Turing Machine for Quantum Computers

Mr. Abdur Razzaq

MTB College Khalid Campus, Manthar road, Sadiq Abad, Punjab, Pakistan.
mirzarazzaq@gmail.com

Abstract— This document gives the Exotic way to revolutionize the Turing Machine's Concept regarding to the Quantum Computing. We are not going to disturb the Turing Machine's overall concept, but we would make some changes that could possibly enhance and refine the original idea of Turing Machine regarding to the pretty new much-demanded subject in Technology, known as Quantum Computing. It's not the very detailed document of Turing machine of quantum computing, It's too brief, but we will mention here all of the important things, which really matters.
[Abdur Razzaq. **Turing Machine for Quantum Computers.** *Researcher* 2015;7(5):81-85]. (ISSN: 1553-9865). http://www.sciencepub.net/researcher. 16

Keywords— Quantum Computing, Turing Machine, Quantum, Turing, Quantum Turing

1. Introduction

Let's move Forward to the beginning now. In Introduction, We just want to mention the layout of this white paper. In first Section, We will discuss about the Turing Machine, that what exactly Turing machine is, what Turing machine basically does, who uses this legacy original idea in this modern era, and why people really think of it as ideal model.

Then we would talk about the other side of our document, Quantum computing. What it is, why it is, when it will come, and things like that. So that you should have the idea of Turing machine and quantum computing side by side, that's why we don't need any of the perquisites for this white paper.

After defining the features and losses of both of them, we will move on our original idea, which is, why not merge both of them (Turing machine and Quantum computing) so that we could gain even more power and a really great working infra-structure. And in the end, we also would mention all of the references through which you could gain even more information about quantum computing with Turing machine.

2. Turing Machine

Turing Machine is the Theoretical model which actually describes the digital computing system. Turing machine is not actually a physical modal. It is just a mathematical model, which was described by Alan Turing in 1937. This model was also basically put forward to Alan Turing's famous mathematical paper on computable numbers in 1937.

- A turing machine is a 7 – tuple $(Q, \sum, \Gamma, \delta, q_0, q_{accept}, q_{reject})$, where Q, $\sum$, Γ are all finite sets and:
- Q is the set of states.
- $\sum$ is the input alphabet not containing the special blank symbol ␣
- Γ is the tape alphabet, where ␣ ϵ Γ and $\sum$ is sub set Γ
- δ: Q x $\Gamma \longrightarrow$ Q x Γ x {L, R} is the transition function
- q_0 is the start state
- q_{accept} is the accept state
- q_{reject} is the reject state, where q_{reject} not equal q_{accept}

Alan Turing was actually a genius mathematician and a computer scientist who died in 1954. Now, Turing machine is, actually a model, which was described on paper accidently. He was working on something else and eventually he found the numbering system for computing to which he gave the name officially known as Turing machine.

Turing machine was not a great hit, infect when he described it, it got flopped. Because at that time, they didn't know that what this model for computers could do, because at that time, computers was a vague term. Nobody knows what a computer actually is. So they just used Alan Turing's Turing machine model as nothing. But in late 20th century, everything changed. When AT&T made its first UNIX base computer in bell labs, they used the first Turing machine model there and then Turing machine became the very great hit.

Everybody like Intel, IBM, so on and so forth, started using it as the ideal model of computation. And that was the really great hit for Turing machine. Unfortunately, Alan Turing itself wasn't really rewarded with his discovery as he should be but it was his own invention or the discovery.

Turing machine is actually the pretty simple machine of its kind; It is that simple that it is using almost everywhere, from several decades. And still is

working fine without any of the big flop. But now, it is the time to enhance it further, because we just can't go ahead always by using the old tools that is an old saying and fortunately it is true.

In Turing machine, what do we do is just compare sequences of several things. Like, say we want to compare some sequences of even numbers and some sequences of odd numbers until the digit 10. Now, what do we do, we can compare them like

1, 2, 3, 4, 5, 6, 7, 8, 9, 10 = Whole numbers row.

1, 3, 5, 7, 9 = Odd numbers sequence

2, 4, 6, 8, 10 = Even number sequence

Now, this is the Turing machine concept in the simple words. Here, you can argue that it is pretty simple, how is it using? Well it is looking pretty simple because the numbers are finite. But, don't get fooled by them here, because what if we uses the infinite numbers?

Let's see them in action in the example given below;

Numbers: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,….....xxx

Even Sequences: 2,4,6,8,10,12,14,16,18,20,……xxx

Odd Sequences: 1,3,5,7,9,11,13,15,17,19,……..xxx

Let's compare them now,

The "Numbers" row is the infinite row of all of the numbers right?

Now, the other side, the "Even Sequences" row of the even numbers which is also infinite right?

Let's move to the other one.

The "Odd Sequences" row of the odd numbers is also infinite. Isn't it? Yeah, offcourse it is. And here everything messes up.

Because the even sequences and odd sequences are not equal to numbers sequences, infect they are the half of it, but how is it possible on earth to compare them and gets the result of same? No, it is not. And that is the point in Turing machine. In Turing machine, we compare everything from ground to the peak so that it could be calculated.

And this is the simplest definition of Turing machine on earth theoretically without any confusion.

3. Problems in Turing Machine Concept

Now, you might say that what the problem in Turing machine's concept is. The problem is that Turing machine has to make the sequences first of all of the data, doesn't matter how large or heavy it is. Because if it doesn't, then how Turing machine would work. And that is the point; let's say what if the problem is 1/0? That is complicated. But if we do this on computer or calculator, then we usually gets an error, which is undefined math problem. But if we leave that error and apply this situation on Turing machine, then we guess, we would rather get an infinite loop which wouldn't stop and the machine would crash away.

Even at the first stage of making sequences, it will crash because it couldn't do that. But we have a solution for all that which we're going to describe in this page below in the bottom. Now let's move on to the next thing, known as quantum computing.

4. Quantum Computing

We've talked a lot about Turing machine idea, but now, lets move on to the quantum computing for now.

So, what is Quantum computing?

We've recently confirmed from several different companies that their Research and Development Departments are now researching on New Technology for Processors something called "Quantum Computing" also known as "Q.C", which would be more than 10,000 if not millions times better in their Processing Capability than the processors does these days.

This is far away better from our imagination. Those Quantum Computing type Processors would be a lot smaller in their size and will be very efficient in their processing capabilities. They wouldn't get heat that easy, and they also would be Recycle-able for the sake of Environment Friendly. They also would be noise free.

Those Processors would work on the basis of Nano Neutron base Advance High-Technology.

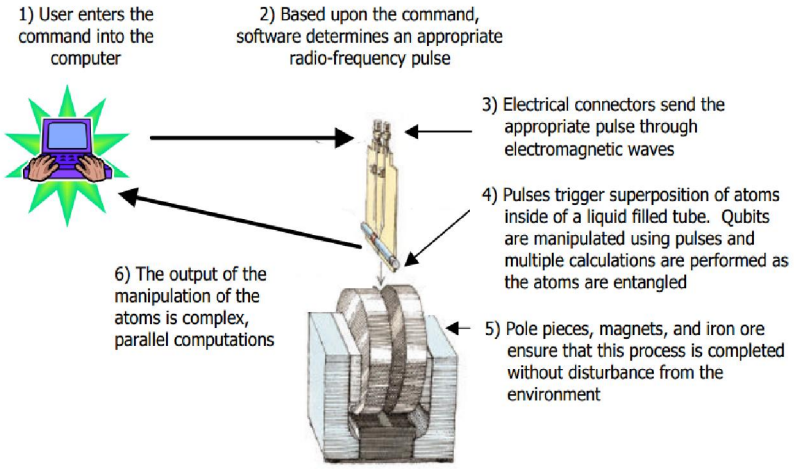
Now, the computers which are working on different major corporations right now, also really great computers, their greatness could be measured by their speed. Everybody wonders when we saw that is 299,792,458 m/s. THE SPEED OF LIGHT. Isn't that great? It is AWESOME! But, you know where as we think, it could go even further. It could go far beyond our imaginations may be million times faster than the speed of light[3]...then we guess it could predict things.

But in quantum computing, there are a lot of troubles right now. Like the quantum computing, __which is still under development, cannot handle any change in noise from its initial state, because if we do any change in noise in the environment surrounding the quantum computer, it would cause a lot of damage to computer. Well, these weaknesses could get overcome, but to do that, we have to wait a bit until it all happens.

As far as Dr. Moore's said about Quantum Computing, he actually didn't said anything about quantum computing itself, but he just gave us an idea of processors, which was pretty simple. That was, if we could make our transistors even thinner every passing couple of years, then we could double up our speed after every two years. Quantum computing is slightly different from all that but it is a little like the original idea too.

Actually Dr. Moore's wasn't the original and the only inventor of quantum computing, some peoples might think so, but the quantum term itself is evolved from past 1930's which was the idea of physics. And now the most popular idea in physics is. But Mr. Moore's actually invoked it in computers.

In quantum computing, the atoms are used as processors. Each bit of information represented as qubit which can represent 0, 1, and in-between values at same time. The in-between position is called superposition[4]. In quantum parallelism atom can travel through different routes simultaneously. We want to implement this concept in Turing machines as it contains several states to solve a problem. By using quantum computing parallelism concept, the machine can simulate execution at all states at the same time.



Anyone can't just predict the huge change about the computer world. To predict these things, you have to work so hard; then we could bring a change. That's what this paper is all about.

Point of comparison	Classical Computing	Quantum Computing
Information representation	A bit: either 0 or 1	A qubit: a superposition of 1 and 0
Number of simultaneous calculations	1	Multiple
Method of calculation	Moving bits through logic gates	Altering states of atoms
Information delivered	Information can be copied without being disturbed	Information cannot be copied or read without being disturbed
Information behavior	One single direction	Spread-out to many routes simultaneously like overlapping waves
Noise tolerance	High: Information can be carried in a noisy channel	Low: The delivering channel needs to be noiseless
Security	Lower: Eavesdropper can break into the communication with high computing power	Higher: Any interruption of communication will be detected by communicating parties
Computation/ Communication cost	Higher as computing or communication volume increases	Lower as computing or communication volume increases

Mr. Moore was also in the direction of quantum computing in the fact that he said if we make transistors thinner, then in 2020, we would reach to the atomic size technology[4], which is exactly what quantum computing is all about but has been started with different opposite company called IBM. We think IBM is exactly following the Moore's law for its quantum computing technology to build once again its reputation into the market. And we think it will.

Quantum computing seems so cool. IBM hasn't told yet but it seems like it is following the Boson's law of Standard model of particle physics. Which is, you know; as we told before, a particle could go beyond the speed of light. Now the speed of light is so high enough to see anything. The problem here is that if a physical particle does that and moves with even faster speed than light, and then someday it will work really really fast.

But the downside of it is what the Engineers at IBM are experiencing, If they let the particle throw into the space in the processor and then wait a bit, an explode happens which blows everything, because regarding the physical theory of science, is that if a mass moves so fast, then it will blow up due to the friction with air and a lot of other very tiny particles which we just cant see from our normal eyes.

This is a problem at which scientists are working. And this is the huge problem. They could resolve it by giving it oil, but in this era, that doesn't make any sense to a typical user to put oil into his machine a lot of times in a day.

As in news, we could also hear that Quantum technology will only just specifically for super-computer users, not for any normal PC or anything like that.

In Super-Computers Environment, any dramatic change doesn't happen as fast as it does in our normal areas. And that is really a big thing to consider. But just because of that, we can't leave technology up in the sky of super-computers. It also should be for normal PC's.

Now, at this stage, We are missing our original point of Turing Machine, which was to make them faster, or to enhance them yes, we think, if IBM would give up their technology right now to users of super-computers, in which we've include all of them holding super-computer, weather satellite in the sky, or a corporation owner. Not just only supercomputers, but also normal PC's. If IBM allows them to use quantum computers, then we think the result would better dramatically. New technologies for Turing Machine will evolve faster with a revolutionary way in this Exotic World.

Now, let's talk a bit about what a normal user can get from this advance quantum computing technology. A normal User can get numerous amounts of benefits from this kind of technology, we kind of get confuse, when we leave users and talks about these high tech corporations.

Corporations/Satellites works for users, like if satellites or any other major corporation upgrades their systems to quantum computers, a lot of people would then get affected by it. They would probably design a new model of the whole internet, and after building that entire internet, they would give it up to live, and users could get more and more internet speed, maybe even more than their own hard-drive.

And not just in satellites, Technology is being use everywhere these days. Everything could get benefit if we introduce the Turing machine's enhanced version by using Quantum Computing. In Soft-computing, there is not just Internet; there are a lot of other things too. Like Live TV with much much better quality. If we compare it to something more efficient then it would probably be apple's Retina display technology. Yes we can see HD Result live, but still we can see all of the pixels in HD. then we could watch Retina Result and much much better sound quality in our TV systems and other machines, which steams data from other sources online. And that is the whole point.

Moore's law was kind of a no-brainer, but The Quantum computing, it is not no-brainer. It is really the most complex and complicated thing that have ever been built by human. We would not wonder if **after their initial release, Time would give it the reward of Most Complicated thing of the century.
"The nineteenth century was known as the machine age, the twentieth century will go down in history as the information age. I believe the twenty-first century will be the quantum age." – Paul Davies[4].

5. Dead Line for Quantum Computing

Now, let's talk about the deadline of that power processor which is base on Quantum Computing, Regarding to Intel, the Quantum Computing Project will get finish in 70 to 80 years regarding to Moore's law. But as technology is evolving so much faster than anybody ever imagined before, so it seems like it would just happen within one decade. IBM has a three-bit quantum computer, Alamos National Laboratory announced a seven-bit NMR (Nuclear Magnetic Resonance), and now IBM

promises a ten-bit computer will emerge soon. It would be really great change to the entire computer industry.

6. What Should We Do Now?

Well, that is the critical part of this article. Right now, we don't have that high technology, but we do have our brains, so beside developing on these low power computers, we should also concern about those high tech machines, that what else could we do with them, we should start making kind of theory on those machines so that we could implement them in future as soon as possible after the arrival of those machines, so that we could save our lot of time.

7. Merger of Quantum Computing with Turing Machine

Now, we have discovered Turing machine and Quantum Computing in several different terms. So, let's merge both of them.

Every field is going to get affected by Quantum computing, but here, we will just talk about the specific one regarding to Turing Machine.

In [4], as we discussed earlier that in Quantum parallelism, atom can travel though different routs simultaneously and in Turing machines, there are many different states; control passes through these sates sequentially and goes to accept or reject state. After merging both steps, Quantum computers will perform calculations simultaneously through these states. It will perform many calculations in single computational step. Different atoms spin in unique different direction and simultaneously solve billions of calculations.

In Turing Machine, the Quantum computing could apply that way. As we know at this point that the Quantum Computing could give us result much more faster than today's technology, maybe more than several millions of times faster, Then it means that Quantum Computing could get result of all of the infinite numbers simultaneously, it means we could save our a lot of time with the future technology and beside that, we also could perform other tasks on it such as running another bunch of applications beside those processing. It all will happen just because of the new processing power that we are going to get in few years, or may be within the decade.

8. Conclusion

In the End, What do we want to say is that Quantum computing is much better technology and is going to be favorite of everybody. So, everybody is going to reward with it. Now, let's review that where are we going so far.

We firstly reviewed the Turing machine's concept, then we have gone to the whole quantum computing process, where we gave its definition with a lot of real world examples, then we looked for its side effects/damages. And in the end, we've merge quantum computing with the original Turing machine idea, which was really amazing.

Acknowledgment

In Acknowledgment, We just are going to give its simplest importance which is that without quantum computing's concept in Turing machine, we can't go anywhere because we have nowhere else to go.

This is the only way for Turing machine to upgrade. And we are sure that it will happen in several years and will get use physically in real world applications. In the END, we hope that you've enjoyed it as we did while writing it.

References

1. *Quantum Computer*. http://en.wikipedia.org/wiki/Quantum_Computing.
2. *Turing Machine*. http://en.wikipedia.org/wiki/Turing_Machine.
3. Irene Klotz. (2012, Jul 5). Is the Higgs boson the first step to a 'Star Trek' transporter? Retrieved from http://www.nbcnews.com/id/48087875/ns/technology_and_science-science/#.UTbwtaylrIU.
4. WenShin Chen, "ISRC Future Technology Topic Brief Quantum Computing" *Bauer College of Business Administration, University of Houston, Houston, Texas*, 77204-6283.
5. Michael Sipser, "Introduction to the Theory of Computation, Second Edition", pp 137-159.
6. *Quantum Turing Machine*. http://en.wikipedia.org/wiki/Quantum_turing_machine.

5/9/2015