Wearables in the Home
for E-Textiles for Healthcare workshop

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Overview

- Introducing myself.

- Why "Wearables at Home?"

- Thinking about opportunities for wearables at home.

- Why wearable proposals fail in peer review.

- Why you should *never* talk to a doctor about your research idea.

- Why you should *never* talk to a patient about your research idea.

- Summing up.

Introducing myself

- Previously Director SPHERE project 2013-2023 (£20M, EPSRC).

- Director CDT in Digital Health 2018-2027 (£7M, EPSRC).

- Director LEAP Digital Health Hub 2023-2026 (£4M, EPSRC).

- Director TORUS Programme Grant 2023-2028 (£8M, EPSRC).

➢ I am an engineer with a decade's experience running projects with clinicians which include a wearable component (but I am not a wearable or e-textile expert).

➢ Also do a lot of peer review and funding panels for EPSRC, NIHR, MRC, etc.

➢ Have worked in industry and also commercialized a medical device.

➢ This is probably a strategy talk for wearable/e-textile researchers **thinking of** developing new wearable technology (pre-commercial/regulatory).
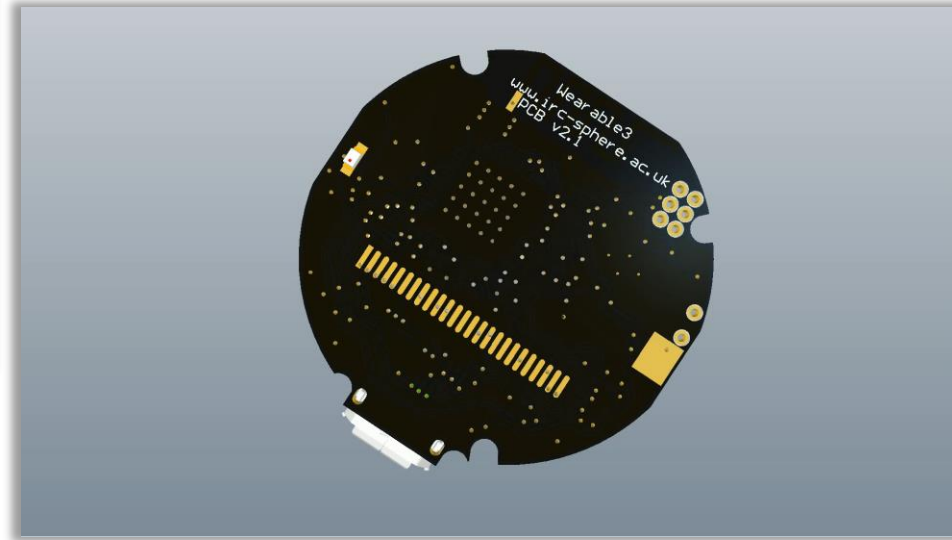
Why "Wearables at Home?"

- All developed countries spend the vast majority of their health & care budget on long term ("chronic") health conditions **(e.g. ~75% in the UK, ~£120Bn per annum)**.

- Examples include: depression, anxiety, dementia, Parkinson's disease, heart disease, diabetes.

- These are conditions that last for years or decades and can't be cured or managed in hospital.

- These patients are generally in the community and usually living at home.

- The more ill they are, the more likely we are to find them at home.

- An obvious opportunity for wearables (and e-textiles).

Opportunities for Wearables at Home

- Research
  - Understanding causes of illness/risk factors
  - Measuring effectiveness of treatment
- Prevention
- Early detection
- Management/Treatment/Therapy:
  - Facilitating remote consultation
  - Monitoring disease progression
  - Alerting/predicting a worsening of the patient's illness
  - Prioritising service delivery
  - Monitoring/adjusting/personalising physical/pharma/talking/music therapy
- Prehabilitation (before surgery)
- Rehabilitation (e.g. after surgery)

> Even for a given disease, these are all **completely different** uses
> How to assess these opportunities?
> Where might your technology fit?
> Given your skillset, what could you develop?

Perspectives on Wearables at Home

In the home/community environment ….

1 Wearables (and e-textiles) do not need to be an end-to-end or complete solution.

2 Wearables (and e-textiles) present complex and weighty user/social challenges.

3 Technology autonomy is key.

1 Wearables (and e-textiles) do not need to be an end-to-end or complete solution.

Homes are commonly- and easily-networked (not just WiFi, but BLE etc).

The wearable/e-textile is probably the most resource-constrained device in the home (energy, storage, bandwidth).

Opportunities which may completely change the requirements for the wearable:

Offload computation (comms/compute trade-off).
Distributed machine learning.
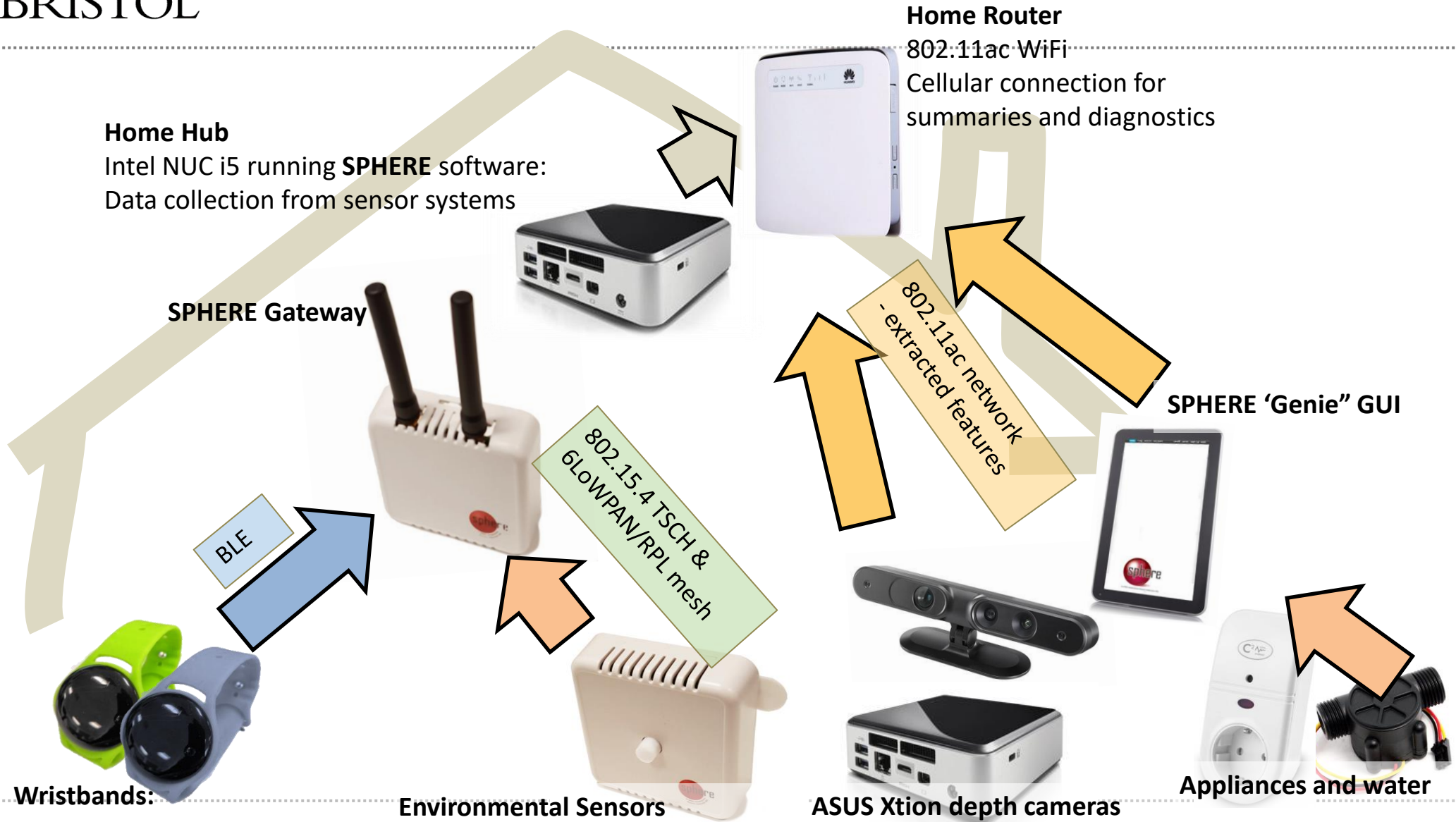Mission- and context-awareness to optimise the wearable.
Data fusion with complementary modalities (e.g. wearable/smartphone, wearable/PIR, wearable/video etc).
Supervision/annotation, ground truth.

Challenge:

Much of the above will be outside your technology skillset.

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Home Router
802.11ac WiFi
Cellular connection for summaries and diagnostics

Home Hub
Intel NUC i5 running **SPHERE** software:
Data collection from sensor systems

SPHERE Gateway

802.11ac network - extracted features

SPHERE 'Genie' GUI

BLE

802.15.4 TSCH & 6LoWPAN/RPL mesh

Wristbands:

Environmental Sensors

ASUS Xtion depth cameras

Appliances and water

2 Wearables (and e-textiles) present complex and weighty user/social challenges.

Placing a technology on a person is inherently intrusive.

Technology on a person always sends a social signal.

Compelling cost/benefit to the user is important **otherwise they won't wear it** ->

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e.g. opportunity

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- Recently-funded project (EPSRC, Bristol & Newcastle Univ).
- Wearable + video for **measuring the effects of new treatments for Parkinson's Disease** in the home (drugs trials) over months.
- Replacing highly subjective, snapshot, in-clinic assessment.
- Why this application?
- Patients: Specifically-consented, highly-motivated, well-resourced, highly-managed cohort.
- End users: Statisticians and trial managers with time to look at the data.

3 Technology autonomy is key.

Unlike a hospital ward or University, there is no IT support department at home. Long term maintenance of technology is a very important consideration (charging, downloading, washing, configuring, troubleshooting, connecting, annotating).

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Other things I wanted to mention:

- Professionals can be end-users for your device (e.g. nurse on the intensive-care nightshift).

- Some professionals have louder voices than others (consider important needs that could be articulated by nurses, allied health professionals, dentists, GPs, paramedics).

- Consider also talking to NHS commissioners and finance directors.

Summing up and advice

- "Wearables at home" implies immense multidisciplinarity:
  - wearable, wireless comms, energy, machine learning, video.
  - design with users (HCI, fashion, social science).
  - clinical input.
- Consequential high risk of downstream failure due to 1. choosing the wrong target *and* 2. not having the right skillset to match a potential technology to the target.
- Many of projects (fortunately) fail at peer-review (or when pitched to investors)/
- **Never** talk to a doctor about your research:
  - Talk to ten, on at least three occasions.
- **Never** talk to a patient about your research:
  - Talk to ten, on at least three occasions.

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An invitation

leap-hub.ac.uk: workshops, funding, fellowships, training and networking for Digital Health in the South West.

Add yourself to the mailing list on the website to receive notifications about those opportunities this year.

Thank you

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