



The TRIL Centre's BioMOBIUS™ Research Platform: An Open, Shareable Hardware and Software System

In a clinical laboratory in St. James's Hospital in Dublin, Ireland, an older woman walks along a mat that is embedded with motion sensors. The woman, who has experienced a recent fall, is also wearing several wireless sensors that monitor her heart rate and the motion of her limbs as she walks across the room. Small video cameras placed around the room also track her movement.

As data is captured by the sensors and cameras, it is processed and streamed to a nearby computer. The computer screen displays a continually changing graph indicating irregularities in the woman's gait that could lead to another fall—and a costly hospital stay. The clinical researcher viewing the screen asks the woman to slow her pace. Her gait becomes more regular and her heart rate slows. The clinician ends the experiment, gives the woman feedback on the results, and together they review a rehabilitation plan to help the woman improve her gait and hopefully, prevent another fall.

Scenarios such as the one above unfold on a regular basis at a clinic in St. James's Hospital in Dublin, Ireland, enabled by the TRIL Centre's BioMOBIUS™ Research Platform. The BioMOBIUS Research Platform is a combination of hardware, sensors, software, services, and a graphical development environment that enables therapists, clinicians and engineers to rapidly deploy technology solutions for biomedical research. The BioMOBIUS Research Platform supports the application needs of a broad range of stakeholders, from non-technical end users (such as older people) to hardware and software engineers.

Applications built using the BioMOBIUS Research Platform can be deployed in a wide variety of settings, from the clinical lab to the home. A typical application comprises wireless sensors that monitor markers such as gait stability, heart rate, and alertness; processing functionality, which converts the sensor data into meaningful information; and a user interface, which enables the clinician to view the information and adjust application settings (for instance, to increase or reduce the frequency of sensor data collection).

The BioMOBIUS Research Platform was developed by the TRIL (Technology Research for Independent Living) Centre— a groundbreaking research collaboration, jointly funded by [Intel Corporation](#) and the Irish government, to explore technology to help older people to continue living independently in the homes of their choice. Intel and the [Industrial Development Agency \(IDA\) Ireland](#) launched the Centre in 2007, jointly investing \$30 million in this three-year research initiative involving researchers from Intel, [University College Dublin](#), [Trinity College Dublin](#) and [National University of Ireland \(NUI\) Galway](#).

The first version of the BioMOBIUS Research Platform was released on 22 April, 2008 and is being made freely available to the research community by the TRIL Centre. It can be downloaded at biomobius.trilcentre.org.

Reusable, Extensible

A key challenge in health care research is the amount of time that must be devoted to technology development. 'In a typical research project, 50 percent of a researcher's time may be spent creating the foundational technologies required to get to the point of collecting data,' says Dr. Aaron Quigley,

the Academic Principal Investigator for the TRIL Technology Platform research strand. 'Every researcher has to essentially reinvent the wheel. That's inefficient, and it stalls research progress.'

The BioMOBIUS Research Platform addresses the problem by enabling researchers to leverage previous technology development efforts. The BioMOBIUS Research Platform is reusable and extensible, with an open architecture. The underlying model relies on the use of discrete functional components or 'blocks' of code that perform certain tasks. Blocks can be reused or reconfigured to create new applications. This allows researchers to spend more time focusing on their research and less on developing technology. The first release of the BioMOBIUS Research Platform includes roughly 40 blocks that users can access to build applications, and anyone can build new blocks that others can reuse, modify and extend.

Simple, User-Friendly

The BioMOBIUS Research Platform addresses another challenge that researchers face: the complexity of sensor software. 'Much health care research relies on wireless sensing capability to collect data, but the software that comes with the wireless sensors usually is esoteric and quite difficult to use,' says Michael McGrath, the Industrial Principal Investigator for the TRIL Technology Platform research strand. 'You have to be a specialized programmer to use the software effectively, due to its complexity.'

The software component of the BioMOBIUS Research Platform is complex too, but the complexity is hidden from most users. The software is based on the EyesWeb graphical development environment, created at the University of Genoa, and it makes the process of creating an application intuitive. The user drags and drops icons (blocks) onto a palette. Each icon represents an input (e.g., motion data or heart rate), output (e.g., a display of a graph) or processing function. The user connects the blocks in the required order of execution to create an application. Even non-technical users can develop simple applications in a matter of minutes.

The technical requirements to use the BioMOBIUS Research Platform are modest. Running the BioMOBIUS Research Platform requires a medium- to high-specification PC or notebook computer (it runs on any x86-32 bit PC running Windows XP, but it works best with a multicore CPU). There is plenty of support at the BioMOBIUS Research Platform website (biomobius.trilcentre.org) for users who need it, including a discussion forum, documentation, guidelines and tutorials.

The BioMOBIUS Research Platform provides support for a variety of hardware, via wired and wireless interfaces. Default blocks are supplied to support a wide range of generic hardware devices (e.g., TCP/IP, Serial, and WDM camera devices). The BioMOBIUS Research Platform also currently supports the SHIMMER (Sensing Health with Intelligence, Modularity, Mobility and Experimental Reusability) family of wireless sensors, developed by Intel's Digital Health Group, as well as Tactex Controls Inc. sensor products.

While the BioMOBIUS Research Platform is designed for ease of use, some engineering support likely will be required to configure and test new applications. In addition, non-technical users who want to develop new blocks will need the help of a software developer to write appropriate code (C++).

BioMOBIUS Research Platform Applications

Today the BioMOBIUS Research Platform is being used primarily by TRIL researchers to help clinicians detect and prevent or ameliorate certain conditions related to ageing, such as falls and cognitive decline, and to help older people to strengthen their social connections. Among other applications developed using the BioMOBIUS Research Platform, TRIL researchers have created a neurological monitor, gait analysis and sleep quality applications, and a falls data capture solution involving the use of USB cameras.

Researchers within and beyond TRIL have shown a strong interest in developing other health care applications as well, including in-home diagnostic tests to identify biomarkers of diseases, such as diabetes and heart disease. Beyond health care, the BioMOBIUS Research Platform can be used for a range of applications that require wireless capture and processing of sensor data, such as sports science applications.

An Expanding Ecosystem

In 2008, applications developed in the lab using the BioMOBIUS Research Platform will be tested in a small number of homes. The TRIL researchers will apply the results to further refine the prototypes

and inform their research. The test results also can be used by clinicians to make informed recommendations to the healthcare and/or social services agencies who serve the older people participating in the pilots.

The establishment of the TRIL Centre and launch of the BioMOBIUS Research Platform have put Ireland in the forefront of research into ageing and independent living. An ecosystem of activity has been growing steadily around TRIL, with the Irish business community, Irish universities, and multinationals such as Intel collaborating to provide research and technology leadership in this important domain.

The TRIL researchers hope that the ecosystem will grow and expand beyond Ireland. 'We're anxious to have researchers around the world embrace the open BioMOBIUS Research Platform,' says McGrath. 'We want to build a global community of practice, with people creating and sharing new blocks and applications that others can use, so we can accelerate research progress.' As future versions of the BioMOBIUS Research Platform are released, TRIL plans to host a series of national and international workshops to promote the platform.

'The TRIL Centre is only scratching the surface of what we can do with the BioMOBIUS Research Platform, especially to empower older people,' says Quigley. 'Today there are 600 million people over the age of 60, and the UN projects that this figure will grow to almost two billion by 2050. Home-based applications that use the BioMOBIUS Research Platform could potentially help those two billion people to monitor their own health, remain in their own homes, and maintain their independence for as long as possible. That's a huge opportunity to do good in the world.'