The vision of SPHERE is to impact a range of healthcare needs simultaneously by employing data-fusion and pattern-recognition from a common platform of non-medical networked sensors in a home environment.

In order to realize this vision, SPHERE will advance the state of the art in key areas:

- ultra low power wireless communications.
- on-body energy harvesting (for battery-free sensors).
- video analytics in unconstrained environments.
- extraction of meaning from complex uncertain datasets.
- the understanding of user/technology interaction.
As Director, I’m charged with leading this project for 5 years. This may sound like a weighty responsibility (and indeed it is), however in truth it feels more like an exciting journey; every week brings a new and perhaps unexpected opportunity to collaborate, a challenging point of view or a moment of genuine discovery.

At the end of our first year, we would like to share with you some snapshots from our journey so far; some technology (of course), but also the new friends we met along the way, the surprises we encountered and some glimpses of the terrain ahead.

I thank the SPHERE team for their excellent endeavours to date; I challenge them to exceed those achievements in 2015.

Professor Ian Craddock
Highlights

- Bristol University and Reading University collaborating on the design of an ultra-low power “smart watch”, currently being manufactured.
- Southampton and Bristol generating designs and design rules for powering devices on the human body.
- The development of 3D camera software to analyse quality of movement.
- More than 120 people from Universities, the NHS, schools and private companies apply to join our wearable competition, launched by the President of Singapore.
- Adding capability to the original proposal by acquiring a “SPHERE House” – thanks to additional support from the University of Bristol, University of West of England and Toshiba.
SPHERE is a growing community. The following people are examples of collaborators, not originally involved as investigators in the project, who started to work with us this year.

**Professor Madeleine Murtagh, Social Scientist, Data to Knowledge Research Group**
“SPHERE affords a fantastic opportunity to develop our theoretical concept Responsible Governance. This approach to research and innovation involves working with researchers, the public, clinicians, industry and other stakeholders to ensure the alignment of science with social norms and values and thereby support ethical research practice alongside positive, sustainable and measurable research impact in society.”

**Dr Nicholas Timpson, Genetic Epidemiologist, MRC IEU**
“The absence of well characterised, reliable and large-scale measurement impairs nearly all epidemiology. With the SPHERE house we have a unique opportunity to undertake a world leading experiment into the use of detailed measurements as a useful contribution to the day to day lives of the population at large. This will allow basic scientists to stage otherwise impossible, longitudinal, experiments to help us understand our lives in real time.”

**Professor Sarah Purdy, Deputy Director NIHR CLARHC West**
“I think there is great potential to work with the SPHERE team to develop new techniques for the self-management of long term conditions and thereby improve health outcomes across the West of England.”

**Dr James Dodd, Clinical Lecturer in Respiratory Medicine**
“SPHERE provides a unique opportunity to help people suffering long term respiratory conditions, in particular Chronic Obstructive Pulmonary Disease (COPD). I am part of a team of doctors and academics from the North Bristol Lung Centre and Academic Respiratory Unit at the University of Bristol - I am working with SPHERE on the early detection of changes in respiratory symptoms, reducing hospital admissions and supporting self-management.”

**Professor Janice Kiely**
**Director, Institute of Bio-Sensing Technology, UWE**
“SPHERE gives us the opportunity to trial a range of novel biosensors in a realistic environment. One key area of interest is testing new sensors for a ‘smart toilet’ aimed at allowing people to monitoring their own health. In addition, engaging with the SPHERE project widens our horizons and enables us to meet researchers who have complementary skill sets.”
Sensor systems should be autonomous – able to operate unobtrusively and without human intervention. Battery replacement or charging is a huge obstacle to this concept. SPHERE has a substantial program of work in on-body energy harvesting, aimed at eliminating batteries from wearables, and on the efficient management of small amounts of power.

This work includes novel ferroelectret and triboelectric fabrics able to generate energy from movement, inductive power transfer to textile coils and 2.45 GHz RF power transfer.

Typical wireless sensors consume far too much power to be supplied by energy harvesters (or by wireless power transfer). This poses a fundamental challenge for the sensor – sensing, processing, storing and communicating a sensor reading using one hundred thousandth of the power of a mobile phone.

This is the printed circuit board layout of the very first SPHERE wearable – in manufacture at the time of writing.

**SPW-1 Specifications:**
- Dimensions 24x39mm
- Ultra-Low Power Design
- Dual Accelerometers
- Efficient PCB Antenna
- Energy-Harvesting Ready
- External Sensor Support

Research leads: Dr Bernard Stark (Electrical Energy Management Group, Bristol), Prof. Steve Beeby (Southampton), Dr Rob Piechocki (Comms Systems & Networks, Bristol), Prof. William Harwin (Cybernetics Research Group, Reading).
These inexpensive wireless sensor modules (shown here being tested before deployment in the SPHERE house) will monitor room occupancy, light levels, sound levels, temperature and air quality. Combined with electricity and water monitoring, this part of the SPHERE sensor system provides baseline information on activities of daily living from more than 65 sensors in the home.

Considerable work in SPHERE this year has focussed on the design of autonomous systems for tracking people in the home, and developing a statistical framework for assessing the quality of habitual movements (walking up stairs, for example).

This type of pervasive video analysis is a great opportunity for SPHERE since very few projects have conceived such “in the wild” deployments of video cameras. The potential for novel, challenging, research is therefore very high.

Modern consumer video systems are extremely powerful but not designed for these applications. This is a challenge for the team.

Research leads: Dr Dritan Kaleshi (Communications Systems and Networks Group, Bristol), Prof. Majid Mirmehdi (Visual Information Laboratory, Bristol).
The ‘user’ is at the core of the SPHERE project and one of our key activities is understanding different people’s experiences of technology and healthcare, focusing in particular on their expectations, motivation, and perceived barriers.

Dr Alison Burrows (pictured) is currently carrying out ethnographic interviews, including walking interviews that allow her observe, experience, and make sense of participants’ everyday experiences. Questions focus on three areas: home in general, home-technology and healthcare at home.

The participants will join focus groups that will be invited to visit the SPHERE house and provide crucial feedback on the first pilot platform.

The study aims to include people with different personal characteristics that may impact upon technology and healthcare-related behaviours.

Research leads: Dr David Coyle (Bristol Interaction and Graphics group) and Dr Rachael Gooberman-Hill (School of Clinical Sciences).
Public Engagement

The SPHERE public engagement strategy has three key aims;

• To enable public and user views to feed into the strategic thinking and development of all stages of the SPHERE project to maximise the impact and excellence of the project.
• To disseminate information about the project to raise awareness and interest and to give the opportunity for more people to engage in the process.
• Explore and respond to ethical questions raised by the SPHERE project.

SPHERE has two Public Advisory groups; a group made up of professionals with a background in social care and other professions that involve working with people in their homes, and a group attending in a personal capacity. SPHERE research is continually informed by the opinions of the members of our Public Advisory Board.

SPHERE, supported by Knowle West Media Centre, has been participating in public events around the city including:

Talking to over a 100 elderly Bristol residents at Bedminster Old People’s Forum, Linkage Older People’s forum, Celebrating Age. In general new technologies for health are seen as a positive development in the area of self-management of disease, the main concern was that we must not lose the human interaction and support offered to people with health issues.

Bristol has always been a city that supports events that raise awareness of science and innovation. SPHERE participated in the Festival of Nature - an event attended by more than 10,000 people over the weekend. A ‘Lego house’ was created using sensors which was a talking point for children and adults alike. Also a prototype video analysis algorithm was used to measure balance of members of the public.

Researchers participated in Bristol Bright Night a European Union funded initiative to which gives the public the chance to meet researchers and find out about their latest discoveries in more than 300 cities.

SPHERE has been working with two Bristol schools, teaching coding to groups of children in preparation for the Dress/Sense competition.
Contact us

If you are interested in SPHERE, attending our events, a potential collaborator or even think that you might wish to be a participant in one of our studies, we would love to hear from you!

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