Simple Implementation of Quantum Bits in Silicon by Decoupling them in Space and Time

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Introduction

- Research in quantum computing is very important to develop applications for medicine, business, trade, environmental and national security purposes.

- Shor Algorithm in quantum computer factor an integer N in Log N

- There are Challenges in the implementation of Quantum Bits

Motivations

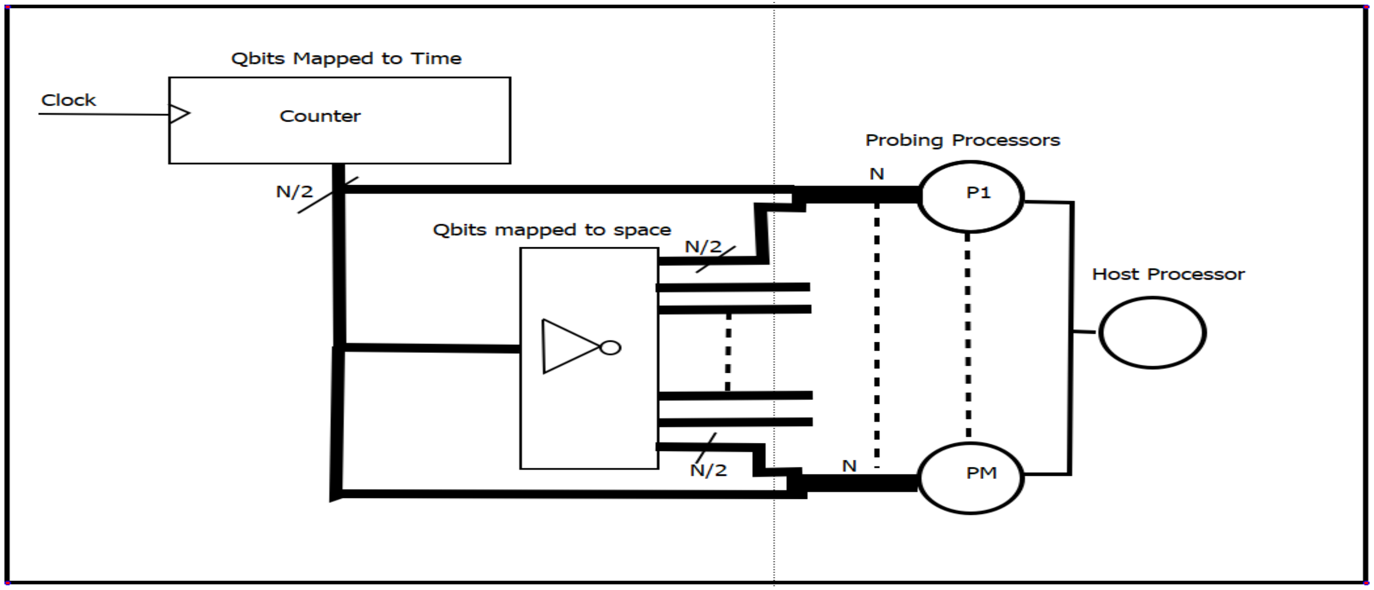
- Today's physical quantum computers suffers from noise
- Quantum-computing needs temperature of liquid helium
- quantum fault-tolerance is difficult, the error rate in terms of ‘qubit-errors’ scales up linearly
- loss of quantum coherence (called decoherence), caused by vibrations, temperature fluctuations, electromagnetic waves and other interactions
- “Problem with Quantum Computers, It’s called decoherence”, Scientific America June 10, 2019

Implementing Quantum Bits in Silicon

- FPGA to decouple each Q bit and map it either in time or Space
- Classical deterministic values of bits are provided by the system in space and time such that all combination of Q-words becomes available from the system
- probing multiple signals in parallel for bits mapped to space and after waiting for the time that allows the bits mapped to time to become available
- INTEL Processor as Host to implement application algorithm

The System To Implement Q-Bits in Silicon

- Using INTEL PROCESSOR as HOST
- GPU FOR PROBING PROCESSORS
- FPGA FOR Q-BITS IN SILICON



Implementation Example

Time	Q3Q2=00	Q3Q2=01	Q3Q2=10	Q3Q2=11
Space	Q3Q2Q1Q0	Q3Q2Q1Q0	Q3Q2Q1Q0	Q3Q2Q1Q0
Q1Q0=Q3Q2	0000 (0)	0101 (5)	1010 (10)	1111 (15)
Q1Q0=Q3/Q2	0001 (1)	0100 (4)	1011 (11)	1110 (14)
Q1Q0=/Q3Q2	0010 (2)	0111 (7)	1000 (8)	1101 (13)
Q1Q0=/Q3/Q2	0011(3)	0110 (6)	1001 (9)	1100 (12)

Complexity of Implementation:

- 20 Q-bits needs 500 Transistors and takes 250 ns in 4 GHz Silicon
- 50 Q-bits needs 1200 Transistors and takes 8 ms in 4 GHz Silicon

Conclusions

- Simplify implementation in Silicon
- Predictable not probabilistic outcome
- Using mature technology as CMOS
- Cost of implementation is far less than Q bits of current systems
- Utilizing advancements of classical computers with developed algorithms and applications for classical computers
- Easy to add error correction to data
- Data from the system is available all the time and not limited to the time when quantum computing phenomena is useable
- Easy to use to develop new algorithms for quantum computing
- Limited to small number of Q-bits