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Keio Research Institute at SFC

- A Step Toward Building Quantum Computers -
Article by Associate Professor Van Meter from Keio Research Institute at SFC
is the cover story for the October issue of *Communications of the ACM*,
a top-level scientific journal based in the United States

The article "A blueprint for building a quantum computer", authored by Rodney Van Meter (Researcher, Keio Research Institute at SFC / Associate Professor, Faculty of Environment and Information Studies, Keio University) and Clare Horsman (former Project Assistant Professor, Graduate School of Media and Governance, Keio University / now at Oxford University), is the cover story for the October issue of *Communications of the ACM*, which is a top-level computer science research journal based in the United States.

1. Quantum Computers

Quantum computers were envisioned in the early 1980s by physicists such as Richard Feynman (formerly at California Institute of Technology / Nobel Prize winner) and David Deutsch (at Oxford University).

Researchers around the world are experimenting with technologies that use the quantum effects of single photons, electrons and other phenomena to potentially solve some problems that are beyond the capabilities of classical supercomputers.

Designing large-scale quantum computers using these technologies is the domain of "*quantum computer architecture*". Associate Professor Van Meter is the leader of the AQUA (Advancing Quantum Architecture) research group (<http://aqua.sfc.wide.ad.jp/>) at the Shonan-Fujisawa Campus of Keio University and has been conducting advanced research in this area for over a decade.

2. About this Article

In the article, the authors describe a framework for research in architectures for quantum computers. The article relates the technology now in the laboratory to elements of a commercially viable quantum computing system.

Also, the authors have pointed out that the error correction necessary to protect the fragile quantum data can make the computer too slow to be useful, unless specialists such as computer architects, compiler writers, and software and hardware engineers collaborate to complement the skills of the experimental and theoretical scientists who are creating the first generation of quantum computing devices.

Comment from Associate Professor Van Meter:

"Quantum information is one of the most exciting areas of research in both physics and computer science today. The physicists have made huge strides since the beginning of experimental efforts more than two decades ago, and the field is now poised to begin building systems large enough to attract the interest of programmers. The next decade should see exciting results and the growth of a vibrant community of quantum computer systems engineers."

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3. The Association for Computing Machinery and *Communications of the ACM*

The Association for Computing Machinery (ACM) (<http://www.acm.org/>), founded in 1947 and based in the United States, is an international association for computer science professionals. *Communications of the ACM* (<http://cacm.acm.org/>) is its flagship magazine, delivered to around 100,000 readers each month.

4. Keio University

Keio has a proud history as Japan's very first private institution of higher learning, which dates back to the formation of a school for Dutch studies in 1858 in Edo, present-day Tokyo, by founder Yukiichi Fukuzawa. Since the school's inception, the students of Keio have risen to the forefront of innovation in every imaginable academic field, emerging as social and economic leaders.

In today's internationally interdependent world, Keio places great effort upon maintaining the finest teaching faculty and the highest standard of research and scholarship. Based on the knowledge and experience of their predecessors, today's Keio students strive to develop the leadership qualities that will enable them to make valuable contributions to tomorrow's society.

5. Keio Research Institute at SFC

Keio Research Institute at SFC was established in July 1996 as a base for advanced research with the aim of making contributions to 21st century society through research results. In addition to this, the Institute promotes bi-directional coordination between education and research at Shonan-Fujisawa Campus of Keio University and related activities conducted by businesses, government and academia in Japan and throughout the world.

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