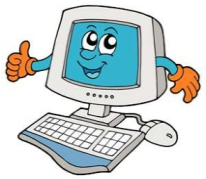
13 Current Trends and Technologies



Today technology has become integral part of human lives. No aspect of human lives has remained untouched from it. The pace with which the technology changes, is unprecedented. Every few months we hear about a new technology coming into market. In this chapter we will look at some emerging technologies in the field of computing, entity recognition, digital photography, and data storage.

Emerging Trends in Computing

The activity that we perform with the use of a computer is generally termed as computing. Though the activities may vary from user to user, the usage of an electronic device capable of processing, storing and communicating with other devices becomes core of this activity.

We all at some point of time must have come across the categories of computers. The categories include supercomputers, mainframe computers, minicomputers, microcomputers and mobile computers. The first four categories required good amount of space for keeping the machine operational. The mobile computers today have revolutionized the use of computers and require minimal space.

The major impact of mobility came with the availability of laptop computers and wireless communication systems. Though smaller mobile computing devices, like Personal Digital Assistant (PDA) did exist. Its impact was not felt to a great extent due to high cost and limited functionality. With availability of communication technologies like Bluetooth, Wi-Fi, GPS etc. and Cellular data services like Global System for Mobile Communications (GSM), Code Division Multiple Access (CDMA), General Packet Radio Service (GPRS) and now 3rd Generation (3G) the scenario has changed completely.

This technology combined with nano technology has given rise to miniature devices. Smart phones and tablets are two such great inventions of this era. In this section we will discuss about two such path-breaking computing trends namely mobile computing and cloud computing. Both these computing trends have changed the computer usage scenario.

Mobile Computing

Smart mobile computing devices are indeed one of the game changing products of recent times. The typical mobile computing device has three primary components: software, communication, and hardware. The mobile devices today come with an inbuilt operating systems and set of applications. Some examples of mobile OS are Android, iOS, Symbian, Windows 8 etc. The inbuilt applications allow us to download games, interactive programs, content of newspapers, books, magazines etc.

The term communication in the above context refers to capabilities such as Internet connectivity and phone usage.

The mobile devices are becoming omnipresent and are reaching remotest areas of the world. With limitless capabilities that these mobile devices offer to the large extent of population, it has now become a necessary tool of our time. The main benefit that mobile devices have given us is that we can do things without being confined to one place. Previous to availability of this technology person had to be present at a specific place. However, today, with availability of various kinds of mobile computing gadgets, one can practically accomplish assigned tasks from any place in the world.

The mobile computing trend has become a great success due to supporting technologies like Wi-Fi and 3G (wide-area telecommunications network). These technologies allow us to be connected to the rest of the world wherever we might be. They allow an access to uninterrupted connection to the World Wide Web, and thus to a large pool of information. Some of the standard features that almost all mobile networks today support are Short Message Service (SMS), General Packet Radio Service (GPRS), Multimedia Messaging Service (MMS), Bluetooth and Wireless Application Protocol (WAP). These services combined give huge set of applications that can be used by users. Let us have a brief look at some of these technologies.

Wi-Fi

Wi-Fi is a wireless networking protocol that allows a Wi-Fi enabled devices to communicate without use of physical cables. It is an industry term used to represent wireless local area network (LAN) protocol based on the 802.11 IEEE network standards. Today it is the most popular means of communication used for wireless data transfer within a fixed location. This technology has formed the basis of creating personal or adhoc networks. Over a period of time, different standards of Wi-Fi, like 802.11a, 802.11b, 802.11g, and 802.11n have been evolved. All the four variants are almost similar except for the data rate allowed and distance the signal can travel. 802.11a gives the lowest data rate (6 Mbits/s to 54 Mbits/s) and has an outdoor range of 120 meters. On the other hand 802.11n gives the highest data rate (15 Mbits/s to 150 Mbits/s) and has an outdoor range of 250 meters. Almost all the mobile phones that you buy today are Wi-Fi enabled.

General Packet Radio Service (GPRS)

As the use of mobile devices increased, so did the user's expectation. GPRS became a cutting edge technology in this thrust of expectation. It took the mobile usage experience to next level by providing a packet switched technology that enabled data communications. This technology is used to allow the mobile phone connect to the Internet. Basically, any network connection that is not voice or text messaging uses a data connection like GPRS. It offers a tenfold increase in data speed over the circuit switched technologies. Theoretically the defined speed is up to 115kbit/s, however, practically the speeds are around 30-40 Kbps.

Using this technology a subscriber can remain connected Internet always.

3G and 4G

The terms 3G and 4G refer to third and fourth generation mobile communication standards. The 1G service was based on analog signaling and reached the data speed of 19.2 Kbps. As the popularity of mobile devices grew so did its customers. The growth led to digital networking and the service came to be known as 2G. It had increased network capacity and had data speed of approximately 1.2 Mbps.

Currently we are using 3G and 4G networking. The 3G service offers faster data transfers, up to speeds as high as 3 Mbps. It offers powerful multimedia services that allow organization to develop applications such as online billing systems and video conferencing. It also provides platform for many popular mobile phone games full of graphics and animation. Using this technology it is also possible to develop applications for mobile TV, instant messaging and video chatting. The only factor that might affect the usage is its subscription cost.

The 4G networks offer advanced mobile services such as video and movie streaming at much higher speed as compared to 3G. Theoretically 4G services can offer download speeds up to 100Mbps and upload speeds of 50Mbps. It has far expanded coverage and hence, offers more or less constant connectivity. The 4G networks are in its infancy stage yet, but its coverage may expand rapidly. The 3G and 4G networking both have a great deal to offer in terms of speed and quality of data communication.

Bluetooth

The mobile phone usage gave rise to the need of sharing data from one mobile to another. One could use SMS to exchange data, but it involved cost. A wireless technology called Bluetooth came as a boon for exchanging data over short distances. It used the short wavelength radio transmissions in the ISM (Industrial, Scientific and Medical) band for communication. This technology helps us create Personal Area Networks (PANs) with high level of security.

Figure 13.1 : Bluetooth Logo

The idea of Bluetooth was initially conceived by a company named Ericsson and later adopted by almost all other companies. Today it has become a standard for a small, cheap radio chip to be plugged into computers, printers, mobile phones and other electronic devices. A Bluetooth chip transmits data at a special frequency to a receiver Bluetooth chip. The receiver chip then gives this information to the computer, mobile phone or any other electronic device that it is associated with. You all must have seen a Bluetooth enabled mobile phone that can pair with mobile phone headset. Figure 13.1 shows the logo of Bluetooth, any device having this logo indicates that it is Bluetooth enabled.

Smartphones and Tablets

Cellular mobile phone has changed the dimensions of connectivity. Normal phones allow us to talk and send text messages. Another term that has become very common today is smartphone. But what exactly is a smartphone? Have you ever wondered how it is different from a mobile cell phone? How it has suddenly become smart? Well a smartphone is a device that lets you make telephone calls, and also provides added features like Personal Digital Assistant (PDA), send and receive E-mails, edit Office documents, use mobile Apps, play games, tune in to radio, stream movies, edit photos, get driving directions via GPS, instant messaging, provides Wi-Fi as well as Bluetooth support and create a playlist of digital tunes. Please note that the features available are non exhaustive and all cannot be mentioned here. Additionally the smartphone also has an Operating System, and a touch screen mechanism. If you look at the features, you will find that they are almost the features of a computer. Well that simply means that we are carrying a pocket computer along with us every time we carry a smart phone. The only drawback that becomes visible at the moment is the small screen size. Figure 13.2 shows a look of smartphone and tablet available in the market today.

Figure 13.2 : Smart Phones and Tablet

A tablet is a portable and mobile computing device. It has a larger touch screen and may have built-in phone facility. It generally uses onscreen virtual keyboard, a passive stylus pen, or a digital pen. It can perform all the operations that can be performed by a mobile phone as well as a computer.

The technology surrounding smartphones and tablets is constantly changing. The screen size, as well as the storage capacities is changing very fast. Hence what we call a smartphone today may change by next month, or next year or later and may become super smartphone!

Satellite Phones

We have already mentioned that the cellular mobile technology has revolutionized the connectivity aspect. But with all the technology in place, at times we still face a problem, problem of *network not available*. The cellular mobile phones have limitation that they need to be in the range of cellular towers. At many places it is still very difficult to erect such towers. Imagine the oil exploration companies working in high sea; we don't have a provision of erecting a cellular tower in the middle of the sea. What happens in such scenarios? How are we able to connect or transmit data in such cases? The solution to this problem is satellite communication technology and satellite phones.

A satellite phone more commonly known as *satphone* is one type of mobile phone. Instead of connecting to the terrestrial cellular towers it connects to the communication satellites orbiting around the earth. Satphones provide functionality like voice calls, text messaging service and low-bandwidth internet access, similar to the terrestrial cellular networks.

The coverage of satphones may include the entire Earth, or only specific region depending on its architecture. Generally the usage of satphones is controlled by the Government, in India we need to take special permission from the Government of India to use satellite phone. Inmarsat is the oldest satellite phone operator. It started is service by providing large fixed installations for ships. Thuraya is another leading satellite phone service provider. Its powerful satellites enable two third of the world's population to communicate using satellite phones. It delivers satellite communication solutions across Europe, Africa, the Middle East, Asia and Australia. Figure 13.3 shows a glimpse of satellite phone.

Figure 13.3 : Satellite Phone

As can be observed in figure 13.3 the satellite phones currently available in the market are almost similar to the regular mobile phones. Satphones are very popular when expeditions happen in remote areas where terrestrial cellular service is not available. With the use of satphones we get uninterrupted connectivity though at a higher cost.

Cloud Computing

The next big thing available to the users today is a technology called cloud computing. Cloud computing allows users to have complete access of their data or resource from any part of the world. The cloud computing facility is available for both personal and official usage. The first type of usage is called Personal Cloud Computing. A typical example of personal cloud computing scenario is Google drive. Google provides us a free drive space of 5 GB shared between Google Drive and Google+ Photos so that you can keep your files, email, and photos accessible from any device, anywhere. This option is always better than carrying a pen drive. Figure 13.4 shows a typical GUI of Google drive.

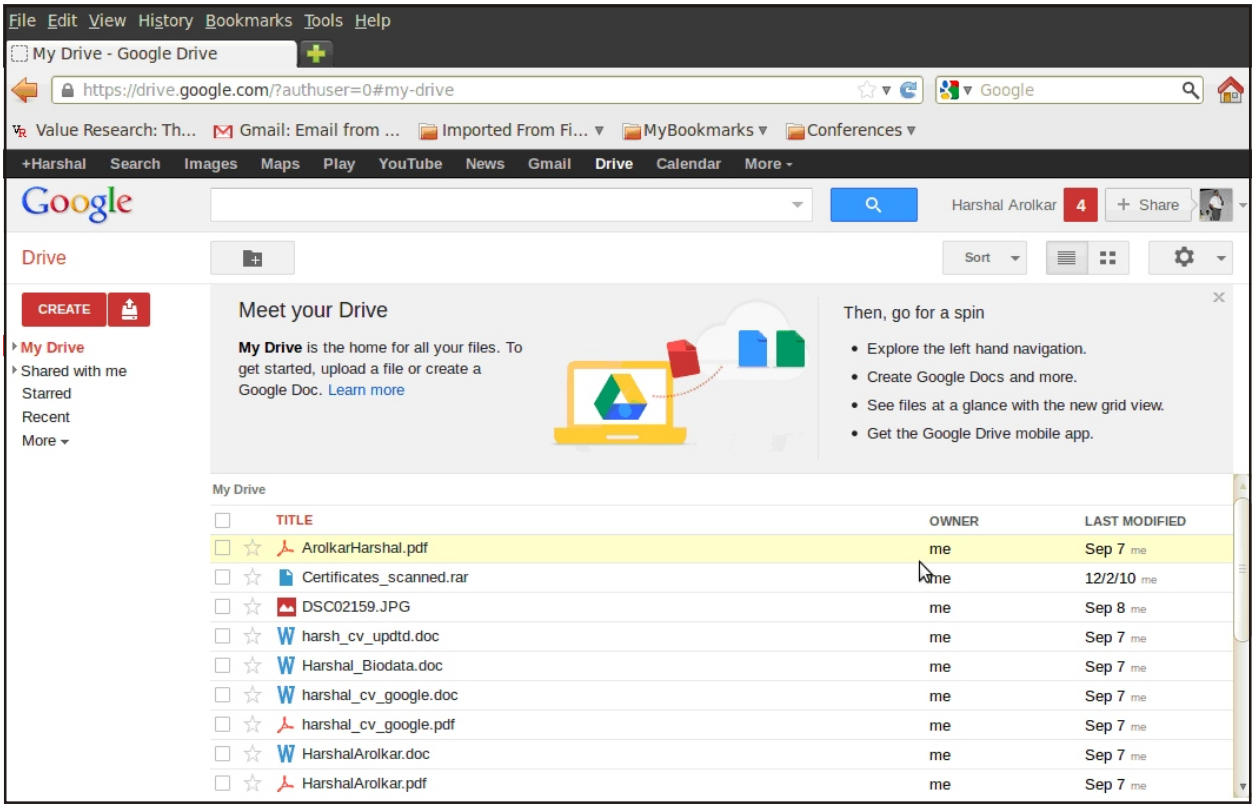


Figure 13.4 : GUI of Google drive

One of the many benefits of the personal cloud is the feature of automatic synchronization. This feature comes in handy when user wants to keep copies at multiple places. Say for example, if a user searches for video on web and purchases this video using mobile device, then this video file not only downloads to their mobile device but also downloads automatically to all the devices that are linked with the cloud account. It is possible to sync the cloud account with multiple devices like user home desktop, office laptop and the mobile phone.

Ubuntu One is the personal cloud platform that allows us to keep all our digital data together. We can use the content, our way, wherever we are. With Ubuntu One suite of cloud services that includes storage, sync, sharing and streaming, we have immediate access to our music collection, favorite photos, videos, important documents and more, at any time and from any device. It was launched in May 2009 to provide sustainable revenue for Ubuntu, the free operating system, which is commercially backed by Canonical. To create your account on Ubuntu One, visit https://one.ubuntu.com/. Figure 13.5 shows the home page of Ubuntu One.

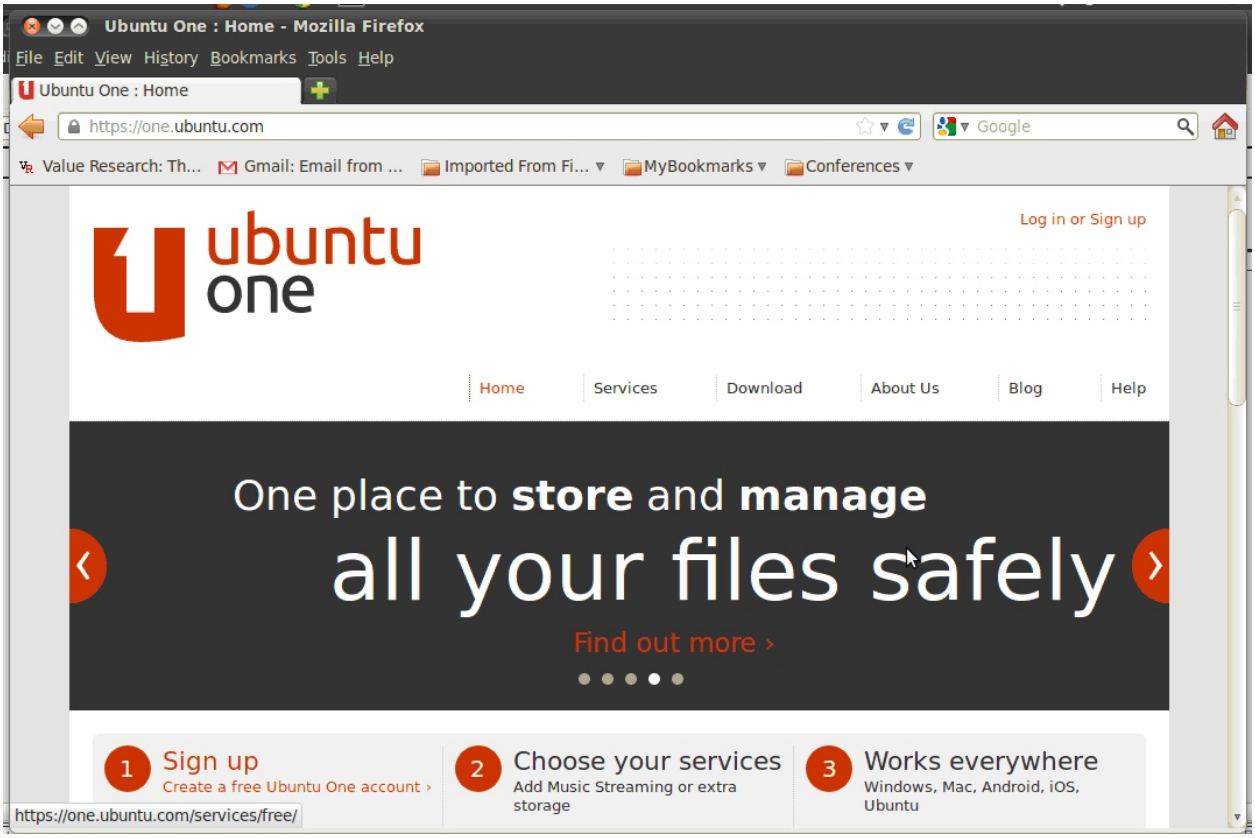


Figure 13.5 : Home page of Ubuntu One

Businesses have also benefitted greatly from the model of cloud computing. For businesses the cloud computing scenario is available in different models namely Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS). Depending on the requirement of the business organization one may choose any of these models. Let us see the basic concept of each of these models in brief.

Software as a Service (SaaS) : A business organization instead of developing its own software application generally uses the software by making payment to the cloud service provider. The service provider hosts the software at its web server, so that the company does not need to install it. The service provider will also manage the software on behalf of the company. This model relieves the business organization from buying, installing and maintaining software or hardware. All they need is an Internet connection that allows them to connect to the software and use it. SaaS examples include customer relationship management as a service. Salesforce.com is one of the most used cloud service for customer relationship management (CRM) software. Figure 13.6 shows the home page of http://www.salesforce.com/in/.

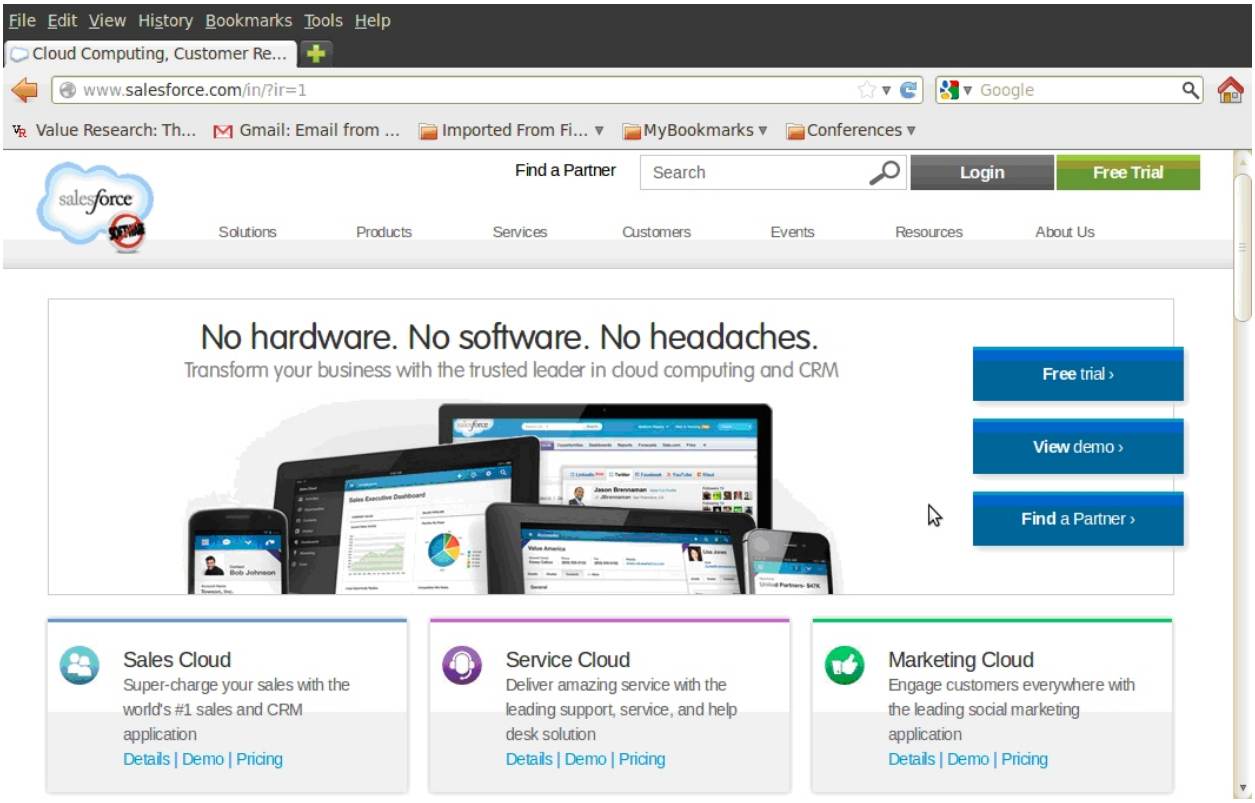


Figure 13.6 : Homepage of http://www.salesforce.com/in/

Infrastructure as a Service (IaaS) : A business organization may hire the hardware infrastructure as a service from the cloud service provider instead of establishing its own physical resources. The hardware at cloud is used to support different operations such as computation, storage, printing, backup, and networking components. The service provider owns all the equipments and is responsible for housing, running and maintaining it. Some of the IaaS providers are Windows Azure Virtual Machines, Google Compute Engine, and HP Cloud.

Platform as a Service (PaaS) : A business organization here is generally a software company that creates the software using tools and/or libraries from the service provider. It also controls software deployment and configuration settings. The service provider provides the networks, servers, storage and other services that are required for developing software. This model facilitates the deployment of software applications without the cost and complexity of buying and managing the underlying hardware and software and provisioning hosting capabilities. Many companies have ventured into the domain of cloud computing. Figure 13.7 shows a glimpse of some of these companies.

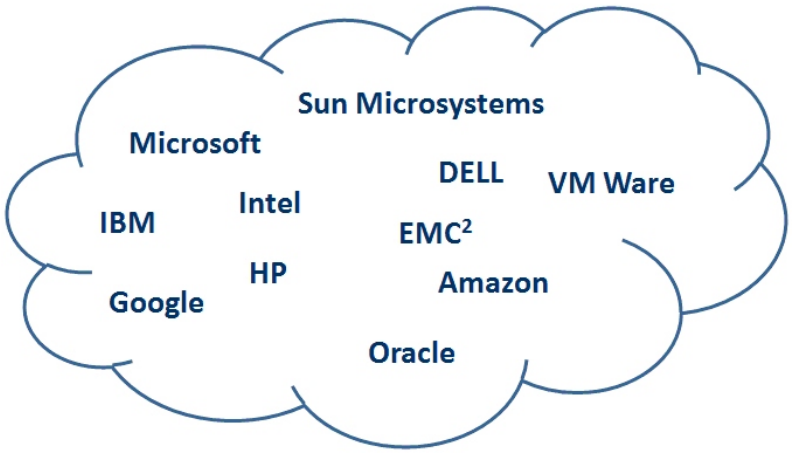


Figure 13.7 : Companies providing cloud services

The cloud computing scenario can be distinguished from normal scenarios by its key characteristics such as it is usually off site, accessed over the internet, minimal IT knowledge is required to access the service, available on all platforms from desktop to mobile phones. Today cloud computing facility is extremely useful for a consumer and for the business for it saves the establishment costs.

Emerging trends in Object/Human Recognition

Today we are living in the world of ubiquitous computing, wherein we are surrounded by computers and sensing devices throughout the physical environment. Though present these computers are effectively invisible to the user. Such ubiquity has been made possible due to availability of cloud computing platforms. One of the major problems in ubiquitous computing domain is the identification of the objects like a specific computer or sensor. In this section we will learn about some techniques like Radiofrequency identification (RFID), Biometrics, Global Positioning System (GPS) and speech recognition that are used for identifying objects.

Radio Frequency identification (RFID)

One of the most widely used technology for identification and tracking of objects used in the market is radio frequency identification system. It consist of three parts; an antenna, a transceiver and a transponder.

The antenna is used to generate radio frequency signals within a relatively short range. The range can vary from 10 centimeters to 200 meters. The antenna may be handheld or fixed and virtually can be mounted on any surface from a computer to a wall.

The transceiver reads the radio frequency signal and transfers the information to a processing device generally a radio frequency reader. It simply works as a decoder to interpret the data that is stored in the transponder.

The transponder is the RFID tag that is attached to the object. The tag is a programmed microchip and is capable of storing information of around 2,000 bytes or less. Further, the tags can be passive or active. The passive tags do not require battery for working while the active tags come along with their own battery.

The transmission of data from RFID tag happens only when the tag passes through the field of the scanning antenna. The tag then detects the activation signal from the antenna, this activates the RFID tag, and it transmits the information on its microchip to be picked up by the scanning antenna. The RFID systems are used in many applications like tracking parts for just-in-time manufacturing, tracking purchase of customers in shopping malls etc. Figure 13.8 shows a brief idea of the implementation of RFID systems.

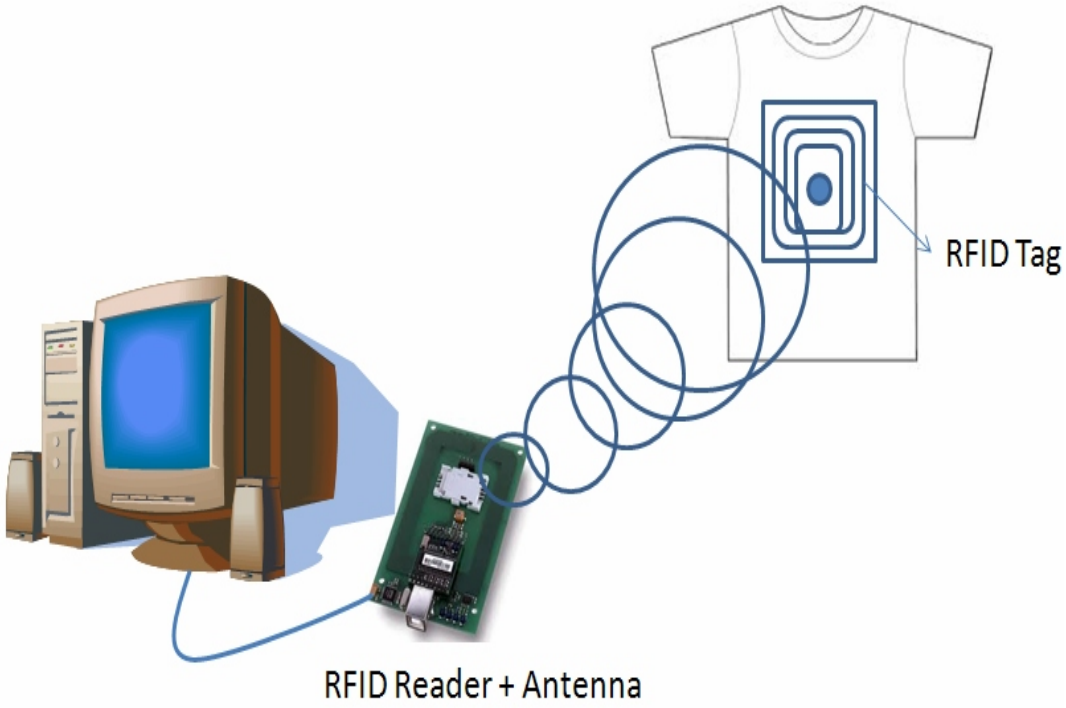


Figure 13.8 : Working of RFID system

RFID technology is being used in many industries for different purposes. In 2008 Beijing Summer Olympic Games, RFID technology was used for high tech ticketing and food tracking. RFID embedded tickets in Beijing games were intended to battle counterfeiting of tickets, to provide speedy entry for visitors at venue gates and to guard against unauthorized access to specific areas of the Olympics compound.

It also helped security personnel monitor the hotels, venues, manufacturers, distribution centers, hospitals and provided support for food safety tracking system in Olympics. The RFID system used in food tracking system monitored production, processing and transport of food packets to different venues.

Animal tracking has been one of the earliest applications of RFID. The livestock are considered to be assets for an owner. As they are constantly on the move it becomes difficult to manage large herds. RFID technology is used to track such constantly moving herds. The RFID tags are attached onto a livestock (in form of earring, neck belt etc) or implanted inside livestock as radio signals do not harm the body. Once installed these RFID tags enables the recording and tracking of individual animals.

We can also create a livestock database that keeps track of the animal's origin, parentage and breed using these unique tags. The RFID usage also helps monitor health of the animals, allows us to keep individual medication and vaccination records, and prevent the spread of disease by tracking and segregating infected livestock at early stages. With lots of proven benefits accruing from the use of RFID technology, it is now becoming a regular part of modern farm management.

RFID technology is also used in libraries nowadays. It is used in library for tracking the movement of books and theft detection. The RFID based library system, consist of smart RFID labels used instead of normal bar codes, the RFID readers (fixed or hand held) and library management software. Using such a system allows libraries to manage their day to day activities more effectively.

To start with we need paper thin flexible smart labels, the size of which may wary as per the need of library but in most cases a label of approximately 2"X2" size will suffice. This label is placed on the inside cover of each book in a library such that it is not obstructed during opening or closing the book. The label has a small antenna and a tiny chip that stores information about the book including a unique Accession number to identify each entity. The information contained on microchips in the labels can be read from any place within the library using RFID scanner/reader. We may additionally require a wireless communication system to transfer details of the label into library information system.

The technology when used facilitates easier and faster issue and return mechanism of books. The use of this technology also reduces the amount of time required to perform circulation operations as the information from RFID tags can be read much faster than from barcodes. It is also possible to read details of multiple books from one rack at a time without removing them. Thus a hand held reader can be moved rapidly across a shelf of books to read all of the unique identification information. This further helps in maintaining proper inventory and also allows us to check if the items are out of order.

Most of us at some point of time must have gone to supermarkets (big shopping complexes). Many people visit such place for buying products. You must have observed that at the exit gates of such supermarkets you are able to hear a strong beep sound. This is a security mechanism is used to stop theft of products. The products contain an RFID tag which is generally removed by the person who generates the bill. In case he/she forgets to remove the tag or someone tries to take of the things forcibly the alarm is raised.

The product purchasing process in supermarkets is often very time consuming, it comprises of the time spent in corridors, time sent to search the product location and finally the time spent in the checkout queues. The RFID technology is now also being used to reduce the time a customer spends to buy a product. The supermarkets now have shopping cart that has a touch-screen monitor, a client card automatic reader, a positioning transmitter and a product reader.

When the customer arrives at the supermarket he takes one such cart and logs into the markets system using his client card. The system after welcoming the customer displays the list of the items that he/she had last purchased. A customer may add more items or remove some items from this list. Then With the help of the cart's navigation system, the customer is directed to the shelves or places where the products in list can be found. As soon as the customer places the products in the shopping cart, the system starts calculating the amount that needs to be paid by the customer. Once all the purchase is made the customer heads towards the exit. As all the process of calculating the bill is over he simply needs to pay the amount and move out of the complex. Many applications of RFID have come into existence today, but discussing all is out of scope of this book.

Biometrics

With the increased use of technology it has become necessary to control the access to information. Many methods like *access rights, password protection, encryption* etc. have been used to control the access. However, for better access control a new technique known as biometrics is now being extensively used in many applications. Biometrics (or biometric authentication) generally involves identification of humans based on their characteristics or behaviour. These human body characteristics include fingerprints, eye retinas and irises, voice patterns, facial patterns, signature and hand measurements. A biometric system generally is made of five components.

1. A sensor that is used to collect the data,
2. Set of signal processing algorithms that performs quality control activities and develops the biometric pattern,
3. Data storage that keeps information to compare the new biometrics patterns with,
4. A matching algorithm that does the actual comparison and
5. A decision process (either automated or human-assisted) that uses the results from the matching algorithm to make decisions.

Today biometric technology is found in many aspects of our daily life. We will find it in applications related to payment of phone bills to accessing personal computers. This section discusses about fingerprint, iris and voice recognition techniques of biometrics used in identification and authentication of users and access control.

Fingerprint Recognition

Fingerprint has been used as an alternate to sign for more than a century now. Generally a person who does not know how to write, when he/she needs to sign a legal document puts his/her thumb on the ink pad and creates its impression on the document. It is an authentic mode of identifying a person.

The modern fingerprint recognition mechanism uses the impressions made by the unique, minute, ridge formations or patterns found on the fingertips. It has been observed by researchers that though two fingerprint patterns are similar, two fingerprints do not have identical individual ridge characteristics. Also the patterns once formed do not get distorted except under some unusual circumstances like accident.

Figure 13.9 shows example of fingerprint features and a fingerprint reader used to mark attendance. Most of the laptops available in the market today provide fingerprint recognition as mode of authentication.

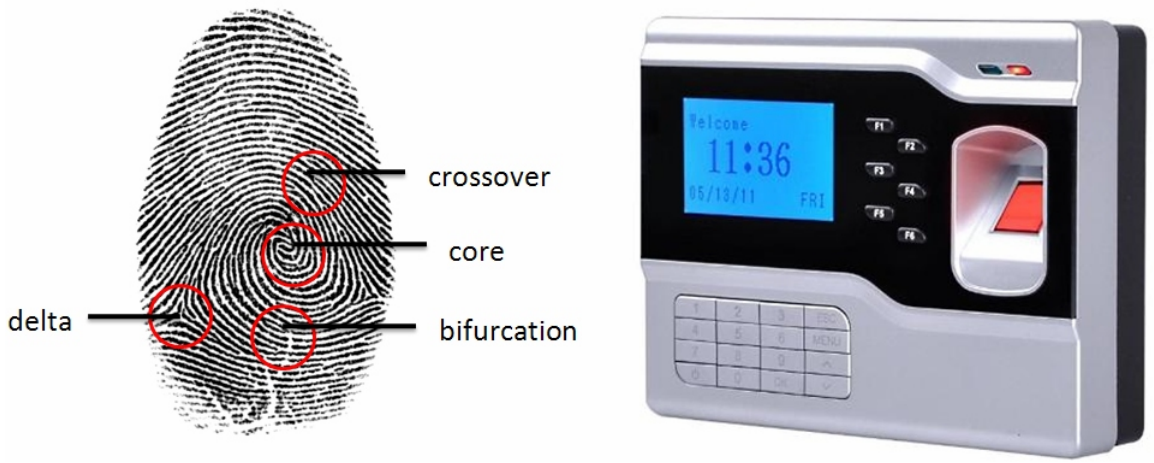


Figure 13.9 : Features of fingerprint and Fingerprint reader

Table 13.1 lists some of the government, forensic and commercial applications of finger print recognition.

Government	Forensic	Commercial
• Identification cards like AADHAR, Ration Card, BPL Cards. • Driver's License • Welfare Disbursement • Passport Control, etc.	• Criminal Investigation • Corpse Identification • Criminal Record Keeping • Terrorist Identification, etc.	• Computer Network Logon • Electronic Data Security • Smarts Cards, like ATM Cards, Debit Card • Facility Access Control • Personal Digital Assistant • Distance Learning, etc.

Table 13.1 : Some application areas of fingerprint recognition

Iris Recognition

Most of the readers who are reading this book must have gone through the process of acquiring AADHAR card. If you remember the process then at one point of time you were

asked to look into a device that captured your iris information. The iris is a muscle within the eye that regulates the size of the pupil, and controls the amount of light entering the eye. It is the colored portion of the eye with coloring based on the amount of melatonin pigment within the muscle.

The iris generally does not change during the person's lifetime. The characteristics of iris do not change even after surgeries and furthermore it has 266 unique characteristics (discussing them is out of the scope of this book). The iris recognition systems used in the market uses up to 173 characteristics. The primary visible characteristic of the iris is the trabecular meshwork, tissue which gives the appearance of dividing the iris radially.

An iris recognition system requires a small high resolution camera to capture picture of the iris. It generally captures a black and white image. It relies heavily on infrared imaging to take such a picture. The application that provides physical access to users requires a user to stand within 3 to 10 inches from the camera. It then centers the iris in a mirror within an area of 1 inch square directly in front of the camera. We also get such systems in laptops nowadays to control logical access to computers. It uses a desktop camera and works well within the distance of about 18 inches to capture the iris image. Some of the major applications of iris recognition today are mentioned below:

- Access to bank accounts at cash machines
- Anti-theft devices
- Authenticated access to buildings and homes
- Automated international border crossing (used as a substitute of passport to stop illegitimate entry into a country by unauthenticated person)
- Automobile ignition and unlocking
- Aviation security
- Biometric-Key Cryptography
- Cell phone and other wireless device based authentication
- Controlling access to restricted areas
- Creation of a "watch list" database used by Government to keep track of terrorists
- Database access and computer login

Voice/Speech Recognition

Voice or speech recognition is a biometric technique that uses an individual's voice as input to control the activity that can be done by him/her. It relies on features influenced by both the biological structure of an individual's vocal tract and the behavioral characteristics of the individual. Although we call it voice/speech recognition the correct term is voice/speech verification.

The technology is being used by banks to verify identity of the caller when making telephone transactions and performing account maintenance. It is also used extensively by mobile phone users to make a call directly by speaking out the name of the person whom call needs to be made. In forensic science it is used to determine the truthfulness of responses a witness gives as part of an investigation.

Similar to other biometric systems to work with voice recognition systems you need to first train the system. In the training period the voice sample is first converted from an analog format to a digital format. The features of the individual's voice are extracted, and then stored as a pattern for further use. The environmental factors like sound in the surrounding, problems in the recording device etc do play a role in efficient working of the system. Some of the application areas of voice/speech recognition are as mentioned below:

Playing back simple information : Used as forensics to identify the voice of a person.

Call steering : Routing of regular callers to appropriate departments or person based on their voice match. It is used in customer service segment.

Automated identification of caller : It is used in customer service segment to identify the caller.

Removing Interactive Voice Response (IVR) menus : It is an improvisation in IVR and automated call handling systems that are often unpopular with customers. This technique removes the push button menus and replaces it with direct call steering.

Voice enabled operations : Enables the user to dial a number or perform an operation on mobile phones by issuing a voice command. Such applications are very useful for blind or partially blind users. We can also open an application window, type a letter or shut down the computer by giving voice commands. Most operating systems today support such facilities.

Global Positioning System (GPS)

The Global Positioning System (GPS) is one of the widely used systems for navigation applications. It is a system created by the U.S. Department of Defense. The system consists of a network of 24 satellites placed into orbit above earth. The GPS was originally intended for military applications, but in the 1980s, the government made this system available for civilian use. It is a very robust system that works in any weather conditions, anywhere in the world, 24 hours a day. As of now there are no subscription fees or setup charges to use GPS. Any device having a GPS receiver can use this system. Almost all the smart phones today come with inbuilt GPS receiver. Alternatively one can download apps that use GPS and help in navigation.

The GPS technology has been found useful in many application areas such as, fleet tracking, cellular telephony, disaster relief and emergency services, aircraft tracking, robotics etc. To pin point the exact location of an object the GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. The GPS receiver take this information and uses a process called triangulation to calculate the user's exact location. The GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. This process is repeated for two to three more satellites and the receiver then can determine the user's exact position and display it on the any electronic map available with the user. To calculate only latitude and longitude the GPS receiver uses at least three satellites. In case of additional information, such as speed, behavior, track, trip distance, distance to destination, sunrise and sunset time and more is needed the GPS receiver needs to be connected with four or more satellites. Some interesting applications of the GPS technology are mentioned below:

Agriculture: It is used for measuring area, preparation of digital agricultural maps, and preparation of digital land ownership maps.

Disaster management : It is used in search and rescue operation, for example lost hikers and adventurers, person buried under debris or under water can be found if they have a cell phone or GPS system that is on.

Military: It is used in different aircrafts like fighter planes, aerial tankers, bombers etc. for accurate identification of position of targets as well as the aircrafts. A navy ship also uses it for the same purpose. It is also used on satellites to obtain highly accurate orbit data and to control spacecraft orientation.

Tracking Deliveries and Shipments: Most courier services use GPS tracking system to monitor delivery of goods to customer. Likewise transportation system uses it to monitor their transport system. A company using this technology can see if its vehicle has been delayed and suggest a faster route, alternatively it can also find out the current location of its vehicle.

Recovery of Stolen Property: Security services can determine the exact location of the stolen vehicle or a device such as mobile phone or a laptop equipped with GPS and can find the vehicle or device very easily.

Emerging Trends in Storage devices

You must have come across client server applications where one machine works as a resource provider while the other works as a resource user. File server is one such application; it is used to provide resources to all the client machines connected to it. Generally a file server is a machine that does login authentication of the users and based on the access control policy set by the administrator allows restricted access to a file resource. The access to such a resource is slow as the processor of the server gets loaded with multiple activities. With availability of high end machines with faster

processing capacities the scenario of data storage has also changed. Today we make use of USB supported external hard drive to create additional storage for our data or simply to take a backup of our data. Also the servers come with attached storage with the capacity of Terabytes. But managing such external devices is always cumbersome. This section discusses about some recent trends in data storage devices.

Network Attached Storage (NAS)

Networks have been used from decades to expand the capacity of computing in an organization. We know that it is possible to give prints on a network printer (a printer that is connected to a network as a device, rather than being connected to a computer). Such a network printer has its own identity (unique IP address) that makes it work faster than a printer shared on a computer. Network Attached Storage (NAS) is a similar technique; it is hard disk storage mechanism that is assigned its own network address rather than being attached to an individual's computer.

The NAS device may consist of a single Terabyte hard disk or array of such hard disks. It is attached to a local area network and assigned a unique IP address. When the user requests for a specific file, the file requests are mapped by the main server that is used to authenticate the user, to the NAS file server. By removing storage access and its management from the authentication server, both application programming and process of sending and receiving files become faster as they are now not competing for the same processor resources.

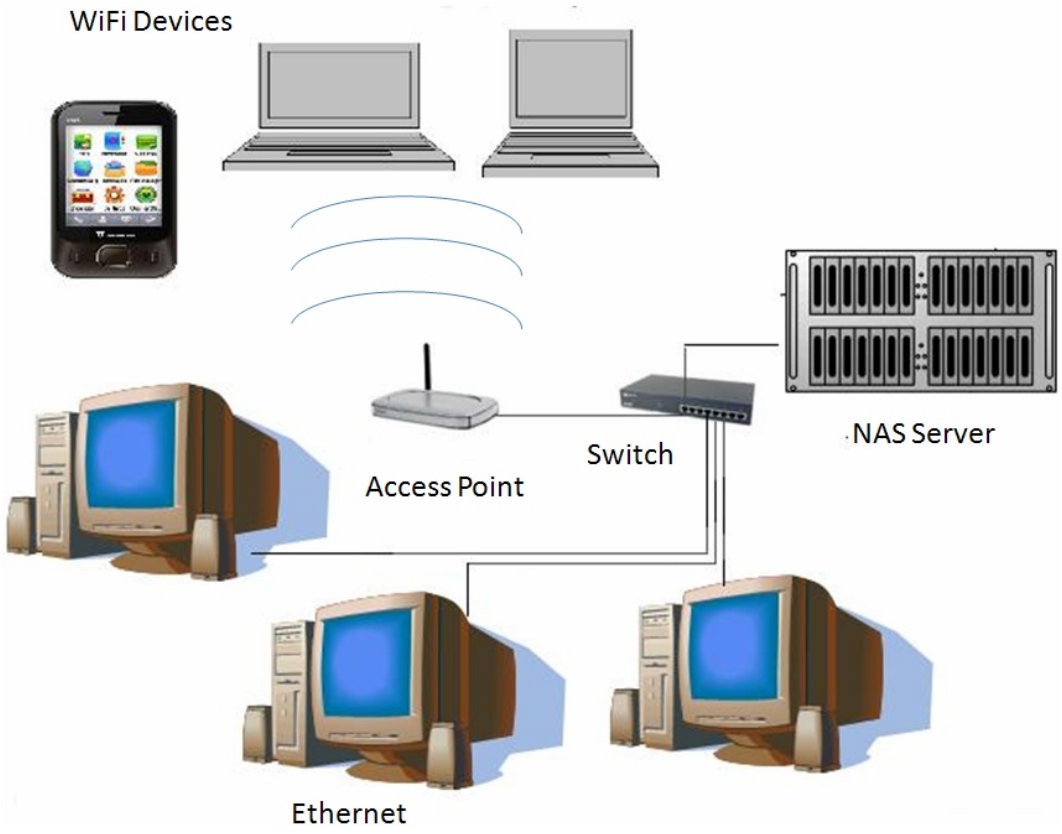


Figure 13.10 : NAS Architecture

With a NAS system in place, we can quickly and simply store and share our data such as music, videos, images and other files from one convenient location. Also the access to these resources can be obtained by heterogeneous clients like, a desktop, laptop, digital camera or a smart phone. Figure 13.10 shows a typical implementation of NAS in an organization.

Storage Area Network (SAN)

A storage area network (SAN) as the name suggests is a dedicated network for storage. It provides access to consolidated, block level data storage. The basic idea of SAN is to allow an application server to have uniform access to different storage devices such as hard disk arrays, tape libraries, and optical storage devices. Due to this uniform access feature these heterogeneous devices appear like locally attached devices to the operating system. Figure 13.11 shows a typical implementation of SAN in an organization.

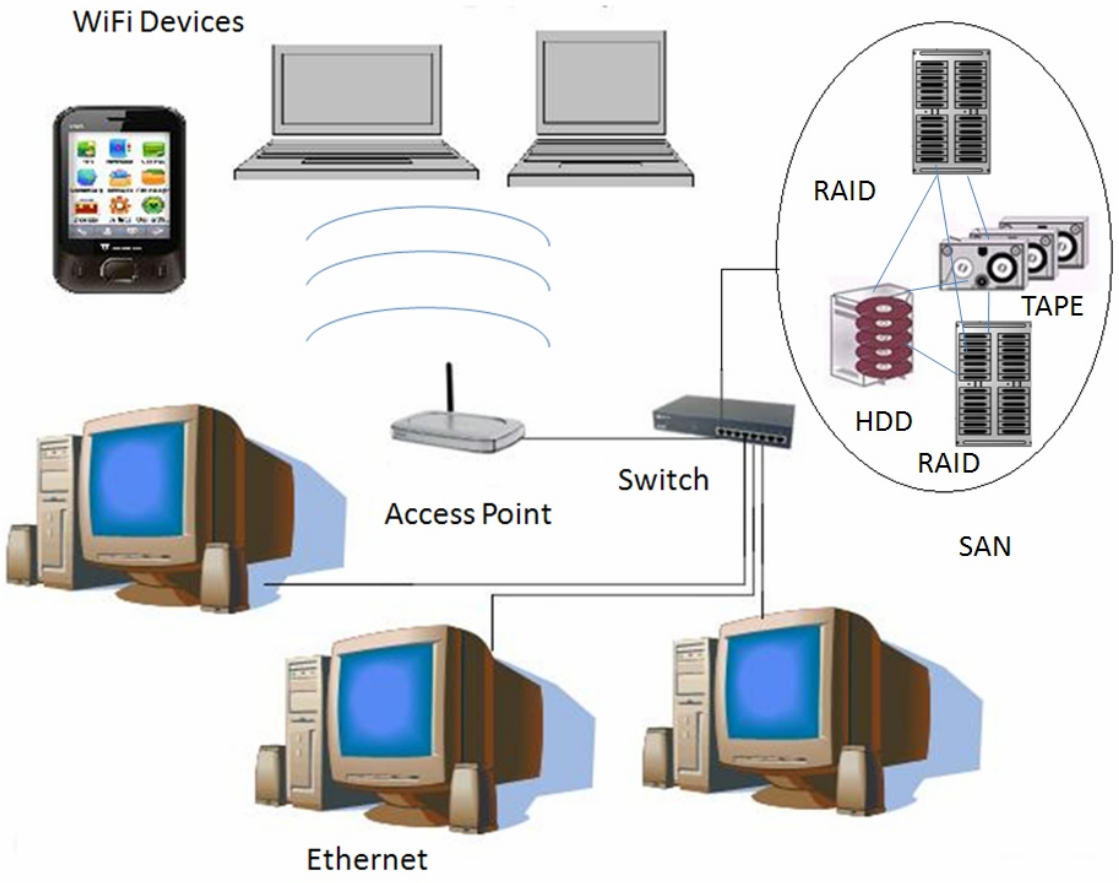


Figure 13.11 : SAN architecture

Observe that SAN is a type of local area network that is designed to handle large data transfers. It supports operations like data storage, retrieval and replication. To take the benefit of this technology we need high end servers, multiple disk arrays and fiber channel interconnection mechanism for communication.

Online Storage options

We have learnt about Google Drive in the cloud computing section. With the advent of cloud computing facility we have also got lot of online storage options. The online storage options can be used for both personal as well as business use. Online storage options are helpful especially when we want to keep backups and require universal access to our data. The beauty of this option is that we can access the data from anywhere in the world, from any device. The only requirement is good internet connectivity. Some of the free online storage options available are ADrive, Microsoft Live Sky-Drive, 4Shared, Mozy, Dropbox, Box, MediaFire, DivShare etc. They offer different services in online storage and provide us with different capacity of storage space. Similar to free options we also have paid options. Such service provider guarantees more security and service parameters as compared to the free service providers. IBackup and Amazon S3 are example of paid storage options. The online storage options in a way can be considered cloud services.

Computer Controlled Devices

The computers are becoming smarter and intelligent day by day. We are quite fascinated by this newer capability of the computers. No wonder if we say that sometimes it becomes really difficult for us to know whether the person on the other side of our telephone conversation is a human or a recorded voice in the machine!

We have heard about automations in organization, wherein machines replaced activities that were performed manually. For example instead of filling the cold drinks bottle manually we now have bottling plants. Machines controlled by programs are used here to fill the bottles of different shapes and sizes. With the advances in computer hardware and software technology, one field that has also grown is the field of robotics. The study of robotics is to mainly understand how effectively a robot can work with the use of sensors and actuators in dynamic environments. Today robots are highly automated mechanical and electronic manipulators controlled by computers.

Some of the application areas of robotics are intelligent home, military applications, farming and animal husbandry, vehicle industry, hospitals, outer space expeditions, disaster management and entertainment. Let us see in brief how a robot is used in these applications.

Intelligent Home : Today automated systems can monitor home security and other indoor activities. Doors and windows of a house can be opened automatically based on certain activity or commands. Electronic appliances such as light, fans, heater, air condition etc. can be pre- programmed to start, stop or change its setting in between the operation. This technology assists the occupants irrespective of their state of mobility. This technology can be used by persons who can move easily within the house or by a person who may be bedridden with an equal ease.

Military Applications : Surveillance is a key to safeguard from activities happening in and around your surroundings. If you remember the scene from movie 3 idiots, the object that Amir

Khan rectifies was also intended for surveillance. Airborne robot drones are used for surveillance in today's modern army. An airborne drone is a small flying machine with the shape of bird or any other object fitted with very high definition cameras, sensors and communication as well as networking tools. It is used to collect vast amount of data of any object of interest from an individual to a country.

Farming and Animal Husbandry : Agriculture is one such field where lot of robotics have been tried and tested. To name a few, automatic water allocation based on soil conditions, automatic harvesting of crop, milking of cows etc.

Vehicle Industry : Vehicle industry uses most of the automation tools available. It uses robotic arms that are able to perform multiple tasks during the car manufacturing process. The tasks that these robots can perform but not limited to are welding, cutting, lifting, sorting and bending. Vehicles today come with additional processors that make these vehicles smart compared to their previous versions. Navigation systems based on GPS are not new in vehicles today. It is being used for getting directions, looking for a place, making sure that the path taken is correct and many more things.

Google has succeeded in introducing the Google driverless car. The project supported by Google is developing technology for driverless cars. The U.S. state of Nevada passed a law on June 29th, 2011 permitting the operation of driverless cars in Nevada and California. The Nevada law came into effect on March 1, 2012, and the Nevada Department of Motor Vehicles issued the first license for a self-driven car in May 2012. The license was issued to a Toyota Prius modified with Google's experimental driverless technology. Figure 13.12 shows driverless Google car.

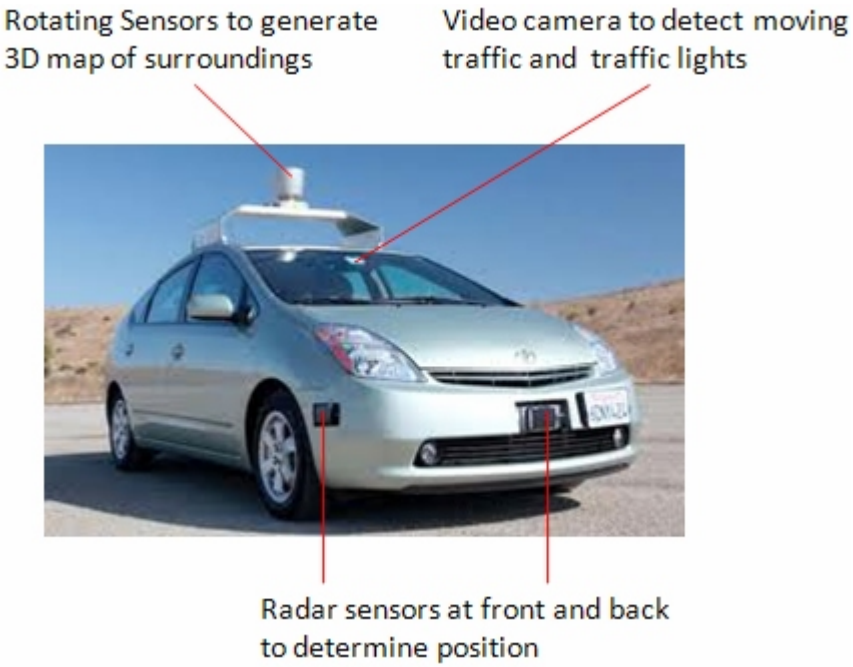


Figure 13.12 : Google driverless car

To start with the driverless project team has equipped ten vehicles, consisting of six Toyota Prius, an Audi TT, and three Lexus RX450h with required technologies. The system is purely based on sensors and navigation map stored in the car. The car drives at the speed limit stored on its maps. It maintains its distance from other vehicles using its system of sensors. It also has an override mechanism that allows a human driver to take control of the car. In the testing phase two people were seated in the car one driver and another engineer. The driver was supposed to take control of the car in case of any mishaps, while the engineer was supposed to correct any software malfunction if it happened.

Hospitals : Health care is another area where intrusion of robotics is saving lives and assisting people to improve their lives. Researchers have developed, robotic suit that enable nurses to lift patients without damaging their backs, a robotic limb linked to tiny sensor in brain called BrainGate that works on thoughts of person rather than any physical action as well as a robotic arm that can perform precision surgery.

Outer space expedition and disaster management : Robots can visit environments that are harmful to humans like volcanoes, deep oceans, moon etc. This makes them a good choice in terms of rescue operations in case of earth quakes and other natural calamities.

You must have heard about India's moon mission called Chandrayaan - 1. It was one of the unmanned moon mission launched by the Indian Space Research Organisation (ISRO) in October 2008, and operated until August 2009. A NASA instrument onboard Chandrayaan - 1, revealed water molecules in amounts greater than predicted. Water on the moon is just one of the many crucial moon findings of this mission.

Entertainment : Entertainment industry has also not remained untouched of the robotics trend. Interactive robots that exhibit behaviors and learning ability have been made by companies like Sony and Honda. The robot manufactured by Sony called QRIO (Quest for cuRIOsity), originally named SONY Dream Robot is humanoid entertainment robot that can move freely, play with a golf ball and can respond to verbal instruction. While the robot manufactured by Honda called HEARBO can pick up, distinguish, and analyze multiple simultaneous sound sources without difficulty. It can easily differentiate between sounds made by children playing on one side of the room, from a doorbell ringing on the other. Figure 13.13 shows a QRIO saluting the audience.

One of the fields that helped computer controlled devices usage grow significantly is Artificial Intelligence (AI). Human being are gifted with intelligence, it gives us the ability to acquire knowledge and skills. It also allows us to apply the knowledge or skill acquired to solve problems, irrespective of whether they are trivial or complex. The field of Artificial Intelligence intends to provide a computer the ability to acquire knowledge and use it in real time scenarios.

Figure 13.13 : QRIO saluting the audience

A simple example of adding AI to a computer is a chess program that stores the step it has taken against a particular move of all opponents and its outcome. Next time when some opponent takes the same step, the computer analyses all its previous moves and decides to choose a move that may help it win.

Including AI in computer systems makes it think rationally like human. It also allows the systems to act rationally like humans. Scientists and engineers are making all their efforts to make computers intelligent enough to compete with humans.

Emerging Trends in Digital Photography

The art of taking photographs or photography has been around for many years. It started in 1840s, when William Henry Fox Talbot, combined light, paper, a few chemicals and a wooden box to produce the first photographic print. This process of producing a photograph has been revised again and again. The major change came with the technological advancements and innovations such as the digital cameras. It allowed photography to advance from a chemical process to digital one that involves bytes of information.

Digital photography is similar to conventional film photography. Digital cameras also use light to create images. The only difference is that instead of using the film to store the image, digital cameras capture images as matrix of pixels. The image becomes sharper with more number of pixels. This is the reason we see 10 megapixels, 12 megapixels etc while looking at the specification of digital camera.

The scenario of digital photography using digital cameras has recently changed with the advent of mobile phones with inbuilt cameras. We get 2 megapixel cameras in a basic model of mobile phone.

In year 2012 Nokia came out with 41 megapixel camera. It promises 7728 × 5354 resolution image. The whole idea of taking a photo and sharing it with our friends in real time on social networks is very fascinating. The entry level digital cameras are facing lot of competition from smart phones due to their capacity of taking photos as well as sharing capacity. To tackle the issue mentioned Samsung has come up with an Android based camera called GALAXY. Figure 13.14 shows the front and the back view of Samsung Galaxy camera.

Figure 13.14 : Front and the back view of Samsung Galaxy camera

Just imagine a camera with an Operating System. Samsung claims that the camera is the only truly connected camera in the world as it support 3G and Wi-Fi. We can connect, upload, share, and even post on our favorite social media. It also has auto cloud back up feature that automatically saves our precious photos into the cloud the instant we take them. To be called as a smart camera it also listens to our voice. The camera is able to perform operations based on our voice command.

Internet Enabled Television

The simple phones have now become smart phones thanks to Internet technology. The televisions have also gone through a drastic technological change from CRT to LED. Today we get flat smart televisions that can be wall mounted and are Wi-Fi enabled. Such televisions have ability to connect directly to the World Wide Web and display content such as YouTube videos, weather reports and streaming movies or television shows. We do not require any computer or outside equipment to display these contents.

The technology is still in its infancy and hence the Internet contents that can be viewed by users vary from manufacturer to manufacturer. For instance, some Internet-enabled TVs are capable of streaming data from YouTube, Amazon Video-On-Demand, Picasa Web Albums, Bloomberg News and a weather channel. Other Internet-enabled TVs additionally display material from eBay and Twitter. Further some Internet-enabled televisions allow us access to Netflix's vast library of films and TV shows. The Internet enabled televisions also come with embedded OS and you can connect the television to the Internet using wireless medium or wired Ethernet connection.

Green Computing

Whenever we use a computing device we tend to use a resource that might cause problems to environment. Use of technology always has two sides of coin, one that improves the quality of life and the other that might affect the environment. Global warming is one such side affect of excessive use of technology. Green computing is the term that signifies efficient use of computing resources.

The main goal of green computing initiative is to minimize the environmental impact and maximize economic viability when using a computing resource. ENERGY STAR program launched in 1992 was the first step towards green computing. The program awarded labels to computing products that minimized the use of energy and maximized the efficiency. The labels could be obtained for products like computer monitors, television sets and temperature control devices like refrigerators, air conditioners, and other such similar items.

The sleep mode function of computer monitors was one of the first results of green computing initiative. This mode is now available in many other devices; it places the electronic device on standby mode if no user activity is detected during a pre set period of time. Virtualization of servers is the current trend in green computing. Rather than using multiple machines as servers, companies today use one high end server with virtualization and create multiple servers from it.

Even if no inbuilt features are provided, we can still use some green computing practices. We can turn off the monitor when it's not in use or use LCD or LED monitors instead of the traditional CRT monitors.

Summary

In this chapter we learnt about some emerging trends in computing technologies. We saw two computing domains called mobile computing and cloud computing. We learnt about different architectures of cloud computing namely SaaS, PaaS and IaaS. We also had a look at technologies used to identify a human or an object like RFID, GPS and Biometrics. In Biometrics we learnt about technologies like finger print recognition, Iris recognition and voice recognition. Then we had a look at emerging trends in data storage, wherein we discussed two data storage architecture; namely NAS and SAN along with different online storage options available. Robotics and computer controlled devices are a norm today; we had a look at some such technologies. Finally we had a look at some technology convergence in form of digital cameras and Internet enabled televisions. The last topic green computing addressed the issue of global warming and how it can be tackled using small steps.

EXERCISE

1. List the technologies that are most common to mobile computing.
2. Differentiate between personal cloud applications and business cloud applications.
3. Explain in brief the working of RFID.
4. What is the significance of Biometric techniques in object identification?
5. Identify at least three differences between finger print recognition and iris recognition.
6. Explain in brief the term SaaS.
7. Explain in brief the term PaaS.
8. Differentiate between NAS and SAN.
9. How is an online storage beneficial to an individual?
10. List some application area where computer controlled devices are used.
11. **Choose the most appropriate option from those given below :**

(1) The term Cloud in cloud computing represents which of the following?

(a) Wireless (b) Hard drives

(c) People (d) Internet

(2) Google Drive is an example of which of the following cloud types?

(a) Private Cloud (b) Public Cloud

(c) Personal Cloud (d) Business Cloud

(3) Which of the following isn't an advantage of cloud?

(a) No worries about running out of storage

(b) Easier to maintain a cloud network

(c) Immediate access to computing resources

(d) Paying only for what you use

(4) Which of the following is not a model of cloud computing?

(a) PaaS (b) IaaS

(c) BaaS (d) SaaS

(5) Which of the following is correct full form of SaaS?

(a) Software alternative accounting standard

(b) Short alert activation supplement

(c) Software as a service

(d) Service as a software

(6) Which of the following represents the maximum storage capacity of the microchip used in RFID?

(a) 10 bytes
(b) 2000 bytes
(c) 1000 bytes
(d) 500 bytes

(7) How many satellites does the GPS receiver require to calculate only latitude and longitude?

(a) One
(b) Two
(c) Three
(d) Four

(8) Which of the following refers to a storage device that is connected directly to a network?

(a) network attached storage
(b) storage area network
(c) direct attached storage
(d) RAID

(9) Which of the following refers to a network of storage devices that can be accessed over a network?

(a) direct attached storage
(b) RAID
(c) network attached storage
(d) storage area network

(10) Which of the following terms refer to the study that finds how effectively a machine can work with the use of sensors and actuators in dynamic environments?

(a) Kinetics
(b) Genetics
(c) Robotics
(d) Biometric

(11) Which of the following refers to a program launched in 1992 as a step towards green computing?

(a) STAR ENERGY
(b) ENERGY STAR
(c) ENERGY SAVE
(d) SAVE ENERGY

Laboratory Exercises

1. Use Google drive to upload some files and explore different operation that you can perform.
2. Open an account in ADrive and compare its feature with Google drive.
3. Create an account on Ubuntu One and explore its features.
4. Try to explore the free trial of salesforce.com
5. Explore your environment and write a report on how RFID is being used at different places.

   Install VEDICS (Voice Enabled Desktop Interaction and Control System) and see how the computer works on voice commands.