Quantum mechanics, one of the most unfathomable areas of science, is coming to the desktop.

Weird science

▲ THE OPEN QUBIT PROJECT EXISTS TO MOBILISE EVERYONE WITH AN INTEREST IN QUANTUM COMPUTING

It's been more than a decade since David Deutsch of Oxford University proved that it's possible to build a computer based on quantum mechanics. Such a machine would be a supercomputer beyond our wildest dreams, performing an unimaginable number of calculations in the blink of an eye. Now, a consortium of amateur enthusiasts is trying to create a software simulation of a quantum computer. Their Open Source program will be freely available, enabling you to experiment with quantum computation on your desktop.

Quantum mechanics is weird. In fact, it's about as weird as you can get and still stay within the realms of science. As Nobel-prizewinning physicist Neils Bohr once said, anyone who is not shocked by quantum theory does not understand it.

Like a conventional computer, a quantum computer works by manipulating data in the form of bits. In a conventional computer, a bit is represented by a circuit whose state, such as its voltage, encodes either a 0 or a 1 — there's no in-between. But in a quantum computer, a bit is represented by an individual particle, like an electron, and things are very different indeed.

Suppose you adopt the convention that an electron spinning clockwise represents a 0, and spinning anticlockwise represents a 1. So at any time, it would be reasonable to assume that the particle represents a 0 or a 1. Wrong! That's only true when you actually measure its spin. Before you take a measurement, the particle is in a strange indeterminate state, called a 'superposition'. In some unfathomable sense, the particle is spinning both clockwise and anticlockwise at the same time. It sounds ludicrous, but experiments have proved that's what happens. The relevance to computing is that a bit in the quantum world, a 'qubit', can be a 0 and a 1 simultaneously. And that's where the fun starts.

The amazing power of the quantum computer stems from the fact that if you have a collection of qubits — a register — in which each qubit is in an indeterminate state, then the register effectively represents all its possible numbers at once. If you then perform a single computation on the register, the computation works on each of the possible numbers simultaneously. David Deutsch explains this in terms of parallel universes: although we see only the single register in our universe, it actually exists in many other universes too, one for each of its possible states. By operating on the register in our universe, we kick off computations in all the other unseen universes, and then magically retrieve the answer. I did say it was weird!

Until now, research into quantum computing has been confined to experts in the field: the mathematics is fearsome, and few physicists have access to the specialised equipment necessary to conduct experiments. But Yan Pritzker is a young US computer enthusiast who wants to change all that. He's organised the OpenQubit project <www.openqubit.org> to mobilise everyone interested in quantum computing. There are already over 200 people signed up, and anyone with an interest in the topic is welcome.

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OpenQubit's first project, being run as a collaborative effort across the web, is to produce a C++ simulation of a quantum computer which will run on a conventional machine. Once the simulation program is complete, it will be possible to research how to write programs to run on a real quantum machine.

It's an exciting field. No-one knows whether the quantum computer will become a workable machine. In a recent lively debate in the 'News for Nerds' webzine, SlashDot <slashdot.org> all shades of opinion were on display, from 'this is cool!' to 'stop living in lala-land with leprechauns and fairies'. One thing's for sure: if a quantum computer is ever built, we'll get the best of all possible worlds.

TOBY HOWARD

The HAVi standard is a way to control consumer electronic devices via a single interface.

Home front

We have seen intelligent fridges and even internet surfing microwaves, but there's a brighter future for intelligent devices in the home. A consortium of eight consumer electronics companies have got together to come up with a standard that will provide the backbone of a home network.

In its present form, HAVi (home audio/visual interoperability) allows you to connect a variety of consumer electronic devices using a common hardware protocol and common software middleware. HAVi works with mostly digital audio/visual devices, such as digital TVs and digital VCRs, set-top boxs, cable modems and digital camcorders. It will also be integrated into up-coming devices such as video-phones and internet-phones. In other words, HAVi makes it easy to create the ultimate home entertainment system without a tangled web of wires, and the entire network can be controlled through a single interface. So you could use the TV in your kitchen to program the video in your sitting-room using Electronic Program Guide, or dial up the internet via your cable modem and surf from the comfort of your armchair.

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The network can take care of its own devices. If a HAVi device is plugged in or out of the network, then the network will detect this and adapt its behaviour accordingly. So if a VCR is unplugged, the network will try to find another VCR on the network and order it to take over the preset recording of programmes, or it will tell the user it cannot find a VCR to carry out the taping. Your PC could also be part of the equation and be used like any other HAVi device, controlling other devices and being *controlled by* other devices when carrying out AV functions.

▼ ONE DAY, ALL HOME ENTERTAINMENT WILL BE ON A NETWORK OPERATED THROUGH A SINGLE INTERFACE

The backbone of this system is built on IEEE 1394. Content and control data can be mixed on the same channel, and 1394 does not need one controlling device but can distribute control among all the devices on the network. It also allows devices to be hot-plugged – added while the network is up and running – and the devices added will configure themselves, so it's perfect for a home network where the user does not want to get involved in configuration. As it stands at the moment, 1394 can move data at speeds of 100, 200 and 400Mbits/s, with 800Mbits/s coming soon. However, the HAVi consortium is also looking at a wireless connection of devices, again based on 1394.

The software layer is built using an open and standardised Java programming environment. As such it is platform independent so can be used on anything from embedded environments in TVs through to PCs. Java applications then carry out the specific functions of each device. These applications can be device specific, so not all manufacturers of HAVi hardware will have to sell devices with exactly the same functionality. New applications can be downloaded as they become available, further enhancing the functionality of your equipment.

The future for this technology looks bright, especially as the HAVi consortium is busy linking its protocols to other projected and existing protocols. A bridge to JINI is being written, so you will be able to access your home network from a JINI network in your office.

Similarly a bridge is being built to HomeAPI, a rival to HAVi that creates a home network for entertainment devices. Using this, HAVi will be able to control security and energy devices: you will be able to set the burglar alarm and turn the heating up from any device in the house with an appropriate interface.

ADELE DYER