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Quantum computing and technologies: State-of-Art and Future Prospects

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Rapid advances in quantum physics and quantum information theory have spurred tremendous discussion about quantum computing and technologies which are expected to be disruptive for many industries. Quantum computing is an emerging technology paradigm of computing and could solve hard computational problems that today's classical computers cannot solve (Franklin et al., 2020). It is estimated that there will be almost 600,000 new jobs in the quantum area in 2040 (Venegas-Gomez, 2020) and numerous industries will need a lot of professionals specializing in quantum computing and technologies.

The governments and big companies such as IBM, Google, and Microsoft have been stepping up their investment in quantum computing and technologies since quantum computing and technologies have great potential to improve national's industrial base, create jobs, and provide economic and national security benefits. For example, as quantum computing could exponentially speed up the processing capabilities over classical computing, quantum computing can greatly facilitate major advancements in areas such as drug development, financial modeling, traffic optimization and weather forecasting.

On the other hand, quantum computing and technologies could pose severe challenges to existing information security infrastructure. For example, quantum algorithm may be used to break existing public-key cryptography, which threatens the status quo of information security in use worldwide and impact the entire business world. Developing countries and small organizations will likely lag in adopting an advanced quantum approach to secure their information infrastructure, further intensifying the digital divide and inequity issues.

To understand the development of quantum computing and technologies and provide useful guidance for businesses, we reviewed the literature and online information about quantum computing and technologies, key application scenarios, major challenges, and identified some research trends for future directions.

References

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