Making the World a better place
With the Internet of Things

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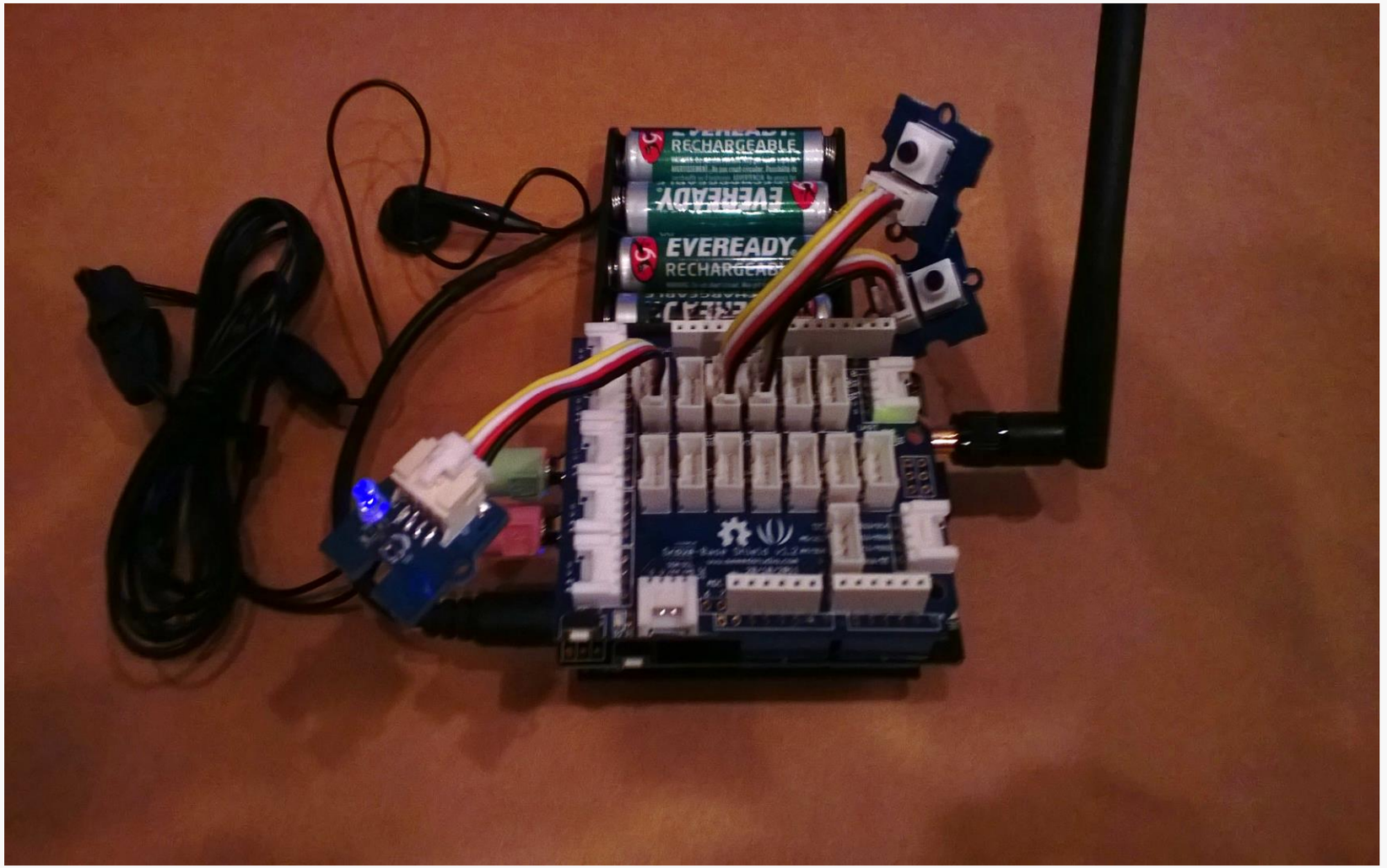
Teaching, Citizen Science, and Quality of Life

Teaching with Things
It started at the coffee cart

- CodeClub World: Scratch, python and HTML lessons
  - Easy to scale delivery
- Some students got bored
  - Especially the more advanced ones
- Could you come and give me a hand at Aranui?
  - How about we try some of this IoT gear?

Hi mum I'm calling you from a mobile I built
I think this could work?



Packages from China and the USA
What's wrong with this picture?

Lots of vendor support
@MicrosoftNZ
@Seeedstudio
@Sparkfun
@Netduino
@elecrow
Tardis.net.nz
embeddedcoolness.com

Many hours later I had assembled 15 kits
Need a bigger living room

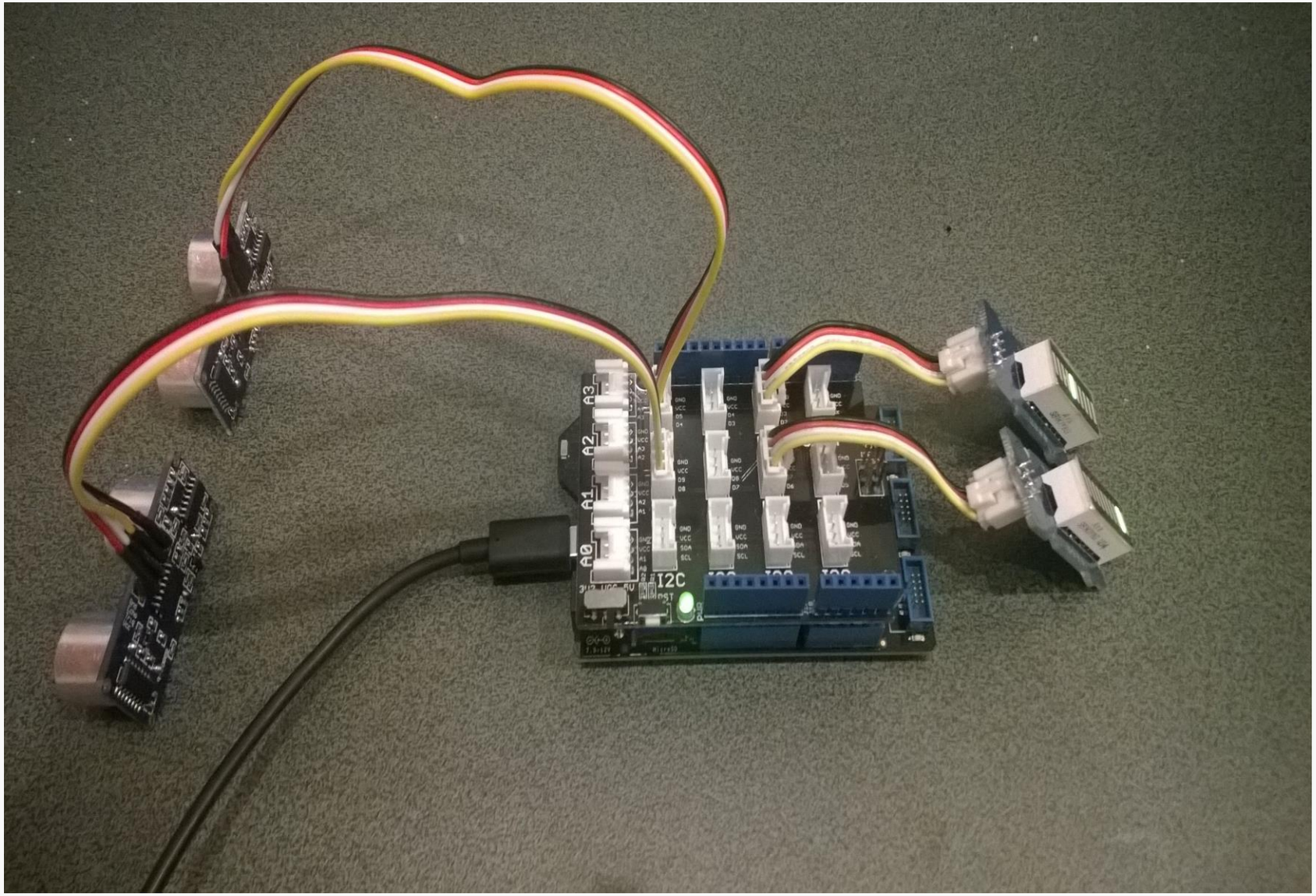
Build things kids can relate to

Regular cadence – Two nights a week was hard work

- Interleave theory & practice
  - Learning the theory without realising it
- Always illustrate concepts with “real-world examples”
  - This was hard to do on the fly, so started lesson plans
- Warm-up challenge every week
  - The competitiveness between boys & girls
- Eat together
  - Coding is a team sport
- Sell it to the parents with the “show n tell”
  - Rather than a doctor or accountant how about an engineer

The Projects – Pulse rate monitor
Bringing it together

The Projects – Backing beeper
Bringing it together



The Projects – Power consumption monitor V1
Bringing it together

The Projects – Power consumption monitor V2
Bringing it together

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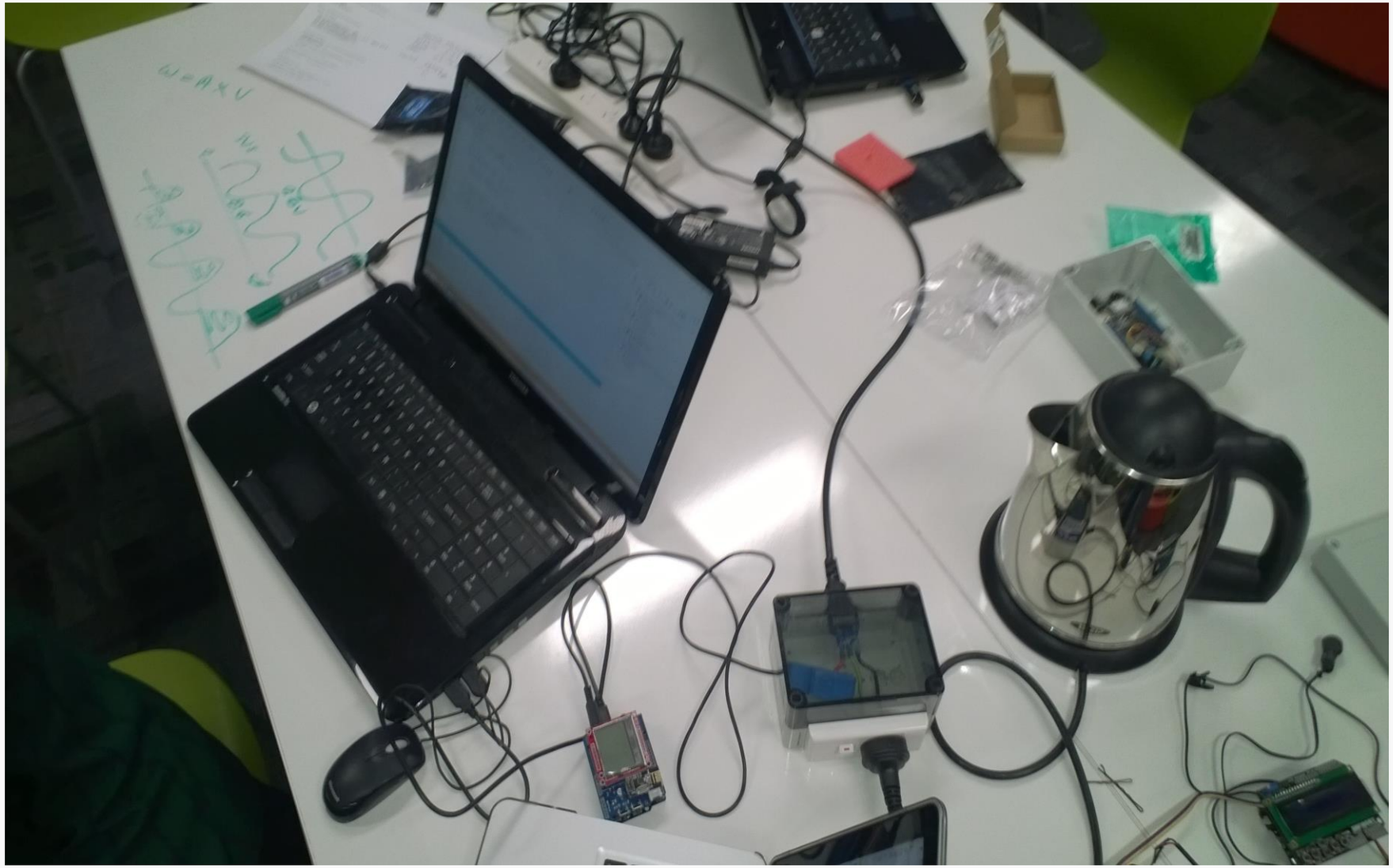
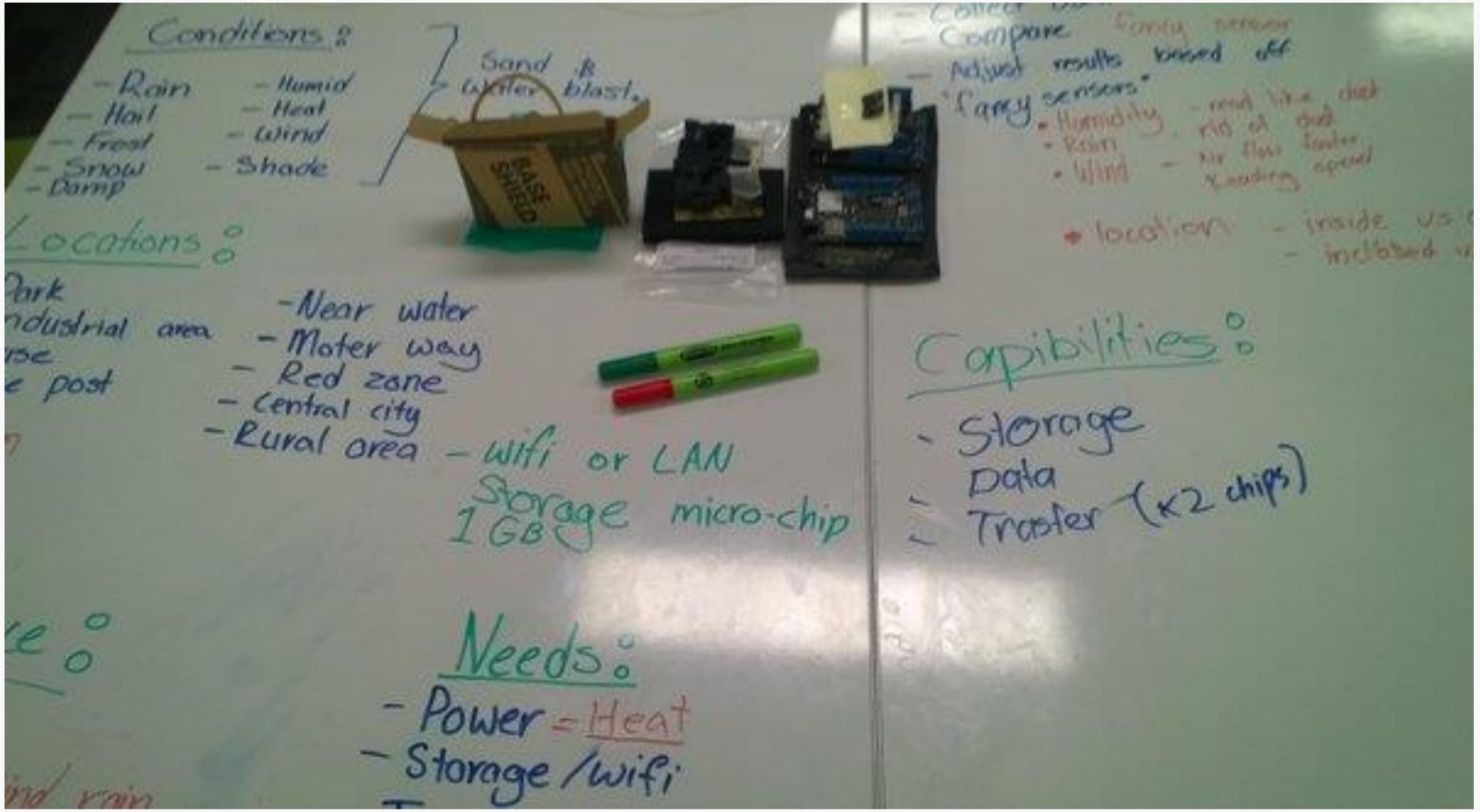
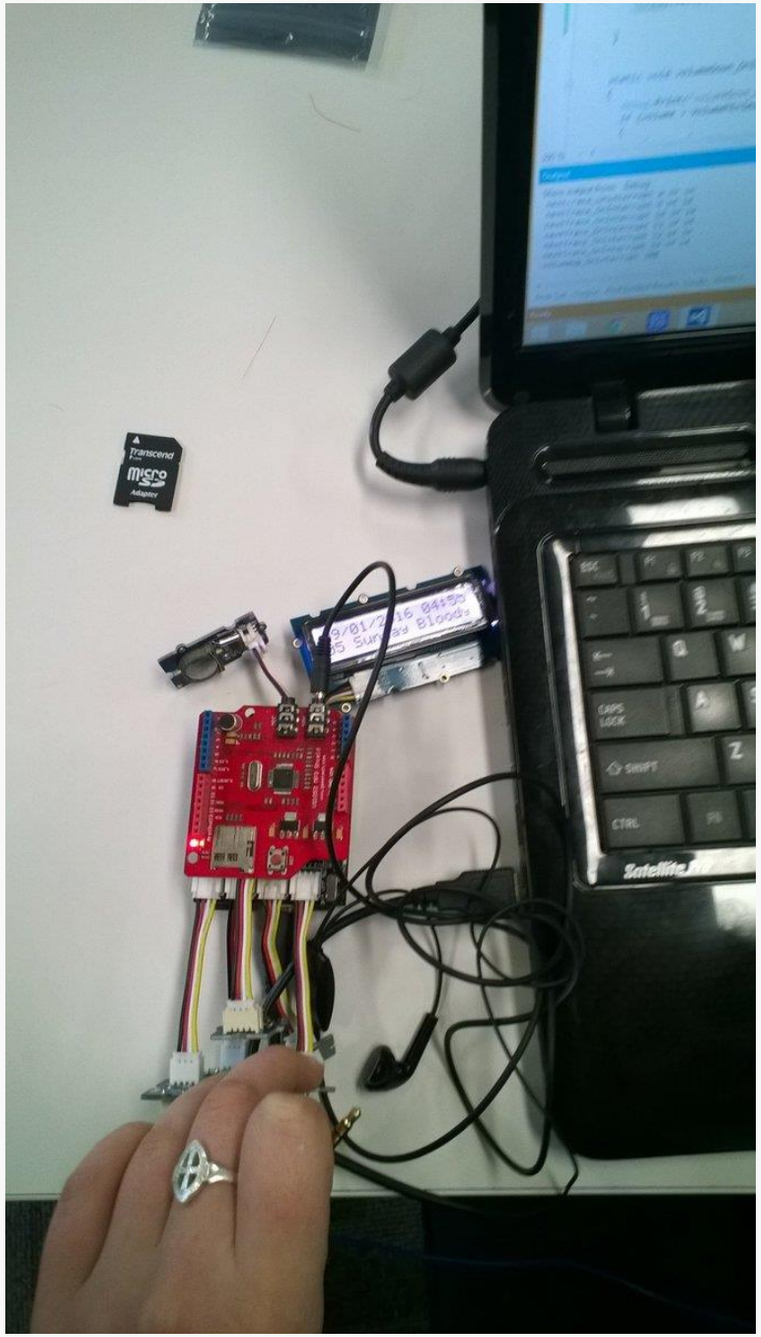
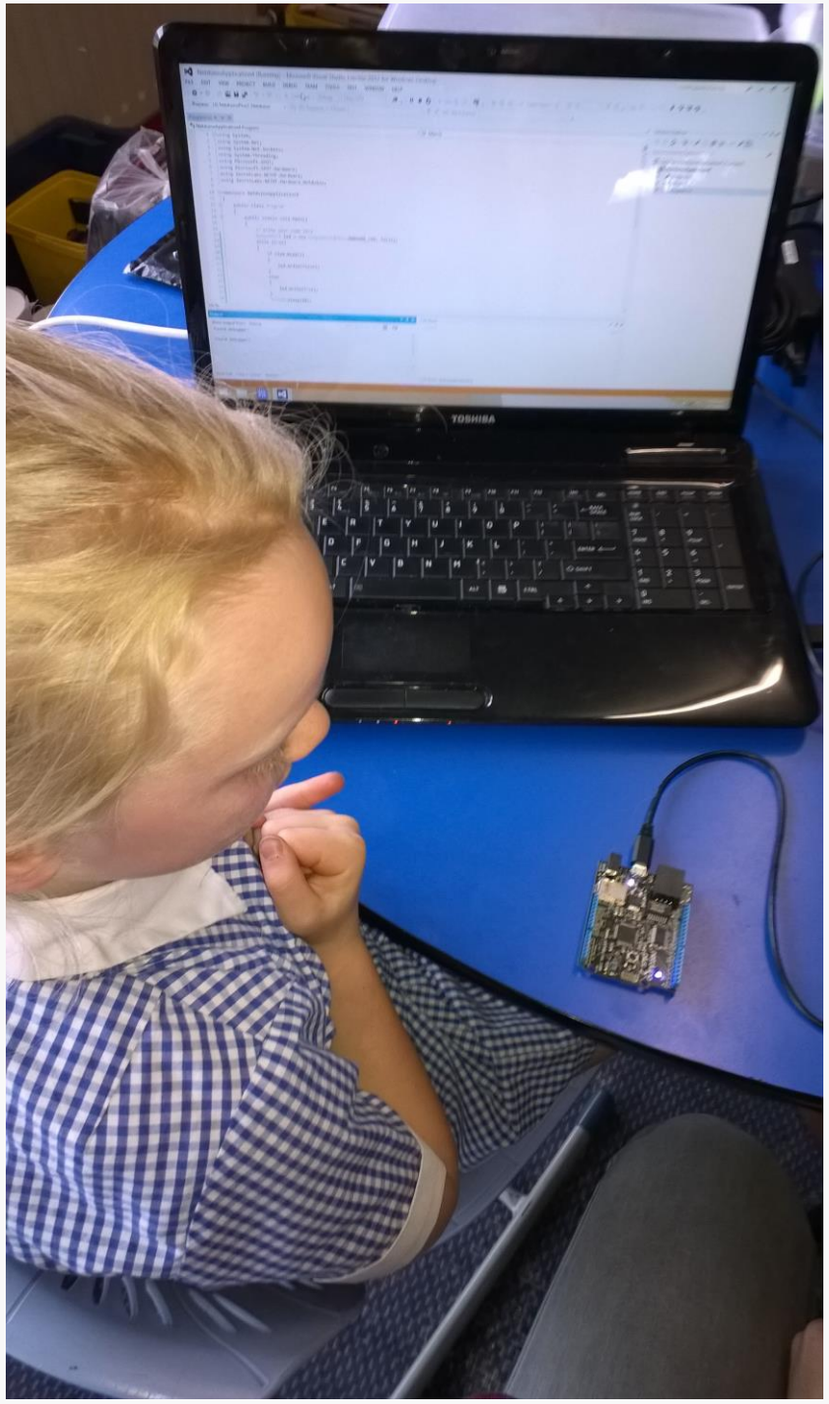


MP3 Player and Pollution sensor
A product is more than code





How young can we go?
They asked if I would come back



Best show n tell sales tool
Students are a lot lighter than me…

Girls only code clubs
It shouldn't be me, but…

- As attendance drops % of girls drops quicker
- What about the pioneers
  - Ada Lovelace
  - Hedy Lamarr
  - Grace Hopper
  - Dame Steve Shirley
  - Megan Smith
- NPR Planet Money - When Women Stopped Coding

My measure of success
One student choosing an IT career…

- Makes me happy
- St Margaret's wants me back
- Several new Burnside projects
- Smart schools project meeting
- Now an Ara contract staff member

Citizen Science & Maker IoT

It started over a beer …

- Could you measure?
  - Temperature and humidity in the canopy
  - Soil temperature and moisture levels
- I could also measure
  - Water flows in irrigation system
  - Power used by irrigation pump & nut drier
- We have some budget
  - Minimal viable Prototype
  - Timeline without any hard deadlines

Blight prevention
Yield and organic certification considerations…

- Sensors in the tree canopy
  - Short season October to Jan
  - Trees are 16yrs old up to 8M tall
- Timing of copper spray application
  - Record sensor data and blight levels in multiple cells
  - Apply spray at different stages to determine optimal
  - Maximum of 3.5KG copper spray per hectare

Drying the walnuts
Harder than it sounds …

2 x 10KW heaters and blower

3 x stacks of 2 bins

Canopy temperature and humidity sensor
It's only got to last 4 months, I can do that

- Sensors in the tree canopy
  - On a pole or hung off a branch
  - Weight, battery power, wireless connectivity
- DIY enclosures
  - Storage Box + 3M Command adhesives
  - Active Electrical Suppliers
  - Glue gun & silica gel packs
- devDuino Sensor Node USD16
  - nRF24L01 range 30M
  - How are we going to get data back to the cloud?

Irrigation management
We have a single moisture sensor for the whole farm…

- Bury multiple sensors in the ground
  - More than just conductivity?
  - Will they survive a wet winter?
  - Portable versions
- Down at ground level
  - Shaded so solar power could be a problem
  - Longer season, maybe all year round
  - The mower…
- Water flow measurement
  - Metric vs. imperial

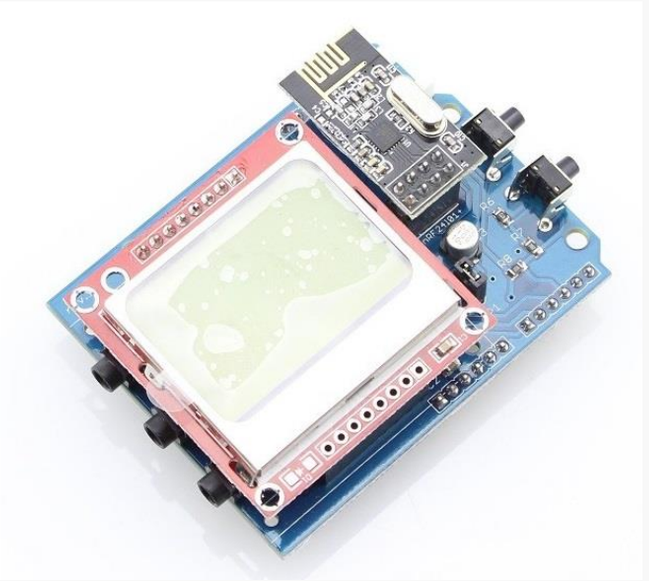
Soil moisture and temperature

That's a bit expensive, how about…

- Soil moisture USD40
  - Trial different types
- Water flow USD16
  - Different pipe sizes
- Seeeduino USD39
  - Lipo battery management
  - External antenna & solar panel
  - IP64 box
- nRF24 shield USD18

Irrigation pump and drier power consumption
At least power for the device won't be a problem

- Non-invasive current sensor USD9.5
  - No need for a sparky
- Arduino clone with LoRaWAN USD39
  - Plug pack power supply
  - Outside aerial
- Energy Monitoring Shield USD23
  - Single or three phase
- Standard electrical fittings and box



My measure of success
They're Family…

- Colin can analyse data in PowerBI or Excel
- Maker economies of scale works for IoT trials
- Shows benefit when
  - Individual cells are compared
  - Compared with neighbour
- Still invited to family events

Quality of Life
This isn't going to end well

The new normal
What can I do to improve it?

- My emotional wellbeing
  - Walked away from job for 7 months
  - No driving for at least a year, walking 16K steps a day
  - 60% of people have one seizure then never again, but I'm not one of them
- Employment
  - OSH requirements
  - Upfront with underlying cause
- Partner and family
  - Where in the world is Bryn?
  - How do we make Bryn feel safe again?

Epileptic Seizure Precursors
That' feels a bit odd

- Measurable
  - Irregular pulse
  - Electrodermal activity
  - Involuntary movement
- Observable
  - Lack of situational awareness
  - Involuntary movements
- Experienced
  - Auditory disturbances
  - Visual disturbances

The watch sensor platform
Thanks mother in-law…

Analysis and notification
I know I can, I'm not sure I can

- Azure IoT Hub for telemetry
  - For a small cohort it's overkill
- Machine Learning vs. Edge computing
  - Close to real-time required
  - Notification jitter and delay
  - Simple algorithm which works on a watch or smartphone
- Security & privacy
  - I really care about keeping my data private
  - Even more important when cohort grows
  - Legislative compliance

More data to improve the training data set
How do I scale detecting a very personal experience

- More seizures
  - I’ve only had 4 or 5
  - Some people have several a day
- More people
  - Grow the cohort to improve detection
- More types of seizure
  - Simple focal seizures
  - Complex focal seizures

Summary
What have I learnt so far

- Battery life is important
- Need more data
- May need better sensors
- Will need additional sensors
- Will need more “volunteers” with different seizures
- Need to learn how to do Xamarin development
- Sensor platform useful for other health problems

Journey continues

Don’t know what it is
Could biopsy but..
Scans every 6 months
Can’t drive for at least year
Can’t get travel insurance for a year

Do stuff that makes me happy

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