IJERST

International Journal of Engineering Research and Science & Technology

ISSN : 2319-5991
Vol. 1, No. 1
March 2015

National Conference on "Recent Prends in Communication & Information Technologies"NCRTCIT 2015

Organized by

Dept. of ECE, Indra Ganesan College of Engg., Trichy, Tamil Nadu, India.

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International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Special Issue, Vol. 1, No. 1, March 2015
National Conference on "Recent Prends in Communication & Information Technologies" NCRTCIT 2015

Research Paper

FAULT TOLERANT DEFLECTION ROUTING QUANTUM COMPUTATION

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Quantum computation can solve certain problems much faster than classical computation. Fault-tolerant (FT) quantum circuit design is required for a practical implementation. Quantum circuits consist of a cascade of quantum gates. Quantum information offers able to perform certain computation tasks. In this we introduce more optimizations to improve the result. The quantum computation gives secure operation when compare to classical computation. The input is un optimized quantum circuit realized using a set of commonly used gates and its output is an optimized FT quantum circuit that only comprises primitive quantum operations supported by the given PMD. The optimization circuit operates in every direction. The optimizations include six cycles. Pesudo code random number generator is used. Quantum error codes are to correct the faults. Fault tolerant deflection routing algorithms used for detect the faults. The fault tolerant deflection routing algorithm is tolerate faults without deadlock. The performance of FTQLS is evaluated using two cost metrics: number of primitive operations (#ops) and number of execution cycles on the critical path (#cycles).

Keywords: Quantum mechanics, PRNG module, Fault tolerant deflection routing algorithm

INTRODUCTION

Quantum cryptography has been developed which promises more secure communication than other technique. Quantum cryptography takes advantage of the unique and unusual behavior of microscopic objects to enable users to securely develop secret keys. Using this method, anyone can send a message since the public key is used to encrypt messages, but only someone with the private key can decrypt the messages. Since the encrypting and decrypting keys are different, it is not necessary to securely distribute a key. The users then use the secret key along with public algorithms to encrypt and decrypt messages. The algorithms are very complex, and can be designed such that every bit of output is dependent on every bit of input. Hash function is used to convert digital arbitrary data to digital data of fixed size. Slight difference in input produces lager difference in output. Easy to compute the hash value for any given message. Infeasible to generate a message in given message. Infeasible to modify the message

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without changing the hash value. Cryptography functions gives secure operation in quantum.

A quantum state is usually in a superposition of multiple states. However, when measured, the superposition collapses to one state. The quantum system also inevitably interacts with the environment. Thus, the information stored in the computer decoheres , resulting in error and consequent failure of computation. Because quantum systems are more delicate and difficult to control, FT quantum circuits are needed for a practical implementation. Many quantum error correction (QEC) codes have been proposed to facilitate FT quantum computation, such as Steane code, Bacon Shor code, Knill code , and surface code. One of the important code is surface code.

PROPOSED SYSTEM

A. Quantum Compiler

Solovay-Kitaev Algorithm (SKA)

The advantage of SKA is its low execution time. Most SKA compilations can be finished within a few seconds. However, its major drawback is a rapid increase in the length of the sequence of gates derived.The Solovay-Kitaev (SK) theorem is one of the most important fundamental results in the theory of quantum computation. In its simplest form the SK theorem shows that, roughly speaking, if a set of single-qubit quantum gates generates run quickly, i.e., it is possible to obtain good approximations to any desired gate using surprisingly short sequences of gates from the given generating set. The SK theorem is important if one wishes to apply a wide variety of different single-qubit gates during a quantum algorithm, but is restricted to use gates from a more limited repertoire.

Skipping Table Algorithm (STA)

The advantage of skipping table algorithm is required minimum gate length sequence.

B. Prng Module

A PRNG is nothing more than a mathematical formula which produces deterministic, periodic sequence of numbers which is completely determined by the initial state called seed. Advantages of PRNG's are their low cost, ease of implementation and Quantum error correction codes are used in this module to correct errors. The PRNG module is mainly used how many gates are optimized in optimization circuit.

Quantum error correction is used in quantum computing to protect quantum information from errors due to decoherence and other quantum noise. Quantum error correction is essential if one is to achieve fault-tolerant quantum computation that can deal not only with noise on stored quantum information, but also with faulty quantum gates, faulty quantum preparation, and faulty measurements. Error correcting codes use a syndrome measurement to diagnose which error corrupts an encoded state. We then reverse an error by applying a corrective operation based on the syndrome. Quantum error correction also employs syndrome measurements. We perform a multi-qubit measurement that does not disturb the quantum information in the encoded state but retrieves information about the error.

C. Pauli Frames

A Pauli frame is a simple and efficient classical computing technique to track the result of applying a series of Pauli gates (X, Y, or Z) to single qubits. Many quantum error correction codes, such as the surface code, project the encoded state into a perturbed code word with erroneous single-qubit Pauli gates applied (relative to states within the code space). The syndrome reveals what these Pauli errors are, up to undetectable stabilizers and logical operators, and error correction is achieved by applying those same Pauli gates to the appropriate qubits (since Pauli gates are Hermitian and unitary).

Quantum gates are faulty, and applying additional gates may introduce more errors. Rather than applying every correction operation, one can keep track of what Pauli correction operation would be applied, and continue with the computation. When a measurement in a Pauli X, Y, or Z basis is normally made on a qubit, the result is modified based on the corresponding Pauli gate which should have been applied earlier. This stored Pauli gate is called the Pauli frame since instead of applying a Pauli gate, the quantum computer changes the reference frame for the qubit.

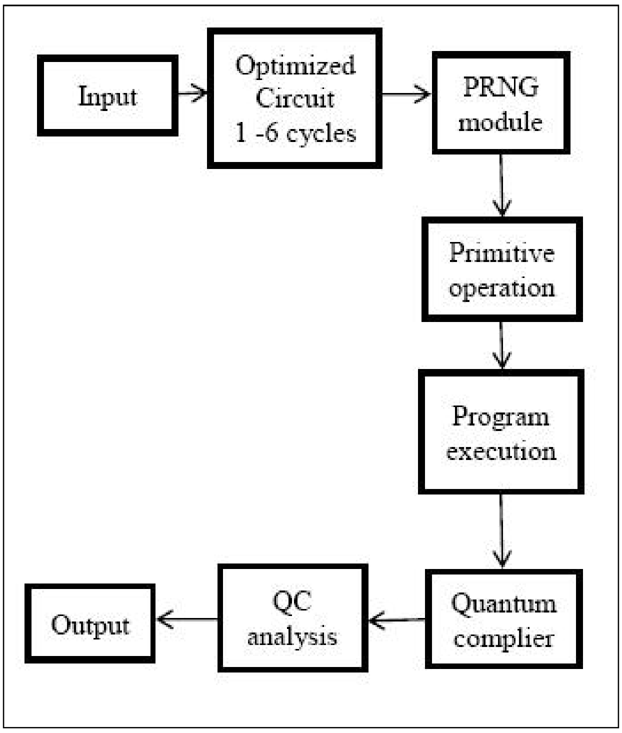
D. Fault Tolerant Deflection Routing

A good fault-tolerant routing algorithm should ensure "0 lost packet" in whatever fault patterns as long as a path exists. The advantage of the FTDR algorithm is the topology-agnostic feature, which is insensitive to the shape of the faulty region. The routing table can be reconfigured during packets transmission The fault diagnosis mechanism uses the single-error-correcting and double-error-detecting (SECDED) Hamming code to detect both transient and permanent link faults. Depending on the shape of the fault region, deterministic fault-tolerant routing algorithms can be categorized into two classes: one can handle regular fault regions. and the other, which is also known as topology-agnostic, can handle irregular fault regions. A reconfigurable routing algorithm is proposed to route packets surrounding a faulty router. For deflection routing, a fault adaptive routing algorithm, based on a cost function to make routing decision, has been proposed.

The cost function takes the route length and local fault status into consideration. Because the routing decision is only based on the fault information of the current router. faults are considered as faulty links which can be both transient and permanent faults. For deflection router, the number of input ports should be equal to the number of output ports, so permanent link failures are assumed to be bidirectional. In each router, a four-bit fault vector is used to represent the fault status of its four links (North, East, South, and West). A "1" in the fault vector represents the corresponding bidirectional links are broken. The faulty region can be any shape as long as it does not disconnect the network. Transient faults are often caused by single-event upset.

E. Modified Block Diagram

The input is given to the optimization circuit. The

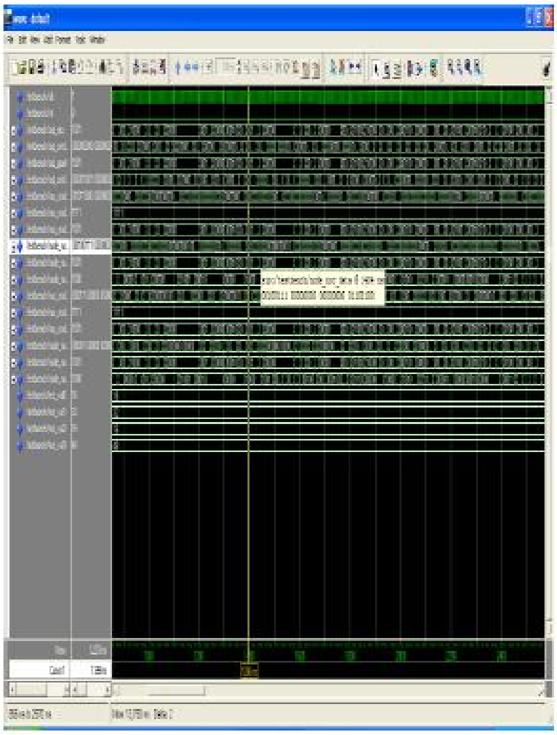


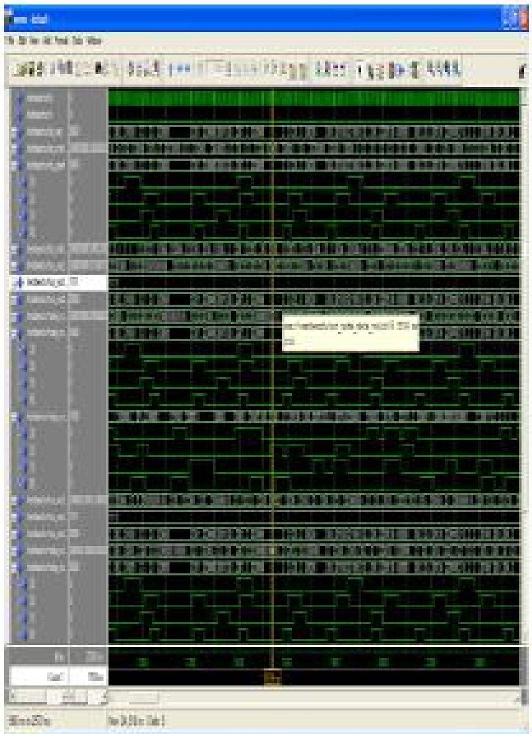
input given through cryptography technique. Encryption key is used to transmit the data to the circuit. Optimization circuit includes behaviour domain and technology domain. The circuit operates for every direction and also including zero state and pre-state. Behaviour domain doesn't contain any PMD functions. The output of the behaviour domain is given to the technology domain through technology mapping. The technology domain includes PMD type and uses library gate functions. The output is given to the Pseudo code random number generator. Quantum error correction codes are used in this module.

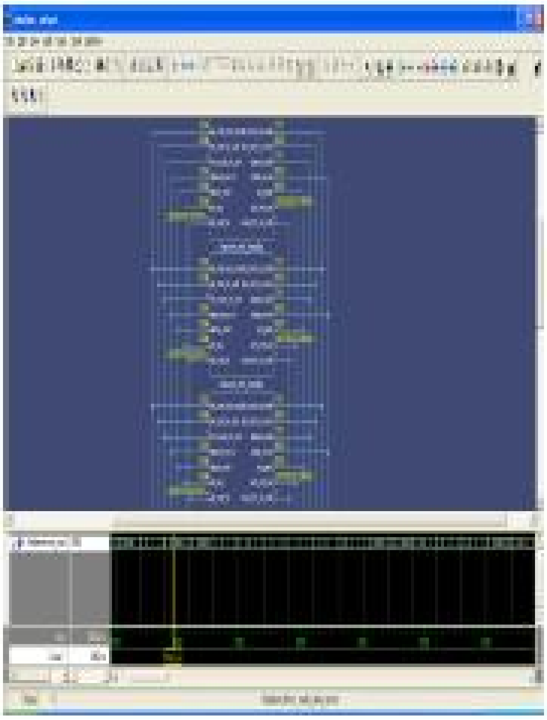
The PRNG module is used to compute how many gates are optimized in optimization circuit. PRNG's are the best choice for cryptography and other application which critically require true random numbers. Advantages of PRNG's are their low cost, ease of implementation and user friendliness.

Primitive operations include number of outputs and cycles. Output is number of operations and cycles is number of critical paths. Quantum compiler using two algorithms they are solovay - kitave algorithm and skipping table algorithm. Solovay-kitave algorithm is used to run the data with minimum time but it increases the data sequence length. To reduce the sequence length skipping table algorithm is used. Quantum compiler analysis includes fault tolerant technique. Fault tolerant deflection routing algorithm is used to detect the faults. This is a efficient method to detect fault and continues the operation.

RESULT







CONCLUSION

In an effective FT quantum circuit synthesis methodology was proposed. The input to the synthesis tool is a non-FT quantum circuit and the output an optimized FT circuit for six PMDs. The optimizations process includes six cycles. The output is optimized several times. The PRNG module is used to correct errors. Error correction codes are used to correct errors. The Solovay - Kitaev algorithm, skipping table algorithm, and a cache table were used to perform quantum compilation. Although fault tolerant quantum computation is effective in synthesizing quantum logic, various other factors also have to be considered in a real application, e.g., total circuit error. Fault tolerant deflection routing is used to detect and correct faults very efficiently. The output of the fault tolerant quantum compilation is optimized output without any fault.

REFERENCES

1. Bacon D (2006), "Operator quantum error-correcting subsystems for selfcorrecting quantum memories", *Phys. Rev. A*, Vol. 73, No. 1, p. 012340.
2. Barrett M D *et al*. (2005), "Quantum information processing with trapped ions," in Proc. AIP Conf., Vol. 770, No. 1, pp. 350–358.
3. DiCarlo L *et al*. (2009), "Demonstration of two-qubit algorithms with a superconducting quantum processor", *Nature*, Vol. 460, No. 7252, pp. 240–244.
4. Kliuchnikov V, Maslov D and Mosca M (2012), "Fast and efficient exact synthesis of single qubit unitaries generated by Clifford and T gates", 2012, arXiv:1206.5236v3.
5. Nielsen M and Chuang I (2000), Quantum Computation and Quantum Information. Cambridge Univ. Press.
6. Rivest R L, Shamir A and Adleman L (1978), "A method for obtaining digital signatures and public-key cryptosystems", *Commun. ACM*, Vol. 21, pp. 120–126, February.
7. Shor P W (1997), "Polynomial-time algorithms for prime factorization and discrete logarithms on a quantum computer", *SIAM J. Comput*., Vol. 26, pp. 1484–1509, October.
8. Steane A M (1996), "Error correcting codes in quantum theory", *Phys. Rev. Lett*., Vol. 77, No. 5, pp. 793–797.
9. Taylor J M, Petta J R, Johnson A C, Yacoby A, Marcus C M and Lukin M D (2007), "Relaxation, dephasing, and quantum control of electron spins in double quantum dots", *Phys. Rev. B*, Vol. 76, p. 035315.

International Journal of Engineering Research and Science & Technology
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ISSN 2319-5991