scientific conferences

VII international scientific conference
Stockholm. Sweden
13-14.02.2024

Scientific conferences

THEORETICAL AND PRACTICAL PERSPECTIVES OF MODERN SCIENCE

Proceedings of the V International Scientific and Practical Conference

13-14 February 2024

STOCKHOLM. SWEDEN

2024

UDC 001.1

BBC 1

VII International Scientific and Practical Conference «Theoretical and practical perspectives of modern science», February 13-14, 2024, Stockholm. Sweden. 107 p.

ISBN 978-91-65423-55-8

DOI https://doi.org/10.5281/zenodo.10689118

Publisher: «SC. Scientific conferences»

Main organization: artmedia24

Editor: Hans Muller

Layout: Ellen Schwimmer

The sample of the citation for publication is Sevda Aghayeva Aydin kizi, Aynur Rzayeva Elman kizi FAMOUS AZERBAİJAN WOMEN VII International Scientific and Practical Conference «Theoretical and practical perspectives of modern science», February 13-14, 2024, Stockholm. Sweden. Pp.19-22, URL: https://sconferences.com

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Content

PROSPECTS FOR THE USE OF QUANTUM COMPUTERS

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Abstract
The article explores the potential applications of quantum computing in the contemporary environment. A special focus is placed on the definition of a quantum computer's idea and essence, as well as the evolution of its application throughout history. It is observed that although quantum computing offers tremendous potential, quantum technologies also provide a number of challenges, mostly stemming from essentially distinct natural laws and the challenges associated with the shift to quantum mechanics. In light of this, the study discusses the potential benefits and new dangers associated with the use of quantum computers.

Keywords: *quantum computer, computing device, negatives, prospects.*

Electronic technology of today is evolving quickly. Before our very eyes, what was only a dream a few years ago is turning into a reality. Nowadays, information plays a crucial role in our daily lives. Human society is searching more and more for systems and means of processing and transmitting information. Even the most potent supercomputers, which take up an entire data center, cannot tackle the issues that humanity faces today. Ordinary people can benefit from the assistance of quantum computers, which can tackle issues of any complexity.

Through the efforts of physicist Richard Feynman, who was awarded the Nobel Prize in physics, the concept of quantum computing technology emerged in the 1980s. Examining the evolution of the quantum computer's history, we will highlight the crucial phases of advancement:

Figure 1. The history of the quantum computer

Quantum computers can open up new horizons for humanity. The development of quantum technology will affect many areas of life. Let's consider the prospects for using quantum computers.

Decomposition into prime numbers is one of the key uses of a quantum computer. The foundation of all contemporary encryption is the fact that nobody can efficiently factor in thirty to forty digits, or more, into prime factors. Such a task would take billions of years on a standard computer. This may take a quantum computer eighteen seconds or less. The concept behind a quantum computer was to leverage the same uncertainty that makes conventional computations so challenging for calculations, turning a disadvantage into an advantage. Let's say you have to figure out a password who's final two characters are unknown. Four potential combinations are as follows: 00, 01, 10, and 11. They all need to be counted independently in the traditional scenario, so replace it with the appropriate value and see what happens. All four configurations, however, can be tested concurrently if the information carrier is a quantum object, such as two qubits superposed in polarization. This means that there will be no more secrets, because any encryption schemes may be instantaneously cracked and access to anything. This applies to everything from bank transfers to instant chat conversations. There may come an exciting point when conventional encryption ceases functioning, and quantum encryption has not yet been established.

Quantum computers could be integrated into a quantum internet that would be more secure than the one that exists today. "Quantum computers and quantum communications allow you to do things much more privately," says MIT physicist Seth Lloyd, who envisions Internet searches that even a search engine couldn't spy on.

It is undeniable that quantum technologies, and particularly quantum computers, are being employed in medicine today, even if their full potential has not yet been realized. Currently, one of the most popular and promising fields is quantum medicine. And from here, a plethora of innovative ideas are likely to be forthcoming. There can be significant advancements in the hunt for novel drugs. There are currently a lot of excellent medications available, but their effectiveness and production rate are quite constrained. Due to the constraints of current computing systems, even with the most recent advancements in speed and precision offered by classical computers, the latter remain relatively tiny. There are countless ways in which the human body can respond to drugs, plus the limitless genetic diversity at the molecular level and the potential outcomes for nonspecific drugs, all of which add up to numbers in the billions. Classical computers are not able to cope with this. And only quantum computers will have the ability to study every possible scenario of an organism's interaction with a drug and present not only the best possible course of action, but also the person's chances of successfully taking the drug - through a combination of more accurate and faster DNA sequencing and a more precise understanding of protein folding. Quantum calculations will make it possible to simulate complex molecular interactions at the atomic level, which will become invaluable when it comes to developing new methods of medical pharmaceuticals. It will be possible to model 20,000 proteins and their interactions with myriad new different drugs (even those that have not yet been invented) with impeccable accuracy. Analysis of these interactions (again using quantum computing) will lead to the creation of new treatments for currently incurable diseases.

The innovations that will be discovered with the help of quantum computers will inevitably lead to a better understanding of how life functions in general, which will subsequently lead to a much more accurate interpretation of it, improving medicines and the results of their action. Quantum computers will help to fully understand the brain and cure the neurodegenerative diseases Parkinson's and Alzheimer's, which cannot be cured today, since it is impossible to calculate the entire sequence of neuron activation - the power of conventional computers is not enough. Quantum computers could help rewire the brain to increase happiness and reduce suffering. At the same time, quantum sensors will make it possible to record the neural activity of the brain, in fact making it possible to even read thoughts.

Working with quantum computers requires special knowledge and methodological skills. A traffic control project in Lisbon is already using quantum computers. Not supercomputers, but quantum systems are best suited for predicting car traffic, demand for transport at a certain moment and travel time, Volkswagen says. Volkswagen's algorithm first analyzes anonymous data about motorists' movements using conventional computers, and then turns to quantum systems to optimize traffic using predictive analytics. Road models created using quantum technologies help reduce downtime of public transport, relieve congestion on roads during rush hours, and adapt the operation of traffic lights to the current traffic situation. In addition, in the future there will be a large number of unmanned vehicles on the roads, from which a quantum computer will collect data and simultaneously control it. To implement such a project, Volkswagen used the power of quantum computers from D-Wave. They first decided to use a traffic management system in Barcelona, where they deployed a large database that collects information about the situation on the roads. Intelligent motion control using quantum computer performance could provide significant support for cities and suburbs.

Another area where quantum computers could help the auto industry make significant strides is in battery technology. Understanding what exactly happens to a battery at the atomic level could pave the way to lighter and even more powerful batteries for electric vehicles. This data will be directly used, for example, in the recently started production of battery cells at the Volkswagen Center of Excellence for Battery Research in Salzgitter. Then every electric vehicle driver will benefit concretely from this research in their daily life.

Fast processing of large data sets or complex calculations are required in various areas of the defense industry. The introduction of quantum computers will simplify software development, speed up the design of various structures, and also reduce the required number of full-scale tests. High performance can be useful when creating systems with artificial intelligence for various purposes - this area is also of interest to military and defense enterprises.

Ray Johnson, a board member of quantum computing startup QxBranch, said that even with state-of-the-art tools that analyze temperature and pressure, there are too many possible ways a given weather pattern could manifest itself, and current weather forecasts are an educated guess at best. . Quantum computing can analyze all this data at once and give a better idea of when and where bad weather will strike. Special services would provide advance notice of severe storms such as hurricanes, and additional preparation time could help save lives.

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However, despite the amazing capabilities that quantum computers provide, quantum technologies present a number of problems, which are mainly caused by fundamentally different laws of nature and the difficulties of transitioning to quantum mechanics.

In essence, quantum computers make almost all modern approaches to programming, processing and data protection obsolete. Humanity will not only have to use new technology, but also focus on creating completely new data transfer protocols and infrastructure.

For major players in the IT market, quantum computers represent both amazing potential and huge risks. Since modern corporations such as Google or Facebook make most of their income from advertising and the sale of user data, they will be forced to completely rebuild their business models because their existing technologies will simply no longer work.

Quantum computing is also attracting significant interest at the government level. The new computer revolution will dramatically reduce the influence of individual politicians, since solutions to most government problems will be easy to calculate. At the same time, issues of regulation of quantum technologies will also be resolved at the political level.

Problems related to the coordination and legislation of quantum computers may arise in the near future - as soon as we see the first machine with enough computing power to threaten the privacy of personal, corporate or government data or disrupt financial systems. Classical encryption systems are publicly available, they are feasible for a quantum computer - this means not only the opportunity to steal money, but in the future also to steal, for example, health: to hack the control of a pacemaker or other devices, of which there will only be more. Like any coin, a quantum computer has two sides: it is not only the advantage of new materials, logistics, optimization, but also a risk.

Modern quantum computing systems are huge and complex machines that are extremely expensive to develop and maintain. Only corporations or universities can afford them. But the same thing happened with ordinary computers, which, instead of taking up entire rooms, fit on our desks - and even in our pockets. Full-fledged quantum computers are likely to appear in the next few decades, but due to their high cost, users will only be able to rent computing power and cloud services, as IBM currently offers. Will today's society witness the creation of tiny quantum smartphones that will have more power than any modern computer and will be able to transmit any information anywhere in the Universe? It's hard to say for sure. But the practical application of laws operating at the quantum level - completely different from those used in our macrocosm, governed by the laws of Newtonian mechanics - already seems quite achievable.

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