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REVIEW ON PARALLEL AND DISTRIBUTED COMPUTING

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ABSTRACT

The idea of parallel and distributed computing was developed by Michael J. Flynn and Paul Baron respectively. As there was simultaneously a large growth in availability of big data and number of users over the internet, the development of parallel and distributed computing came into existence which were developed on fundamental concepts like message passing, memory management, concurrency, etc. Basically, In parallel computing multiple processors perform operations or tasks assigned to them concurrently. Memory in parallel computing can be either shared or distributed. Parallel computing generally requires a single computer, it uses the multi processors to solve a problem by breaking it into instructions and solving each resource simultaneously. There are generally three types of parallelism which are - bit level, instruction level and task parallelism respectively.

The distributed system is a collection of autonomous systems that are connected over the network. These systems communicate and coordinate with each other through passing messages so that the users perceive this as a single entity. In other words a single task is divided over various systems that communicate through the internet. There are generally two types of distributed system which are client/server and peer to peer systems. This paper contains information regarding parallel and distributed computing, their advantages, disadvantages, applications and in the near future how it can be improved further.

Keywords: Parallel Computing, Distributed Computing, Memory, Parallelism, Network.

I. INTRODUCTION

Due to the increase in demand of supercomputers in the 60s or 70s and with the growing popularity of big data, the idea of development of parallel computing and distributed computing came into existence. Parallel computing generally refers to breaking down bigger problems into smaller problems so that they can be executed using multiple processors that communicate with each other via shared memory and the result of these problems are combined using some kind of algorithms upon completion. Parallel computing is widely used in weather forecasting, smartphones, laptops or desktops, astrophysics, etc. The biggest advantage of parallel computing is its ease of handling and executing big data as it saves time because it uses multiple cores which helps the application to run faster. There are mainly three types of parallelism which are as follows:-

- ❖ Bit-Level Parallelism
- ❖ Instruction-Level Parallelism
- ❖ Task Parallelism

Another type of systems which are now most popularly used are the distributed computing system which is a model in which various components of a system are shared among various systems but they work as a single unit. These types of systems can be physically together or can be connected over the network either LAN or WAN. This type of system is used to basically improve the performance of large scale projects combining the working of many systems which helps in decreasing workload as well. The main advantage of using distributed systems is that they provide reliability, scalability and overall high performance which helps in meeting the growing demand of markets or users or businesses. There are generally three types of distributed computing which are:-

- ★ Distributed computing system
- ★ Distributed information system
- ★ Distributed pervasive system.

This paper contains information about parallel computing, distributed computing, their advantages and disadvantages and how they are used, their various applications in various fields and how they can be improved further in the forthcoming future as technology keeps on growing.

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II. PARALLEL COMPUTING

Parallel computing refers to the process running multiple applications/tasks simultaneously on different processors. Generally, its architecture is to break down larger problems into smaller and independent problems that can be processed at a single time. It is done by multiple computers communicating over shared memory that combines results upon completion. It saves a lot of time as it divides a large problem into more than one processor. Let us understand with the help of a figure given below:-

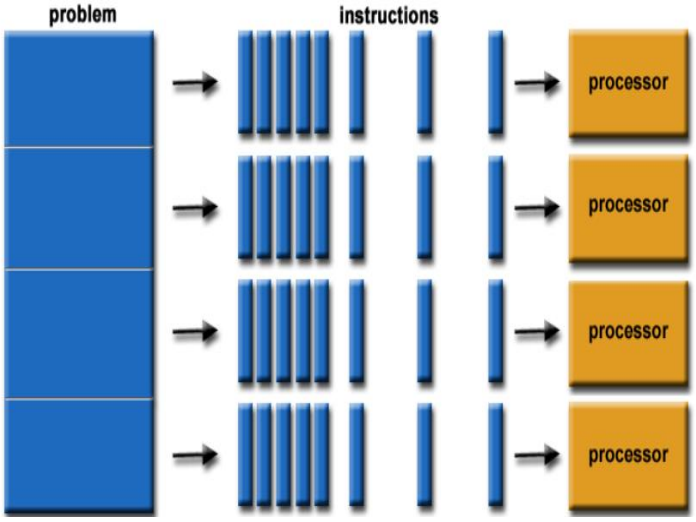

Fig 1

The above diagram shows how a larger problem is divided into smaller problems which are named as instructions and are sent into multiple processors for execution. This type of computing is mostly used in weather forecasting, astrophysics, medical image and diagnosis, data mining, etc.

Types of parallelism-

- **Bit-Level Parallelism-** The type in which every task is dependent on the processor word size. In other words it is based on increasing processor size as it reduces the number of instructions to be executed to be performed on a bigger task. For Instance, suppose there is an 16-bit processor and an operation has to be performed on 32 bit numbers. So in this case it will first execute the lower 16 bits and then the other 16 bits, thus two instructions will be required to execute the operation using a 16 bit processor.
- **Instruction-Level Parallelism-** In this type of parallelism , a processor decides how many instructions will be executed in a single clock cycle of the CPU. A processor can only execute less than instruction at a single clock cycle. The instructions can be re-arranged and grouped which can be later executed simultaneously without affecting the result of the task.
- **Task Parallelism-** In this type of parallelism, a task is divided into subtasks and these subtasks are then executed simultaneously. This execution is performed by processors concurrently.

This technique of breaking down bigger problems into smaller sub parts also known as decomposition helps in processing a large chunk of data efficiently. Thus, parallel computing is widely used in maintaining databases, data mining, multimedia technologies, simulation of systems, advanced graphics, global weather forecasting, visualization, etc. These are the few fields in which parallel computing is widely used for the simple concept that these types of systems maintain a huge amount of data in less time. The main advantages of parallel computing are as follows:-

1. Saves time by completing tasks in a short clock cycle span.
2. Diversity- Can perform many tasks simultaneously using multiple processors.
3. Has a good amount of data storage and computations.
4. Helps us provide high performance at low costs.

Like any other system, this type of computing also has some disadvantages which can be further solved in the future and make it more efficient to work.

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III. DISTRIBUTED COMPUTING

This type of technology is a much wider technology that has been around for a few decades now. Distributed computing basically means when several different computers are connected with each other via network. They are different from shared memory systems as here different computers are used to solve a problem with computations divided among various connected computers which are known as nodes and these nodes use message passing to communicate with each other. Although each individual node has its own functionality, distributed systems are used to use these shared resources and provide communication service to the users. The most common example of a distributed system is the Internet which connects all the computers over the world and communicates through shared resources and messages. Let us understand this with the help of a figure given below:-

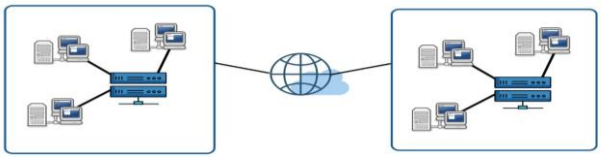

Fig 2

In this figure we can understand that there are several computers which are connected with each other through the network and are communicating with each other by sharing information and resources.

Types Of Distributed Computing

There are three types of distributed computing which are as follows:-

- Distributed Computing System- This type of computing is used in high performance. It also has its subtypes which are as follows:-

Clustering Computing- These are the collections of computers that work together as a unit to perform tasks. Clusters are basically connected through LAN and each computer(node) is using the same operating system. When any request comes from the client the hub i.e the main computer divides the problems into simpler problems and then send instructions to the other nodes and after execution these nodes send back the information to the main node and the result is shown. Cluster computing is widely used in weather modeling, earthquake, simulation, forecast, etc.

Grid Computing- In this type several systems are divided into sub groups called grids. Each grid can differ in their admin domain, hardware, software, topologies, etc. As different computers can have different OS so there is a control node which helps them to communicate and pass messages. It is still a developing technology so it has a lot of drawbacks that can be solved.

- Distributed Information System-It provides an ease of use for computer users as this type of computing is a collection of information systems that share resources and communicate through the internet. The most common examples of this type are transaction processing, enterprise, etc.
- Distributed Pervasive computing- This type of computing basically integrates everyday objects like earphones, mobiles, speakers, etc with processors so that they can communicate with each other. These are the systems that are available anywhere and everywhere.

Therefore, distributed computing has the following advantages-

➔ A system crash of one node does not affect the other node.

➔ It is easy to install and debug new services.

➔ It has a fast computation speed so it provides high performance at less expense.

This type of system has some drawbacks like troubleshooting and diagnostics, security issues and high maintenance cost which can be improved in the near future.

IV. CONCLUSION

As both these technologies were developed several decades ago and with the rapid growth of new technologies they can be improved more to make it more efficient and competition worthy. In the upcoming future parallel computing can be used in the field of artificial intelligence and robotics which can be used to distribute data and

work on shared memory and can function as robots as well. It will help in increasing high performance criteria. a distributed computing can still make a lot of improvements in grid computing as it can have a better customisation of its architecture. It can have better memory management as hungry applications can take advantage of message passing interface. The job submission can also be improved as they do not interact with each other before passing the information. These are the few points in which these technology can be improved further to make it more efficient and user friendly.

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