EXCEPTIONAL RESEARCH THAT MAKES AN IMPACT

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CASE STUDY: INTERNET OF THINGS IMPROVES AVAILABILITY OF CRUCIAL HOSPITAL EQUIPMENT

Against the backdrop of the Covid-19 pandemic – which put significant pressure on healthcare systems worldwide – researchers from the Institute for Manufacturing, University of Cambridge, have shown how the Internet of Things (IoT) can support hospitals in making efficient use of non-critical equipment.

THE CHALLENGE

As the transformative effects of Industry 4.0 bring digital transformation to every sector, the healthcare industry is no exception.

By integrating digital technologies such as the Internet of Things (IoT) into hospitals, there are huge opportunities for healthcare professionals to dramatically enhance patient care, save staff time and reduce costs by automating non-critical support tasks. This is particularly important in light of the Covid-19 pandemic which has placed a severe strain on the UK National Health Service, with large and rapid changes in demand for inpatient care. In addition, it has been recognised that in such unprecedented times, a digital transformation at different levels within in the NHS is important to deliver [1].

However, there are several perceived challenges facing healthcare organisations who wish to benefit from digital solutions. Digital solutions can seem over-complicated and over-developed and can be perceived as expensive and risky, requiring significant initial investment and ongoing operating costs.

THE RESEARCH

Using solution development guidelines from the **Digital Manufacturing on a Shoestring** project, the team looked at ways in which low-cost solutions, typically used in UK manufacturing small- and medium-sized enterprises, could be repurposed for non-critical IoT-based support in hospital environments.

Shoestring delivers a toolbox of modular solutions that can be readily adopted by small and medium-sized manufacturers, using off-the-shelf, affordable technologies. The solutions incorporate low-cost industrial and consumer components (such as Raspberry Pis) and low-cost sensors (such as Bluetooth low- energy beacons, off-the-shelf sensors and motion cameras), combined with existing cloud computing platforms, human-machine interaction (low-cost AR/VR technologies) and openly available IoT suites.

To find out whether these solutions could be applied in a healthcare setting, the team worked alongside Addenbrooke's Hospital (Cambridge University Hospitals) to carry out interviews with clinical engineers, clinicians, nurses, and other healthcare professionals. This helped the team understand the hospital support process challenges related to equipment maintenance, logistics and facility management.

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Interesting findings from the interviews revealed that it was particularly important for hospital staff to have better visibility of where individual pieces of equipment were located; how much they were being used; and, knowledge of whether equipment was defective and/or required servicing.

By establishing what digital solutions already existed, and what could be adapted, the team developed a list of possible demonstrators from the manufacturing domain, which could be easily repurposed for hospitals. Because Shoestring solutions in manufacturing are peripheral to the manufacturing processes, i.e., they are add-on, non-intrusive solutions, the team applied these characteristics to the hospital domain, ensuring any demonstrator would be peripheral to staff activities and not patient facing.

The result was the development of a low-cost IoT prototype that monitored the monthly utilisation in hours of healthcare equipment for maintenance purposes. Using IoT sensors to monitor how much a medical device (such as a blood pressure monitor) was being used, the prototype would enable hospital staff to identify when it might need servicing or replacing.

"There's been some talk about putting sensors into machines to detect when they are powered up and in use and record this information somewhere so we can actually monitor whether or not that piece of equipment is running or sat on a shelf doing nothing in a ward. Something that would tell this would be fantastic." Clinical engineer, Addenbrooke's Hospital.

The approach used by the team to develop the prototype could be used to further explore how to identify and reuse other types of manufacturing low-cost digital solutions in healthcare settings. For example, thermometers reporting temperature remotely.

THE IMPACT

This research has shown how using IoT to automatically monitor hospital equipment can increase its availability and proper management, crucial for automating maintenance relates tasks, which is particularly important in the light of the ongoing COVID-19 pandemic.

"This project demonstrated the ease and robustness with which IoT technologies in the manufacturing industries can be repurposed for hospital environments. We are looking forward to identifying further crossover areas between the two seemingly unrelated domains of manufacturing and healthcare." Anandarup Mukherjee, Research Associate, Institute for Manufacturing, University of Cambridge.

The project has accelerated further developments of low-cost manufacturing solutions that can be adapted for the healthcare environment. For example, temperature monitoring in fridges and stock rooms to prevent stock wastage. Other examples trialled in Cambridge University Hospitals include a digital solution for enabling dilat traceability while saving time expenditure on administrative tasks as well as a digital food menu solution for a speech and language therapy ward.

It is hoped that the project will contribute to the development of a research proposal to national funding bodies to enable more hospitals to identify their needs, and adopt and benefit from existing low-cost digital solutions that address these needs.

[1] **https://www.nao.org.uk/wp-content/uploads/2019/05/Digital-transformation-in-the-NHS.pdf**

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PROJECT AND TEAM

M26: IoT-based Devices for Non-critical Support in Hospitals

Professor Duncan McFarlane, Dr German Terrazas, Dr Florian Urmetzer and Dr Anandarup Mukherjee, Institute for Manufacturing, University of Cambridge; Ewen Cameron and Dan Northam-Jones, Addenbrooke's Hospital, Cambridge University Hospitals.

PITCH-IN

Pitch-In aims to collaboratively identify and address barriers to the successful development, introduction and further exploitation of Internet of Things technologies across four key sectors, Cities, Energy, Health and Wellbeing and Manufacturing, whilst also overcoming the social and organisational barriers related to managing the introduction of IoT. The project is funded until 2021 through Research England's **Connecting Capability Fund**.