A Cumulative method of Page ranking using quantum algorithm for diffusing a Google bomb

Monisha Loganathan [1,*]

[1] *Department Of Computer Science and Engineering,*

Pondicherry Engineering College, Pondicherry- 605014, India.

Abstract — Over the years, Internet has become the viral tool for searching files, documents and other important articles with a single click of the toggling button. With its profound effervescence, the field of Information Retrieval (IR) has gained its increasing importance. But the deciding factor is the time constraint which is required to make a successful search. This paper focuses on Diffusing a Google Bomb with a help of a Page Rank vector using a Quantum Algorithm. In recent years, the field of Quantum computation is essentially harnessing and exploiting the amazing laws of quantum mechanics to process information by inducing two lurid concepts: Superposition and Entanglement. So here a Page Rank is being induced with the help of a Adiabatic Page Rank vector and a power speed up equation so that there is an Enhanced Page Ranking done thereby diffusing the Google Bombs by ignoring a specific constant which could cause a Google washing.

Keywords: Qubits , Quantum Algorithm, Adiabatic Quantum Computing , Hamiltonian ,Eigen Values, Page Rank Vector, Google Bomb.

1 Introduction

With the advent of the Internet, Internet Retrieval has been evolving. A successful search depends on the search criteria which are being used for searching the documents.[2] The promise of quantum computing rests with the bizarre physics that occurs at the subatomic level. Different research teams have worked on creating quantum processors that store information as qubits (quantum bits), which can represent both the 1 and 0 of binary computer language at the same time. That dual possibility state allows for much more efficient information processing and storage .[1]

Entanglement is one of the concepts which is ajar for various improvements in quantum computation. Classical Page Rank Algorithm requires a time complexity *O[n log (n)]*. [3].Whereas a PageRank vector makes use of a power speed up which is prevalent in all quantum algorithms and thereby it can easily crack a google bomb by explicity correlating the link terms and finally ignoring the specific link constant. This algorithm is far better when compared to that of a classical page rank with a power of *O(poly(log n))* [4] so that a google bomb can be diffused with a polynomial speedup for top log n set of nodes.

* Electronic mail: monishals@yahoo.com

2 Adiabatic Quantum Algorithm for Diffusing Google Bomb

As the numbers of the Web pages grow rapidly day by day, it requires an efficient and optimised way of Page Ranking. Moreover an adiabatic quantum algorithm [4] paves the way for the generation of up-to-date Page Ranks. It is proved that an adiabatic quantum computation requires 8 superconducting flux qubits[5].

Adiabatic Algorithms make use of Hamiltonian operators which corresponds to the total energy of the system.[4]. The adiabatic local Hamiltonian is given by the expression [5] :

$$h[s(t)] = [1 - s(t)]h_0 \; - \; h_p$$

The quantum state can be represented as a two dimensional Hilbert Space involving 1 and 2 qubit interactions.[4, 5].

$$H(s) = \sum_{i=1}^{n} h(s)_{ii}\, \sigma_i^+ \sigma_i^- \; + \; H(s) = \sum_{i=1}^{n} h(s)_{ij}\, \sigma_i^+ \sigma_j^- \; + \; \sigma_j^+ \sigma_i^-$$

The probability of finding "i" will give the Page Rank of i.

The approach:

An intermediate state is obtained within the adiabatic system which is a open system where there is an effect on bound states. This state determines the web links to the target page.

$$h[m(t)] = m(t)[h_p \; - \; h_i \;\;] + |\eta_i\rangle$$

$|\eta_i\rangle$ represents the relevant web links associated with the target page i.

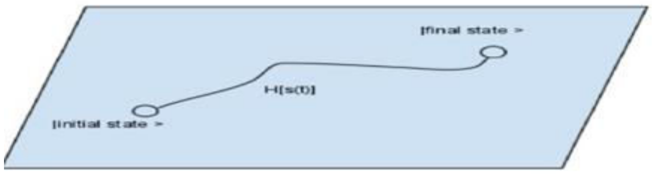
According to the copy –model[4] , The probability of adding a link form a newly added vertex to a uniformly random link is p(*turing parameter*). p takes a positive value or zero. As quantum states can also be negative. The indication of p being negative will state that the links are irrelevant to the target page and so p can be made disable(or made to the 0) thus diffusing the induction of a new Google Bomb.

3 Definitions

System : Open Quantum System

Expression /symbol	**Definition**
$h[s(t)]$ $h_0 \; - \; h_p$	Adiabatic Hamiltonian. Initial and final Hamiltonian
$H(s)$ $\sum_{i=1}^{n} h(s)_{ii(ij)}\, \sigma_{i(j)}^+ \sigma_{i(j)}^-$	Excitation subspace (2^n) – single particle. Matrix elements of h(s(t)).
$h[m(t)]$	Intermediate adiabatic Hamiltonian state

4 Figures



The above figure represents the initial and final adiabatic Hamiltonian States.

5 References

[1]M. A. Nielsen and I. L. Chuang, *Quantum Computation and Quantum Information* (Cambridge University Press, 2004).

[2] S. Brin and L. Page. The anatomy of a large-scale hypertextual web search engine. *Seventh International World-Wide Web Conference*, April 1998.

[3] Christian Borgs,Michael Brautbar, Jennifer Chayes and Shang-Hua Teng ,*A Sublinear Time Algorithm for PageRank Computations,* WAW 2012

[4] Silvano Garnernone,Paolo Zanardi,Daniel A. Lidar(An Adiabatic Quantum Algorithm for PageRank Searching)(NASA Quantum future technologies 2011)
[5]Charles Epstien,-Adiabatic Quantum Computing – an overview[Dec 2012].