our goal.

This placement taught me a whole lot in regard to project management, problem solving, responsibility, remote working amongst others. It was not smooth sailing throughout as we had to overcome some difficulties during the project, but, this only made me become a better Engineer than I was before I started. It was my first foray into any kind of work outside University related projects and I am happy that it was a success.

I would like to say a big thank you to [Ceri Batchelder](#), [Ramsay Taylor](#), [Walter Bassage](#), [Steve Jubb](#) and [Michael Faulks](#) who organised and helped us during the project even during unprecedented times. [#internship](#) [#lorawan](#) [#summerplacement](#) [#internetofthings](#) [#iot](#)

## APPENDIX 3

### [Alex Kelly](#)

• 1st

IT Tinsley Bridge - First Class Honours Degree in Computing - Over 15 years working in IT in a range of diverse sectors

4d • 4 days ago

A big thank you to LORAWan intern team [Ceri Batchelder](#) [Ramsay Taylor](#) [Michael Faulks](#) [Steve Jubb](#) for putting it together. It was fun mentoring/setting challenges for the team [Onyeka Obidiegwu](#) [Ammar Aboagwa](#) [Mo-anna Tucker](#) [Mark Harris](#) (and others) and helping out. Hope its inspired to the possibilities for an exciting technology for the region. [The University of Sheffield](#), [AMRC](#), [Sheffield Digital Limited](#), [#iot](#) [#lorawan](#) [#i40](#) [#industry4point0](#) [#smartsheffield](#) <https://lnkd.in/eXQF2-Q> [#mentoring](#) [#innovation](#)

[Link to post and video](#)