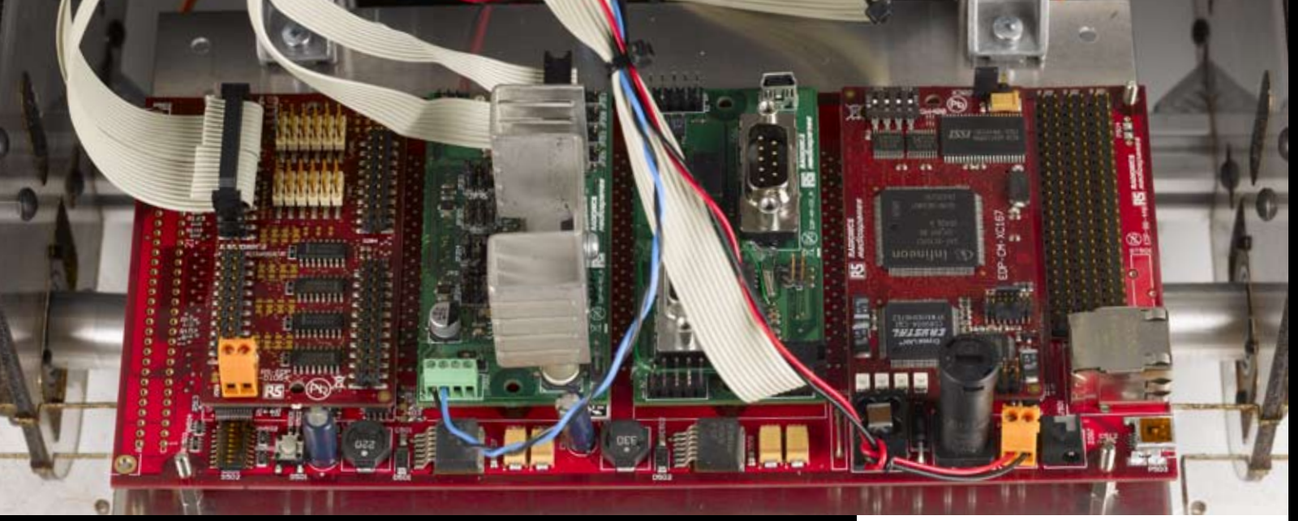


"The basic software and simple motor tests were up and running surprisingly fast, almost 2 to 3 days ahead of conventional methods"

The implementation

The first robot that NeuroRobotics developed with the RS EDP required two motor drives and quadrature encoders; an obstacle sensor processing over an I2C bus; a 16 bit processor that was fast enough to run various motor control and navigation algorithms; and suitable software tools that enable coding, debug via JTAG and flash download facilities.

NeuroRobotics chose the following components of the RS EDP:

- EDP Base Board
- EDP Motor Control application module
- EDP XC167 CPU module based on the Infineon 16 bit Microcontroller
- EDP Basic comms application module
- Keil uVision 3 software tools

NeuroRobotics installed the software, plugged in the modules, wired the robot motors and sensors and started testing some basic code within 2 hours of receiving the kit. Technical questions relating to the hardware and software, along with support on the C software libraries, were dealt with swiftly by a combination of online support material and RS engineers. "The basic software and simple motor tests were up and running surprisingly fast, almost 2 to 3 days ahead of conventional methods" said Simon Morrison, Managing Director of NeuroRobotics. "The Keil software development tools are extremely professional."

The novel mapping technique of the EDP baseboard enabled NeuroRobotics to quickly switch and test the EDP STR912 CPU module based on the ST Microelectronics STR912 Microcontroller. This technique forms the core of the EDP Virtual CPU concept, which allows several different processor modules to appear functionally transparent in terms of the various buses and power lines.

"The large number of processor-based electronics that exist inside research-based robotic systems stand to benefit enormously from the EDP Virtual CPU concept. This concept means that application modules designed to the RS EDP specifications can access specialised processor cores," said Morrison.

RS provides the Gerber files on an IP-free basis, enabling designers to develop a rich variety of application modules. This also means that if a module isn't available, designers can customise their own.

Why NeuroRobotics chose RS

In a market flooded with countless embedded hardware and supporting software tools, the prospect of yet another system for the robotics engineer to evaluate, learn and gear up for was not an attractive proposition for NeuroRobotics. From a business perspective, the cost of the engineers learning a new system, purchasing new kit, migrating existing hardware & software, and the associated risk with an unknown and untested solution created a barrier to change.

"After reviewing the new RS EDP, it became clear very quickly that this was a new concept. From a purely commercial perspective, this concept can save the company money, time and deliver substantial value-added functionality and performance to help boost profits," said Morrison. "From a purist robotics perspective, this system opens doors to more rapidly develop the robotic system. This is because upon closer examination, a large number of the factors affecting the choice of hardware are weighted in favour of the RS EDP."

"If RS continue to develop this system and furnish the engineer with an extended range of application modules, offer further software tools and continue on the path to developing a more structured set of documents and technical support base, then this system could become the choice for designers on a large scale," said Morrison.

NEURO ROBOTICS LIMITED

NeuroRobotics case study

The RS Embedded Development Platform (EDP) helped:

- Save the cost of purchasing multiple manufacturer specific development kits
- Save the time and cost of constructing application circuitry
- Ease the integration of unfamiliar and new technologies

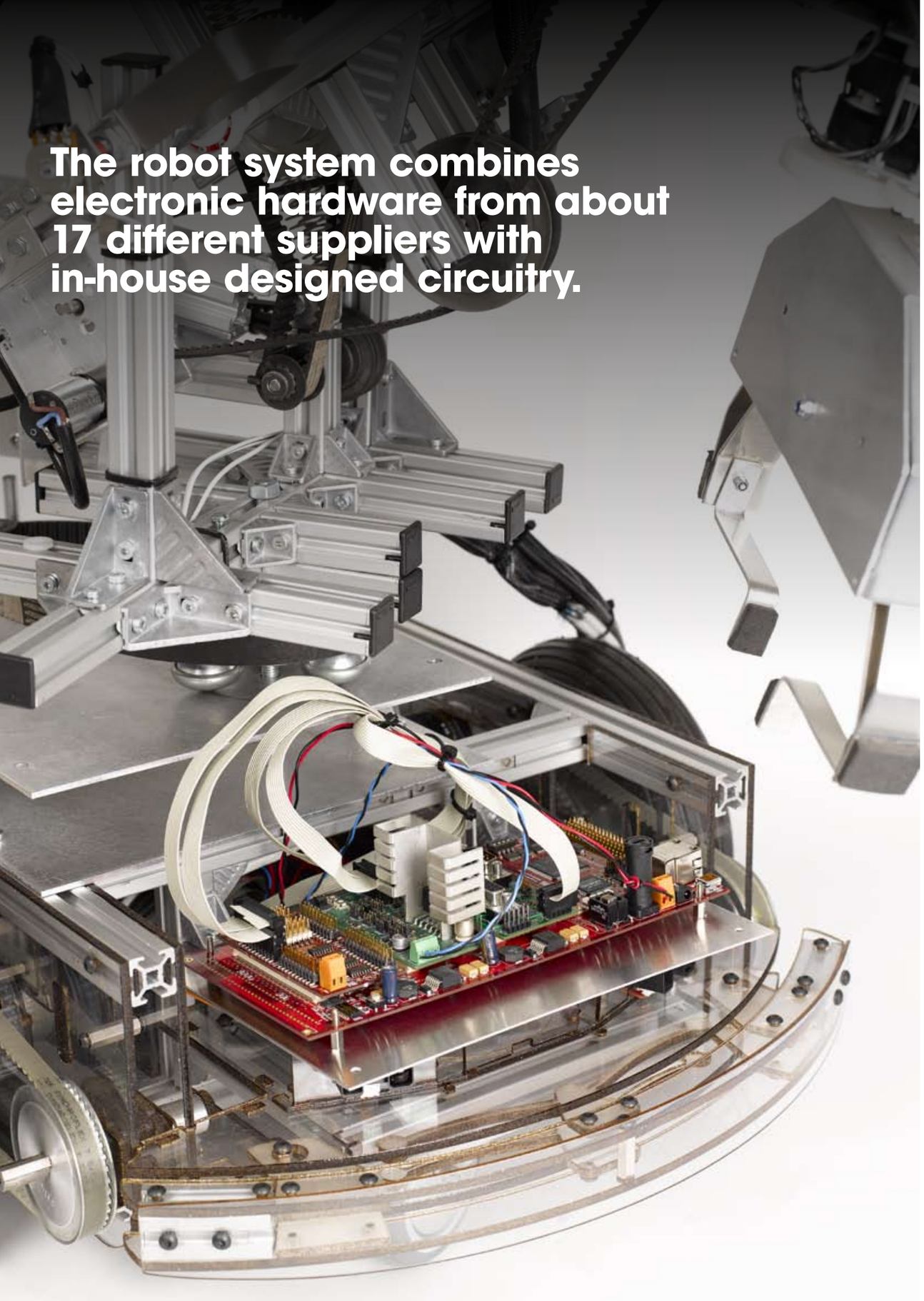
Robotics is a rapidly growing and exciting field that spans most areas of science and engineering.

Established in 2005, NeuroRobotics is an emerging company engaged in robotics research and commercialising several unique robotic designs. The company focuses on telerobotic systems, customised manipulators and haptic interfaces[1] for the service industry. NeuroRobotics works in close partnership with various universities and international partners, including Sussex University Centre for Computational Neuroscience and Robotics (CCNR).

A typical robotics research platform that NeuroRobotics would design and manufacture incorporates many electronic, mechanical and software subsystems that interact tightly within a continually changing and uncertain environment. This complexity poses considerable technical and commercial challenges relating to design flexibility, development time, required skills and cost.
The robot they have recently developed using the RS EDP is to be used in hazardous environments, like bomb disposable.
The arm mimics human hand and arm movements and swivels a full 360 degrees.

Challenge: Inflexible components lead to high costs and long timelines

Each robot that NeuroRobotics designs for its highly specialised research and development work comes with its own distinct configuration of sensors, actuators, communication tools, HMIs and other electronics, which then need to be integrated and connected with specific circuits. This introduces a huge amount of complexity.



The robot system combines electronic hardware from about 17 different suppliers with in-house designed circuitry.

The robot system combines electronic hardware from about 17 different suppliers with in-house designed circuitry. Each circuit uses a specific type of connector and fixing method, so there's a good deal of complexity involved in configuring the cables and connector arrangements. Add to this the fact that each processor-based unit invariably runs on a unique operating system and comes with its own software development kit and debugging tool.

In many respects, building a robot is like conducting an orchestra. In order for the robot to function harmoniously, several levels of software provide instructions to the hardware sub-systems' architecture, whose topology can be hierarchical, flat, distributed and centralised - or a mix of these. The resulting system will incorporate a large number of electronic circuits that need to be powered and communicate with each other.

Each application circuit and sub-system needs to be tested and validated for "fitness" within the whole system, as an incompatible component could compromise the entire system. All possible configurations need to be rigorously tested making the process very tedious and time consuming. Before the RS EDP, this testing took an additional 30 hours per robot. Also, the need to purchase different development kits and components makes the whole affair very expensive.

"After reviewing the new RS EDP, it became clear very quickly that this was a new concept. From a purely commercial perspective, this concept can save the company money, time and deliver substantial value-added functionality and performance to help boost profits"

Challenge: Multi-disciplinary technological demands

Robotics development requires a multi-disciplined engineering team competent in:

a. Mechanical engineering
b. Software engineering
c. Artificial Intelligence
d. Electronics & Electrical Engineering
e. Mathematics
f. Dynamics & Statics

Focusing in on the software engineering aspect of robot design, even more complexity exists. Systems may be programmed in C, Basic, Java or a combination of several languages. Some may be configured in different modes with software; some would use jumper switch configurations and some DIP switch settings. Once the system is wired up with all the necessary power and communication cable looms, some software development takes place on a Windows platform, while the rest may take place in a DOS shell. A myriad of device drivers and software tools then need to be installed in the right configuration (some are incompatible with others) and in the correct order. Unless a firm has a multi-disciplined team dedicated to each subsystem, the high-level architect is often the only person who knows the intricacies of the entire system.

Setting up the electronic circuits is another daunting challenge that designers face. During development and debug, electronic circuits sometimes need to be removed in order to debug or modify jumper switches. This can be problematic if the designer needs to access multiple connectors and cable feeds for I2C, SPI, analogue power, digital power, Digital IO, RS232, JTAG debug terminals and an array of motor and sensor wiring. Apart from the EMC challenges of such a setup, frequent unplugging and plugging in of connectors can result in static damage, poor connections, strain on the PCB and there is also the risk of plugging the wrong connector into the wrong socket.

The solution – A universal platform and a library of IP free software codes

The RS EDP eliminated many of these 'administrative' challenges, enabling NeuroRobotics to focus their skilled resource on developing the robotics application. Here are three of the many benefits they reaped:

Saving development time:
Usually, designers would have had to start by selecting several different microcontrollers and purchasing their corresponding development kits in order to test and identify the optimum microcontroller(s) for each design. With the RS EDP as a universal platform and the ability to 'plug and play' different microcontrollers, the design development time was reduced by approximately 45%.

Flexibility from manufacturer and technology:
Designers were now able to use and combine microcontrollers and application circuitry from an array of manufacturers from the RS EDP portfolio. NeuroRobotics were able to plug-in different microcontrollers for test on a common platform without having to change other parts. Additionally, the flexibility to choose the optimum application circuitry from the Application Modules portfolio significantly lowered their costs as well.

Overcomes the barriers of technical expertise:
Today's robotic engineers have to increasingly have a broad range of skills. The RS EDP comes with different options for Computer and Application Modules which helped NeuroRobotics' designers to grasp and adopt new hardware technologies more easily. The RS-EDP centre also includes a library of code-software available for free download as well as full application examples. These provide a base for designers to quickly focus coding for their specific applications.

[1] Haptic technology refers to technology which interfaces to the user via the sense of touch by applying forces, vibrations and/or motions to the user. [Wikipedia]