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Australian Researchers Hit Winning Note with Robot-Operated Clarinet

A NICTA/UNSW team has won a significant international technology award, winning first place in the ARTEMIS Orchestra competition in Athens with a robotically operated, computer-driven clarinet.

The NICTA/UNSW project, led by NICTA's Dr John Judge, developed the clarinet-player over the last eight months. According to Dr Judge, his team won first place due to the high level of technical difficulty in the design of its robot "mouth", and the device's unique, completely embedded computer system. The clarinet works without an attached PC, the human interface achieved via USB attached keyboard, LCD screen and LEDs.

"The general standard of the entries rose significantly from last year and the clarinet player was no exception," said Artemisia President Dr Yrjö Nuevo. "The jury placed it as the overall winner due to its playing ability and the complexity of its mouthpiece design. This competition is about demonstrating the capabilities of embedded systems by using them to perform the complex task of playing a musical instrument, and the NICTA/UNSW clarinet achieved this."

The Australian entry played Rimsky-Korsakov's *Flight of the Bumblebe*e and Ravel's *Bolero*. The second-placed team from Eindhoven impressed the judges with a robotically-driven guitar, which sounded extremely realistic, but first place went to the NICTA/UNSW entry because its technological difficulty was higher.

The robot's "mouth" uses two servomotors that apply force to the clarinet reed to make a sound. The smaller servomotor mimics the action of the human tongue, while the second applies a damping force to the reed, copying the action of the human lip. Force is applied to the clarinet keys by brass plungers with rubber or nylon feet depending on the key. "It is conceivable that in the near future, we could see an entire orchestra made up of computer-driven instruments like this clarinet," said NICTA Chief Technology Officer Dr Chris Nicol, "They will interpret a musical score and follow a conductor."

Around 98 percent of computing devices are now embedded in all kinds of equipment, which get smaller and smarter each day. The ARTEMIS Orchestra competition challenges contestants to build devices that play real musical instruments, to demonstrate the creative potential of embedded systems. Aimed at higher education and universities, the competition is organised by the association of European actors in embedded systems research and development (ARTEMISIA).

The UNSW's Professor Joe Wolfe, who contributed music acoustics expertise to the project, said a big challenge (as for real-life clarinetists) was to avoid squeaks. This was achieved only a week before the ARTEMIS Orchestra competition, when important circuit boards were completed. Fortunately, "when we turned it on, it already knew how to play scales, very quickly and accurately," said Professor Wolfe.

“It is pleasing to see NICTA-sponsored technology taking its place on the European stage,” said NICTA CEO Dr David Skellern, “Avenues such as ARTEMISIA provide enormously valuable links between Australia’s ICT innovations and Europe’s sophisticated and far-reaching ICT marketplace.”

A video clip of the robot performing is available at www.nicta.com.au. Photography is available on request.

The NICTA/UNSW clarinet was developed by NICTA in partnership with the University of New South Wales. The project team included UNSW Computer Science and Engineering student Mr Mark Sheahan, NICTA Project leader Dr John Judge, and Dr Peter Chubb, who developed the music interpretation software. Mechanical design, construction, and CAD components were provided by UNSW, including Kim Son Dang and Dr Jay Katupitiya from the School of School of Mechanical & Manufacturing Engineering and Jean Geoffroy and Paul Santus from the School of Physics. The university’s Professor John Smith and Professor Joe Wolfe respectively contributed electronic and music acoustic expertise. The clarinet will now be used by the UNSW School of Physics’ Acoustics Lab to better understand the gestures of human players.

About NICTA

National ICT Australia Limited (NICTA) is a national research institute with a charter to build Australia’s pre-eminent Centre of Excellence for information and communications technology (ICT). NICTA is building capabilities in ICT research, research training and commercialisation in the ICT sector for the generation of national benefit.

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