TECHERA 2017

We can only see a short distance ahead, but we can see plenty there that needs to be done

- Alan Turing

Madanapalle Institute of Technology & Science

(UGC- Autonomous)

Department of Computer Science & Engineering

MESSAGE FROM THE CORRESPONDENT

I feel exhilarated that the Department of Computer Science & Engineering, of MITS is bringing out a magazine called TECHERA from the year 2015. This Magazine brings out the intellectual brilliance in various new techniques introduced in Information Technology industry.

``HARD WORK, SINCERITY, DEDICATION AND ENTHUSIASTIC DEVOTION TO WORK WILL FETCH YOU UNBOUND SUCCESS, MAY THE LORD SHOWER HIS BLESSINGS ON YOU``

I heartily congratulate the students and the staffs of CSE Department and Wish them a grand success.

Dr. N. Vijaya Bhaskar Choudary
Correspondent

FROM THE CHAIRMAN

Your blessings be bestowed upon us leading into the right path in organizing Magazine “TECHERA” by the Department of Computer Science& Engineering students and faculty of **MITS** and thereby make this magazine a grand success.

Chairman

Sri. N. Krishna Kumar

MESSAGE FROM THE PRINCIPAL

I feel delighted about the magazine "**TECHERA**" to be hosted by the Department of Computer Science & Engineering of MITS. On this magnanimous occasion, I congratulate all the students and faculty members of department for their great efforts and coordination in bringing out the magazine a great success.

Principal
Dr. C. Yuvaraj

MESSAGE FROM THE HEAD OF THE DEPARTMENT

TECHERA is dedicated for addressing the emerging topics and challenges in the area of technology. **TECHERA** is to create great awareness on new innovative ideas and technologies. I wish the readers of **"TECHERA"** for their support and also can provide the useful feedback to improve the standards of magazine.

Dr. M. Sakthi Ganesh
Head of the Department

EDITORIAL DESK

The annual release of the department magazine **“TECHERA – 2017”,** mark the spirit of exploration among students in an environment of erudition.

This year’s edition of “**TECHERA - 2017**” focuses on current trends in Computer Science and Information Technology which are the major rays of hope for developing a new world of science. It is a collection of information and facts, featuring the recent developments of fascinating and conceptual communication.

The editorial team owes its gratitude to all who have made “**TECHARA - 2017”,** a scintillating event.

Editors

ABOUT MITS

Madanapalle Institute of Technology & Science is established in 1998 in the picturesque and pleasant environs of Madanapalle and is ideally located on a sprawling 26.17 acre campus on Madanapalle - Anantapur Highway (NH-205) near Angallu, about 10km away from Madanapalle.

MITS, originated under the auspices of Ratakonda Ranga Reddy Educational Academy under the proactive leadership of and **Dr. N. Vijaya Bhaskar Choudary, Secretary & Correspondent** and **Sri. N. Krishna Kumar, Chairman** of the Academy.

MITS is governed by a progressive management that never rests on laurels and has been striving conscientiously to develop it as one of the best centers of Academic Excellence in India. The Institution's profile is firmly based on strategies and action plans that match changing demands of the nation and the student's fraternity. MITS enjoys constant support and patronage of NRI's with distinguished academic traditions and vast experience in Engineering & Technology.

ABOUT DEPARTMENT

The Department of Computer Science & Engineering offers 4-year degree, which is established in the year 1998. The course is flexible and has been structured to meet the evolving needs of the IT industry. The Department is offering M. Tech Computer Science & Engineering from the academic year 2007 - 2008. The Department has obtained UGC-Autonomous Status in the year 2014 and is running the Programmes successfully meeting all the requirements. The College Academic Council, Board of Studies of the department strive to provide quality education and most advanced curriculum and syllabus to make the students industry ready and excel in the contemporary business world.

The B.Tech. Programme under Department of Computer Science & Engineering was Accredited by the National Board of Accreditation (NBA) of All India Council for Technical Education (AICTE)

VISION

To excel in technical education and research in area of Computer Science & Engineering and to provide expert, proficient and knowledgeable individuals with high enthusiasm to meet the Societal challenges

MISSION

M1: To provide an open environment to the students and faculty that promotes professional and personal growth.

M2: To impart strong theoretical and practical background across the computer science discipline with an emphasis on software development and research.

M3: To inculcate the skills necessary to continue their education after graduation, as well as for the societal needs.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Program Educational Objectives (PEOs) of the department of CSE are given below:

PEO1: Gain Successful Professional career in IT industry as an efficient software engineer.

PEO2: Succeed in Master/Research programmes to gain knowledge on emerging technologies in Computer Science and Engineering.

PEO3: Grow as a responsible computing professional in their own area of interest with intellectual skills and ethics through lifelong learning approach to meet societal needs.

PROGRAM SPECIFIC OUTCOMES (PSOs)

The Computer Science and Engineering Graduates will be able to:

PSO1: Apply mathematical foundations, algorithmic principles and computing techniques in the modelling and design of computer - based systems

PSO2: Design and develop software in the areas of relevance under realistic constraints.

PSO3: Analyze real world problems and develop computing solutions by applying concepts of Computer Science.

CONTENT

1. EDGE COMPUTING

With the progressing development of information technology, the Internet of Things (IoT) has come to play an important role in our daily lives. Interconnected sensors/devices can collect and exchange different data among themselves through modern communication network infrastructure connected by millions of IoT nodes. Then, a variety of IoT applications can provide more accurate and more fine-grained network services for users. In this case, more and more sensors and devices are being interconnected via IoT techniques, and these sensors and devices will generate massive data and demand further processing, providing intelligence to both service providers and users. In conventional cloud computing, all data must be uploaded to centralized servers, and after computation, the results need to be sent back to the sensors and devices. This process creates great pressure on the network, specifically in the data transmission costs of bandwidth and resources. In addition, the performance of the network will worsen with increasing data size. In cloud computing-based service, the data transmission speed will be affected by the network traffic, and heavy traffic leads to long transmission times, increasing power consumption costs. Thus, scheduling and processing allocation is a critical issue that should be considered.

To address the aforementioned problems and issues *edge computing* came into picture. Edge computing is a method of optimizing cloud computing systems by performing data processing at the edge of the network, near the source of the data. This reduces the communications bandwidth needed between sensors and the central datacenter by performing analytics and knowledge generation at or near the source of the data. This approach requires leveraging resources that may not be continuously connected to a network such as laptops, smart-phones, tablets, and sensors.

Edge computing covers a wide range of technologies including wireless sensor networks, mobile data acquisition, mobile signature analysis, cooperative distributed peer-to-peer ad hoc networking and processing also classifiable as local cloud/fog computing and grid/mesh computing, dew computing, mobile edge computing, cloudlet, distributed data storage and retrieval, autonomic self-healing networks, remote cloud services, augmented reality, and more.

NEED FOR EDGE COMPUTING

1. Reduce the Amount of Data Transmitted and Stored in Cloud
2. Reduce the Lag Time in Data Transmission/Processing
3. Reduce the Signal to Noise Ratio

EDGE COMPUTING ARCHITECTURE

The edge-computing servers are closer to the end user than cloud servers. Thus, even though the edge-computing servers have less computation power than the cloud servers do, they still provide better QoS (Quality of Service) and lower latency to the end users. Obviously, unlike cloud computing, edge computing incorporates edge computation nodes into the network. Here the edge computation nodes are called edge/cloudlet servers. The structure of edge computing can be divided into three aspects, the front-end, near-end, and far-end, as shown in Figure 1.1. The differences among these areas are described below in detail.

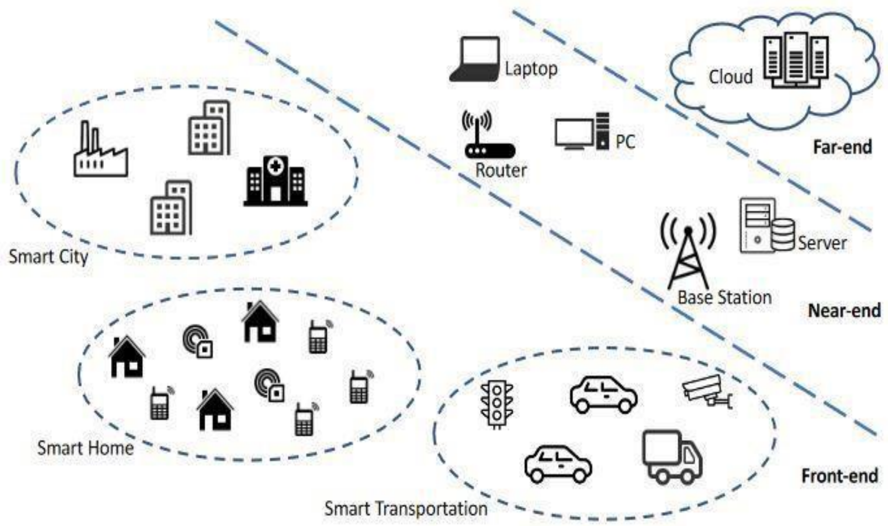

Figure 1.1: A typical architecture of edge computing networks.

Front-end

The end devices (e.g., sensors, actuators) are deployed at the front-end of the edge computing structure. The front-end environment can provide more interaction and better responsiveness for the end users. With the computing capacity provided by the plethora of nearby end devices, edge computing can provide real-time services for some applications. Nonetheless, due to the limited capacity of the end devices, most requirements cannot be satisfied at the frontend environment. Thus, in these cases, the end devices must forward the resource requirements to the servers.

Near-end

The gateways deployed in the near-end environment will support most of the traffic flows in the networks. The edge/cloudlet servers can have also numerous resource requirements, such as real-time data processing, data caching, and computation offloading. In edge computing, most of the data computation and storage will be migrated to this near-end environment. In doing so, the end users can achieve a much better performance on data computing and storage, with a small increase in the latency.

Far-end

As the cloud servers are deployed farther away from the end devices, the transmission latency is significant in the networks. Nonetheless, the cloud servers in the far-end environment can provide more computing power and more data storage. For example, the cloud servers can provide massive parallel data processing, big data mining, big data management, machine learning, etc.

WORKING

IoT gateways perform several critical functions such as device connectivity, protocol translation, data filtering and processing, security, updating, management and more. Newer IoT gateways also operate as platforms for application code that processes data and becomes an intelligent part of an edge device-enabled system.

IoT gateways sit at the intersection of edge systems-- connected devices, controllers and sensors and the cloud. An IoT gateway device bridges the communication gap between IoT devices, sensors, equipment, systems and the cloud. By systematically connecting the field and the cloud, IoT gateway devices offer local processing and storage solutions, as well as the ability to autonomously control field devices based on data input by sensors.

As the abilities and needs of devices proliferate, it is often not possible to have them communicate directly with systems. Some sensors and controllers don't support energy-intensive protocols like Wi-Fi or Bluetooth. Some devices aggregate data so that it is overwhelming and invaluable in its raw form and they are all connecting to a variety of public and private networks.

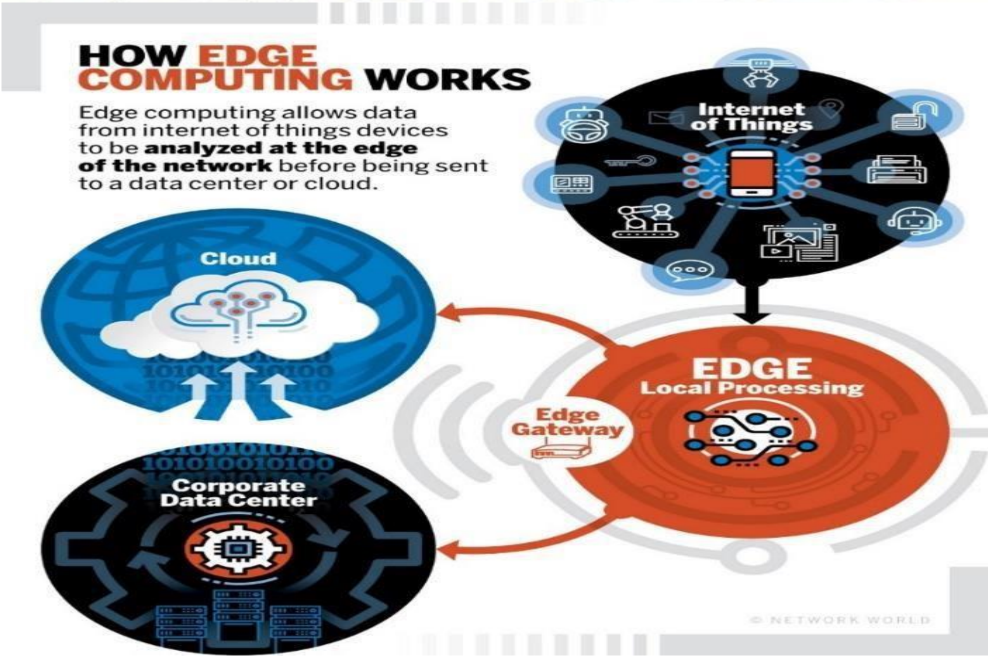

Figure 1.2 : Working of edge computing.

IoT gateways help to bridge the gap between operations and IT infrastructure within a business. They do this by optimizing system performance through the operational data they gather and process in real-time in the field or at the network edge. IoT gateways can perform a number of enhancements on the OT and IT silos:

- **High Scalability** – they are able to take intelligent data from the data center or cloud and push into the field or network edge.
- **Lowering Costs** – end-point devices needn't have as high processing power, memory or storage since the gateway does this all for them.
- **Faster Production** – an accelerated and more advanced production line can decrease time-to-market significantly.
- **Reduce Telecommunications Cost** – less M2M communication means a smaller network and (WAN) traffic.
- **Mitigate Risks** – gateways can isolate devices and sensors that aren't performing before they cause bigger problems for the production line.

TYPES OF EDGE COMPUTING

Local Devices

Devices sized to accommodate a defined and specified purpose. Deployment is "immediate" and they are suitable for home or small office applications. Running the security system for the building (Intel SOC appliance) or storing local video content on a DVR are examples.

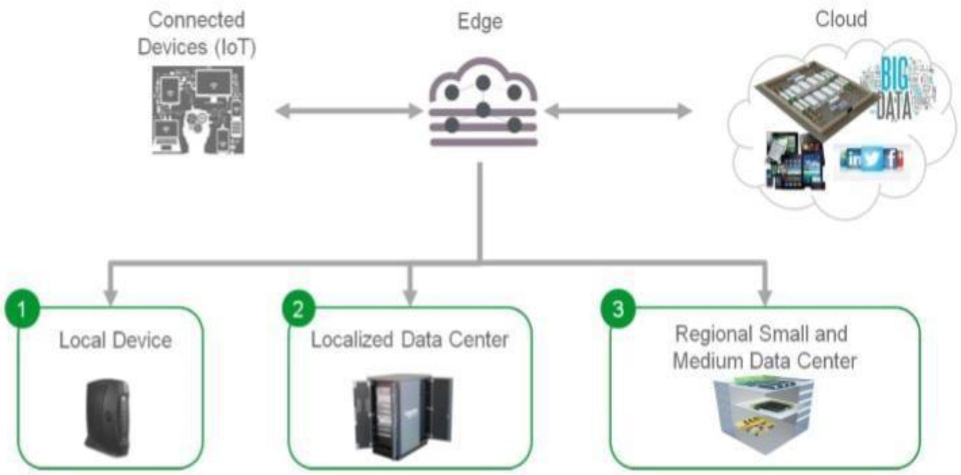

Figure 1.3: Types of edge computing.

Localized Data Centers

These data centers provide significant processing and storage capabilities and are fast to deploy in existing environments. These data centers are often available as configure -to-order systems which are pre-engineered and then assembled on site.

Regional Data Centers

Data centers that have more than 10 racks and are located closer to the user and data source than centralized cloud data centers are called regional data centers.

BENEFITS OF EDGE COMPUTING

- Speed
- Security
- Scalability
- Versatility
- Reliability

Edge computing offers several advantages over traditional forms of network architecture and will surely continue to play an important role for companies going forward. With more and more internet capable devices hitting the market, innovative organizations have likely only scratched the surface of what's possible with edge computing.

APPLICATIONS

- Autonomous Vehicles
- Smart Cities
- Industrial Manufacturing

- Financial Sector
- Healthcare

CHALLENGES IN EDGE COMPUTING

- Data Privacy and Data Security
- Cost
- Resource Management

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2. FOG COMPUTING

Figure 2.1: Fog Computing

Fog computing is a model in which data, processing and applications are concentrated in devices at the network edge rather than existing almost entirely in the cloud. Fog Computing is a paradigm that extends Cloud Computing and services to the edge of the network, similar to Cloud, Fog provides data, compute, storage, and application services to end-users.

Fog computing is a paradigm which extends cloud computing paradigm to the edge of the network. Terms **Edge Computing** and **Fog Computing** are often used interchangeably. Similar to Cloud, Fog provides data, compute, storage, and application services to end-users. This enables new breed of applications and services.

CHARACTERISTICS OF FOG COMPUTING

- ✓ Proximity to end-users, its
- ✓ Dense geographical distribution
- ✓ Support for mobility.

Fog reduces service latency, and improves QoS (Quality of Service), resulting in superior user-experience. Fog Computing supports emerging Internet of Everything (IoE) applications that demand real-time/predictable latency (industrial automation, transportation, networks of sensors and actuators). Fog paradigm is well positioned for real time Big Data and real time analytics, it supports densely distributed data collection points, hence adding a fourth axis to the often mentioned Big Data dimensions (volume, variety, and velocity).

Unlike traditional data centers, Fog devices are geographically distributed over heterogeneous platforms, spanning multiple management domains. That means data can be processed locally in smart devices rather than being sent to the cloud for processing.

NEED FOR FOG COMPUTING

In the past few years, Cloud computing has provided many opportunities for enterprises by offering their customers a range of computing services. Current "pay-as-you-go" Cloud computing model becomes an efficient alternative to owning and managing private data centers for customers facing Web applications and batch processing Cloud computing frees the enterprises and their end users from the specification of many details, such as storage resources, computation limitation and network communication cost.

However, this bliss becomes a problem for latency-sensitive applications, which require nodes in the vicinity to meet their delay requirements. When techniques and devices of IoT are getting more involved in people's life, current Cloud computing paradigm can hardly satisfy their requirements of mobility support, location awareness and low latency.

Fog computing is proposed to address the above problem. As Fog computing is implemented at the edge of the network, it provides low latency, location awareness, and improves quality-of-services (QoS) for streaming and real time applications. Typical examples include industrial automation, transportation, and networks of sensors and actuators. Moreover, this new infrastructure supports heterogeneity as Fog devices include end-user devices, access points, edge routers and switches. The Fog paradigm is well positioned for real time big data analytics, supports densely distributed data collection points, and provides advantages in entertainment, advertising, personal computing and other applications.

APPLICATIONS

The advantages of Fog computing satisfy the requirements of applications in these scenarios.

- Smart traffic lights and connected vehicles
- Wireless sensor and actuator networks
- IOT and Cyber-Physical Systems (CPSS)

SECURITY IN FOG COMPUTING

There are various ways to use cloud services to save or store files, documents and media in remote services that can be accessed whenever user connect to the Internet. The main problem in cloud is to maintain security for user's data in way that guarantees only authenticated users and no one else gain access to that data. The issue of providing security to confidential information is core security problem, that it does not provide level of assurance most people desire. There are various methods to secure remote data in cloud using standard access control and encryption methods.

It is good to say that all the standard approaches used for providing security have been demonstrated to fail from time to time for a variety of reasons, including faulty implementations, buggy code, insider attacks, mis-configured services, and the creative construction of effective and sophisticated attacks not envisioned by the implementers of security procedures. Building a secure and trustworthy cloud computing environment is not enough, because attacks on data continue to happen, and when they do, and information gets lost, there is no way to get it back. There is a need to get solutions to such accidents.

The basic idea is that we can limit the damage of stolen data if we decrease the value of that stolen data to the attacker. We can achieve this through a preventive decoy (disinformation) attack. We can secure Cloud services by implementing given additional security features.

ADVANTAGES OF FOG COMPUTING

Bringing data close to the user: Instead of housing information at data center sites far from the end-point, the Fog aims to place the data close to the end-user.

Creating dense geographical distribution: First of all, big data and analytics can be done faster with better results. Second, administrators are able to support location-based mobility demands and not have to traverse the entire network. Third, these edge (Fog) systems would be created in such a way that real-time data analytics become a reality on a truly massive scale.

True support for mobility and the IoT: By controlling data at various edge points, Fog computing integrates core cloud services with those of a truly distributed data center platform. As more services are created to benefit the end-user, edge and Fog networks will become more prevalent.

Numerous verticals are ready to adopt: Many organizations are already adopting the concept of the Fog. Many different types of services aim to deliver rich content to the end-user. This spans IT shops, vendors, and entertainment companies as well.

Seamless integration with the cloud and other services: With Fog services, we're able to enhance the cloud experience by isolating user data that needs to live on the edge. From there, administrators are able to tie-in analytics, security, or other services directly into their cloud model.

FUTURE OF FOG COMPUTING

With the increase in data and cloud services utilization, Fog Computing will play a key role in helping reduce latency and improving the user experience. We are now truly distributing the data plane and pushing advanced services to the edge. By doing so, administrators are able to bring rich content to the user faster, more efficiently, and – very importantly – more economically. This, ultimately, will mean better data access, improved corporate analytics capabilities, and an overall improvement in the end-user computing experience

Cisco's Ginny Nichols coined the term fog computing. The metaphor comes from the fact that fog is the cloud close to the ground, just as fog computing concentrates processing at the edge of the network. According to Cisco, fog computing extends from the edge to the cloud, in a geographically distributed and hierarchical organization.

"Fog could take a burden off the network. As 50 billion objects become connected worldwide by 2020, it will not make sense to handle everything in the cloud. Distributed apps and edge-computing devices need distributed resources. Fog brings computation to the data. Low-power devices, close to the edge of the network, can deliver real-time response"says Technical Leader Rodolfo Milito, one of Cisco's thought leaders in fog computing.

"The Internet of Everything is changing how we interact with the real world," Milito added:"Things that were totally disconnected from the Internet before, such as cars, are now merging onto it.

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3. QUANTUM COMPUTING

INTRODUCTION

Quantum computing refers to the use of quantum mechanical phenomena like superposition, entanglement to perform computing. Traditional computing works with bits. That is all information is processed and exchanged in 1, 0 /true-false signal which comprises a bit. That is bit is the unit of information in traditional computing. In quantum computer qubits are used instead.

It is generally considered the area of study focused on developing computer technology based on the principles of quantum theory, which explains the nature and behaviour of energy and matter on the quantum (atomic and subatomic) level. Development of a quantum computer, if practical, would mark a leap forward in computing capability far greater than that from the abacus to a modern day supercomputer, with performance gains in the billion-fold realm and beyond. The quantum computer, following the laws of quantum physics, would gain enormous processing power through the ability to be in multiple states, and to perform tasks using all possible permutations simultaneously.

At the moment, quantum computing still resides within a largely theoretical or speculative realm. The potential is staggering, involving a computational power many times the order of all the world's existing classical computers combined.

Considering the potency, quantum computing has got a vast array of applications, most of which we cannot even comprehend today. It is known to have applications in cryptography, in simulating complex systems, in the development of new materials and drugs, and many more. Quantum computing technology has potential to change dynamics in military affairs, commerce, and strategic balance of power.

CLASSICAL COMPUTER VS QUANTUM COMPUTER

Classical Computer	Quantum Computer
It is large scale integrated multi-purpose computer.	It is high speed parallel computer based on quantum mechanics.
Information storage is bit based on voltage or charge etc.	Information storage is Quantum bit based on direction of an electron spin.
Information processing is carried out by logic gates e.g. NOT, AND, OR etc.	Information processing is carried out by Quantum logic gates.
Circuit behaviour is governed by classical physics.	Circuit behaviour is governed explicitly by quantum mechanics.
Classical computers use binary codes i.e. bits 0 or 1 to represent information.	Quantum computers use Qubits i.e. 0, 1 and both of them simultaneously to run machines faster.
Operations are defined by Boolean Algebra.	Operations are defined by linear algebra over Hilbert Space and can be represented by unitary matrices with complex elements.
No restrictions exist on copying or measuring signals	Severe restrictions exist on copying and measuring signals
Circuits are easily implemented in fast, scalable and macroscopic technologies such as CMOS.	Circuits must use microscopic technologies that are slow, fragile and not yet scalable e.g. NMR (Nuclear magnetic resonance).

HISTORY AND DETAILS

To Understand about Quantum computing we need to first unravel the origins of quantum theory.

Origin of Quantum Theory

German physicist Max Planck publishes his groundbreaking study of the effect of radiation on a "blackbody" substance, and the quantum theory of modern physics is born.

Through physical experiments, Planck demonstrated that energy, in certain situations, can exhibit characteristics of physical matter. According to theories of classical physics, energy is solely a continuous wave-like phenomenon, independent of the characteristics of physical matter. Planck's theory held that radiant energy is made up of particle-like components, known as "quanta." The theory helped to resolve previously unexplained natural phenomena such as the behavior of heat in solids and the nature of light absorption on an atomic level. In 1918, Planck was rewarded the Nobel Prize in physics for his work on blackbody radiation.

Other scientists, such as Albert Einstein, Niels Bohr, Louis de Broglie, Erwin Schrodinger, and Paul M. Dirac, advanced Planck's theory and made possible the development of quantum mechanics–a mathematical application of the quantum theory that maintains that energy is both matter and a wave, depending on certain variables. Quantum mechanics thus takes a probabilistic view of nature, sharply contrasting with classical mechanics, in which all precise properties of objects are, in principle, calculable. Today, the combination of quantum mechanics with Einstein's theory of relativity is the basis of modern physics.

Generations of Computers

The computer as we see it today is a result of extensive research and development through the decades. The word 'computer' comes from the word compute which means 'to calculate'. Computers were developed from calculators as the need arose for more complex and scientific calculations.

Charles Babbage is known as the father of computers because of his immense contribution to the world of programming. His idea was soon developed into a programmable computer that could calculate and print logarithmic tables with huge precision.

The First Generation (1943-1958)

This generation is often described as starting with the delivery of the first commercial computer to a business client. This happened in 1951 with the delivery of the UNIVAC to the US Bureau of the Census. This generation lasted until about the end of the 1950's (although some stayed in operation much longer than that). The main defining feature of the first generation of computers was that vacuum tubes were used as internal computer components. Vacuum tubes are generally about 5-10 centimeters in length and the large numbers of them required in computers resulted in huge and extremely expensive machines that often broke down (as tubes failed).

The Second Generation (1959-1964)

In the mid-1950's Bell Labs developed the transistor. Transistors were capable of performing many of the same tasks as vacuum tubes but were only a fraction of the size. The first transistor-based computer was produced in 1959. Transistors were not only smaller, enabling computer size to be reduced, but they were faster, more reliable and consumed less electricity.

The other main improvement of this period was the development of computer languages. Assembler languages or symbolic languages allowed programmers to specify instructions in words (albeit very cryptic words) which were then translated into a form that the machines could understand (typically series of 0's and 1's: Binary code). Higher level languages also came into being during this period. Whereas assembler languages had a one-to- one correspondence between their symbols and actual machine functions, higher level language commands often represent complex sequences of machine codes. Two higher-level languages developed during this period (Fortran and Cobol) are still in use today though in a much more developed form.

The Third Generation (1965-1970)

In 1965 the first integrated circuit (IC) was developed in which a complete circuit of hundreds of components were able to be placed on a single silicon chip 2- or 3-mm square. Computers using these IC's soon replaced transistor-based machines. Again, one of the major advantages was size, with computers becoming more powerful and at the same time much smaller and cheaper. Computers thus became accessible to a much larger audience. An added advantage of smaller size is that electrical signals have much shorter distances to travel and so the speed of computers increased.

Another feature of this period is that computer software became much more powerful and flexible and for the first time more than one program could share the computer's resources at the same time (multi-tasking). The majority of programming languages used today are often referred to as 3GL's (3rd generation languages) even though some of them originated during the 2nd generation.

The Fourth Generation (1971-present)

The boundary between the third and fourth generations is not very clear-cut at all. Most of the developments since the mid 1960's can be seen as part of a continuum of gradual miniaturization. In 1970 large-scale integration was achieved where the equivalent of thousands of integrated circuitswas crammed onto a single silicon chip. This development again increased computer performance (especially reliability and speed) whilst reducing computer size and cost. Around this time the first complete general-purpose microprocessor became available on a single chip. In 1975 Very Large-Scale Integration (VLSI) took the process one step further. Complete computer central processors could now be built into one chip. The microcomputer was born. Such chips are far more powerful than ENIAC and are only about 1cm square whilst ENIAC filled a large building.

During this period Fourth Generation Languages (4GL's) have come into existence. Such languages are a step further removed from the computer hardware in that they use language much like natural language. Many database languages can be described as 4GL's. They are generally much easier to learn than are 3GL's.

The Fifth Generation (the future)

The "fifth generation" of computers were defined by the Japanese government in 1980 when they unveiled an optimistic ten-year plan to produce the next generation of computers. This was an interesting plan for two reasons. Firstly, it is not at all really clear what the fourth generation is, or even whether the third generation had finished yet. Secondly, it was an attempt to define a generation of computers before they had come into existence. The main requirements of the 5G machines was that they incorporate the features of Artificial Intelligence, Expert Systems, and Natural Language. They utilize various new technologies like 'Quantum computing' and 'superconductors'. The goal was to produce machines that are capable of performing tasks in similar ways to humans, are capable of learning, and are capable of interacting with humans in natural language and preferably using both speech input (speech recognition) and speech output (speech synthesis). Such goals are obviously of interest to linguists and speech scientists as natural language and speech processing are key components of the definition. Parallel processing again is a relatively new concept that is still in the nascent stage but has immense potential.

Origin of Quantum Computing

The spark of quantum computing was struck by Richard Feynman. In 1981 at MIT, he presented the following quandary: classical computers cannot simulate the evolution of quantum systems in an efficient way. Thus, he proposed a basic model for a quantum computer that would be capable of such simulations. With this, he outlined the possibility to exponentially outpace classical computers. However, it took more than 10 years until a special algorithm was created to change the view on quantum computing, the Shor algorithm.

In 1994, Peter Shor developed his algorithm allowing quantum computers to efficiently factorize large integers exponentially quicker than the best classical algorithm on traditional machines. The latter takes millions of years to factor 300-digit numbers. Theoretically, the Shor algorithm is capable of breaking many of the cryptosystems used today. The possibility to break cryptosystems in hours rather than millions of years using quantum computers lit a fire of interest for quantum computing and its applications. In 1996, Lov Grover invented a quantum database search algorithm that presented a quadratic speedup for a variety of problems. Any problem which had to be solved by random or brute-force search could now be done 4x faster.

In 1998, a working 2-qubit quantum computer was built and solved first quantum algorithms such as Grover's algorithm. The race into a new era of computer power began and more and more applications were developed.

Twenty years later, in 2017, IBM presented the first commercially usable quantum computer, raising the race to another level.

APPLICATIONS

- Applications in Machine Learning
- Applications in Computational Chemistry
- Applications in Financial Modeling
- Applications in Cyber Security

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Article by

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4. BRAIN GATE: TURNING THOUGHTS INTO ACTION

INTRODUCTION

The concept of using thought to move a robotic device, a wheelchair, a prosthetic, or a computer was once strictly the stuff of science fiction, but no longer. Brain Gate collects and analyses the brainwaves of individuals with pronounced physical disabilities, turning thoughts into actions. The potential to better communicate, interact, and improve people's way of life is about to explode.

Brain-computer interface (or) Directed Neural Interface

A brain-computer interface (BCI), sometimes called a direct neural interface or a brain-machine interface, is a direct communication pathway between a human or animal brain and an external device.In this definition, the word brain means the brain or nervous system of an organic life form rather than the mind. Computer means any processing or computational device, from simple circuits to silicon chips.

Types of BCI:

- **BCI**: Direct communication pathway between a brain or brain cell culture and a device (computer)
- **One way BCIs**: Information passes from brain to computer or computer to brain
- **Two way BCIs**: Information is exchanged between brain and computer
- **Invasive BCI**: The chip is implanted directly into the grey matter of the brain. Produces the highest quality signals but are prone to scar tissue build up.

Brain Control Motor Function

The brain is "hardwired" with connections, which are made by billions of neurons that make electricity whenever they are stimulated. The electrical patterns are called brain waves. Neurons act like the wires and gates in a computer, gathering and transmitting electrochemical signals over distances as far as several feet. The brain encodes information not by relying on single neurons, but by spreading it across large populations of neurons, and by rapidly adapting to new circumstances.

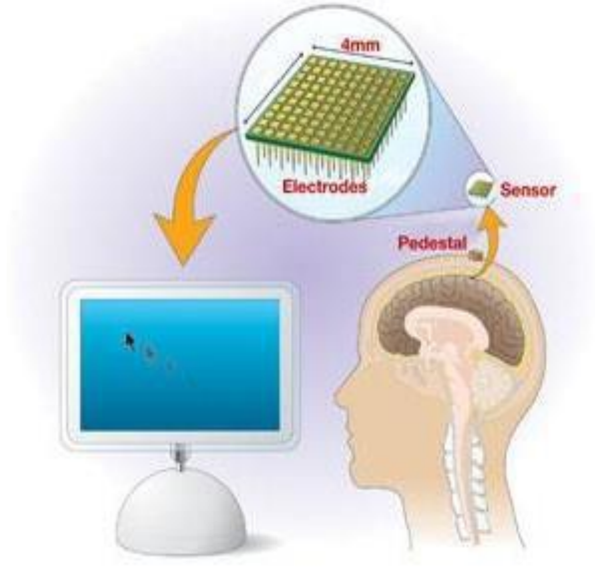

Figure 4.1: Brain Gate Working

Motor neurons carry signals from the central nervous system to the muscles, skin and glands of the body, while sensory neurons carry signals from those outer parts of the body to the central nervous system. Receptors sense things like chemicals, light, and sound and encode this information into electrochemical signals transmitted by the sensory neurons. And interneuron's tie everything together by connecting the various neurons within the brain and spinal cord. The part of the brain that controls motor skills is located at the ear of the frontal lobe.

Communication with the Body

Muscles in the body's limbs contain embedded sensors called muscle spindles that measure the length and speed of the muscles as they stretch and contract as you move. Other sensors in the skin respond to stretching and pressure. Even if paralysis or disease damages the part of the brain that processes movement, the brain still makes neural signals. They're just not being sent to the arms, hands and legs.

A technique called neuro feedback uses connecting sensors on the scalp to translate brain waves into information a person can learn from. The sensors register different frequencies of the signals produced in the brain. These changes in brain wave patterns indicate whether someone is concentrating or suppressing his impulses, or whether he is relaxed or tense.

Neuroprosthetic Device

A neuroprosthetic device known as Brain gate converts brain activity into computer commands. A sensor is implanted on the brain, and electrodes are hooked up to wires that travel to a pedestal on the scalp. From there, a fibre optic cable carries the brain activity data to a nearby computer.

"The principle of operation of the Brain Gate Neural Interface System is that with intact brain function, neural signals are generated even though they are not sent to the arms, hands and legs. These signals are interpreted by the System and a cursor is shown to the user on a computer screen that provides an alternate "Brain Gate pathway". The user can use that cursor to control the computer, just as a mouse is used.

The Brain Gate System consists of a 4x4 millimetre sensor, about the size of a baby aspirin, with 100 tiny electrodes, each thinner than a human hair. The sensor is implanted on the surface of the area of the brain responsible for voluntary movement, the motor cortex. The electrodes penetrate about 1 mm into the surface of the brain where they pick up electrical signals known as neural spiking, the language of the brain from nearby neurons and transmit them through thin gold wires to a titanium pedestal that protrudes about an inch above the patient's scalp. An external cable connects the pedestal to computers, signal processors and monitors. Converting digitized intentions into meaningful action, however, is not simple. Active neurons fire between 20 and 200 times a second and they work in teams.

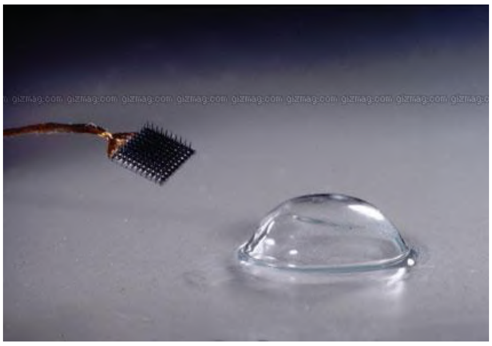

Figure 4.2: 4X4 SENSOR

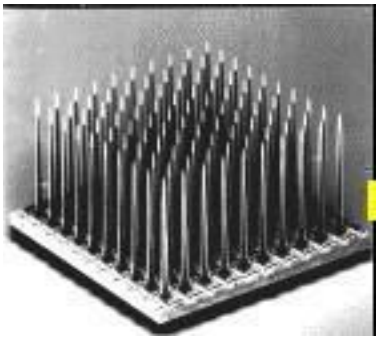

Figure 4.3: NUERO CHIP

Nuero Chip

Currently the chip uses 100 hair-thin electrodes that 'hear' neurons firing in specific areas of the brain, for example, the area that controls arm movement. The activities are translated into electrically charged signals and are then sent and decoded using a program, which can move either a robotic arm or a computer cursor.

System Work

The patient directs his thoughts to move the cursor on his computer screen. The sensor in his brain picks up those hard-to-detect electrical signals and sends them through three computers that process them into signals just like those from a computer mouse. These processors, which currently sit on a cart and are not mobile, will eventually become wireless and small enough to fit inside the body.

Figure 4.4: Brain Gate System

So when he's connected, the patient can just "think" the cursor from place to place on- screen like the rest of us use a mouse.

Advantages

- The Brain Gate system is based on cyber kinetics platform technology to sense, transmit, analyse and apply the language of neurons.
- The Brain Gate Neural Interface System is being designed to one day allow the interface with a computer and / or even faster than, what is possible with the hands of a person.
- Currently available assistive device has significant limitations for both the pers and caregiver. For example, even simple switches must be adjusted frequent that can be time consuming. In addition, these devices are often obtrusive and user from being able to simultaneously use the device and at the same time contact or carry on conversations with others.
- Potential advantages of the Brain Gate System over other muscle driven or brain computer interface approaches include:
  - ✓ its potential to interface with a compute weeks or months of training;

- ✓ its potential to be used in an interactive environment user's ability to operate the device is not affected by their speech, eye movement noise;
- ✓ the ability to provide significantly more usefulness and utility than other approaches by connecting directly to the part of the brain that controls hand gestures.

Disadvantages

- ➢ The U.S. Food and Drug Administration (FDA) have not approved the Brain Gate Non Interface System for general use.
- ➢ The Brain Gate System is an investigational device in the United States, and is status (Investigational Device Exemption). In the United States, this investigate can only be used in pre-marketing clinical trials approved by the FDA.

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Article by

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5. SELF-DRIVING CAR

An autonomous car (also known as a driverless car, auto, self-driving car, robotic car) is a vehicle that is capable of sensing its environment and navigating without human input. Autonomous vehicle navigation gains increasing importance in various growing application areas. Autonomous cars use a variety of techniques to detect their surroundings, such as radar, laser light, GPS, odometer, and computer vision. Throughout the past decade, we have witnessed one of the greatest strides in automobile technology with the focus on autonomous cars. Recently self-driving cars are coming up in the news, though the researchers have been experimenting with self-driving vehicles for over 45 years. These vehicles require a broad range of technologies and infrastructures to operate properly. Each vehicle is required to continuously collect and interpret vast amounts of information. Every system of the car must work with the surrounding environment. Some autonomous vehicles update their maps based on sensory input, allowing the vehicles to keep track of their position even when conditions change or when they enter uncharted environments. For any mobile robot, the ability to navigate in its environment is one of the most important capabilities.

The navigation task can be defined as the combination of three basic competences: localization, obstacle detection, path planning and vehicle control.

The potential application areas of the autonomous navigation of mobile robots include automatic driving, guidance for the blind and disabled, exploration of dangerous regions, transporting objects in factory or office environments, collecting geographical information in unknown terrains like unmanned exploration of a new planetary surface, etc. Maintaining a dynamic speed with the front car or an obstacle is efficiently done here with distance measuring sensors. Stepper motor controlled rotating sensor is used at the time of changing lane. Pollution and global warming is going to a severe state for the existence of human. Vehicles run by burning oil are a major cause for this. Here, the energy required for the movement of the vehicle has been derived through solar PV power which is green in nature.

Technology

Google's robotic cars have about $150,000 in equipment including a $70,000 LIDAR(Light Detection and Ranging)system. The range finder mounted on the top is a Velodyne 64-beam laser. This laser allows the vehicle to generate a detailed 3D map of its environment. The car then takes these generated maps and combines them with high-resolution maps of the world, producing different types of data models that allow it to drive itself.

Hardware Components used

- LIDAR (Light Detection and Ranging)
- Automotive Radar (Radio Detection and Ranging) System
- GPS (Global Positioning System)
- Position Estimators
- Systems like ABS (Antilock Braking System)

Block Diagram

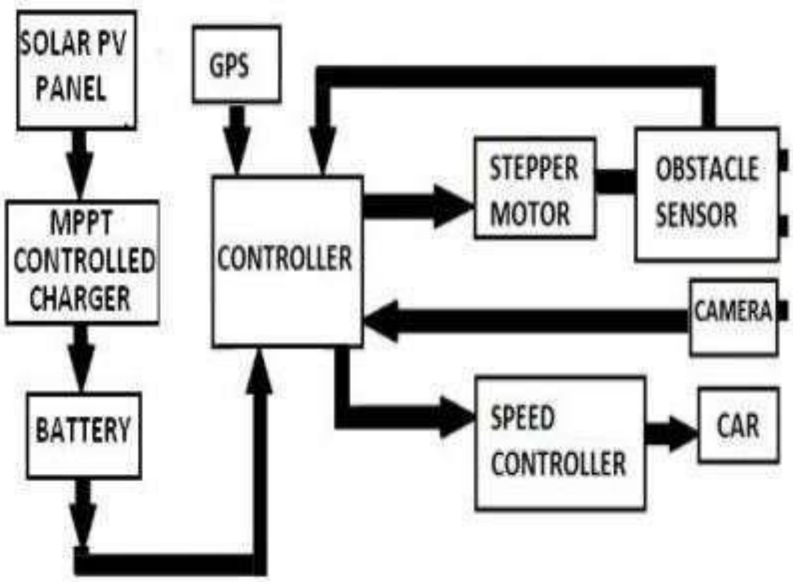

Figure 5.1: Block diagram of the prototype

Software used

- The software used in a Google's self-driving car is named Google Chauffeur with Artificial Intelligence.
  - A powerful computer is placed under the rear passenger seat.
  - All the hardware components are connected to the computer.
  - When the software has chosen the best path ahead the software controls the following,
    - Steering wheel
    - Accelerator

- Break
- Gear

Advantages:

- Avoid accidents.
- Current location can be easily identified by GPS.
- Manage traffic Flow.
- Increasing Roadway capacity.

Disadvantages:

- If the user is using internet with less security, then it can be caught by the hackers
- Hackers can turn system on or off
- Hackers can change the route
- In case of failure in main sensor and backup sensor the vehicle can create chances of accidents

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6. BIOMETRICS

Biometric can be described as a measurable physical and/or behavioural trait that can be captured and used to verify the identity of a person by comparing the metric to a previously stored template. The area of biometrics can therefore be defined as the task of automatically recognizing a person using his/her distinguishing traits. Examples of these "distinguishing traits" are fingerprints, voice patterns, facial characteristics etc. The idea of biometric identification is not new, it have been around for centuries. Example of a biometric is the photo on identification cards and passports, which still is the most important way of verifying the identity of a person. As early as the 14th century, the Chinese were reportedly using fingerprints as form of signature. During the late 1890‟s, a method of bodily measurement called "Bertillonage" (after its founder Alphonse Bertillone) was used by Police Department in Paris & France The term "biometrics" is derived from two Greek words *"bios"* for life and *"metron"* for measure. Identification based on the number of bodily measurement and physical description. The difference today, is that we now have access to technologies enabling us to do these verifications automatically and almost in real-time. Practically all biometrics system work in the same manner, first a person is enrolled into a data base using.

The specified method, information about a certain characteristics of the human being is captured, this information is usually placed through an algorithm that turns the information into a code that the database stores. When the person need to be identified, the system will take the information about the person, again this new information is placed through the algorithm and then compares the new code with the ones in the database to discover a match and hence identification.

CLASSIFICATION OF BIOMETRICS

Aphysiologicalcharacteristicisarelativelystablephysicalcharacteristic,such as an individual fingerprint, hand geometry, iris pattern, or blood vessel pattern on the back of the eye. This type of biometric measurement is usually unchanging and unalterable without significant duress to the individual.

Physical biometrics:

- *Fingerprint*: Analyzing finger tip patterns.
- *Facial Recognition*: Measuring facial characteristics. Hand Geometry- Measuring the shape of the hand.
- *Iris recognition:* Analyzing features of colored ring of the eye. Vascular Patterns- Analyzing vein patterns.
- *Retinal Scan:* Analyzing blood vessels in the eye.
- *Bertillon age:* Measuring body lengths A behavioural characteristic is more are flection of an individual psychological makeup.
- A *signature* is the most common behavioral biometric used for identification. Because most behavioral characteristics vary over time, an identification system using these must allow updates to enrolled biometric references.

Behavioral biometrics:

- *Speaker Recognition:* Analyzing vocal behavior.
- *Signature:* Analyzing signaturedynamics.
- *Keystroke:* Measuring the time spacing of typedwords.

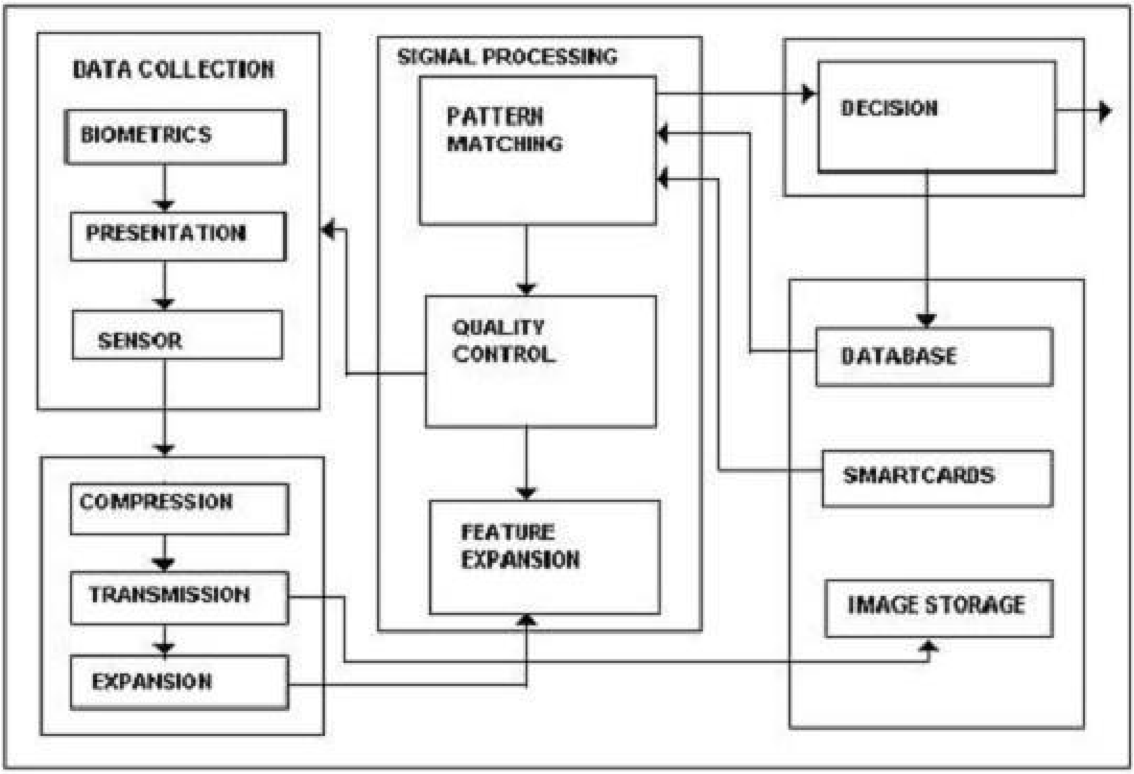

Figure 6.1: Basic Structure of Biometric

BIOMETRIC SYSTEM COMPONENTS ANDPROCESS

- **COMPONENTS:**

  Three major components are usually present in a biometric system:

  - A mechanism to scan and capture a digital or analog image of a living person's biometric characteristic.
  - Software for storing, processing and comparing the image.
  - An interface with the applications system that will use the result to confirm an individual's identity.

- **PROCESS:**

  Two different stages are involved in the biometric system process –

  - Enrolment
  - Verification

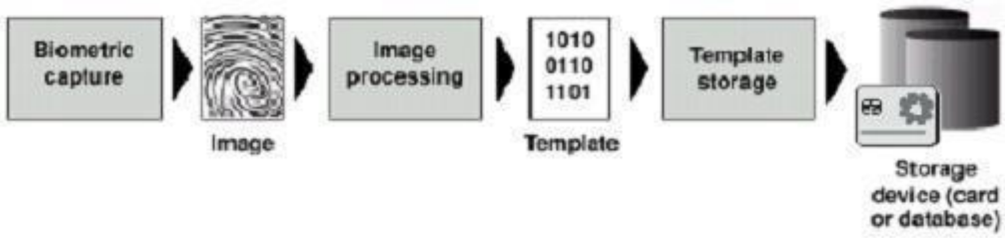

Figure 6.2: Enrolment Process

As shown in Figure 6.2, the biometric image of the individual is captured during the enrolment process (e.g., using a sensor for fingerprint, microphone for voice verification, camera for face recognition, scanner for eye scan). The unique characteristics are then extracted from the biometric image to create the user's biometric template. This biometric template is stored in a database or on a machine-readable ID card for later use during an identity verification process.

Authentication Systems

- Verifying the identity that user claims to have.
- It can be offline.
- Typical applications: Access Control, all kinds of applications where cards are used.

Authentication (1-to-1 comparison) confirms that the credential belongs to the individual presenting it. In this case, the device that per forms the authentication must have access only to the individual's enrolled biometric template, which may be stored locally or centrally.

VERIFICATION:

Based upon the security requirements of the system Figure 6.3 illustrates the identity verification process. The biometric image is again captured. The unique characteristics are extracted from the biometric image to create the users "live" biometric template. This new template is then compared with the template previously stored and a numeric matching score is generated, based on the percentage of duplication between the live and stored template. System designers determine the threshold value for this identity verification score.

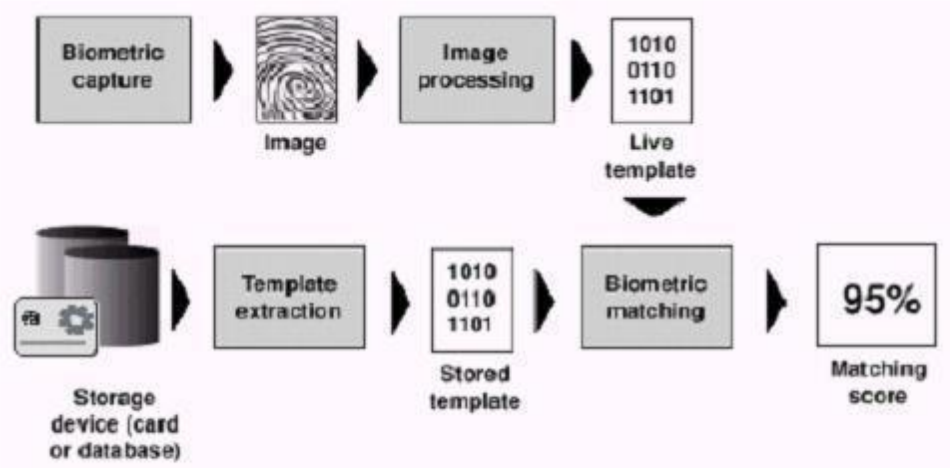

Figure 6.3: Verification Process

TYPES OF BIOMETRICSYSTEM

There are two kinds of Biometric System

1) **Recognition Systems**
   - Identifying a person among the whole group of users enrolled in the system.
   - It must be an online system.
   - Typical applications :Forensics

Identification (1-to-many comparison) verifies if the individual exists within a known population. Identification confirms that the individual is not enrolled with another identity and is not on a predetermined list of prohibited persons. Identification will typically need a secured database containing a list of all applying individuals and their biometrics. The biometric for the individual being considered for enrolment would be compared against all stored biometrics. For many applications, an identification process is used only at the time of enrolment to verify that the individual is not already enrolled.

2) **Authentication Systems**

- Verifying the identity that user claims to have.
- It can be offline.
- Typical applications: Access Control, all kinds of applications where cards are used.

Authentication (1-to-1 comparison) confirms that the credential belongs to the individual presenting it. In this case, the device that per forms the authentication must have access only to the individual's enrolled biometric template, which may be stored locally or centrally.

BIOMETRICACCURACY

BIOMETRIC ACCURACY

A key factor in the selection of the appropriate biometric technology is its accuracy. Biometric accuracy is the system ability of separating legitimate matches from imposters. When the live biometric template is compared to the stored biometric template, a matching score is used to confirm or deny the identity of the user. System designers set this numeric score to accommodate the desired level of accuracy for the system, as measured by the False Acceptance Rate (FAR) and False Rejection Rate (FRR).

False Rejection Rate (FRR) refers to the statistical probability that the biometric system is not able to verify the legitimate claimed identity of an enrolled person or fails to identify an enrolled person.

False Acceptance Rate (FAR) refers to the statistical probability of False Acceptance or incorrect verification. In the most common context, both False Rejection and False Acceptance represent a security hazard.

Equal-Error Rate When the decision threshold is adjusted so that the false-acceptance rate equal the false-rejection rate.

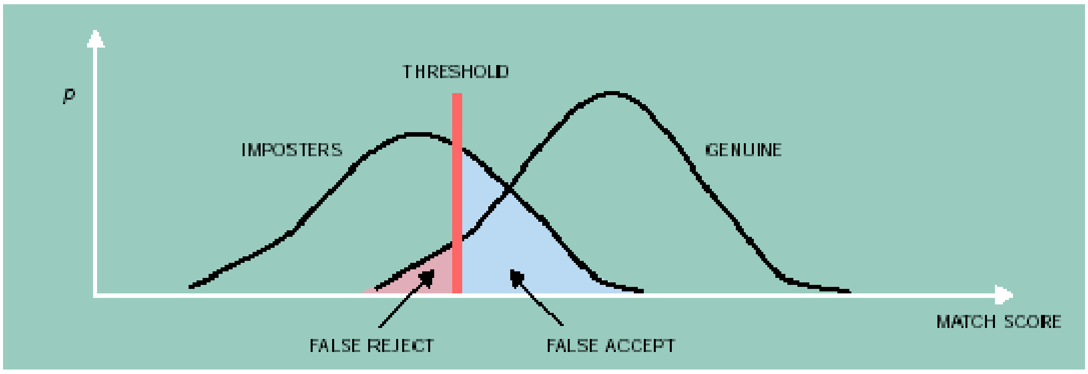

Figure 6.4: Error Rate

If a mismatching pair of fingerprints is accepted as a match, it is called a false accept. On the other hand, if a matching pair of fingerprints is rejected by the system, it is called a false reject. The error rates are a function of the threshold as shown in Figure 6.4. Often the interplay between the two errors is presented by plotting FAR against FRR with the decision threshold as the free variable. This plot is called the ROC (Receiver Operating Characteristic) curve. The two errors are complementary in the sense that if one makes an effort to lower one of the errors by varying the threshold, the other error rate automatically increases. In a biometric authentication system, the relative false accept and false reject rates can be set by choosing a particular operating point (i.e., a detection threshold). Very low (close to zero) error rates for both errors (FAR and FRR) at the same time are not possible. By setting ahigh threshold, the FAR error can be close to zero, and similarly by setting a significantly low threshold, the FRR rate can be close to zero. A meaningful operating point for the threshold is decided based on the application requirements, and the FAR versus FRR error rates at that operating point may be quite different. To provide high security, biometric systems operate at a low FAR instead of the commonly recommended equal error rate (EER) operating point where FAR=FRR.

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7. BIOCHIP TECHNOLOGY

A fully integrated biochip needs to perform all analytical functions including sample preparation, mixing steps, chemical reactions, and detection in an integrated microfluidic circuit. For most current biochips, sample preparation from the 'real' samples of bodily fluids represent the most difficult procedure to be realized in the chip level.

Thedevelopment of a self-contained and fitly integrated biochip system for sample-to-answer DNA analysis that starts from sample preparation (i.e., magnetic bead-based target cell capture, cell pre-concentration and purification, and cell lysis), followed by PCR and microarray electrochemical-based detection. Complex biological sample and reagent solutions are placed on the device, while electrochemical signals corresponding to genetic information are the primary output. The first stage is sample preparation for PCR; the second stage is amplification of the DNA strands; and the third stage includes the subsequent operations, such as mixing the droplet that contains DNA strands with other reagent droplets, detecting the concentration of intermediate product droplets, and the hybridization of the amplified DNA sequences.

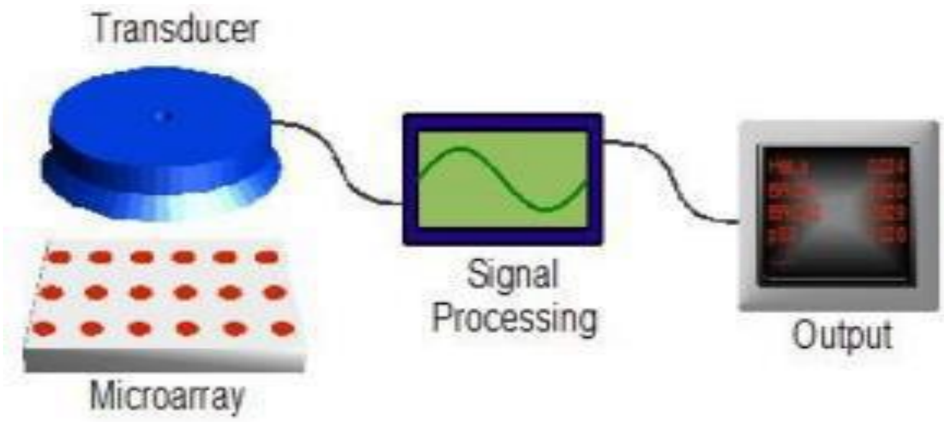

Figure 7.1: The Biochip Platform

COMPONENTS

Today's, biochip implant is basically a small (micro) computer chip, inserted under the skin, for identification purposes. The biochip implant system consists of two components; a transponder and a reader or scanner. The *transponder* is the actual biochip implant. The biochip system is a radio frequency identification (RFID) system, using low-frequency radio signals to communicate between the biochip and reader. The reading range or activation range, between reader and biochip is small, normally between 2 and 12 inches. The reader "reads" or "scans" the implanted biochip and receives back data (in this case an identification number) from the biochip. The communication between biochip and reader is via low-frequency radio waves.

Computer Microchip

The microchip stores a unique identification number from 10 to 15 digits long. The storage capacity of the current microchips is limited, capable of storing only a single ID number. The unique ID number is etched or encoded via a laser onto the surface of the microchip before assembly. Once the number is encoded it is impossible to alter. The microchip also contains the electronic circuitry necessary to transmit the ID number to the reader.

Antenna Coil

This is normally a simple, coil of copper wire around a ferrite or iron core. This tiny, primitive, radio antenna receives and sends signals from the reader or scanner.

Tuning Capacitor

The capacitor stores the small electrical charge (less than 1/1000 of a watt) sent by the reader or scanner, which triggers the transponder. This activation allows the transponder to send back the ID number encoded in the computer chip. As radio waves are utilized to communicate between the transponder and reader, the capacitor is tuned to the same frequency as the reader.

Glass Capsule

The glass capsule holds the microchip, antenna coil, and capacitor. It is a small capsule, the smallest measuring 11 mm in length and 2 mm in diameter, about the size of an uncooked grain of rice as shown in Figure 7.2 and 7.3. The capsule is made of biocompatible material such as soda lime glass. After assembly, the capsule is hermetically (air-tight) sealed, so no bodily fluids can touch the electronics inside. Because the glass is very smooth and susceptible to movement, a material such as a polypropylene polymer sheath is attached to one end of the capsule. This sheath provides a compatible surface which the bodily tissue fibers bond or interconnect, resulting in a permanent placement of the biochip.

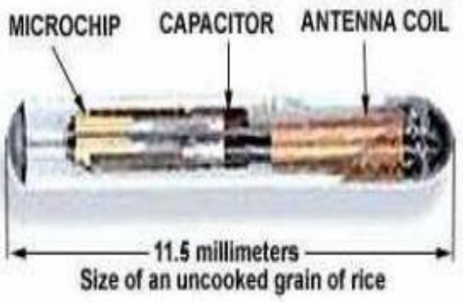

Figure 7.2. Components of a Biochip

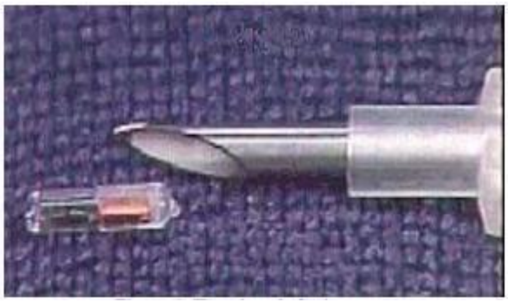

Figure 7.3: Hypodermic Syringe

The biochip is inserted into the subject with a hypodermic syringe as shown in Figure 7.4. Injection is safe and simple, comparable to common vaccines. Anaesthesia is not required nor recommended. In dogs and cats, the biochip is usually injected behind the neck between the shoulder blades. Trovan, Ltd., markets an implant, featuring a patented "zip quill", which you simply press in, no syringe is needed. According to AVID "Once implanted, the identity tag is virtually impossible to retrieve‖. The number can never be altered."

The reader:

The reader consists of an "exciter" coil which creates an electromagnetic field that, via radio signals, provides the necessary energy (less than 1/1000 of a watt) to "excite" or "activate" the implanted biochip. The reader also carries a receiving coil that receives the transmitted code or ID number sent back from the "activated" implanted biochip. This all takes place very fast, in milliseconds. The reader also contains the software and components to decode the received code and display the result in an LCD display. The reader can include a RS-232 port to attach a computer.

Figure 7.4: **The Biochip Reader**

HOW IT WORKS

The reader generates a low-power, electromagnetic field, in this case via radio signals, which activates the implanted biochip. This activation enables the biochip to send the ID code back to the reader via radio signals. The reader amplifies the received code, converts it to digital format, decodes and displays the ID number on the reader's LCD display. The reader must normally be between 2 and 12 inches near the bio-chip to communicate. The reader and biochip can communicate through most materials.

APPLICATIONS

- Also potent in replacing passports, cash and medical records.
- Tracking and identification devices in animals around 1983 for monitoring fishery.
- Now widely used in monitoring pets and animals in zoos.
- Implanted under the skin of the animal with a unique ID number.
- A biochip can store and update financial, medical, demographic data, basically everything about a person.
- Biochip as Glucose Detector
- Biochip as a Blood Pressure sensor.

ADVANTAGES

- To rescue the sick.
- To find lost people.
- To locate downed children and wandering Alzheimer's Patients.
- To identify person uniquely.
- They can perform thousands of biological reactions operations in few seconds.
- In monitoring health condition of individuals in which they are specifically me played.
- They can perform thousands of biochemical reactions.

DISADVANTAGES

- They raise critical issues of personal privacy.
- They mark the end of human freedom and dignity.
- They may not be supported by large % of people.
- There is a danger of turning every man, women, and Child into a controlled slave.
- Through cybernetic biochip implants people will think and act as exactly pre-programmed. They can be implanted into one's body without their knowledge.

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