Modern Trends Used In Operating Systems For High Speed Computing Applications

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***Abstract-* Operating system researches traditionally consist of adding new functions to the operating system in other words inventing and evaluating new methods for performing functions. Operating systems are the single most complex piece of software in a computer system, which contains hundreds of thousands, if not millions, of lines of code. Today's operating system research is directed at finding new ways to structure the operating system in order to increase its flexibility, allowing it to adapt to changes in the application set it must support. This paper presents a comprehensive survey report about its requirements and evolutions of emerging operating system for modern technology based next generation.**

Keywords: Operating systems, Processes, Batch processing, Time-sharing, Multi-programming.

I. INTRODUCTION

Operating system is a system s/w. which control and manage the hardware through bios (basic i/o system).bios is the part of operating system which is built in the system and it run application s/w on a hardware. It is an interface b/w user and system/s is a complex s/w. In a simple word operating system is that which is active on a ram before switch of the system. There is no basic definition of operating system. The operating systems key elements are

- A technical layer of software for driving software components.
- A file system for organizing and accessing files logically.
- Simple command language enabling users to run their own programs and manipulating files.

Operating systems came into being for time saving and best utilizes the resources. No one can easily understand what working behind the screen user can only use graphical and command based screen. This working can be hiding from the user because user can easily use and run their program. The purpose of the operating system is providing the environment to execute the user program.

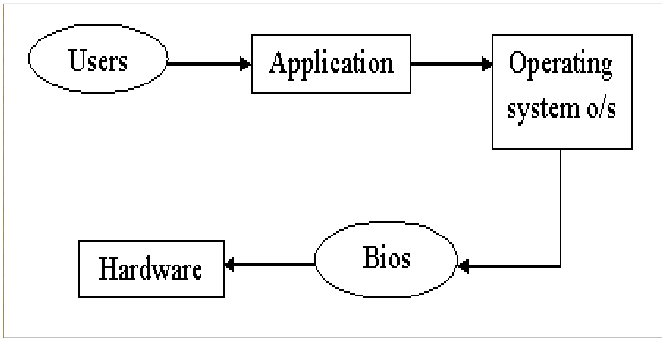

Fig. 1 User interactions with hardware through O/S

The operating system is a best resource manager it control and allocate the resources in the system. The resources are processor, memories, I/O devices and files. Hence operating system is a process manager, Device manage, memory manager, and file manager.

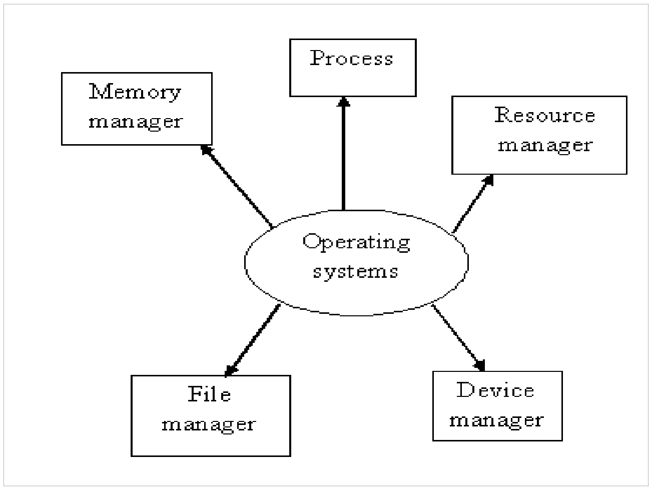

Fig. 2 The manager components of operating system.

A. *Process Manager*

Operating system manages the process on hardware level and user level. To create, block, terminate, request for memory, Forking, releasing of memory etc. in multi tasking operating system the multiple processes can be handle and many processes can be create ,block and terminate ,run etc. it allow multiple process to exist at any time and where only one process can execute at a time. The other process may be performing I/O and waiting.

The process manager implements the process abstraction and creating the model to use the CPU. It is the major part of operating system and its major goal is scheduling, process synchronization mechanism and deadlock strategy

B. *File Manager*

Is a computer program and provide interface with file system. it manage the file like creation, deletion, copy, rename etc files typically display in hierarchical and some file manager provide network connectivity like ftp, nfs, smb or webdav.[1]

C. *Memory Manager [2]*

Is a way to control the computer memory on the logic of data structure? It provides the way to program to allocate in main memory at their request. The main purpose of this manager is

It allocates the process to main memory; minimize the accessing time and process address allocate in a location of primary memory. The feature of memory manager on multi tasking is following.

- Relocation
- Protection
- Sharing
- Logical organization
- Physical organization

D. *Device Manager [3]*

Allow the user to view its capability and control the device through operating system. Which device may be enabling or disable or install or ignore the functionality of the device. In Microsoft windows operating system the control panel applet is the device manager .it also built on web application server model. Device Manager provides three graphical user interfaces (GUIs). Device manager manage the.

- Device configuration
- Inventory collection
- s/w distribution
- initial provisioning

E. *Resource manager [4]*

Is a way to create, manage and allocate the resources? Operating system is a responsible to all activities which is done in computer. Resource manager is the major part of operating system .the main concept of operating system is managing and allocate the resources. The resources of the computer are storage devices, communication and I/O devices etc. these all resources manage and allocate or de allocate by resource manager.

II. HISTORICAL ACHIEVEMENTS IN OPERATING SYSTEMS EVOLUTIONS

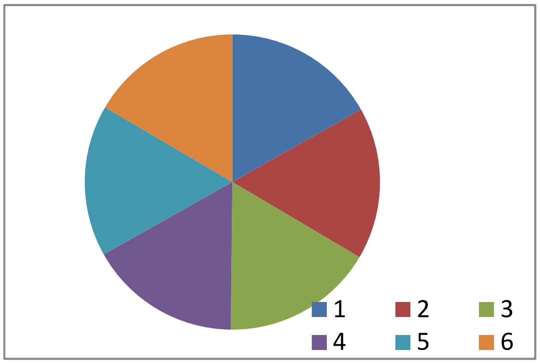

Fig. 3 Emergence of most prominent concepts in O/S.

In fig. 3 the graph basically represents the values of different features of operating systems which creted a diversity efficeny reducing bottle neck and excellent job handlingin other word revoltionising the operating systems of today and future.

1. 1986 micro kernel
2. 1970 multi tasking
3. 1969 virtual memory
4. 1967 muti programming
5. 1961 symmetric multi processing
6. 1955 batch processing

III. FEATURES OF MODERN OPEATING SYSEMS

A. *Batch system/processing [6], [16]*

A batch system is the one which can run without end user interaction or where data and programs are collected together in a batch before processing. Every piece for a batch process is called a job. Jobs are stored in queues in to be processed.

While each job is translated to JCL (job control language) a language to provide instructions to the monitor .The monitor or batch operating system is simply a computer program relying on processor to fetch instructions and relinquishing the control.

Monitor is system software controlling the sequence of events. For this to be so much of the monitor must always be in the main memory and available for execution. That portion is referred to as resident monitor. The monitor reads in jobs one at a time from input devices (typically a card reader or magnetic tapes or magnetic drums), as it is read the current job is placed in the user program area and the control is passed to this job .when the job is completed, it returns to the monitor which immediately reads in the next job, the result of each job is sent to output device.

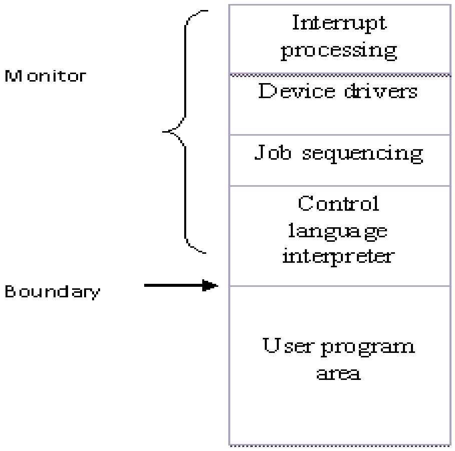

Fig. 4 Taken from operating systems book by William Stallings 7th edition

Advantages

1. Transfers maximum work to the operating system from user.
2. Improves processor utilization

Disadvantages

1. Difficult de-bugging.
2. Large turnaround time from user pint of view.
3. Interference between batch jobs.
4. A corrupt job can affect other pending jobs.
5. A job can enter an infinite loop.

B. Spooling (simultaneous peripheral operation online)

It is a technique in which an intermediate device e.g. disk, hard drive, secondary memory storage is posed b/w a process at the lowest speed or a limited I/O buffer device. Spooling is referred to a process of transferring data by placing it in a temporary working area where another program can access it for processing it at a later point in time. Spooling was the first and the simplest of multi programming system. [8]

Operating system uses a circular or a cyclic buffer for the implementing spooling. An example of spooling is when a thread of the process generates to be printed on a slow output device like a printer. As the thread produces lines must faster than a printer can print, due to this reason we like the thread to be able to complete its execution quickly. These thread outputs are directed to a circular buffer and this buffer may be present in a primary storage or on a disk. The thread which is creating these lines to be printed as often called a spooler. [16] An advantage of spooling is output of the job was gained quickly as soon as the job was completed. A spooling system greatly improves system throughput by disassociating any program from slower devices. Spooling system is a prone to deadlock situations. [8][5]

C. Multiprogramming Systems

Early computers used to run one process at a time Multi programming is termed as rapid switching of CPU between multiple processes in memory. Multiprogramming is carried out only when the currently running process requests for I\O or the process terminates. This action was commonly carried out to keep the processor busy when the I\O request was being served. Now a day it is super ceded my multitasking when processes loose the CPU as their time quantum expires. Multiprogramming exhibits the efficient use of processor by overlapping or by executing priority for the processor demands and its I\O devices from different use Even with automatic job sequencing provided by simple batch operating system the processors are often idle. The problem is that I\O devices are slow as compared to processor.

***Design* [7]**

Layer- 0

It is responsible for multiprogramming aspects of the of the programming system .It is the most lowest level of multiprogramming system design in other words it is also referred to as scheduler .It is responsible for allocating to the CPU .dealing with the interrupts context switching when a process changes its states.

Layer- 1

This layer is basically concerned with the memory allocation to the process, in modern terms it is referred to as pager

Layer- 2

This layer deals with the communication between operating system and console

Layer- 3

This layer manages all input devices connected with the computer.

Layer- 4

This layer in fact consists of user programs and space.

In fig 5 the graph represents the difference b/w uni-programming and multiprogramming. As you see the uni-programming process in graph which considers a system of 512MB memory excluding the operating system, a disk, a terminal and a printer three processes p1, p2 and p3 are submitted for execution at the same time. Assuming minimal processes requirements p2 and p3and continuous disk and printer for p3.considering a uni-programming environment these processes will be executed in sequence p1 complete in 6 min, p2 waits until 6 min are completed and then p2 completes at 15 min after that p3 begins and finishes at 40 min after its initiation .now suppose that these process run concurrently in a multiprogramming environment because there is little resource contention b/w the process all three can run in nearly minimum time while existing with the other in the same system.p2 and p3 are allotted enough processor time to keep their i/o operation active.p1 will be requiring 6 min to its completion but at the end of that time p2 will be 1/3 finished in 15mins and p3 will be half finished .this improvement is evident comparing the both environments and the process executing in them.

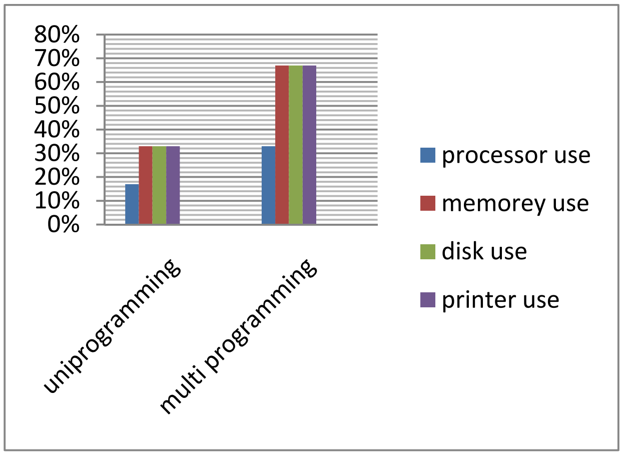

Fig. 5 Graphical representations of multiprogramming verses uni-programming:

D. Time sharing [16]

Time-sharing is the sharing a computing resource among many users by means of multi-programming. The first involved timesharing or time slicing. The idea of multiprogramming was extended to allow for connecting multiple terminals to the computer, with each in-use terminal being associated with one or more jobs on the computer. The operating system is held responsible for switching between the jobs, now often called processes, in such a way that favors user interaction. If the context-switches occurred quickly enough, the user had the impression that he or she had direct access to the computer.

Interactive processes are given a higher priority so that when IO is requested (e.g. a key is pressed); the associate process is abruptly given control of the CPU so that it can process it. This is usually done through the use of an interrupts that cause the computer to realize that an IO event has occurred.

E. Symmetric multi processing

SMP is a computer architecture that provides fast performance by making multiple CPU’s available to work simultaneously completing individual processes.SMP uses single operating systemshares disk memory and input\output resources. Both UNIX and NT use SMP. SMP system ranges from 2 to 32 or more processor. However if one CPU fails the complete SMP system is down. Clusters of two or more SMP systems are use to overcome failure resilience if one system fails other continue to work.[10][11][12]

Design

This figure illustrates the general design of SMP. there are multi processors each having its own cache and ALU ,these processors are communicate to each other through memory by sending signals and they are joined or interlinked to each other through a system bus.[9][6]

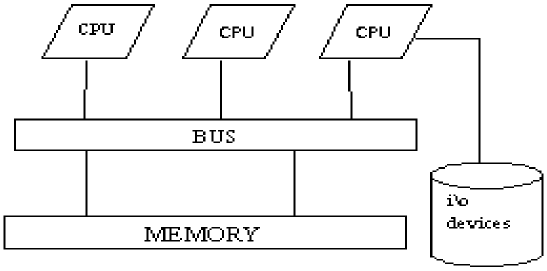

Fig. 6 Organization of a typical SMP system.

Advantages [12]

- SMP has many advantages in science, industry and business. However word processors and games are written in such a format that that they cannot gain large benefit from concurrent systems. For games it is usually because writing a program to increase performance on SMP systems can produce loss on uni-processor systems.[1]
- SMP is used to give high levels of performance as any processes can run and any of its related threads too.[2]
- SMP provides a good load balancing because systems process can run on any processor thus reducing the bottle neck effect.

F. Virtual Memory

Are the part of secondary memory and the concept of virtual memory increase the available memory enlarging the address space or place in memory where the data will be stored? Now a day of virtual memory is the basic part of secondary memory because the size of currently operating system is very large according to the main memory so it cannot be possible the whole operating system can mapped on the main memory due to the virtual memory make possible due its functionality. Virtual memory is dynamically the operating system give size control to the user. Virtual memory is the major achievement in the operating system and it is the gate of developing inheritance application.

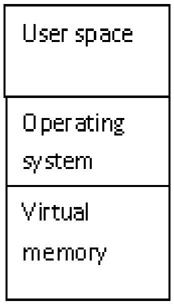

Fig. 7 Interfaces of virtual memory with system.

VM is part of an operating system enabling to use memory address space (RAM) independent of other processes running concurrently on the same system using space that is larger than the actual RAM .in a system using VM physical memory is divided into equal sized pages. The memory addressed by a process is also logically paged into same size. When a process refers a memory address and memory fetches that address of address of referred page and places in subsequent physical page of RAM .subsequent references wit in that logical page are translated to a physical page. When a process references an address from another logical page it is too fetched into the vacant memory space of physical page and become a part of these likely references. VM enables each process to behave as it has access to the complete memory space.

To itself since the address that it uses to reference memory are translated by VM mechanism. Virtual memory has two main methods to free up the ram.

- Paging
- Swapping

1. Paging [6]

The data or process can be mapped on main memory from secondary memory due to the paging of virtual memory.

2. Swapping [6]

Is the method or way to free up the main memory the process page can be release it will be swapped out from the main memory and the next page of the process will be swapped in the main memory on the previous page.

Those methods on implement logically in operating system by data structure different algorithms.

- FIFO (first in first out)
- Optimal
- LRU (least recently used)

1. Least recently used (LRU) [9]

Policy replaces the pages in memory that has not been referenced for the longest time. BY the principle of locality, it should be the page which is least likely to be referenced in the near future. LRU policy does nearly as good as the optimal policy. The problem with this approach is the difficulty in implementation. One approach would be to tag each with the time of its last reference, this is done with each memory reference both instruction and data.

2. Optimal [6]

Optimal policy selects for replacement that page for which the time to the next reference is the longest this results in less page faults .this replacement policy is impossible to implement because it requires the operating system to have more knowledge of future events.

3. First in first out (FIFO) [6], [9]

This policy is the simplest replacement policies to implement. This policy treats the page frames allocated to a process as a circular buffer and pages are removed in round robin style i.e. it is the simplest algorithm in operating system assigning each page a time slice of equal portions in circular manner handling every page without priority .all that it requires is a pointer that circles through the page frames of the process. The logic behind this algorithm is that replacing the page that's the longest in memory this reasoning may also fall wrong because there may be pages that are used throughout the life of a program such pages will be in out paged by the FIFO algorithm.

4. Cleaning policies [6], [9]

Cleaning policy is opposite to fetch policy it is concerned with determining when a modified page is moved out to secondary memory.

- Pre-cleaning
- Demand cleaning

1. Pre cleaning [9]

This policy writes modified pages before their page frames are needed so that pages can be written out to batches. A page is written out but remains in main memory until the page replacement algorithm dictates that it is to be removed though pre cleaning allows the writing of pages in batches but it does not make sense to write out hundreds and thousands of pages to find that the majority have been modified before they could be replaced.

2. Demand cleaning [6]

This policy applies to pages written out to secondary memory only when it has been selected for replacement. The drawback of demand cleaning is the writing of a dirty page is coupled to and precedes the reading in of a new page. This technique may minimize two page transfers before it can be unblocked this approach decreases processor utilization.

A better approach to overcome the flaws of both the cleaning policies is to allow adaptation of the following policy clean only pages that are replaceable decoupling the replacement operations .WITH page buffering replaced pages can be set on two lists modified and unmodified. The page on the unmodified list can be periodically written out in batches and moved to unmodified list. A page on the unmodified list is either reclaimed as referred or lost when its frame is assigned to another page.

Advantages of virtual memory [6]

- At low cost more memory available
- large application run on less main memory
- More application run on once.
- Make less Accessing time to the disk

Disadvantages of virtual memory [6]

- Speed of the system slow.
- Process switching will be slow.
- Stability of the system reduces.
- Less hard drive space for user.

G. Micro kernel [9], [6]

Micro kernel is a small privileged source that provides process scheduling memory management and communication services and depends on other processes to perform some of the functions mainly associated with the operating system kernel. The micro kernel approach was popularized by its use in mach OS which is the core of the Macintosh Mac OS X operating system.

The basic concept underlying the microkernel architecture is that only absolutely essential functions of Os be in the kernel. Less essential functions be moved into microkernel and executed in user mode. Components outside the microkernel interact via peer basis i.e. by sending a message passed through the microkernel and micro kernel in exchange produces a message, validating massage passing between components and grants access to hardware a message of a microkernel has a header identifying the receiving and sending process a body contains direct data and control information

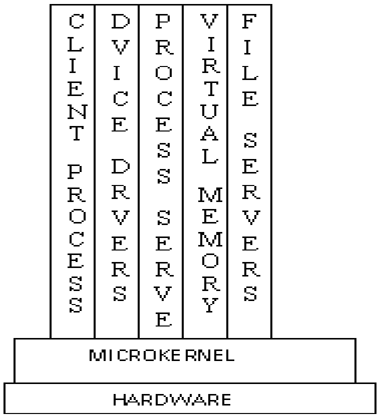

Fig. 8 Taken from operating systems book by William Stallings 7th edition

Microkernel prevents message passing unless exchange is allowed i.e. within a single system a client network environment is observed.

Example: If any application wishes to open a file like Microsoft word document it send a message to the file server system .it the process wishes to create threads it sends a message to process server thus each of the servers can send message to other servers in return invoking primitive functions inside the microkernel.

There have been number of advantages of microkernel such as [6]

- Uniform interfaces
- Extensibility
- Flexibility
- Portability
- Reliability
- Support object oriented operating system (OOOS)

In the designing of a microkernel there are no hard and fast rules but there is a set of functionalities that every microkernel should perform these functions depend directly on the hardware and those functions needed to be supporting the servers and different applications on user mode.[9]

- Low-level memory management
- Inter process communication.(IPC)
- I\O and interrupt management.

H. Scheduling [6]

The resources have to be shared so they have to be shared so the scheduled according to queue. Consider disk as a resource if there is only one user the FIFO algorithm is considered enough. However considering a multi tasking system in which multiple process give request so they should be serviced carefully .since a disk is hardware so one of the aims of scheduling a disk device is to wear out less on a surface.

*1. **Scheduling objectives** [9]*

- A system designer while designing a scheduling system considers different factors during the development of the scheduling discipline like as the type of system and user needs. Depending on the system both the user and designer expect the system to perform the following objectives.
- Maximized through put an attempt to perform maximum number of processes in a unit time.
- Maximized resource utilization: an attempt to keep the system resources busy.
- Avoiding indefinite postponement: during the reception of the services.
- Enforce priority: if a system assigns priority to a process, scheduling should favor high priority process.
- Minimize over head: consider as an important objective of scheduling. Over head mostly result in wasted resources but a certain amount of Resources in certain effectively in an overhead greatly improves overall system performance.

2. Scheduling levels [9]

- High level
- Inter-mediate
- Low level

High level

Scheduling allows which resources are allowed to Compete for resources. This level is also named as admission scheduling for it determines which job gains admission to the system. Once initiated and admitted to the system they become a single process or group of process. This algorithm of scheduling dictates the degree of which is multiprogramming .en functions depend directly on the hardware and those functions needed to be supporting the servers and different applications on user mode entering too many process into the system saturating system resources in result leading to poor performance. High level schedule times often limit large main frame system performing batch operation.

Inter-mediate level

After the high level scheduling comes the inter-mediate level scheduling algorithm determines which process is going to compete for processors. this algorithm respond to short term fluctuation in system load, temporarily suspending and resuming processes to achieve smooth system operation and help realizing certain system performance goals. This level acts as a buffer between admitting jobs to the system and assigning processors to jobs represented by processes.

Low level

In a system working on low level scheduling algorithms determine which active process will be assigned to a processor by the system and when the next become available. Low level scheduling algorithms assigning priority to every process reflect its importance –the more important the processes the more likely algorithm selects it to execute.

3. *Scheduling algorithms [9]*

- First in first out scheduling
- Shortest process first (SPF) scheduling
- Shortest remaining times (SRT) scheduling

First in first out scheduling [9]

It is the smallest scheduling algorithm another words also called first come first serve (FCFS). DISPATHER Dispatches processes according to the time of arrivals at the ready queue. once a process has occupied a processor, process will run until its completion it is a fair algorithm such as scheduling processes according to their arrival times in result all processes are treated equally but the disadvantage is long process make short process wait and un important process wait, this algorithm does not guarantee short response time.

Shortest process first (SPF) scheduling [9]

A non preemptive scheduling discipline where scheduler selects a process that has waited small run time could its completion. SPF has low average waiting time over FIFO algorithm. SPF selects a process to be given service in a manner enshrining the next process will complete and leave the system as soon as possible. This result in reducing the number of waiting processes also reducing process number waiting behind the large process. SPF faces a key problem as its required precise knowledge for how long a process shall run and this information is usually not available

Shortest remaining times (SRT) scheduling [9]

This scheduling is preemptive and opposite to SPF. SRT is effective for job processing system that receive incoming string of job In a SRT algorithm scheduler select the process with smallest run time to completion. In a SRT a newly arrived process either a shortest run time over runs a running process with long run time to completion. Here again SRT requires estimate a features process behavior. The algorithm must account information about elapsed time of service of the running process and performing occasional preemptions. SRT algorithms offers performed minimize waiting times in theory but in situation certain due to preemptions SPF provides better performance.

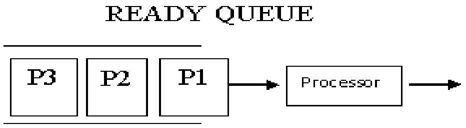

Fig. 9 Execution model of a typical process management systems of O/S

IV. FUTURE OF OPERATING SYSTEMS [13]

Operating systems have been developing completely in an opposite direction that is they are not any simpler in design and working but are day by day becoming more complex .Current operating systems are traditionally built bottom-up: Start with the machine, then connect it somehow to the user. Their goal is to package the processor, memory, disk and other peripherals so as to manage them remotely. Next generation operating systems start up with user, they are not any more related t the hard ware; these operating systems are less use full as compared to today's operating systems.

Some features of future operating systems are

- user interface
- Knowledge navigator
- Multi touch
- Self automated
- Self diagnosing

User interface [13]

At first user inter faces were one-dimensional
Usually in dos in 1980, u types a line and operating system in return writes the lines back. with MAC OS and Windows 3.0 the operating systems user interface became 2-dimensional .next generation operating systems will become 3-dimensional in pictorial form, the computer screen will not be any more a glass board but it will be view point with information landscape in a 3-dimension.

Knowledge navigator [14]

The Apple CEO John Sculley unveiled his dream for the computer of the future, which he called the Knowledge Navigator. The important feature of knowledge navigation is that u interacts with the computer by speaking and the computer acts as an intelligent navigator by interpreting the voice and seeking to the user requirements.

While simple voice recognition capabilities do exist today, but we are far away from being able to incorporate into an operating system the ability to deal reliably with the infinite possibilities of spoken input. In other words, we are many, many years away from having operating systems that are capable of responding to such spoken commands as "Computer, find some good maps of deforestation in Brazil from 1982 through 1999 and deliver them to my e-mail. Oh, and any related charts or graphs as well please. I need them for a lecture this afternoon. Do these up as PowerPoint slides, please."

Multi touch [15]

Multi-touch sensing technology enables a user to interact with a system with more than one finger at a time, as in chording and bi-manual operations. Such sensing devices are inherently also able to accommodate *multiple users* simultaneously, which is especially useful for larger interaction scenarios multi touch have been implemented in several different ways depending upon the applications and interfaces .both touchable and touch walls project an image through acrylic glass and then send back the image through the led's When a finger or an object touches the surface, causing the light to scatter, the reflection is caught with sensors or cameras that send the data to software which dictates response to the touch, depending on the type of reflection measured. Touch surfaces can also be made pressure-sensitive by adding a pressure-sensitive coating that flexes differently depending on how firmly it is pressed, altering the reflection. When a finger makes a contact or touches the screen, the touch disrupts the panel's electrical field. The disruption is registered and sent to the software, which then is going to initiate responses to the gesture.

Self automated

Self automated operating systems are not generally in application today. Self automated operating systems are that a user only feed the input to the computer rest of the work is done by operating systems the user is no longer needed in today operating systems

Self healing [16]

The major property of self-healing system is that it self-diagnosis itself, the system provides technology to automatically diagnose the problems from the symptoms and the results of diagnosis can then be used to trigger automated reactions. A fault or defect in hardware or software can be associated with a set of possible observed symptoms called errors and referring the data produced by the system as a result of observing errors as an error report. In a system which is predictive self-healing error reports caught by the system are instead encode to a set name value pairs described by an extended protocol to form an error event. Error events are and their relevant data is gathered to help facilitating self-healing and are then dispatched to a software component called diagnosis engines . These engines are designed to form an underlying problems corresponding to these symptoms. These engines run silently at the back end of a running system.

Predictive Self-healing tasks [16]

– To simplify the tasks to compose, configure and develop high-quality solutions and in a continuous manner measure their ability.
– Maximizing the systems abilities and services once deployed by automatically diagnosing, isolating and recovering from the occurred faults by being predictive and proactive where ever possible.
– Guiding system administrators through any of the tasks requiring human intervention, including repairing and explaining problems detected or predicted by the system using a clear concise language and linking continuously updating repair procedures and documentations.

V. CONCLUSION

With the changing demands of the fast and high bandwidth data processing applications, the structure and implementation techniques of underlying operating systems have been evolved through many decades. In this research paper the mainly focused is on different aspects and features of modern operating systems, also there in depth working, their design and implementation concepts in brief. Also this paper is introducing different demanding aspects and features of future operating system which will revolutionize the world of computing and will facilitate the computer based application platforms as well as systems.

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