A Prototype For Quantum Database In Hybrid Quantum

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This study proposes a prototype*And a possibility to converge both this quantum database and classical database. This study mostly identifies the gap between this classical database and quantum database and it proposes a hypothesis and prototype which can be implemented in future products. It is a way that can be used in future industrial product development on hybrid quantum computers. The existing concept used to consider oracle as a black box this study opens up the possibility for the quantum industry to develop the QASAM module so that we can develop a fully quantum database instead of using a classical database as BlackBox.As the Toffoli gate is basically an effective NAND gate it is possible to run any algorithm theoretically in quantum computers. So we will propose a logical design for memory management for the quantum database, security enhancement model, Quantum Recovery Manager & automatic storage management model and more for the quantum database which will ensure the quantum advantages.In this study, we will also explain the Quantum Vector Database as well as the possibility of improvement in duality quantum computing.It opens up a new scope, possibilities and research area in a new approach for quantum database and duality quantum computing.*

CCS Concepts: • **Computer systems organization** → *Quantum computing*; • **Software and its engineering** → **Software infrastructure**; • **General and reference** → *Reference works*; **General literature**; **General literature**; Reference works; Performance; • **Information systems** → *DBMS engine architectures*; *Main memory engines*; Key-value stores; Database utilities and tools; • **Hardware** → Quantum technologies;

Additional Key Words and Phrases: Quantum Computing,Quantum Industry,Prototype Of Software,Quantum Database,Computer science; Database systems; Computer industry

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1 INTRODUCTION

Even quantum Oracle can be explained as a very lesser number of qubits or more but this is not the thing that we want to achieve. We are trying to focus on the matter of implementing a similar product by converting each component and process of oracle into a dual quantum computer or hybrid quantum computer or QuTech hardware then it will have more processing and shorting power than usual. So we will propose a logical design for memory management for quantum database & security enhancement model. We will always have a Hamiltonian[[36]][[37]] of the signal from binary sources. Quantum computing holds an immense amount of capabilities to solve any classical problems that are unresolved.Apart from the problems in the classical computer, it is shown that quantum query complexity related problems are still unresolved [[53]]. *Quantum computing* mostly developed theoretically with few well known components QKD(quantum

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key Distribution)[[7]],Entagle[[7]],Teleporation[[7]],quantum dot, spin qubit, NV center qubit. Within the Quantum Search Algorithm, the quantum oracle is considered as a black box that has only one operation to perform i.e..improving the performance of searching operations. So in simpler terms, if we need to break the RSA[[11]] algorithm with a key and we need to search for the key within this system the quantum oracle will be considered as a black box which would help the searching process faster. *nitrogen-vacancy center* is also used in many cases of quantum cryptography. And eventually, a 2048 Bit RSA key can be broken with some excess of 17million noisy qubit [[39][40] [41] [43]](But for noisy qubit [[35]]). There are quite a few ways to produce quantum memory that can store quantum information ie. nitrogen vacancy, quantum dot, etc. We can always control the flow of electrons within QPU. It is possible to control entanglement of qubit too[[9]]. NV with trapped ion is also a mechanism to obtain qubit in quantum information[[8]]. A dual quantum computing offers a little better method for searching & shorting and simulating quantum information.

practical large-scale quantum computation

[42] is described in many results of previous research.so far the existing *blackbox as quantum oracle* is never been described properly, you may check the existing mechanism in [68] [69].so we are going to propose a prototype of an ecosystem for the quantum database from software stack respect that can be used for future product development.

1.1 Abbreviations and Acronyms

QPU quantum processing unit, QKD quantum key distribution, entangle , teleportation, quantum dot, nv (nitrogen vacancy) center qbit, qubit RECO Recovery Process, CKPT checkpointing,DBRW database writer process, himeltonian, OpenQL[[38]],QASAM[[44]],pyquil,datafiles where data is stored in a file in binary format,SQL Structured Query Language, QVM Quantum Virtual Machine, RDBMS[[1] [2]] Relational Database Management System OQFile Oracle Generated quantum file which will be retrieved by QASAM,QFile will be considered as QASAM generated instructions stored in a logical location in a quantum storage, blind quantum, QASM Quantum Automatic Storage Management.

1.2 OTHER RECOMMENDATIONS

- To simulate we can use IBM Q[[28]] ,IBM Qiskit[[21]] , Google Cirq[[22]] Microsoft Q#[[23]] and QuTech[[29]],see also [[59–62]].
- **Proposed Method for Searching and Shorting for Quantum Database:** For searching and shorting operations we will propose to use duality quantum computing [4] , [5] , [6] in hybrid quantum or fully quantum database.
- **SOFTWARE STACK IMPLEMENTATION:** It is possible to implement a QASAM-based low-level instruction set using this study which will be able to work as a fully / hybrid quantum database.

1.3 Proposed Simulation:

We may consider a sycamore circuit for storage's simulation as mentioned in [[32]].

2 QUANTUM DATABASE ARCHITECTURE FOR COMPLEX DATAMODEL :

For complex datamodel (eg. Traditional RDBMS) we will have multiple quantum software stack(eg. QASAM) which will able to store and retreive quantum information.

2.1 Quantum Database Memory Management

A quantum memory explained in [[18]][[19]]. But in hybrid quantum, it is possible to simulate a shared memory. Before we begin to propose an alternative improvement to the existing architecture I would like to introduce the term eg. QPROC which will denote the Quantum process that will either retrieve any instruction from QPU or generate QASAM instructions. In this Fig 1 it is clear we will keep all the process as it was before but we will introduce a new process that will deal with the average of the histogram which will be generated from the QPU of the quantum accelerator we mentioned it QHist Reader. and QCKPT the quantum databases' checkpointing process will be there to generate the checkpointing within a quantum database we will rewrite the same thing which will interact with DBQASAM and the checkpointing will be rewritten as see

1

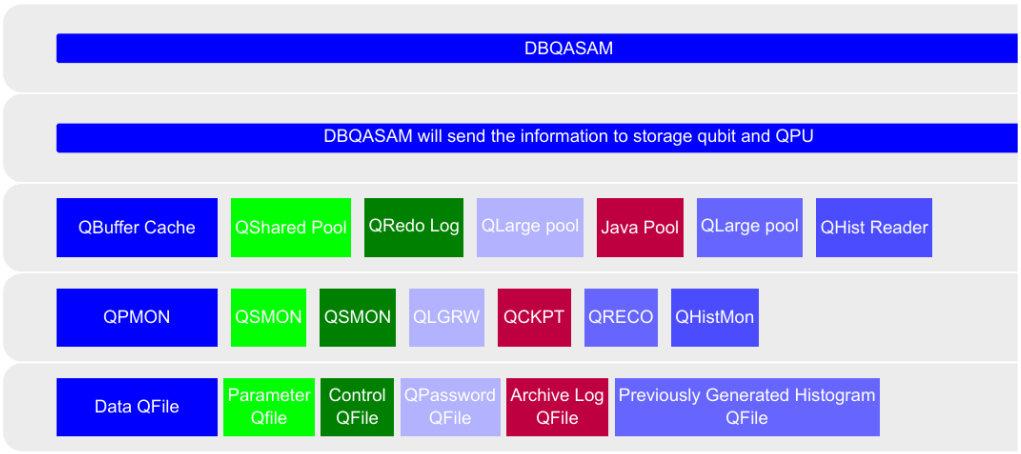

Fig. 1. Quantum Logical Databases' File Structure And Memory Management

1

1. As changes are made to the hybrid quantum database, they are quickly recorded in the redo log which will be QFile.

2. We have three redo log entries. They are all shown in blue, because QDBRW has not yet written any of the changes to the datafiles.

3. The database writer will write out some changes. Here, the changes for entries 1 and 2 have been written to the datafiles which will be basically a QFile and it will store data in *storage qubit*. we will call these datafiles as *Data QFile.*

4. A checkpoint(QCKPT) is recorded every three seconds. Here the checkpoint is redo log entry 3, because all prior changes have been written.

5. This process continues. More redo records are written in a QFile Fig 1

6. More changes are written to a QFILE which will be the datafiles(these datafile will be stored in a *storage Qubit*. Fig 1

7. and finally the Quantum checkpoint(QCKPT) Fig 1 is advanced.

8. [for information about classical database , see A , B , C]: Similarly we can put all other processes and components within the quantum database to enhance the performance of databases' searching and shorting mechanism.In the case of a

[1] 1figure is made based on [[1]]

classical database, we use LRU(least recent use) algorithm before updating data in memory so in our quantum database (ie. in DBQASAM)we will have the luxury of using quantum automata, QCA [[54][55] [56]] to obtain maximum quantum advantages.

2.2 Quantum Files in Quantum Storage

In this Fig 1 it is explained clearly that we can easily store necessary quantum files in quantum storage as it will be basically few storage qubits (mentioned in [[15]] and we can easily store them in sycomore circuted quantum storage using QASM(Quantum ASM. see 2.3) , also see C;while we may use duality quantum computing retrieve quantum data (

Definition 2.1. quantum data is just stored quantum information in qubit which can be retrieved at any point in time using any possible searching mechanism.

)

Along with the mentioned files which were there in the classical computer we will store other information of previously executed queries and previously processes' histogram also into quantum storage which can be accessed for future references. In the case of storing data, it is quite natural we will consider quantum storage, and quantum storage can be two types 1. the quantum accelerator which will have a complete database will consist of quantum storage or it will be another accelerator that will have quantum storage and it will be attached with a classical computer. This classical computer will be responsible to generate instructions through qx[[13]], Pyquil[[10]] through quantum algorithms in the first cases. But in second cases quantum to classical layer Fig 8 will communicate the other quantum storage to retrieve the data. As it is mentioned in [[15]] we can even have a shared memory in a quantum hybrid computer and a smiler qubit can be used for a dual quantum computer also.

2.3 Quantum Automatic Storage Management:

As mentioned in [[1]] a Quantum Automatic Storage Managent must holds storage qubit and all storage qubits must holds data. This QASAM module will be the sub-module of DBQASAM and it will always ensure QDBWR to write the transactions back into storage qubits. Combining multiple storage qubit we can easily form a defferent separate group of storage qubit that can store the quantum information ie. quantum data which can be retrived during the query execution process.For simulation of storage qubit check [[32]][[33]] see Fig 2 for logical structure [2] [3] [4] In 3 we can easily simulate a quantum storage cluster multiple sycramore circuted storage qubit.These storage clusters will be accessable with ASMQASAM low level instruction sets.

2.4 Quantum Recovery Manager and Logical Backup Mechanism:

As mentioned in [1] [45] that a recovery manager is necessary to perform the logical backup operation of the quantum database. We will use the Quantum recovery manager for the same purpose.it will be a QASAM module (say RMAN-QASAM), which can be executed from a classical computer or a quantum network-based connectivity.It will keep the backup in the same QFile which will ensure an on-demand recovery process off Quantum datafiles, and Quantum parameter files etc.

[2] 2 is based on [[1]]
[3] 3 is based on [[1] and [32]]
[4] 3 Sycramore cicruitery storage qubit cells are proposed to be used to create qubit clusters [32]

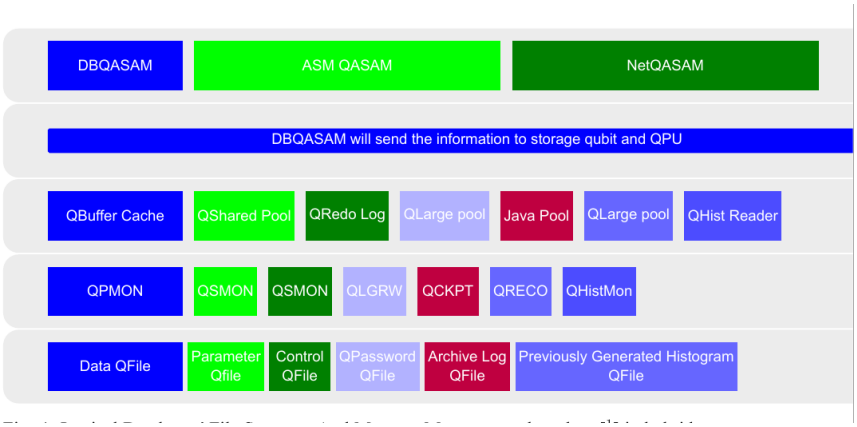

Fig. 2. Quantum Logical Databases' File Structure And Memory Management

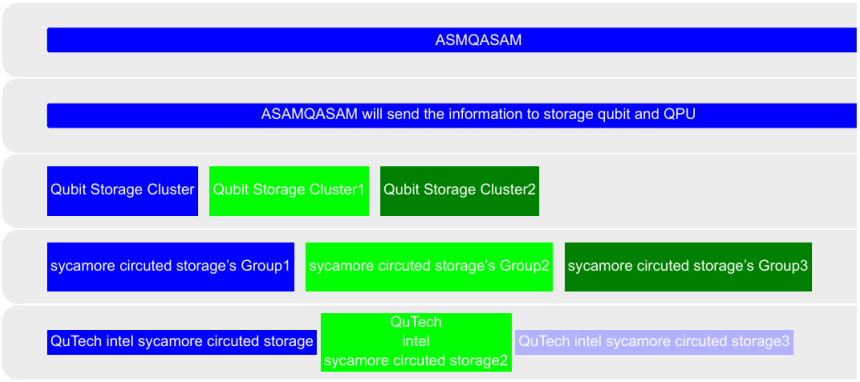

Fig. 3. Quantum Logical Automatic Storage Management

2.5 The enhancement in module For Authentication Will Look Like:

If we consider database security only (As proposed in [[14]]) the Authentication module for either of any RDBMS, can be kept in this quantum accelerator, and then we can allow authenticated clients to execute SQL[1] [2] statements after receiving the quantum signal from the quantum network [[20]]. [5] This will finally return a Quantum Signal from the histogram generated by the QPU finally to clients whether the user is authenticated or not. To simulate this mechanism with PyQuil you can easily define a QVM based on this authentication mechanism and simulate such a scenario. This process most likely works in the classical computer which is mentioned in [[14]] but in this case, we will store these files in QASAM formats which will be retrieved only by the same QASAM compiler. As each and every Quantum Computer/accelerator will be an analog device so we can our case we will consider it as OQASAM (Oracle QASAM)or DBQASAM(for the generic database) as this QASAM will be different for different purposes. Each and Every file generated by OQASAM we will consider it as OQFile.So the most possible authentication mechanism would be as

[5] 4 Figure is generate using a tool [34]

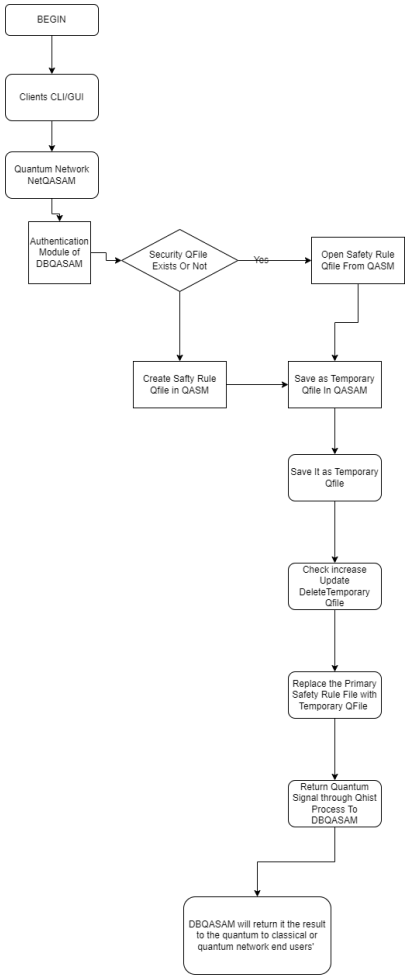

Fig. 4. Security Enhancement Module Flow Diagram For users' Authentication

mentioned in Fig 4 However in this case whole authentication module will be redesigned with quantum cryptography[[16]] as QPU will have more computing efficiency than a classical computer. As it is mentioned in [[15]] We can easily connect from one instance to another eg. and intercommunication between different nodes is possible with NetQASAM.This authentication module(or prototype) can be used for admin users' authentication in hybrid quantum.

2.6 Data Compression Of Backup and Quantum Datafiles:

In [[66, 67]] a quantum compression is proposed to be accomplished for

> with two different topological layouts a fully connected triangle processor and a partially connected line processor

[66].so we can apply compression on quantum data for quantum datafiles as well as for quantum data backups.

2.7 Quantum Active-Active Database Cluster:

As [63], [57, 58, 65] shows a distributed quantum computing mechanism.In many ways we can have a Quantum Real application Cluster too. This figure 5 is pretty much intuitive and it is used for describing the architecture from the

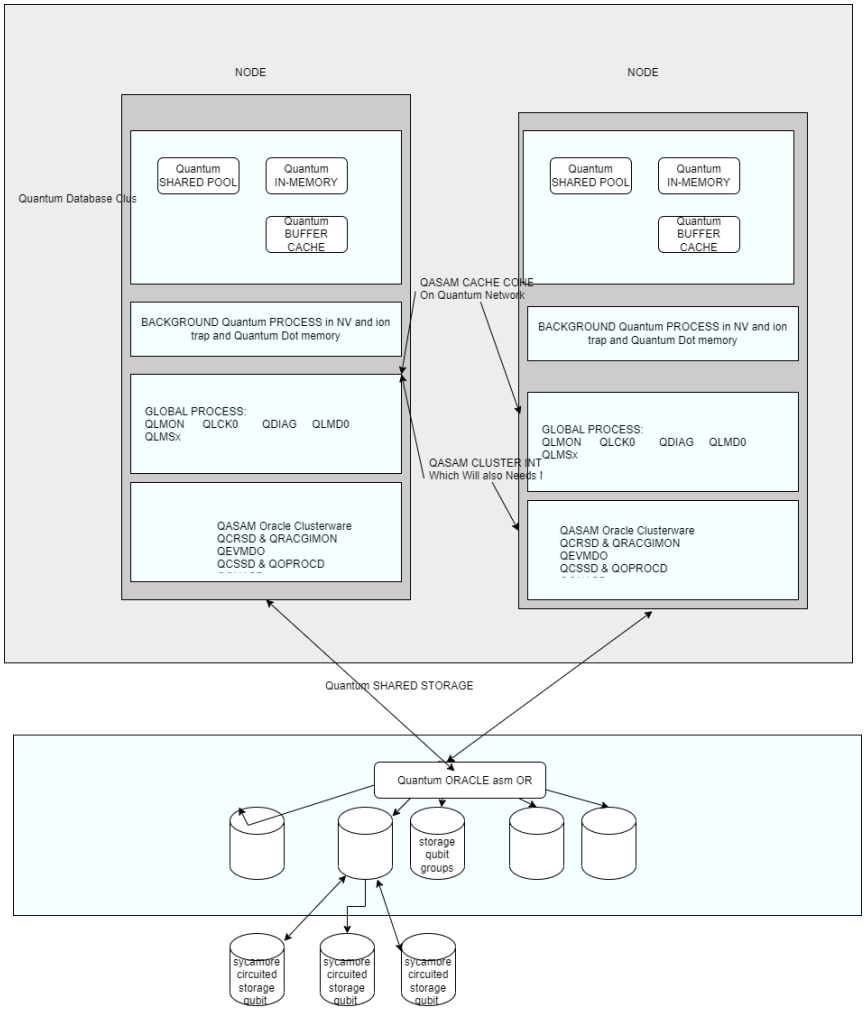

Fig. 5. Quantum Active-Active Database Cluster Architecture

software stacks' viewpoint.5 is most likely our QASAM's low level instruction sets combining all components. In this case also we need a textitQuantum Voting Disk which help us during split-brain syndrome[1].This Quantum voting disk will reside in ASAMQASAM in case of distributed cluster mechanism.In this regard we will also have Quantum CSS , Quantum Event manager , Quantum GPSS , Quantum LMSn , Quantum Plug and Play daemon etc. see G.If shared storage resides over a classical computer(eg. NAS,SAN storage) the only option to read and write them with toffoli gate so there will be no quantum advantages unless and until same data will be migrated to the new fully quantum storage.So

quantum cluster infrastructure stack will be able to communicate to another quantum database node with a quantum network. with entangled qubit states so that both nodes can synchronize with each other in quantum network.

3 QUANTUM VECTOR DATABASE

Vector database[[46] [47]] offers little more efficiency for the end users who doesn't need any complex data model. The Quantum vector database [[48]] is possible if we can convert any vector search algorithm in Quantum computing with hamiltonian simulation. We will use duality quantum computing for the retrieval of quantum information from the storage qubit.In this way we can avail a fully/hybrid quantum advantages for vector database too.

4 QUANTUM DATABASE MODEL IN DATA CENTER

Here we will gradually describe a model for Blind Quantum Quantum Database.To achieve quantum blindness two or more datacenter must talk to each other over quantum internet or quantum network. so if they are connected with the quantum internet state of quantum data qubits must be teleported to another data center. [6] In Fig 6 we considered the

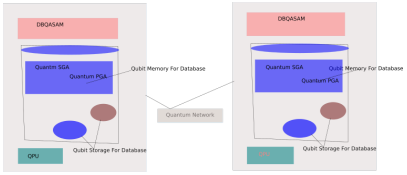

Fig. 6. Blind Quantum For Quantum Database (QuTech Intel Hardware)

left-hand side with quantum data center and right-hand side as a quantum-enabled disaster recovery center. [7] In Fig 6 7 . describe how we can have a disaster recovery center or grid infrastructure with multiple database deployed over quantum network. we can ship archive log or query to apply in different location to replicate data in standby database.To achieve a Quantum Blind Quantum database just like QLDB[[30]] has we can simply add another layer with quantum cryptography, more precisely quantum firewall, quantum internet gateway to form a fully quantum enabled datacenter and user doesn't need to worry about the qubit circuitry for accessing data or quantum information.

5 METHODS

This research is a study which is based on the survey [[17]]proposes based on the past research work and RDMS which explores the gap between theoretical research developed by quantum computing and currently deployed RDMS[[1]] [[2]] eg. Oracle[[1]] and DB2[[2]].It also proposes a logical mechanism of memory management , authentication module as the way title is suggested to achieve a industrial product on dual quantum computer.

Ethical approval declarations (only required where applicable) : Neither human subjects or samples nor animal subjects or samples are used.

6 DISCUSSION

The moving quantum computer is not widely discussed how we can use them in a sycamore circuit but in my opinion, it can be used with sycamore circuited qubits or within a hybrid quantum computer. Even a hybrid quantum computer holds

[6] 6 is based on [[29]]
[7] 7 is based on [[29]]

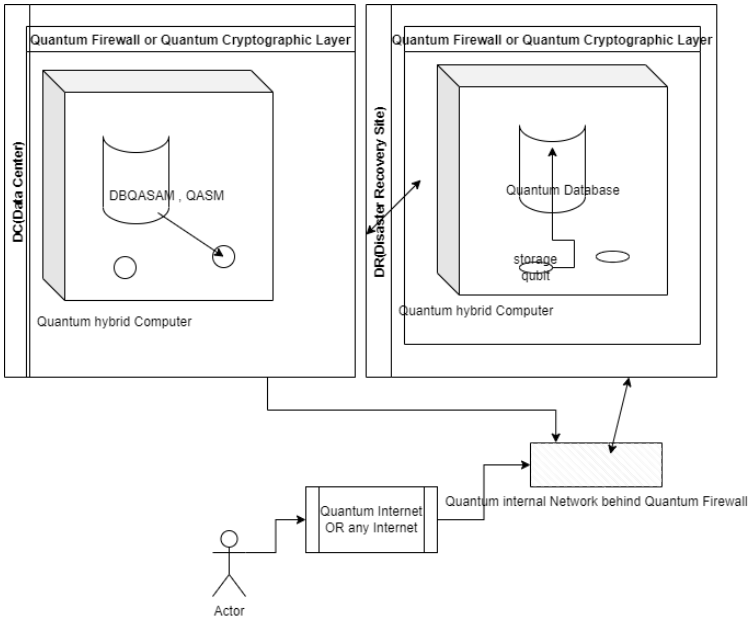

Fig. 7. Blind Quantum For Quantum Database (QuTech Intel Hardware)

a small difference from the fully quantum computer but we can always use a hybrid quantum computer to get users' input to provide a blind quantum experience to the end users.

6.1 Challenges:

- Duality quantum computing is not constructed for Hybrid Query as the way PVLDB mentioned.
- Duality quantum computing is not constructed higher dimensional quantum data models.

6.2 Possibilities:

By this way we can achieve a quantum blind quantum database system which will able to run on QuTech hardware mentioned in Fig 6.

A QUANTUM ACCELERATOR:

8

In the case of quantum accelerator as shown in Fig. 8, it is quite natural to have OpenQL[[38]] as human-like language and QASAM as low-level language. The block design of the quantum accelerator is used as follows. Quantum circuitry consists of qubit gates and circuits and qubit can be controlled by a superimposition state and coupled together to control entanglement. Qubits can be also optimized any many different ways as they can overlap with qubits' state. Qubits can also have magnetic interaction which may also reduce qubit's sophistication. QASAM in Fig. 8, is used as assembly languages for Quantum accelators[[13]].

[8] 8 is based on [29]

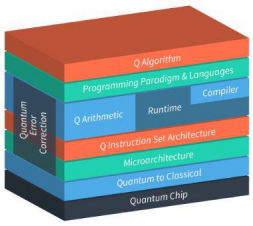

Fig. 8. Quantum Computers' Block Design (QuTech Intel Hardware)

B CLASSICAL DATABASE:

However within the classical database we may compress the data or may not, as searching and shorting operation of data can be time-consuming due to compression and decompression of data. Now in the case of quantum databases, we can only use logical memory management to propose a design that is already in use with mathematical explanations for quantum databases in dual quantum computers. Also shorting of unsorted databse can be explained in dual quantum computer[[24]]

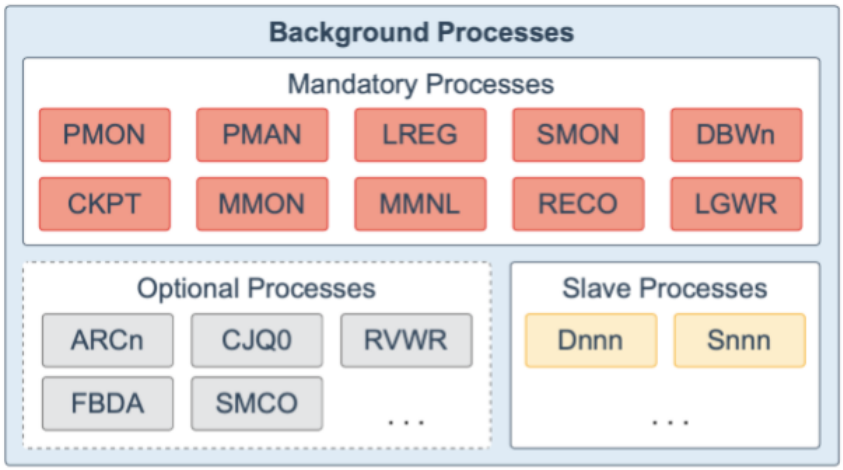

Fig. 9. Background Process

[9]

This will be a prototype of the industrial approach for developing a robust RDBMS[[1] [2]] for hybrid quantum and dual quantum computers. In the quantum algorithm, an oracle is a black box that is basically a classical database.There are a few background processes that are part of any robust database[[1]] eg. oracle, DB2[[2]] i.e.. CKPT(checkpointing), RECO(Recovery process), DBRWn(it writes data into datafiles), LGWR(writes redo logs) etc. as described in the images. In fact, the current version of oracle also introduced many more features which is containerization. But CKPT

[9] 9 is based on [1]

is responsible for creating Checkpoint. We will take a glance at the CKPT process now. The CKPT process is actually responsible for updating the headers for many datafiles. just like Fig. 9, and Fig. 10,

1. As changes are made to the database, they are quickly recorded in the redo log. [10] **2.** We have three redo log entries.

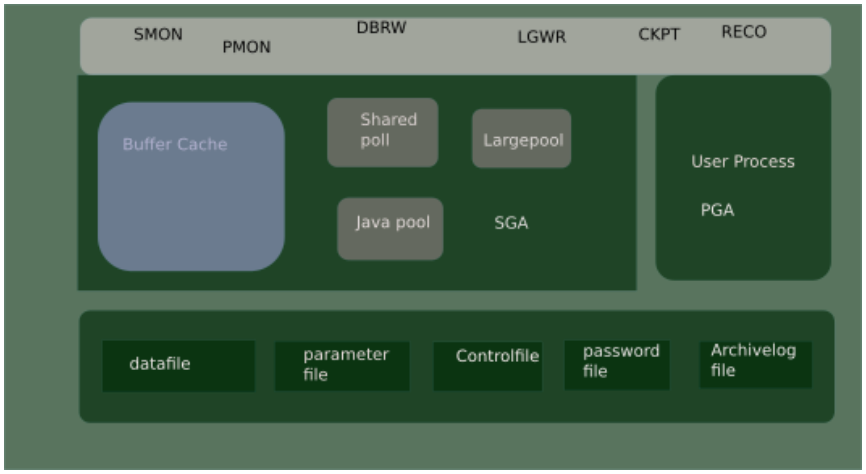

Fig. 10. Database Architecture

They are all shown in blue, because DBRW has not yet written any of the changes to the datafiles.

3. The database writer will write out some changes. Here, the changes for entries 1 and 2 have been written to the datafiles.

4. A checkpoint is recorded every three seconds. Here the checkpoint is redo log entry 3, because all prior changes have been written.

5. This process continues. More redo records are written

6. More changes are written to the datafiles.

7. and finally the checkpoint is advanced.

8. Similarly we can put all other processes and components within the quantum database to enhance the performance of databases' searching and shorting mechanism.

C DUAL QUANTUM COMPUTER:

A newly proposed quantum computer was proposed in 2008 and duality computer, or the duality quantum computer and the duality mode of quantum computers. The duality computer is based on the particle-wave duality principle of quantum mechanics. Compared to an ordinary quantum computer, the duality quantum computer is a quantum computer on the move and passing through a multi-slit. It offers more computing operations than is possible with an ordinary quantum computer. The two distinct operations are the quantum division operation and the quantum combiner operation. The division operation divides the wave function of a quantum computer into many attenuated, and identical parts. The combiner operation combines the wave functions in different parts into a single part. The duality mode is a way in which a quantum computer with some extra qubit resource simulates(an example is mentioned in[[25]])

[10] 10 is based on [1]

a duality computer. The main structure of duality quantum computers and duality mode, the duality mode, their mathematical description, and algorithm designs are reviewed. [[3]].see [4] , [5] , [6] for more information.

D BLIND QUANTUM QUANTUM DATABASE:

Definition D.1. We will consider a blind quantum quantum database where end-users do not need to worry anything about qubit or low-level instruction set of QASAM rather they are still able to retrieve/store information from the quantum database without considering anything about qubit and gates.

E VECTOR DATABASE:

A vector database usually consists of a storage layer, worker layer, coordinator layer, access layer, and log backbone. Storage layers have key-value storage (KV-storage) and other types of storage. But the searching and shorting operations take place in Vector database searching operation takes place with NN (nearest neighborhood-based).see [[47]] [[48]]

F DISTRIBUTED QUANTUM COMPUTER DQC:

Definition F.1. A distributed quantum computer (DQC), we mean a network of limited capacity quantum computers connected via classical and quantum channels. Each computer (or node) possesses a quantum register that can hold only a fixed limited number of qubits. Each node also possesses a small fixed number of channel qubits which can be sent back and forth over the network. Each register qubit can freely interact with any other qubit within the same register. Each such qubit can also freely interact with channel qubits that are in the same computer. In particular, each such qubit can interact with other qubits on a remote computer by two methods: 1) The qubit can interact via non-local operations, or 2) The qubit can be teleported or physically transported to a remote computer in order to locally interact with a qubit on that remote computer.

[58]

G ORACLE REAL APPLICATION CLUSTER:

In [1] we can see to achieve an Oracle Real Application Cluster(which is an active-active cluster), we need cache coherency, Cache Fusion, cardinality, client cluster, cluster configuration policy, Cluster Ready Services Daemon (CRSD), Cluster Synchronization Services (CSS), Event Manager (EVM), Distributed Transaction Processing (DTP), General Parallel File System (GPFS), Global Cache Service Processes (LMSn), Grid Plug and Play Daemon (GPNPD), High Availability Cluster Multi-Processing (HACMP)This figure 11 explains that cache coherency and cache fusion algorithm are used to make this clustering work.

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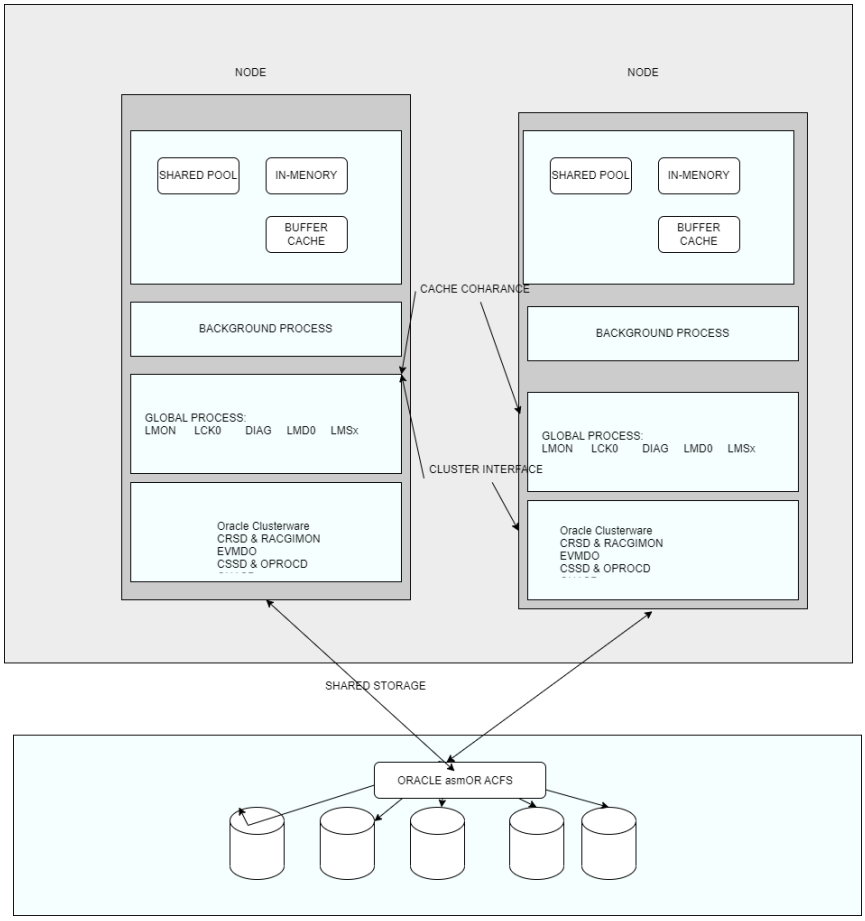

Fig. 11. Oracle RAC Database Architecture

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- **G.1 Author Information:**

Fig. 12. Chakraborty Sayantan, (Founder, CADENTIC®)
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I have worked 10 years with different organizations including MNCs in contractual positions as Oracle Database Administrator/ Oracle E-Business Suit Database Administrator. I am holding extensive knowledge in oracle database,terraform,kuberneties etc. I am currently working as self-employed for my own multiple brand eg.CADENTIC® , ZOQOLO® , CADENTIC ZETTADATEN™ under business name: NDEDGE INFORMATICS PVT LTD.I have worked earlier with 20 different clients since I begun my carrier.I am recently looking for a doctoral program also. My most highest degree is : Masters In Computer Application from PAILAN COLLAGE OF MANAGEMENT AND TECHNOLOGY in 2009,and my Current organization located at: lp.110/36/3 Manikpur,Manashbhumi Po.Italgacha kolkata 700079 (as mentioned above). ,