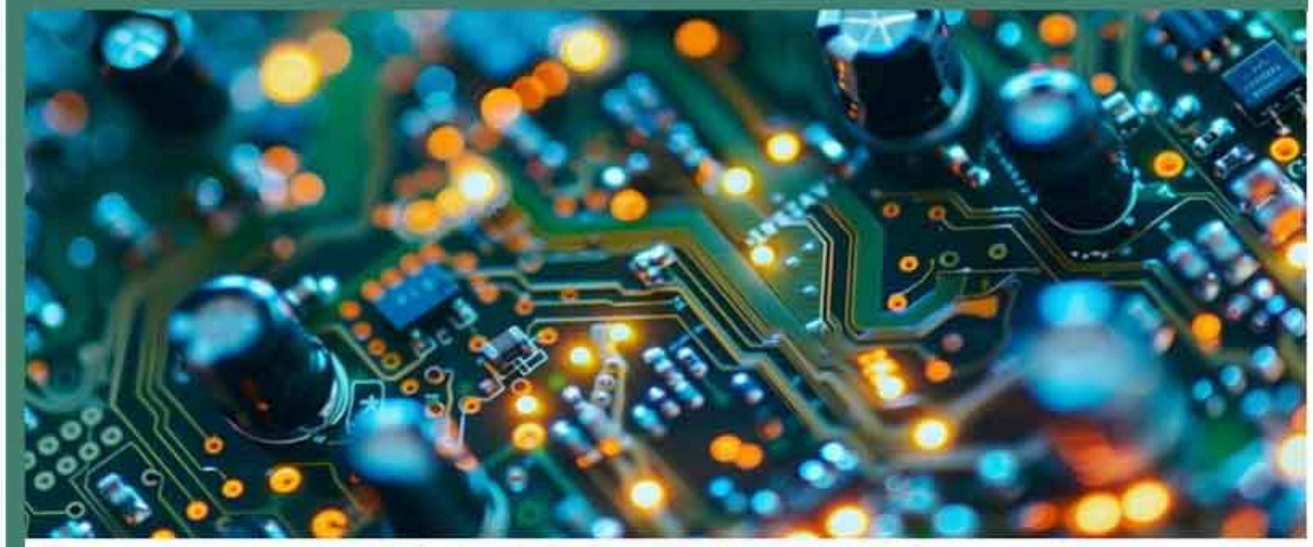
AY-2024-2025

E-ZINE

Technical Magazine from ELECTRONICS & COMMUNICATION ENGINEERING



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT VISION

To impart the best technical education instilled with discipline, values and leadership qualities that will produce professional technocrats in Electronics and Communication Engineering.

DEPARTMENT MISSION

M1: To impart fundamental Electronics and Communication Engineering concepts and a broad set to technical skills.

M2: To prepare Electronics and Communication Engineering graduates who will effectively and responsibly in practicing engineering.

M3: To impart practical exposure on latest technological developments in Electronics and Communication Engineering.

Program Educational Objectives (PEO's)

On successful completion of UG in Electronics and Communication Engineering, the Graduates will:

PEO1: Acquire adequate knowledge in the field of Electronics and Communication Engineering to have a successful career.

PEO2: Pursue higher studies with the focusing on R&D activities in the related areas.

PEO3: Take up entrepreneurship by practicing lifelong learning with innovation

Program Specific Outcomes (PSO's)

PSO1: To design and implement application specific electronic systems to provide real time solutions combating societal, ecological and economical issues in the areas of communication, networking, embedded systems and VLSI.

PSO2: To demonstrate proficiency by quickly adapting to changes in technology and tools and administer professional engineering practice through lifelong Learning and contributing immensely to research and development

GATES INSTITUTE OF TECHNOLOGY
Autonomous
Approved by A.I.C.T.E. & Permanently Affiliated to JNTUA, Ananthapuramu,Gootyanantapur(v), Gooty, Ananthapuramu(Dist.)-515401

Editors:
Dr. V. Ramanath, B. Veerendra Reddy, K.Yasaswini.

E-ZINE 2024 Technical Magazine,

Issue 1, April 2024

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

With the evolution of the computer age, Electronics & Communication have crept into every sphere of human life, thus increasing its scope manifolds. Electronics is now a part of our everyday life, from your pocket FM radio to televisions, computers, mobile phones and even the high-end satellites that are helping us in every path. At Gates, we have an excellent and well established Department of Electronics and Communication Engineering (ECE). The Department was started in 2001 with 60 seats in UG program. This intake increased to 90 in 2004, 120 in 2010 and 180 in 2011. The department also started a PG program in VLSI and Embedded System Design in 2012 with an intake of 18. The department has a team of well-qualified, experienced and committed faculty with industrial and research background. They carefully nurture the young engineers and lay down a strong foundation in both technological and analytical aspects. The department has well established Electronics laboratories with state of art facilities. The department uses audio visual teaching aids such as, models, charts and LCD projectors for effective teaching. Students of our department are encouraged to actively participate in technical events and national level paper presentations and few of them got awarded in those events. The department has IETE Association through which students are allowed to enrich their technical knowledge by organizing and attending national level workshops, seminars and working model exhibitions. The activities under the flagship of various associations have given an ample scope for both student and teaching community to get acquainted with latest developments in areas like Digital Image Processing, Embedded Systems, Mobile & Satellite Communications and much more.

MESSAGE



It‘s gives me immense pleasure to see the creative expressions of students who had contributed to “E-ZINE 2K24”. It aims at providing a platform to the students to explore their latent capabilities and talent, to express their creativity in writing articles. I acknowledge my heartful thanks to Faculty members and Edtitorial team members for their contribution and their hard efforts to bring out this magazine. At last, I am very much thankful to all the authors who had sent their article for E-ZINE 2K24. My Heartfelt Wishes to all.

Dr. Archek Praveen Kumar

HOD, Dept. of ECE

Gates Institute of Technology

Gooty

Department Vision:

"To impart the best technical education instilled with discipline, values and leadership qualities that will produce professional technocrats in Electronics and Communication Engineering."

Department Mission:

M1: To impart fundamental Electronics and Communication Engineering concepts and a broad set of technical skills.

M2: To prepare Electronics and Communication Engineering graduates who will engage effectively and responsibly in practicing engineering.

M3: To impart practical exposure on latest technological developments in Electronics and Communication Engineering.

Programme Educational Objectives (PEOs):

On successful completion of UG in Electronics and Communication Engineering, the Graduates will:

PEO1: Acquire adequate knowledge in the field of Electronics and Communication Engineering to have a successful career.

PEO2: Pursue higher studies with the focusing on R&D activities in the related areas.

PEO3: Take up entrepreneurship by practicing lifelong learning with innovation

Programme Outcomes (POs):

On successful completion of UG in Electronics and Communication Engineering, The graduate will have an ability to

PO1: Apply the knowledge of Mathematics, Science and Engineering to solve the engineering problems in analog and digital electronic systems.

PO2: Identify, formulate and analyze the problems from the various issues of communication systems.

PO3: Design Analog and digital systems to meet the desired needs within a realistic constraint.

PO4: Design a circuit, conduct experiments, analyze and interpret the results to Provide valid conclusions.

PO5: Use modern tools to simulate electronic systems and analyze the performance of various models.

PO6: Develop electronic systems and solutions to meet the societal needs, considering awareness of security, health and legal issues.

PO7: Provide innovative ideas by understanding the impact of engineering solutions for the sustainable developments.

PO8: Function with professional ethics and social responsibilities.

PO9: Work as an individual, member of a team or leader in multidisciplinary activities.

PO10: Communicate effectively with outside world and engineering fraternity.

PO11: Demonstrate the knowledge of project and finance management skills to carry out projects in multidisciplinary environment.

PO12: Engage lifelong learning and to adapt rapidly changing technologies.

Programme Specific Outcomes(PSOs):

On successful completion of UG in Electronics and Communication Engineering, the Graduates will:

PSO1:To design and implement application specific electronic systems to provide real time Solutions combating societal, ecological and economical issues in the areas of communication, networking, embedded systems and VLSI.

PSO2: To demonstrate proficiency by quickly adapting to changes in technology and tools and administer professional engineering practice through lifelong Learning and contributing immensely to research and development.

TABLE OF CONTENTS

S.No	Title	Page NO.
1	**Smart Traffic Management using IoT and AI**	1-5
2	**6G Communication Systems and Future Networks**	6-9
3	**AI-Based Predictive Maintenance Systems**	10-13
4	**Internet of Vehicles (IoV) for Smart Transportation**	14-17
5	**RF Energy Harvesting for Wireless Sensor Networks**	18-21
6	**Visible Light Communication (VLC) Systems**	22-25
7	**RISC-V Architecture in Modern Processors**	26-30
8	**Artificial Intelligence in Medical Electronics**	31-36
9	**Free Space Optical Communication (FSO)**	37-39
10	**Image Processing Techniques for Face Recognition**	40-50

1. Smart Traffic Management using IoT and AI

CHILLARA DEEPIKA

IV YEAR

Introduction

Rapid urbanization and population growth have led to a significant increase in the number of vehicles on roads, resulting in traffic congestion, accidents, and pollution. Traditional traffic management systems rely on fixed timers and manual monitoring, which are often inefficient in handling dynamic traffic conditions. To overcome these challenges, modern systems integrate Internet of Things (IoT) and Artificial Intelligence (AI) technologies for intelligent traffic control.

Smart Traffic Management Systems (STMS) use connected devices, sensors, and advanced algorithms to monitor, analyze, and control traffic flow in real time. These systems aim to reduce congestion, improve road safety, and enhance overall transportation efficiency.

Architecture of Smart Traffic Management System



Figure 1.1: Smart Traffic Management System Architecture

The diagram illustrates a smart traffic management system integrating IoT and AI technologies. Traffic lights are controlled by a traffic controller that collects real-time data from the road. Cameras capture traffic conditions and send video data to an edge AI unit for local analysis, such as vehicle detection and congestion monitoring. The processed data is transmitted through a network switch to an IoT gateway, which aggregates and forwards information using communication technologies like 5G, 4G LTE, or fiber networks. This data is then sent to a cloud server for advanced analytics and storage. Authorities can monitor traffic conditions through a dashboard on mobile or computer devices. The system enables real-time decision-making, adaptive signal control, and efficient traffic flow management, reducing congestion and improving road safety.

A typical smart traffic management system consists of the following components:

- Sensors and Cameras: Detect vehicle count, speed, and road conditions
- IoT Devices: Collect and transmit real-time data
- Communication Network: Uses technologies like 5G, Wi-Fi, or LoRa
- Cloud/Edge Computing: Processes large volumes of traffic data
- AI Algorithms: Analyze data and make decisions
- Traffic Control Units: Adjust traffic signals dynamically
- User Interface: Displays traffic information to authorities and users

Working Principle

The system begins by collecting real-time data using sensors such as infrared sensors, cameras, and GPS devices. These IoT devices continuously monitor traffic density, vehicle movement, and environmental conditions.

The collected data is transmitted through a communication network to a central server or cloud platform. AI algorithms process this data to identify traffic patterns, predict congestion, and detect incidents such as accidents or violations.

Based on the analysis, the system dynamically controls traffic signals by adjusting signal timings. For example, if one road has heavy traffic, the green signal duration is increased to reduce congestion. The system can also provide real-time updates to drivers through mobile applications or digital displays.

Internet of Things (IoT)

IoT enables connectivity between devices such as sensors, cameras, and controllers.

Functions:

- Real-time data collection
- Device communication

- Remote monitoring

Applications:

- Traffic prediction
- Accident detection
- Adaptive signal control

Advantages

- Reduced traffic congestion
- Improved road safety
- Lower fuel consumption and pollution
- Efficient use of road infrastructure
- Enhanced commuter experience

1. 6G Communication Systems and Future Networks

R GAYATHRI

III YEAR

Introduction

6G is the next generation of wireless communication beyond 5G. It aims to provide ultra-high data rates, extremely low latency, and advanced connectivity for futuristic applications such as holographic communication and AI-driven networks.

6G aims to achieve higher data rates, lower latency, and greater energy efficiency than 5G. Planned advances include new air interface designs, improved coding and modulation, and reconfigurable intelligent surfaces. Research also explores integration with satellite, Wi-Fi, and non-terrestrial networks,

Transmission

The frequency bands for 6G are undetermined. Initially, Terahertz was considered an important band for 6G, as indicated by the Institute of Electrical and Electronics Engineers, which stated that "Frequencies from 100 GHz to 3 THz are promising bands for the next generation of wireless communication systems because of the wide swaths of unused and unexplored spectrum.

Research into terahertz radiation (300–3,000 GHz) and millimeter-wave frequencies (30–300 GHz) explores their potential for 6G mobile networks. These high frequencies can support large data rates but are easily blocked by obstacles. Unlike the microwave bands (2–30 GHz) used in 5G and Wi-Fi, and the lower-frequency radio waves used in 1G–4G, their commercial feasibility remains uncertain, as 5G millimeter-wave use is limited by cost.

Architecture of a 6G communication system:

The diagram illustrates the architecture of a 6G communication system, focusing on high-frequency terahertz-based networks and integrated functionalities. The process begins with a reduced antenna core network, which simplifies infrastructure while maintaining high efficiency. This connects to free space 6G mobile networks that enable wireless communication over air using advanced propagation techniques. A key feature is the use of terahertz waves (above 1 THz), which provide extremely high data rates and bandwidth for next-generation applications.

At the front end, remote units with integrated sensing and communication capabilities play a vital role. These units not only transmit data but also sense environmental conditions, enabling intelligent and adaptive networking. Amplification of terahertz signals is necessary due to their high attenuation, ensuring signal strength over distance without interference from other bands.

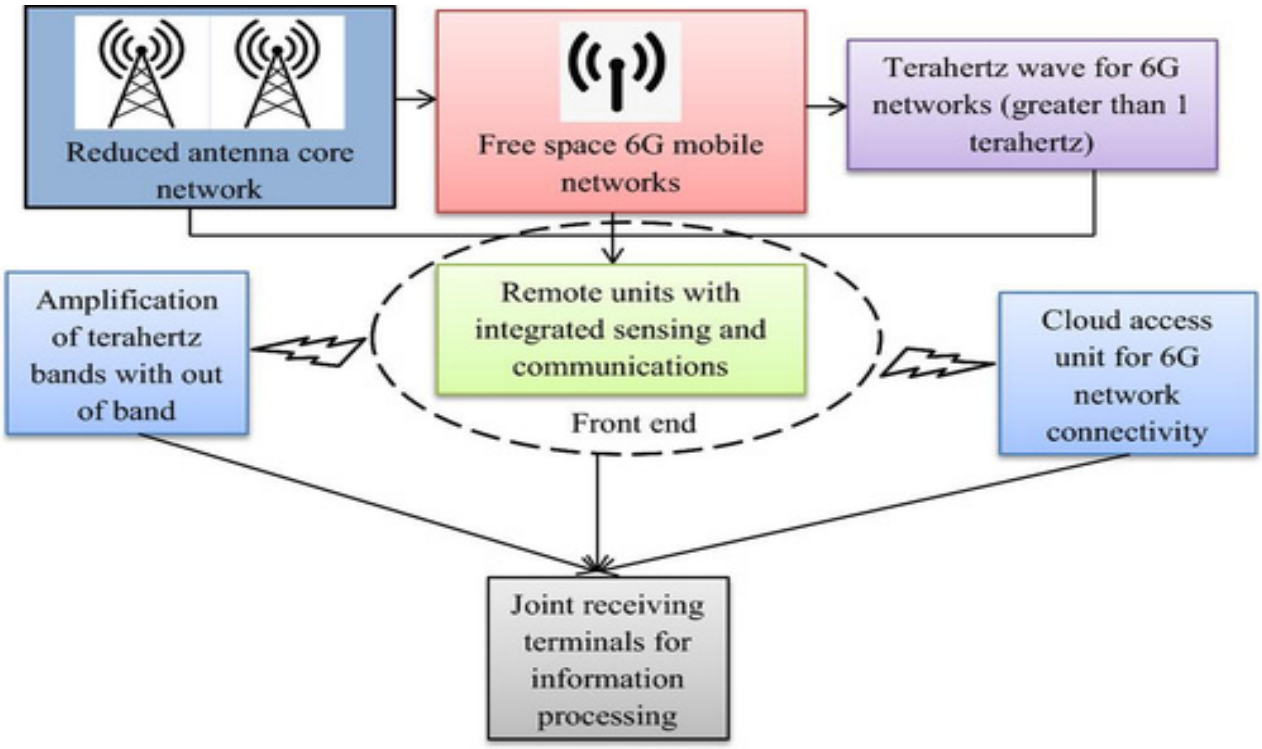


Figure 1.3: Diagram 6G

Additionally, cloud access units provide network connectivity and support data storage and processing, enabling real-time services and scalability. All these components work together and feed into joint receiving terminals, where information is processed efficiently. This integrated system ensures ultra-fast communication, low latency, and high reliability, making it suitable for advanced applications like smart cities, autonomous systems, and immersive technologies in future 6G networks.

Highlights the key enabling technologies of 6G communication systems:

The diagram highlights the key enabling technologies of 6G communication systems. At the center is 6G, surrounded by major components. The air interface represents advanced transmission techniques for faster and more reliable wireless links. New spectrum refers to the use of higher frequency bands like terahertz to achieve ultra-high data rates.

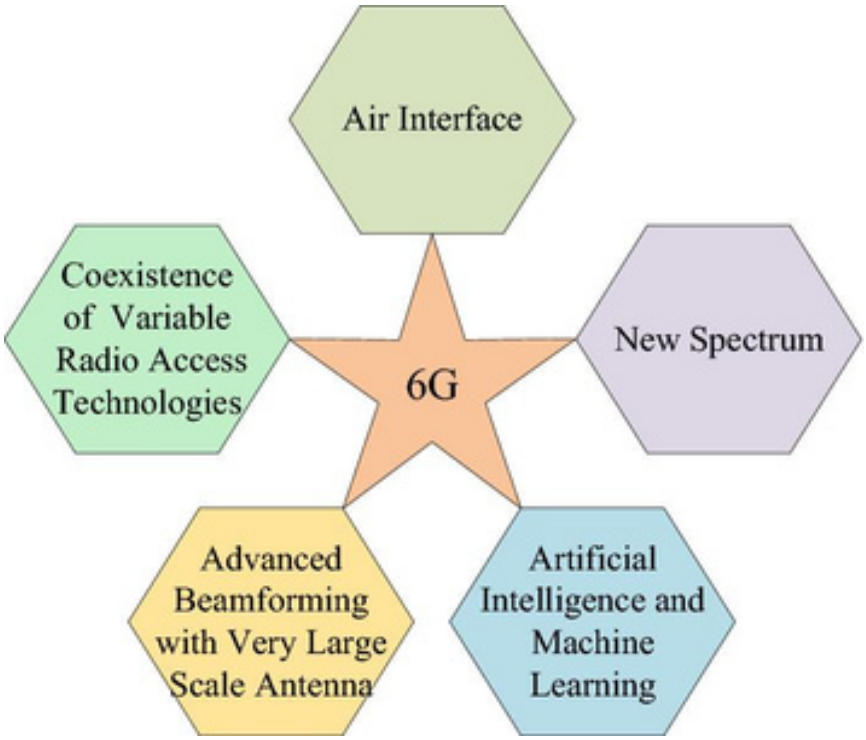


Figure 1.4: Diagram

Artificial Intelligence and Machine Learning enable intelligent network management and automation. Advanced beamforming with very large-scale antennas improves signal strength and coverage. Finally, coexistence of variable radio access technologies ensures seamless integration of different communication systems, enhancing flexibility, efficiency, and connectivity in future networks.

Applications

- **Holographic communication**
- **Smart cities**
- **Autonomous systems**
- **Remote healthcare**

Advantages

- **Ultra-high speed**
- **Very low latency**
- **Global connectivity**

Conclusion

6G will revolutionize communication by enabling futuristic applications and intelligent connectivity.

3. AI-Based Predictive Maintenance Systems

LEKIREDDY GANESH REDDY

IV YEAR

Introduction

AI-Based Predictive Maintenance Systems represent a significant advancement in modern industrial and engineering practices. These systems use artificial intelligence (AI), machine learning (ML), and data analytics to monitor the condition of equipment and predict potential failures before they occur. Unlike traditional maintenance approaches such as reactive maintenance (fixing after failure) or preventive maintenance (scheduled servicing), predictive maintenance focuses on real-time data and intelligent decision-making to optimize system performance and reliability. Predictive maintenance uses AI and data analytics to predict equipment failures before they occur. It reduces downtime and maintenance costs by identifying issues early.

In industrial environments, machinery and equipment are critical assets, and unexpected failures can lead to costly downtime, safety risks, and reduced productivity. AI-based predictive maintenance addresses these challenges by continuously collecting data from sensors embedded in machines. These sensors monitor parameters such as temperature, vibration, pressure, and operating conditions. The collected data is then analyzed using AI algorithms to detect patterns, anomalies, and early signs of wear or malfunction.

Machine learning models play a key role in this process by learning from historical and real-time data. Over time, these models improve their accuracy in predicting when a component is likely to fail. This enables maintenance teams to take timely action, such as repairing or replacing parts, thereby preventing breakdowns and extending equipment lifespan.

Block Diagram

IoT-based predictive maintenance block diagram, showing how data flows from industrial equipment to intelligent decision systems. The process begins with industrial equipment equipped with sensors and actuators that collect real-time operational data such as temperature, vibration, and pressure. This data is transmitted through field gateways, which act as intermediaries between physical devices and cloud systems. The data is then sent to a cloud gateway, enabling remote monitoring and centralized data handling.

Next, the data is processed using a streaming data processor, which handles continuous data flow in real time. The processed data is stored in a data lake and a big data warehouse, where large volumes of structured and unstructured data are maintained for analysis.

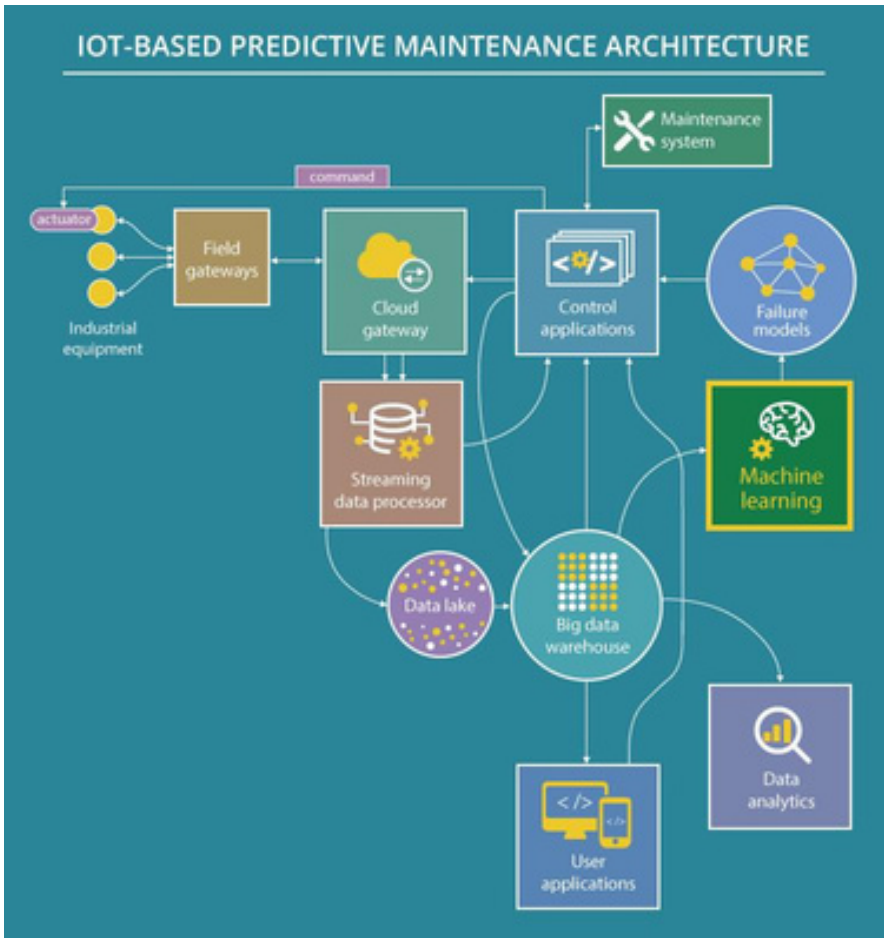


Figure 3.1: IoT-Based Predictive Maintenance Block Diagram

Machine learning models analyze this data to identify patterns and predict potential equipment failures. These predictions are represented as failure models, which are used by control applications to make intelligent decisions.

The system also includes data analytics tools and user applications, allowing operators to visualize insights and monitor system performance. Finally, a maintenance system uses these predictions to schedule timely repairs and send commands back to the equipment.

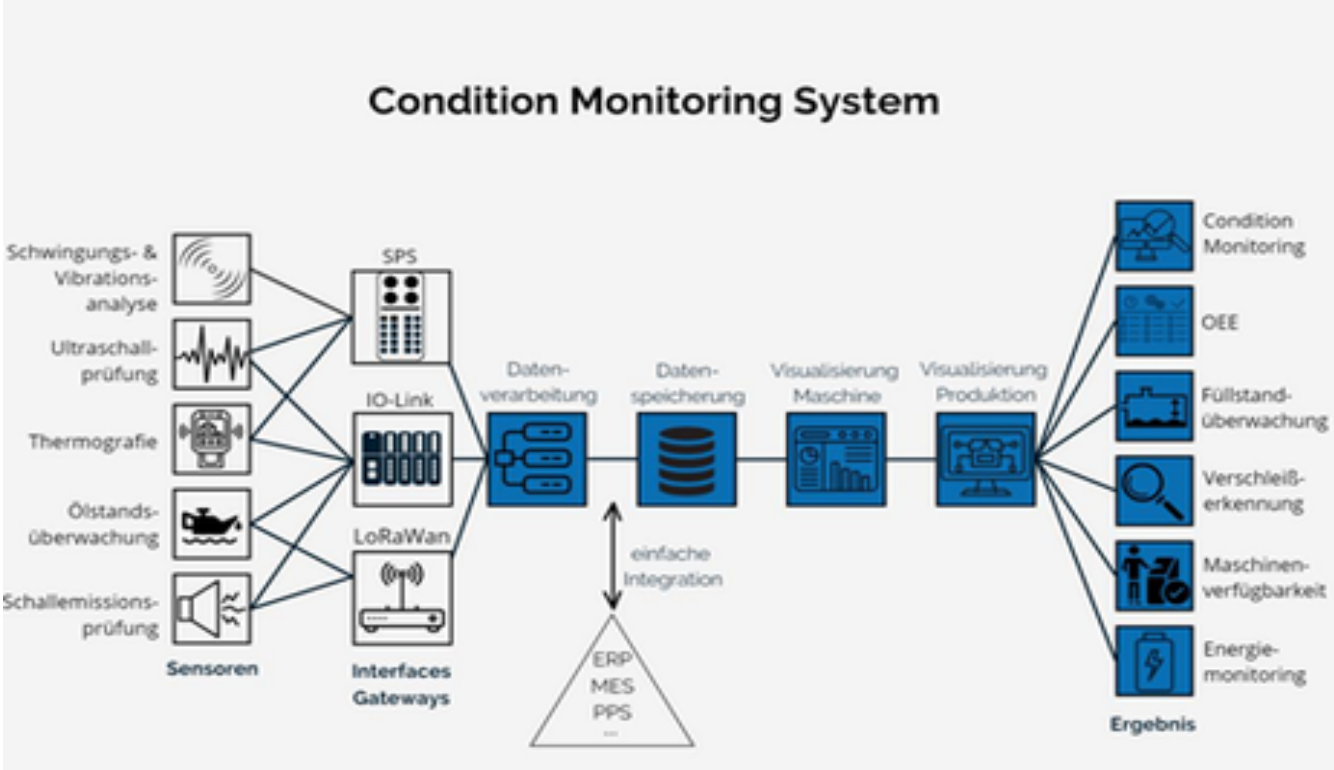


Figure 3.2: Data Analytics and Failure Prediction Model

The process begins with various sensors that collect real-time data from machines. These include vibration sensors (for detecting mechanical faults), ultrasonic sensors, thermography (for temperature analysis), oil condition monitoring, and acoustic emission sensors. Each type of sensor captures specific parameters that indicate the condition of the equipment.

The collected data is transmitted through interfaces and gateways such as SPS (PLC systems), IO-Link, and LoRaWAN. These gateways ensure proper communication between sensors and the processing system, enabling both wired and wireless data transfer. Next, the data undergoes data processing, where raw signals are filtered and analyzed. The processed data is then stored in a data storage system, allowing historical data tracking and future analysis.

The system provides visualization tools for both machines and production processes. These dashboards help operators monitor equipment performance in real time and make informed decisions.

Applications

- Manufacturing industries
- Power plants
- Automotive systems
- Aerospace

Advantages

- Reduced downtime
- Cost savings

- Increased reliability

Conclusion

AI-based predictive maintenance improves efficiency and ensures smooth industrial operations.

1. Internet of Vehicles (IoV) for Smart Transportation

CHAKALI HEMANTH KUMAR

III YEAR

Introduction

The Internet of Vehicles (IoV) is an advanced communication framework that connects vehicles, road infrastructure, pedestrians, and cloud networks to enable intelligent transportation systems. It is an extension of the Internet of Things (IoT), specifically designed for vehicular environments. IoV allows real-time data exchange between different entities, improving road safety, traffic efficiency, and driving experience.

With the rapid growth of smart cities, IoV plays a crucial role in managing transportation systems. It supports applications such as accident prevention, traffic monitoring, navigation assistance, and autonomous driving. By integrating technologies like sensors, wireless communication, artificial intelligence, and cloud computing, IoV transforms traditional transportation into a smart and connected ecosystem.

Architecture of IoV

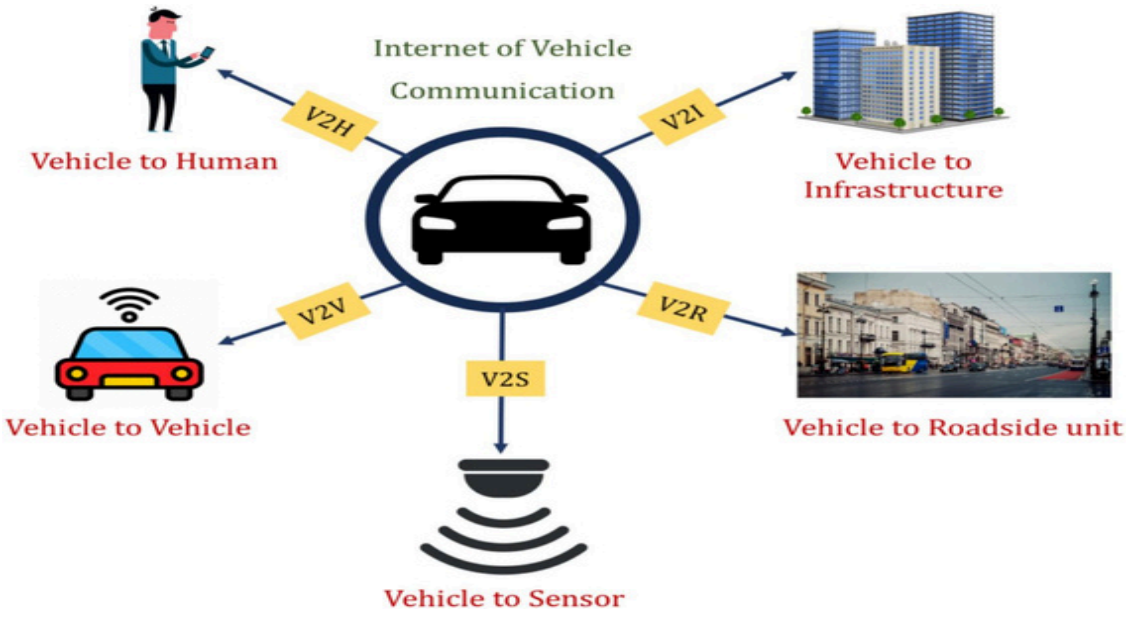


Figure 4.1: Architecture of Internet of Vehicles (IoV)

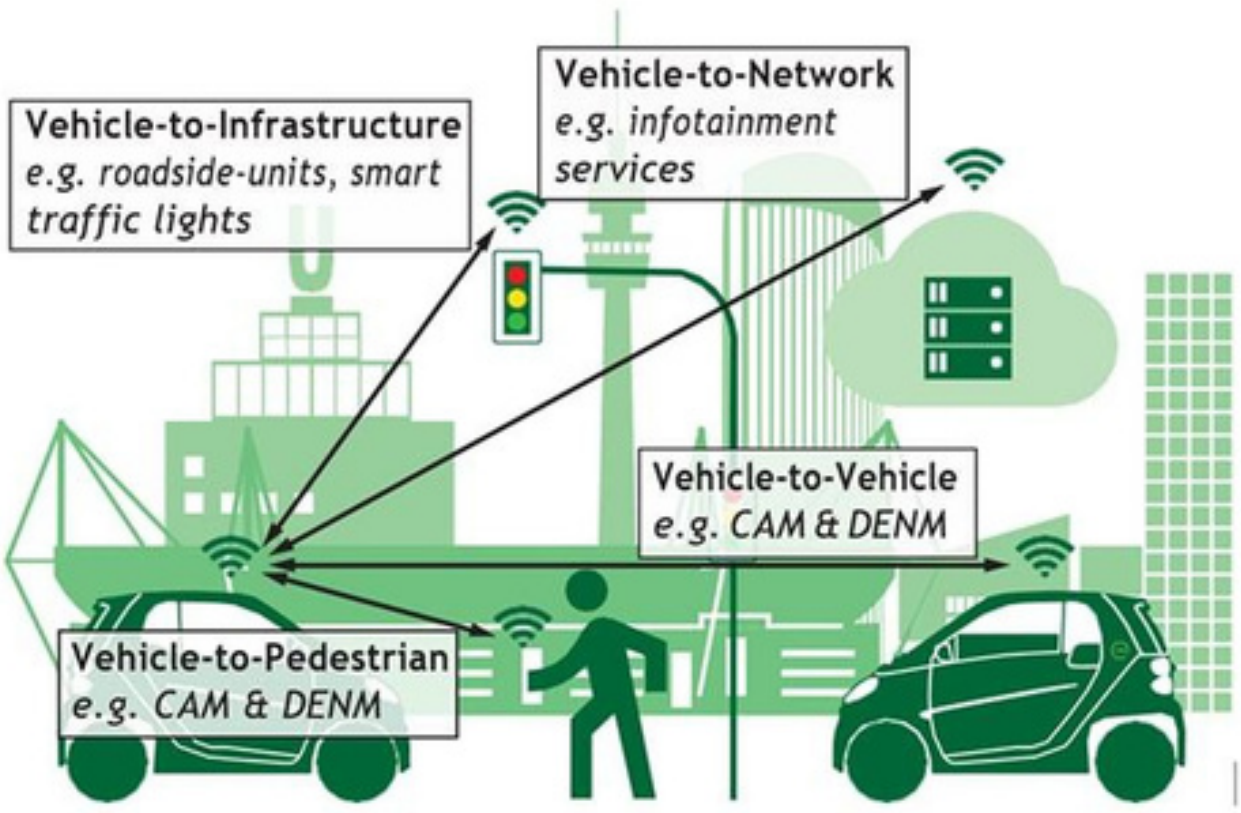


Figure 4.2: IoV Communication Model

The architecture of IoV is typically divided into three layers:

Perception Layer:

This layer includes sensors such as GPS, cameras, radar, and LiDAR installed in vehicles. These sensors collect real-time data about vehicle location, speed, surroundings, and road conditions.

Network Layer:

This layer handles communication between vehicles and infrastructure using technologies like 4G/5G, Wi-Fi, and DSRC. It supports V2V (Vehicle-to-Vehicle), V2I (Vehicle-to-Infrastructure), and V2X (Vehicle-to-Everything) communication.

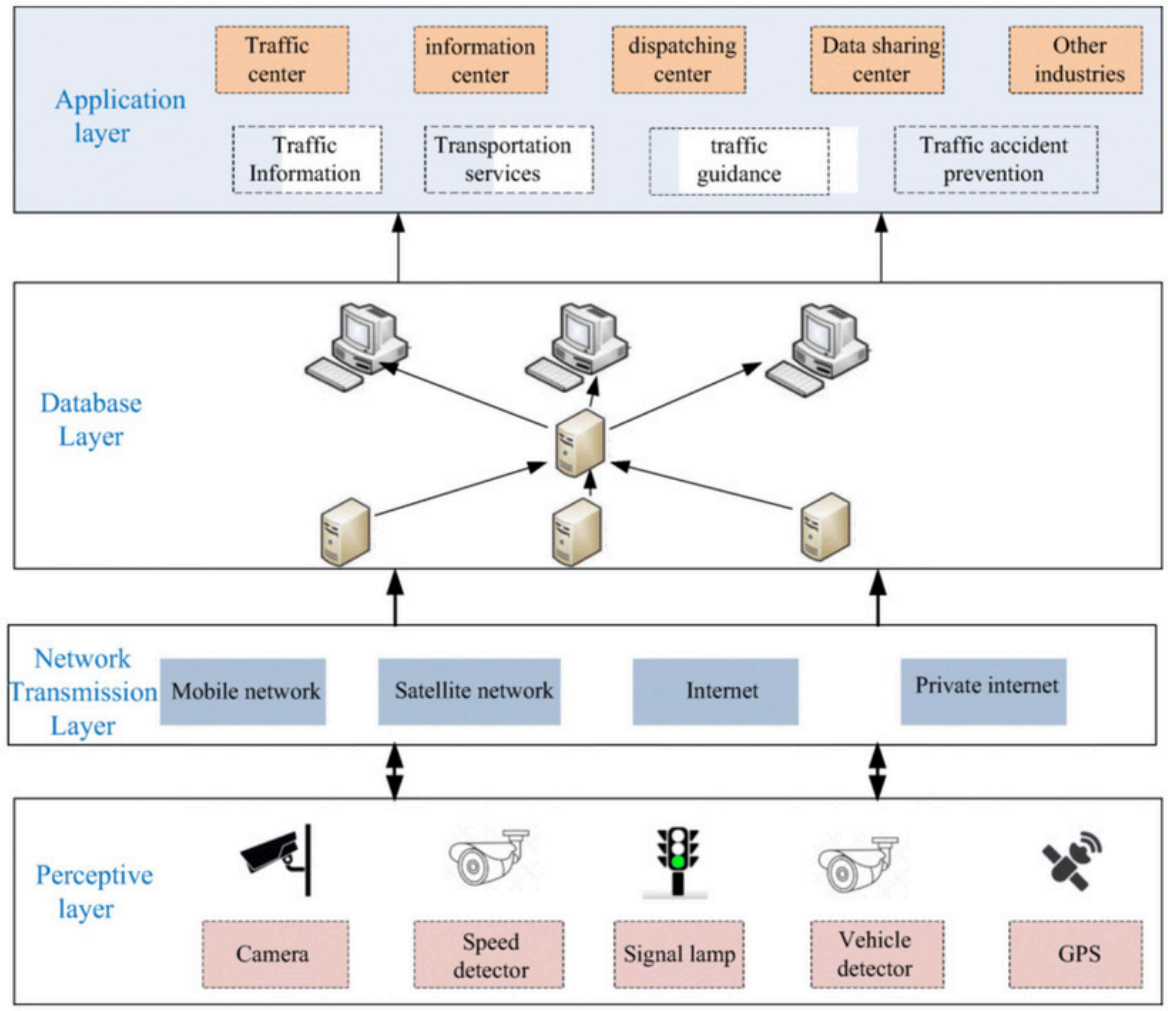


Figure 4.3: IoV is typically divided into three layers

Application Layer:

This layer processes the collected data and provides services such as traffic control, navigation, safety alerts, and infotainment systems.

Key Communication Technologies

IoV relies on several communication methods:

- Vehicle-to-Vehicle (V2V): Vehicles exchange information such as speed, position, and direction to avoid collisions.
- Vehicle-to-Infrastructure (V2I): Communication with traffic signals and road systems helps manage traffic flow.
- Vehicle-to-Everything (V2X): A broader communication model that includes interaction with pedestrians and networks.

Applications of IoV in Smart Transportation

Traffic Management: IoV helps reduce congestion by optimizing traffic signals and providing real-time route suggestions.

Road Safety: Vehicles can share alerts about accidents, weather conditions, and obstacles, reducing the chances of collisions.

Autonomous Vehicles: IoV supports self-driving cars by providing continuous communication and environmental awareness.

Fleet Management: Organizations can monitor vehicle performance, location, and fuel usage efficiently.

Emergency Services: Emergency vehicles can receive priority signals to move faster through traffic.

Advantages of IoV

- Enhances road safety and reduces accidents
- Improves traffic efficiency and reduces congestion
- Provides real-time information to drivers
- Supports smart city development
- Enables advanced services like autonomous driving**.**

1. RF Energy Harvesting for Wireless Sensor Networks

The diagram represents a rectenna system (rectifying antenna), which is used for wireless power transfer by converting electromagnetic (RF) signals into usable DC electrical power.

The process begins with the transmission antenna (E1), which radiates electromagnetic waves carrying energy through free space. These waves are captured by the receiving antenna (E2), which is part of the rectenna system. The receiving antenna converts the incoming electromagnetic waves into an RF electrical signal.

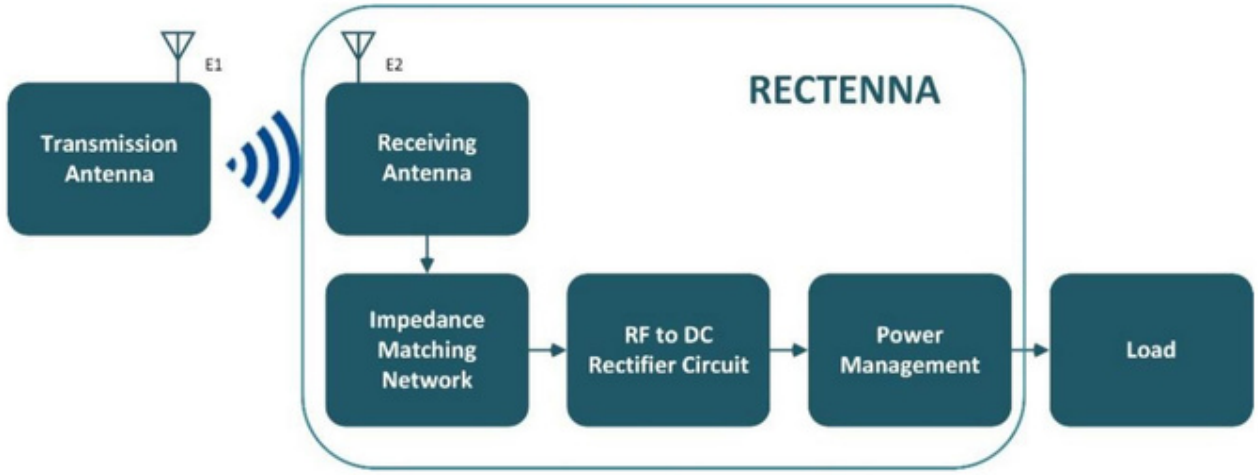


Figure 5.1: RF Energy Harvesting Rectenna System

Next, the signal passes through an impedance matching network. This stage is crucial because it ensures maximum power transfer between the antenna and the rectifier by minimizing signal reflection and losses. Proper impedance matching significantly improves the efficiency of the system.

The RF signal is then fed into the RF-to-DC rectifier circuit, which is the core component of the rectenna. This circuit, typically using diodes, converts the alternating RF signal into direct current (DC). The efficiency of this stage determines how effectively the system can harvest energy.

After rectification, the output goes to the power management unit. This block regulates the voltage, filters noise, and may include energy storage elements such as capacitors or batteries to provide a stable and usable DC output.

Finally, the processed DC power is delivered to the load, which could be any electronic device such as sensors, IoT devices, or low-power circuits.

Overall, the rectenna system enables wireless energy harvesting and transfer, making it highly useful in applications like wireless charging, remote sensing, RFID systems, and future energy-efficient communication

networks.

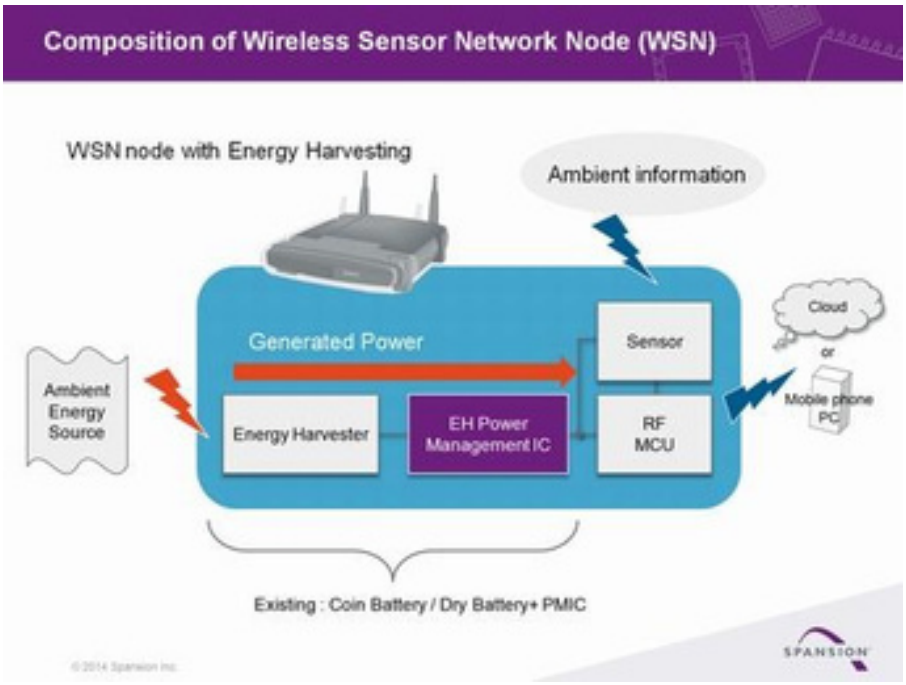


Figure 5.2: Wireless Sensor Network Node Architecture

The diagram shows the composition of a Wireless Sensor Network (WSN) node with energy harvesting, highlighting how it collects energy, senses data, and communicates information efficiently.

A WSN node operates by first obtaining energy from an ambient energy source, such as solar, thermal, vibration, or RF signals. This energy is captured by the energy harvester, which converts environmental energy into electrical power. Unlike traditional battery-powered systems, this approach enables long-term, maintenance-free operation.

The harvested energy is then managed by the Energy Harvesting (EH) Power Management IC. This component regulates, stores, and distributes power efficiently to different parts of the system. It ensures stable voltage levels and may include storage elements like capacitors or rechargeable batteries to handle fluctuations in energy availability.

The generated power is supplied to the sensor unit, which collects ambient information such as temperature, humidity, pressure, or motion. This sensed data is then processed by the RF Microcontroller Unit (RF MCU). The RF MCU acts as the brain of the WSN node, performing data processing, control operations, and wireless communication.

Once processed, the data is transmitted wirelessly to external systems such as a cloud server, mobile phone, or computer. This enables remote monitoring and real-time analysis, which is essential for applications like environmental monitoring, healthcare, industrial automation, and smart agriculture.

The diagram also indicates that traditional systems rely on coin or dry batteries with Power Management ICs, but energy harvesting reduces dependency on batteries, improving sustainability and reducing maintenance costs.

Overall, this architecture demonstrates how WSN nodes integrate sensing, energy harvesting, power management, and communication into a compact system, enabling efficient, self-powered operation for modern IoT and smart environment applications.

. Software Defined Radio (SDR) Systems

Block Diagram

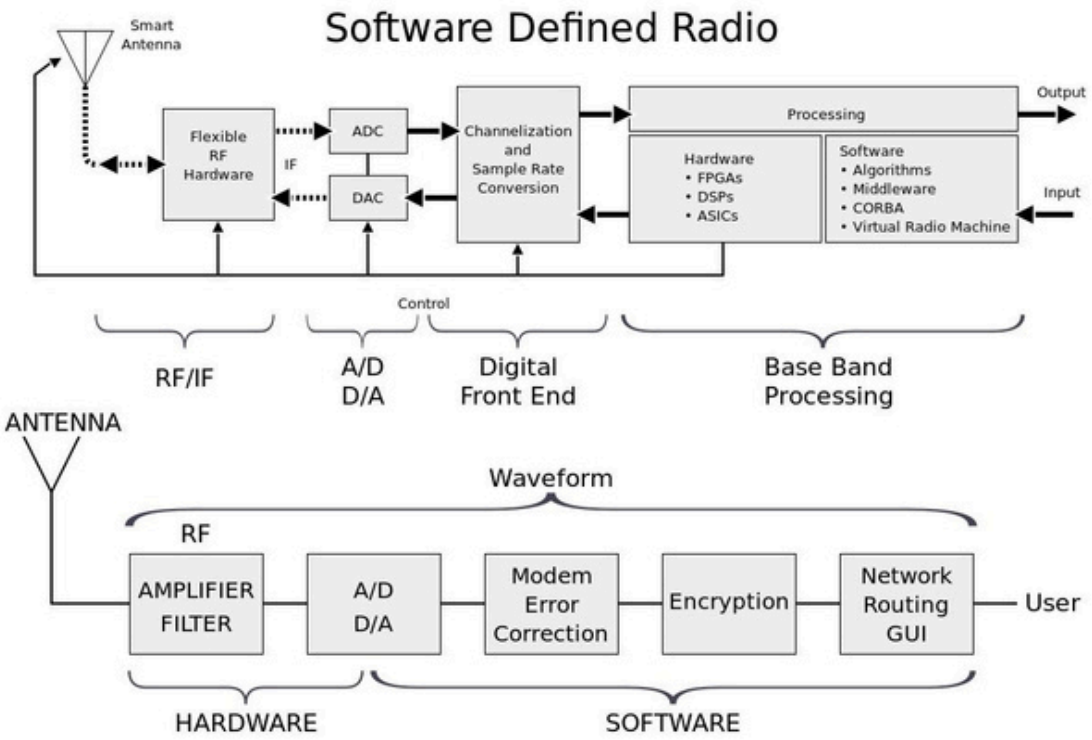


Figure 5.3: Software Defined Radio (SDR) Block Diagram

In SDR systems, traditional hardware components like modulators and filters are replaced by software processing. The RF signals are converted into digital form using ADC, processed using DSP algorithms, and then converted back to analog using DAC. This allows flexibility to change communication standards through software updates.

6. Visible Light Communication (VLC) Systems

POLA GOWTHAMI

IV YEAR

Introduction

Visible Light Communication (VLC) is a wireless communication technology that uses the visible light spectrum (approximately 400–700 nm) for data transmission. It is a part of optical wireless communication and uses Light Emitting Diodes (LEDs) as transmitters and photodiodes as receivers. VLC enables simultaneous illumination and communication, making it highly efficient and cost-effective.

Unlike traditional radio frequency (RF) systems, VLC uses light waves, which are abundant and unlicensed. It is particularly useful in environments where RF signals are restricted, such as hospitals, aircraft, and underwater systems. VLC is also considered a key technology for future high-speed communication systems, including Li-Fi.

Working Principle of VLC

The diagram illustrates the working process of a Visible Light Communication (VLC) system from transmission to reception.

The process begins with binary data, which represents the information to be transmitted in the form of 0s and 1s. This data is then passed to the modulation block, where it is converted into a suitable signal format for transmission. Modulation controls how the data is encoded onto the light signal.

Next, the modulated signal is applied to the LED driver circuit, which regulates the current supplied to the LED. The LED acts as the transmitter and converts the electrical signal into light by rapidly switching ON and OFF according to the data. This switching occurs at very high speeds, making it invisible to the human eye.

The light travels through the VLC channel, which is the free space between the transmitter and receiver. At the receiver side, a photodiode detects the incoming light and converts it back into an electrical signal.

This signal is then processed in the demodulation stage, where the original binary data is recovered. Finally, the output is the reconstructed binary data, completing the communication process.

Bottom of Form

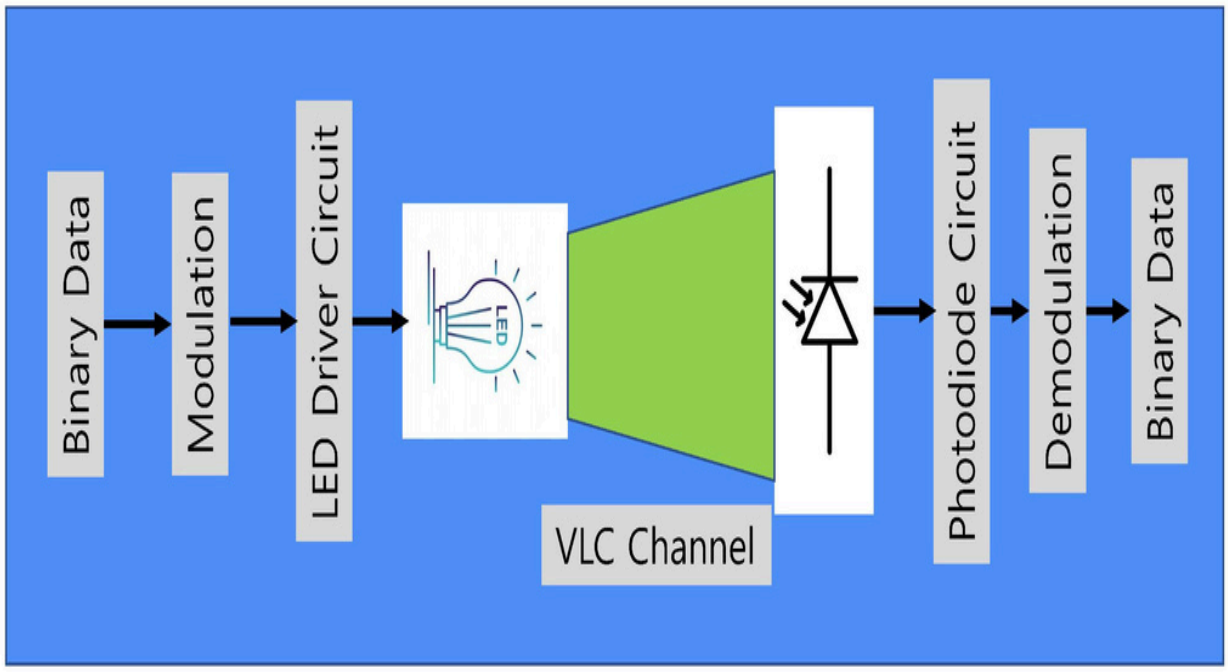


Figure 6.1: Smart Traffic Management System Architecture

VLC operates based on Intensity Modulation and Direct Detection (IM-DD). In this method, the intensity of light emitted by an LED is varied according to the data signal.

At the transmitter, electrical data is converted into optical signals by rapidly switching the LED ON and OFF. These changes occur at very high speeds, so they are not visible to the human eye. At the receiver, a photodiode detects the light and converts it back into an electrical signal. The signal is then processed to recover the original data.

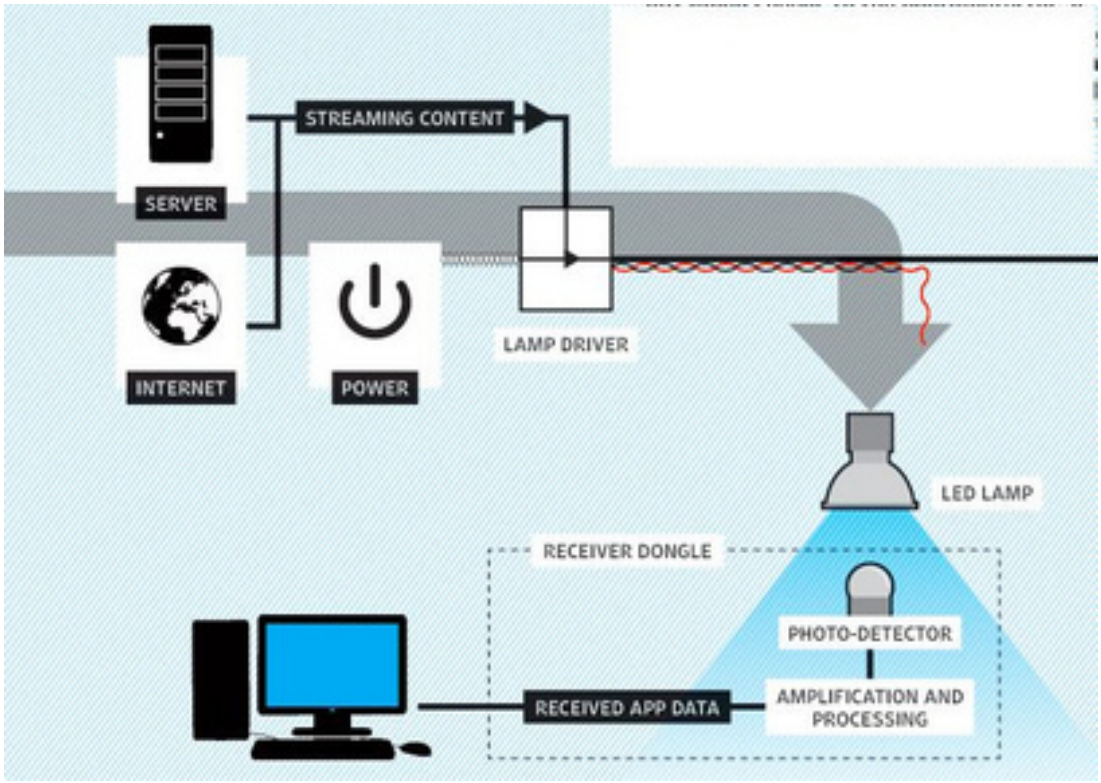


Figure 6.2: Cloud-Based Intelligent Traffic System with Edge AI

This method allows high-speed communication while maintaining normal lighting functionality.

Components of VLC System

A VLC system consists of the following main components:

LED Transmitter: Acts as the light source and sends data through modulated light signals.

Driver Circuit: Controls the LED and ensures proper modulation of the signal.

Optical Channel: The medium through which light travels. It may include reflections from walls and objects.

Photodiode Receiver: Detects incoming light and converts it into electrical signals.

Signal Processing Unit: Processes the received signal, removes noise, and retrieves the original data.

Modulation Techniques

Several modulation techniques are used in VLC systems:

- On-Off Keying (OOK): Light ON represents binary ‘1’ and OFF represents ‘0’.
- Pulse Width Modulation (PWM): Information is encoded in pulse width.
- Orthogonal Frequency Division Multiplexing (OFDM): Enables high data rates and efficient bandwidth usage.

- Color Shift Keying (CSK): Uses different colors of LEDs to transmit data.

These techniques improve system performance, reliability, and data rate.

Advantages of VLC

- High bandwidth due to large visible light spectrum
- Energy efficient as it uses LED lighting systems
- Secure communication since light cannot pass through walls
- No electromagnetic interference
- Low cost and easy implementation

Applications of VLC

VLC is used in various fields:

- Li-Fi Technology: Provides high-speed wireless internet
- Indoor Positioning Systems: Used in shopping malls and airports
- Vehicle Communication: Headlights and taillights for data exchange
- Healthcare: Safe communication in hospitals.
- Underwater Communication: Effective where RF signals fail.

7. RISC-V Architecture in Modern Processors

ROYAL ISAAC

III YEAR

Introduction

The rapid evolution of processor technology has transformed modern electronics from smartphones and IoT devices to high-performance computing systems. At the heart of this transformation lies a new, disruptive instruction set architecture (ISA) known as RISC-V (pronounced “risk-five”). Unlike proprietary architectures, RISC-V is an open-source ISA, enabling engineers, researchers, and companies to design and customize processors without licensing restrictions. This openness has positioned RISC-V as a strong competitor to traditional architectures such as ARM and x86 in modern processor design.

RISC-V

RISC-V is based on the principles of Reduced Instruction Set Computing (RISC), which emphasizes simplicity, efficiency, and performance. It was developed at the University of California, Berkeley as a research project and later evolved into a global standard supported by the RISC-V International.

Unlike traditional ISAs, RISC-V is:

- Open-source and royalty-free
- Highly modular and extensible
- Simple yet powerful in design

This allows designers to tailor processors for specific applications—from tiny embedded systems to supercomputers.

Core Principles of RISC-V Architecture

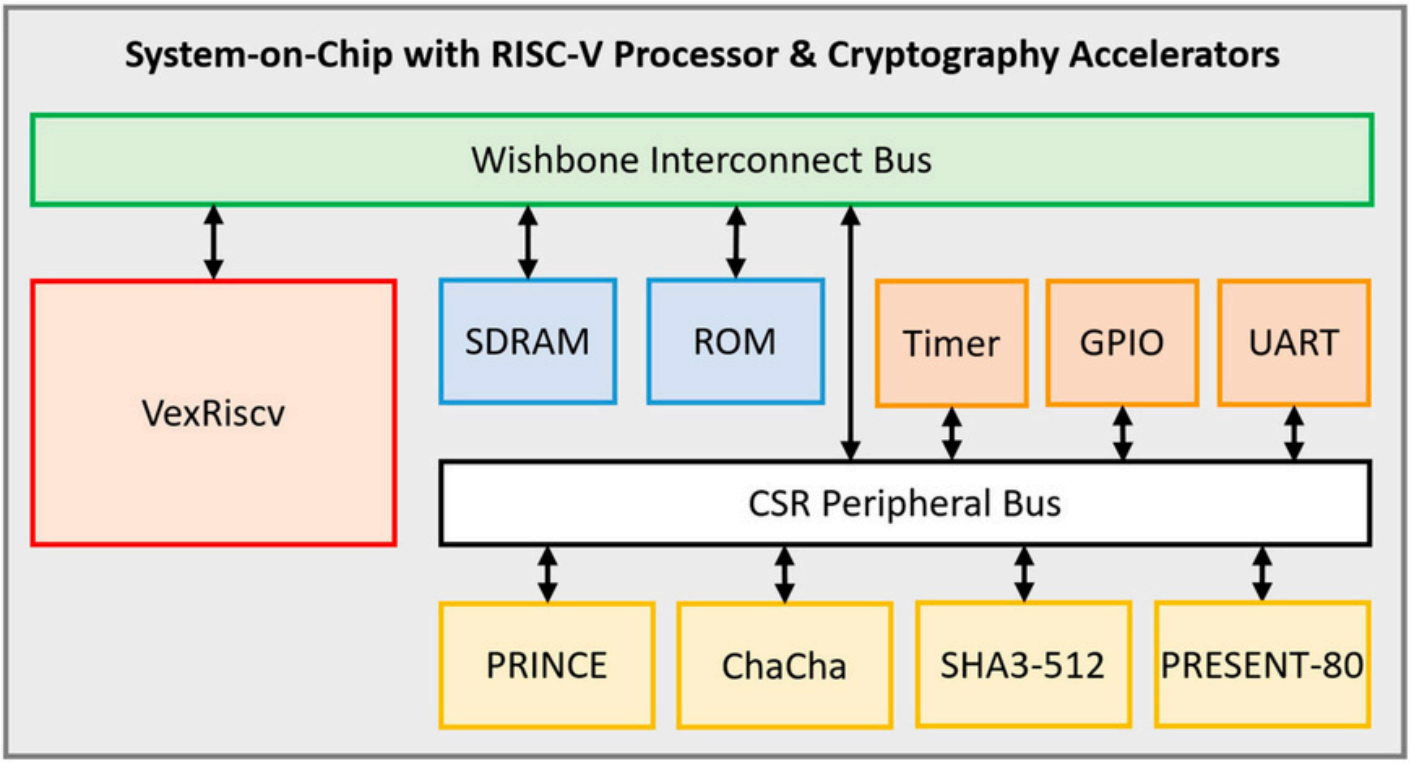


Figure 7.1: RISC-V System Architecture

The diagram represents a System-on-Chip (SoC) built around a RISC-V processor (VexRiscv) integrated with memory, peripherals, and cryptographic accelerators through a structured bus architecture. At the core of the system is the VexRiscv processor, which is a configurable and lightweight RISC-V CPU. It acts as the main control unit, executing instructions and coordinating all system operations. The processor communicates with other components through the Wishbone Interconnect Bus, which serves as the primary high-speed communication backbone of the SoC. This bus enables efficient data transfer between the processor, memory, and peripherals. Connected to the Wishbone bus are memory components such as SDRAM and ROM. SDRAM provides dynamic storage for runtime data and program execution, while ROM stores fixed instructions or boot code. These memory units ensure that the processor has access to both temporary and permanent data storage.

The system also includes a CSR (Control and Status Register) Peripheral Bus, which is used for low-speed communication with peripheral devices. Peripherals such as Timer, GPIO, and UART are connected through this bus. The timer helps in scheduling and time-based operations, GPIO allows interaction with external hardware pins, and UART enables serial communication with external devices.

A key feature of this architecture is the inclusion of hardware cryptographic accelerators, namely PRINCE, SHA3-512, and PRESENT-80. These modules are connected via the CSR bus and are designed to perform encryption, decryption, and hashing operations efficiently. Offloading these tasks from the CPU significantly improves performance and reduces power consumption, especially in secure applications.

Simplicity: RISC-V uses a small set of simple instructions, making hardware implementation easier and faster.

The architecture consists of a base instruction set with optional extensions such as:

- Integer (I)
- Multiplication (M)
- Floating Point (F, D)
- Atomic Operations (A)
- Vector Processing (V)

Load/Store Architecture

Operations are performed on registers, while memory is accessed only through load and store instructions.

Scalability

RISC-V supports multiple word lengths:

- **RV32 (32-bit)**
- **RV64 (64-bit)**
- **RV128 (future scope)**

RISC-V Instruction Format

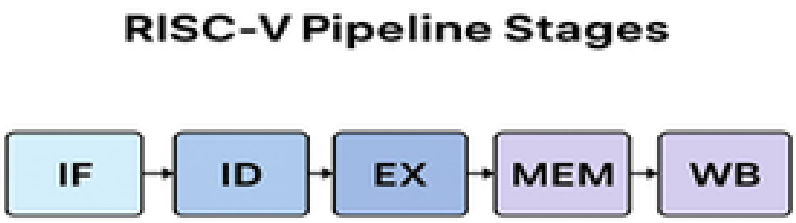


Figure 7.2: RISC-V Instruction Pipeline

The diagram shows the five-stage RISC-V instruction pipeline, which improves processing speed by executing multiple instructions simultaneously in different stages.

- IF (Instruction Fetch): The processor fetches the instruction from memory.
- ID (Instruction Decode): The instruction is decoded, and required registers are identified.
- EX (Execute): Arithmetic or logical operations are performed.
- MEM (Memory Access): Data is read from or written to memory if needed.
- WB (Write Back): The result is written back to the register file.

This pipeline increases efficiency and throughput in modern processors.

RISC-V instructions are designed with fixed formats to simplify decoding:

- R-Type**: Register-to-register operations**
- I-Type**: Immediate operations**
- S-Type**: Store instructions**
- B-Type**: Branch instructions**
- U-Type & J-Type**: Addressing and jumps**

This structured format improves processor efficiency and reduces complexity.

RISC-V in Modern Processors

RISC-V is rapidly gaining traction across industries due to its flexibility:

Embedded Systems

RISC-V cores are widely used in microcontrollers for IoT and wearable devices due to their low power consumption.

Artificial Intelligence

Custom RISC-V extensions enable hardware acceleration for AI and machine learning applications.

High-Performance Computing

RISC-V is being explored for supercomputers and data centers due to its scalability and customization.

Consumer Electronics

Companies are integrating RISC-V into smartphones, smart TVs, and edge devices.

Advantages of RISC-V

Open-source ecosystem (no licensing fees)

Customizable instruction sets

Lower power consumption

Faster development cycles

Strong academic and industry support

Conclusion

RISC-V represents a paradigm shift in processor architecture by offering an open, flexible, and efficient alternative to traditional ISAs. Its modular design and growing ecosystem make it ideal for modern applications

ranging from embedded systems to high-performance computing. As industries continue to demand customizable and cost-effective solutions, RISC-V is poised to play a crucial role in shaping the future of electronics and communication engineering.

8. Artificial Intelligence in Medical Electronics

KENDOLI DEEPIKA

II YEAR

Introduction

The Internet of Medical Things (IoMT) is the subsets of the Internet of Things (IoT) technologies that consists of inter-network-connected medical devices for healthcare monitoring. IoMT devices, also referred to as healthcare IoT, enable human intervention-free healthcare monitoring by integrating automation, interfacial sensors, and machine learning-based artificial intelligence. IoMT technology connects patients with clinicians through medical devices, allowing remote access to collect, process, and transmit medical data over a secured network. IoMT technologies aid in reducing unnecessary hospital stays and thereby the associated health costs by facilitating wireless monitoring of health parameters. The IoMT medical technologies segment covers wearable, in-home personal real-time health-monitoring devices and hospital or clinical-based point-of-care (POC) devices [1]. The wearable personal health monitoring device category includes smart wristbands, electronic textiles and garments, smartphone-integrated devices, and sports watches for fitness and activity monitoring [2], as illustrated in Figure 1.

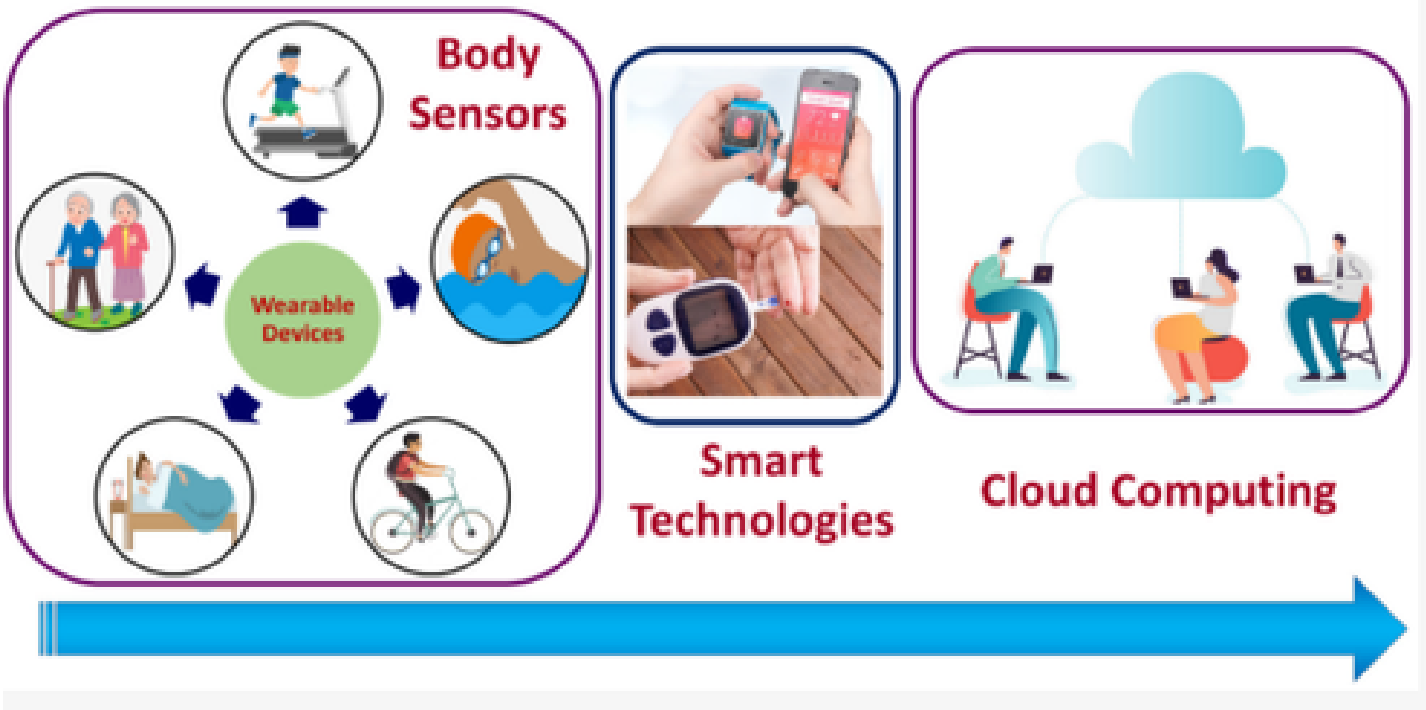


Figure 8.1: IoMT Architecture with Cloud Integration

IoMT wearable devices can also monitor involuntary falls of older adults. Falls in the older population are inevitable, but their circumstances can be monitored and prevented to avoid chronic injuries. IoMT technologies aid in reducing unnecessary hospital stays and thereby the associated health costs by facilitating wireless monitoring of health parameters.

Traditional healthcare monitoring is undergoing transformational change, and digital healthcare enables automated detection tools and integrated cloud products in consumers' hands. This digital transformation enables patients, clinicians, and people in rural communities to access quality healthcare services for a better outcome. POC devices such as ultrasound, thermometers, glucometers, and ECG readers come with Internet connectivity and cloud storage facilities that let users track their health. The improvements in these technologies are crucial for improvised healthcare for adjusting insulin doses and connecting the patients directly with clinicians. Advanced healthcare centers have started utilizing the smart-bed concept, which could alter the bed's angle and position by monitoring the patient's sleeping posture. IoMT-enabled devices also help transform traditional home healthcare services. For example, the intelligent home-medicine dispensing system automatically uploads information about patient medical history to the cloud. It alerts doctors and patients about the medication that must be taken and alerts the clinician when the patient is not taking medicine. Technological advancement, industrial adaptation, and urbanization are increasing demands in the healthcare system with the rising population. The improvement in IoMT-incorporated devices with smartphones, sensors, and actuators can ensure periodic healthcare monitoring, and all these aspects are the focus of this review.

The Role of AI in Establishing a Smart Sensor Network

Artificial intelligence (AI) has been a topic of interest among researchers and biomedical industries due to its ability to process large amounts of data, produce accurate results, and control processes to generate the most optimized outcome. AI is not new because machines are being used for decision-making and predicting the expected effects of diseases and consequences in the longer term. In this modern world, most day-to-day tasks are assisted by machines and algorithms. Several factors, such as fairness, explain ability, accountability, reliability, and acceptance, are considered using reliable machine–algorithm-coordinated outcomes. AI can be interpreted as the ability of the computer or robot to reproduce human intelligence in the form of software and algorithms. AI can perform intellectual processes such as logical reasoning, knowledge-based learning, drug discovery, guided surgery, and advanced imaging.

Machine learning (ML) is the most widely used AI method for making predictions from patterns (Figure 2A). Based on the algorithm structure and learning method, ML can be further classified into various types (Figure 2B). Learning methods can be further classified as supervised, unsupervised, and reinforced learning. In supervised learning, the algorithm is trained with input data. Supervised learning is used in applications where historical data are available and can be used to predict possible future events. As these algorithms use historical data for training, methods are more straightforward and accurate. These algorithms can be further divided into regression and classification algorithms. Regression algorithms can be used when the input variable and output variable have a relationship, such as in weather forecasting. In classification algorithms, output variables can be categorized into classes such as yes–no and true–false with respect to input variables. Due to these features, supervised learning can solve a real-world problem and predict the output based on available data. Unsupervised learning methods can identify a pattern in each dataset even if data are not classified or labelled correctly.

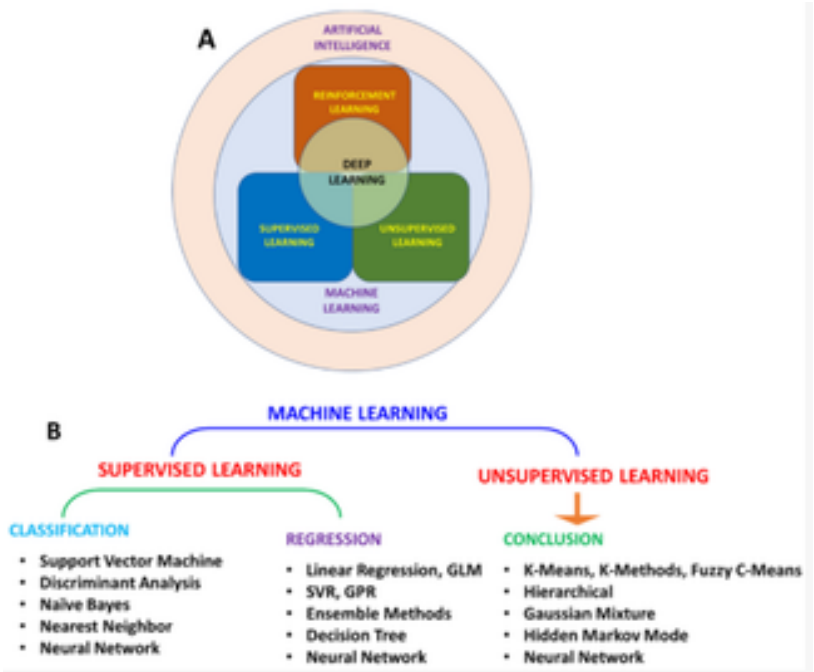


Figure 8.2: AI, ML and DL Relationship

In this direction, algorithms become computationally complex, and accuracy also decreases. These algorithms can divide data into groups based on similarities and differences in data. These can be divided into two categories: (a) clustering and (b) association. In the clustering algorithms group, the data in clusters based on similarities, such as the purchase behavior of a group of customers, helps in marketing products. An association algorithm is a rule-learning algorithm that finds relationships in variables in each dataset, for example, shopping patterns of individual customers to suggest products to customers. Reinforced learning is a reward/penalty-based learning method. Algorithms assign positive values to desired results and negative values to undesired effects. These algorithms are hard to train and time-consuming. Deep learning (DL) is a particular type of ML that teaches computers to mimic human behavior. DL uses neural networks (NN), which require much computational power for a complex problem. However, recent computing power and data analytics advancements have enabled DL algorithms to observe, learn, and react to difficult situations. The DL algorithm can adopt supervised, unsupervised, or reinforced learning approaches based on the desired application. The best application example is email provider services, where AI is used to separate spam from essential emails, and with each new datum, its accuracy improves. Most of the current weather forecasts are based on AI model prediction.

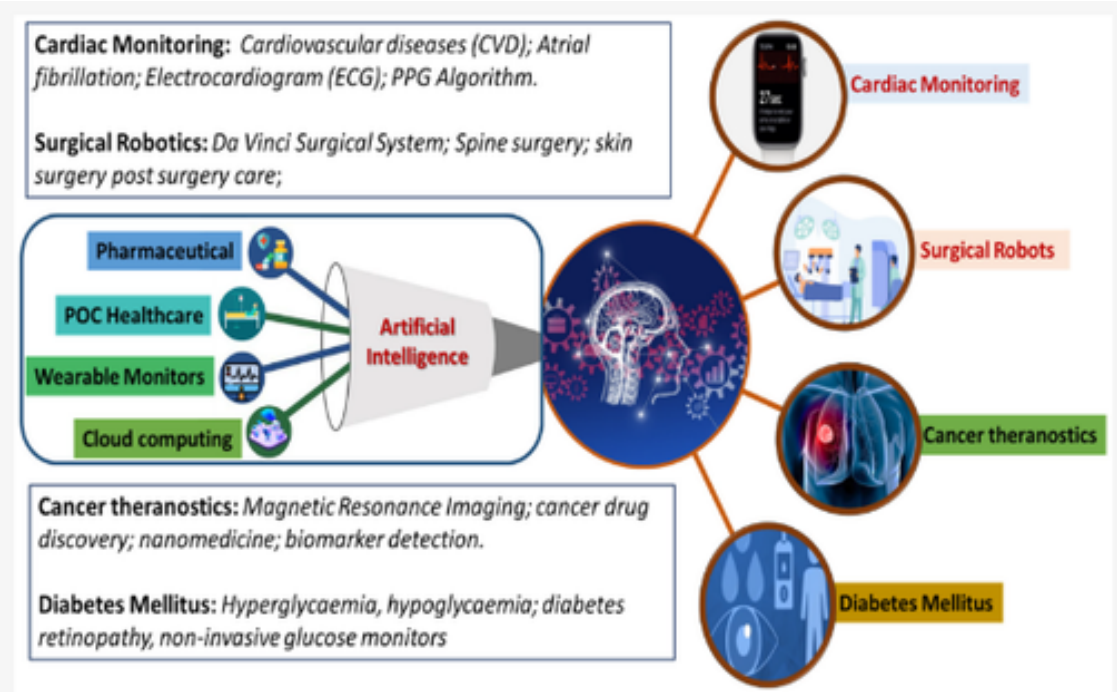


Figure 8.3: AI Applications in Healthcare

The commercialization of developed AI-based systems has established a technology transformation platform called “PathAI”. Such AI-based technologies have proven to improve patient’s health outcomes via efficient pathological diagnosis. Similarly, *“PAGER”* is a healthcare management application helping with patient treatments by giving appropriate recommendations. AI also benefits the drug-development sector by finding possible new drugs by using molecular modeling and training medical data. AI has also helped in the development of technologies for human–machine interfaces. Technologies involving human–machine interfaces

require a sensor that generates high-quality data and an AI algorithm with powerful data analysis capability. These have been found to be helpful in the medical field. A few reported examples are artificial limbs and wearable sensors to collect real-time data about the patient [19,57,58]. This review focuses on exploring advancements in developing IoMT and AI-assisted platforms for cardiac monitoring, cancer diagnosing, surgeries, diabetic monitoring, and other related diseases, as illustrated in Figure 4.

Applications in real-world systems

- Intelligent Imaging and Diagnostics: AI systems, such as PathAI (mentioned in), use machine learning to detect diseases like cancer from CT scans and X-rays faster and often more accurately than human radiologists.
- Wearable IoT Sensors: Wiley reports that AI-based sensors are used for monitoring, including liquid sensors for biomarkers in body fluids and gas sensors for detecting volatile organic compounds in breath.
- Surgical Robotics: AI trains robots to provide high precision in minimally invasive surgeries, analyze procedural data, and improve surgical techniques.

.

9. Free Space Optical Communication (FSO)

KANCHIREDDY GARI HARITHA

IV YEAR

Introduction:

Free Space Optical (FSO) Communication is an advanced wireless technology that uses light propagation through free space to transmit data between two points without the need for physical fiber cables. Instead of radio frequency (RF) signals, FSO systems employ laser beams or light-emitting diodes (LEDs) to carry information through the atmosphere. This makes FSO a promising solution for high-speed, secure, and cost-effective communication.

FSO operates on the principle of line-of-sight (LOS) transmission, where a transmitter sends a modulated optical signal through the air, and a receiver captures and demodulates it. The system typically consists of an optical transmitter, propagation channel (free space), and an optical receiver equipped with photodetectors. Due to the use of light waves, FSO can achieve very high data rates, often comparable to fiber optic communication, making it suitable for broadband and backhaul applications.

One of the key advantages of FSO is its ease of deployment. Since no cables are required, installation is quick and cost-efficient, especially in urban environments where laying optical fiber is expensive or impractical. Additionally, FSO offers high security, as narrow laser beams are difficult to intercept, reducing the risk of unauthorized access.

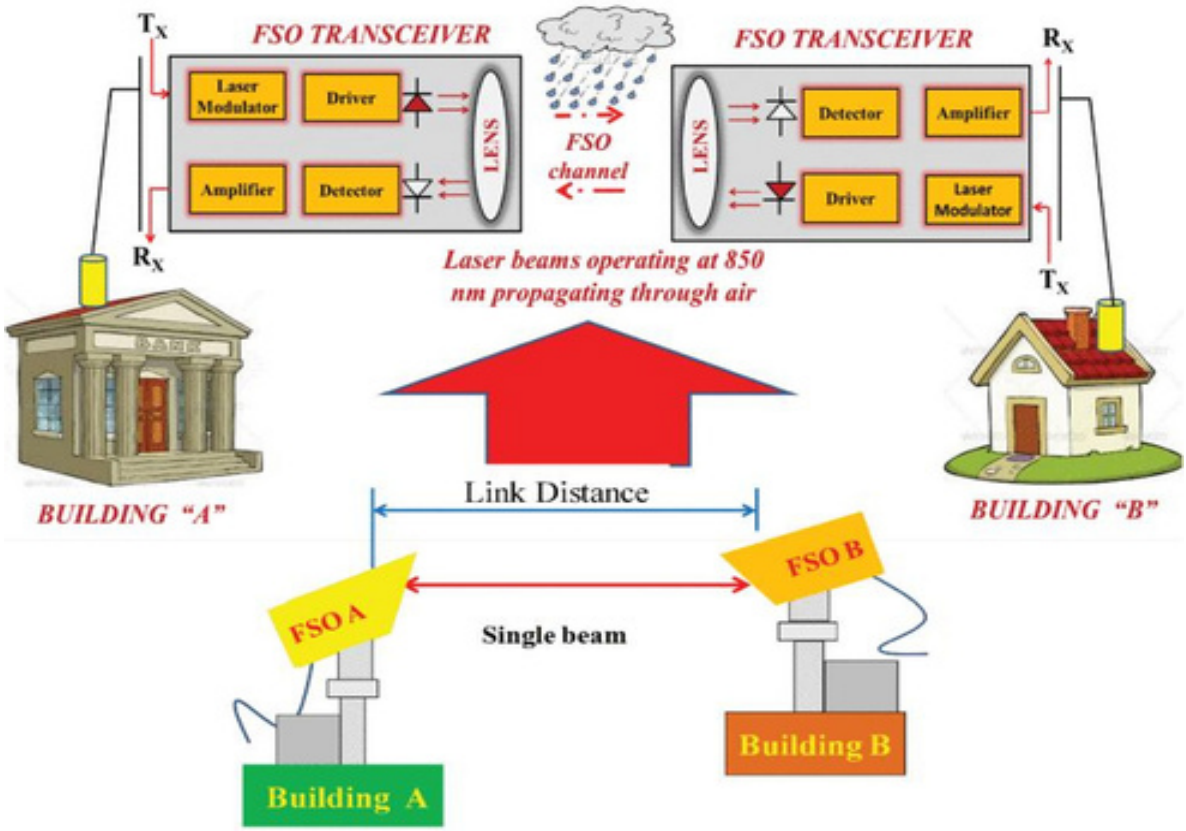


Figure 9.1: Free Space Optical Communication System

However, FSO systems are highly dependent on environmental conditions. Factors such as fog, rain, dust, and atmospheric turbulence can degrade signal quality and reduce transmission range. Precise alignment between transmitter and receiver is also critical for reliable communication.

Despite these challenges, FSO is gaining attention in applications like last-mile connectivity, satellite communication, disaster recovery, and military communication systems. With ongoing advancements in adaptive optics and hybrid RF-FSO systems, this technology is expected to play a significant role in the future of high-speed wireless communication.

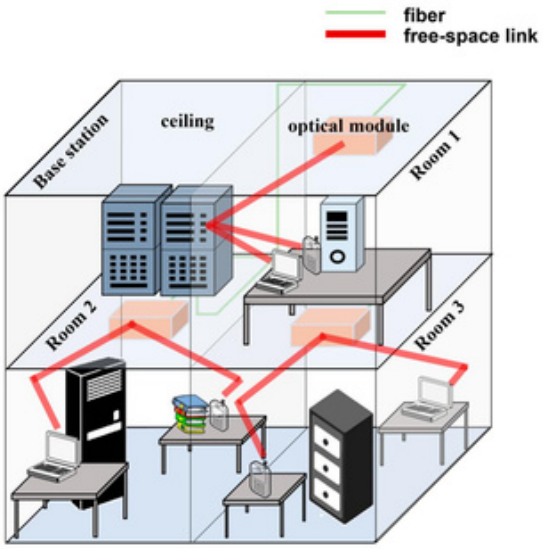


Figure 9.2: Indoor FSO Network Architecture

The diagram shows an indoor Free Space Optical (FSO) communication system integrated with fiber links. A base station connects to different rooms using optical fiber (green lines), while free-space optical links (red lines) distribute data wirelessly within and between rooms. The optical module mounted near the ceiling acts as a transmitter/receiver, sending laser signals to multiple devices like computers and servers. These signals reflect or directly reach users in different rooms, enabling high-speed communication without cables. This hybrid system combines the reliability of fiber with the flexibility of FSO, providing efficient, high-bandwidth indoor networking across multiple locations.

Free Space Optical (FSO) communication uses laser beams to transmit data through the air over long distances. It is similar to Li-Fi but designed for outdoor and long-range applications like building-to-building communication. FSO provides very high data rates but is affected by weather conditions such as fog and rain.

Uses:

Free Space Optical (FSO) communication is widely used in modern communication systems due to its high speed, flexibility, and cost-effectiveness.

Some important uses are:

1. Last-Mile Connectivity: FSO is used to provide high-speed internet access between service providers and end users, especially where laying optical fiber is difficult or expensive.

2. Building-to-Building Communication: It enables secure, high-bandwidth links between buildings in campuses, offices, and industries without physical cables.

3. Satellite and Space Communication: FSO is used in inter-satellite communication and space links due to its high data rate and low interference compared to RF systems.

4. Military and Defense Applications: Used for secure communication in battlefields because laser beams are difficult to intercept and detect.

5. Disaster Recovery: FSO systems can be quickly deployed in emergency situations where existing communication infrastructure is damaged.

6. Cellular Backhaul: Supports high-speed data transfer between base stations in telecom networks.

7. Indoor Wireless Networking: Used in offices and smart buildings for high-speed data transmission using optical wireless links.

8. Smart Cities and IoT: FSO helps in connecting sensors, surveillance systems, and smart infrastructure efficiently.

Overall, FSO plays a vital role in high-speed, secure, and flexible communication systems across multiple domains.

10. Image Processing Techniques for Face Recognition

GOGULA KUSUMA,

KURLA LAKSHMI

III YEAR

Introduction

The idea of this project is to automate the manual work of taking attendance using face recognition techology. We can implement face recognition algorithms with ease using OpenCV. Mainly we have to code for:

- face recognition : Includes taking images, training images to algorithm, track images --> using OpenCV
- User interface : Includes GUI components such as buttons like take images, train images, track images, form input components like enter ID, NAME; Notification and attendance --> using tkinter
- Backend functionalities : Includes using Database(secondary storage here), file manipulation using OS,printing attendance in excel sheet.

how to code face recognition with OpenCV, after all this is the only reason why you are reading this article, right? OK then. You might say that our mind can do these things of face recognition so easily but to actually code them into a computer is difficult? Don't worry, it is not. Thanks to OpenCV, coding face recognition is as easier as it feels. The coding steps for face recognition are very similar in real life also.

- Data Gathering: Gather face data (face images in this case) of the persons you want to recognize
- Training of Recognizer: Feed that face data (and respective names of each face) to the face recognizer so that it can learn.
- Recognition: Feed new faces of the persons and see if the face recognizer you just trained recognizes them.

OpenCV is a game changer in this AI world . It advances and automates many tasks in so many domains. It has so many highly optimised , powerful and ready go algorithms which can implemented in a single line. OpenCV comes equipped with built in face recognizer, all you have to do is feed it the face data. It's that simple and this how it will look once we are done coding it.

OpenCV Face Recognizers:

Face recognition is trending nowadays for authentication and verification tasks .

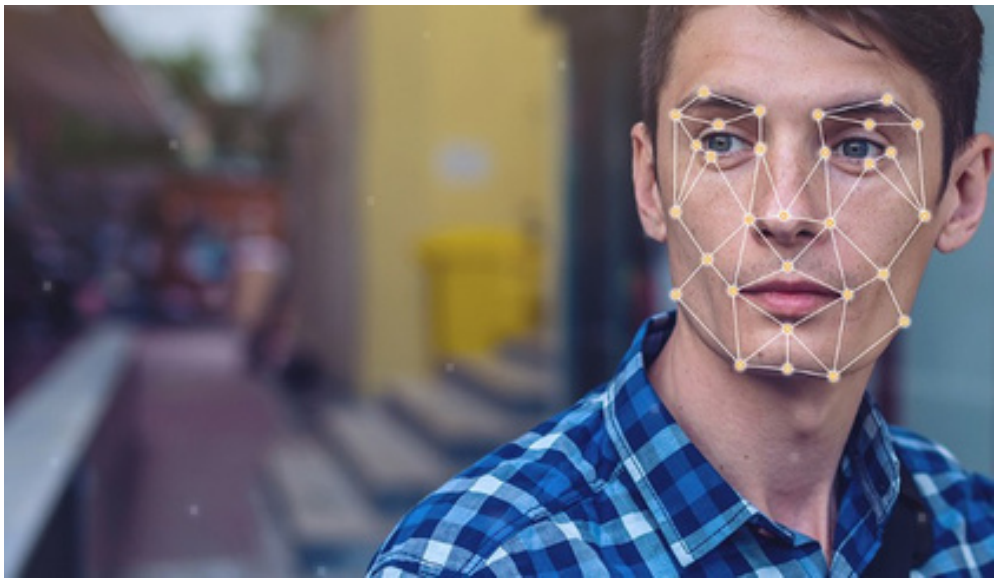


Figure 10.1: OpenCV Face Recognition System

OpenCV has three built in face recognizers and thanks to OpenCV's clean coding, you can use any of them by just changing a single line of code. Below are the names of those face recognizers and their OpenCV calls.

- **EigenFaces Face Recognizer Recognizer –**

cv2.face.createEigenFaceRecognizer()

- **FisherFaces Face Recognizer Recognizer –**

  cv2.face.createFisherFaceRecognizer()

- Local Binary Patterns Histograms (LBPH) Face Recognizer - cv2.face.createLBPHFaceRecognizer()

Eigen-Faces Face Recognizer

This algorithm considers the fact that not all parts of a face are equally important and equally useful. When you look at some one you recognize him/her by his distinct features like eyes, nose, cheeks, forehead and how they vary with respect to each other. So you are actually focusing on the areas of maximum change (mathematically speaking, this change is variance) of the face. For example, from eyes to nose there is a significant change and same is the case from nose to mouth. When you look at multiple faces you compare them by looking at these parts of the faces because these parts are the most useful and important components of a face. Important because they catch the maximum change among faces, change the helps you differentiate one face from the other. This is exactly how EigenFaces face recognizer works.

EigenFaces face recognizer looks at all the training images of all the persons as a whole and try to extract the components which are important and useful (the components that catch the maximum variance/change) and discards the rest of the components. This way it not only extracts the important components from the training data but also saves memory by discarding the less important components. These important components it

extracts are called principal components. Below is an image showing the principal components extracted from a list of faces.

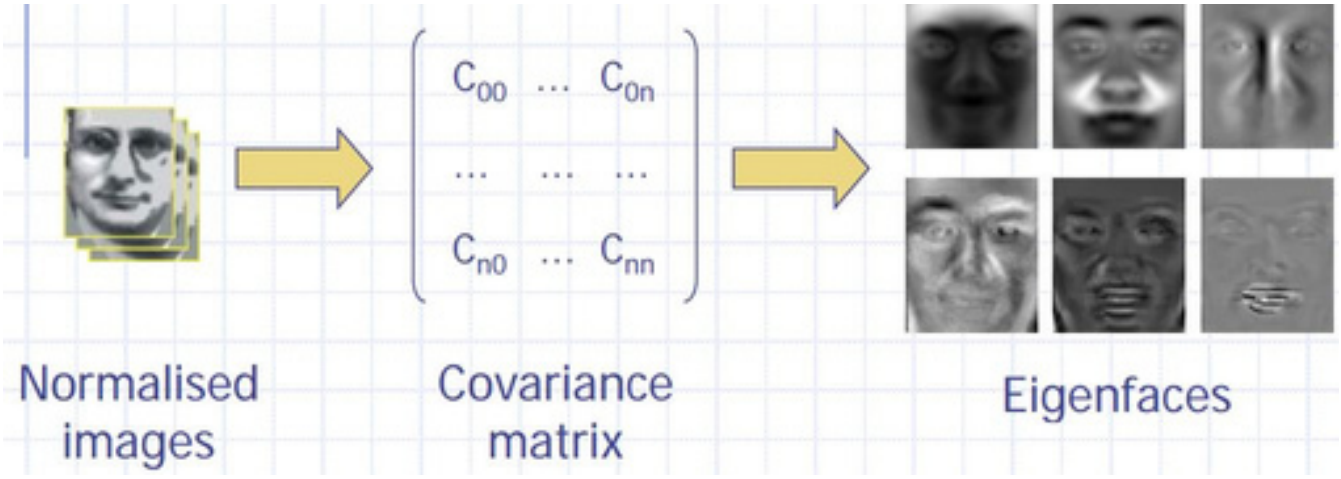


Figure 10.2: EigenFaces Model

You can see that principal components actually represent faces and these faces are called eigen faces and hence the name of the algorithm.

So this is how EigenFaces face recognizer trains itself (by extracting principal components). Remember, it also keeps a record of which principal component belongs to which person. One thing to note in above image is that Eigenfaces algorithm also considers illumination as an important

component.

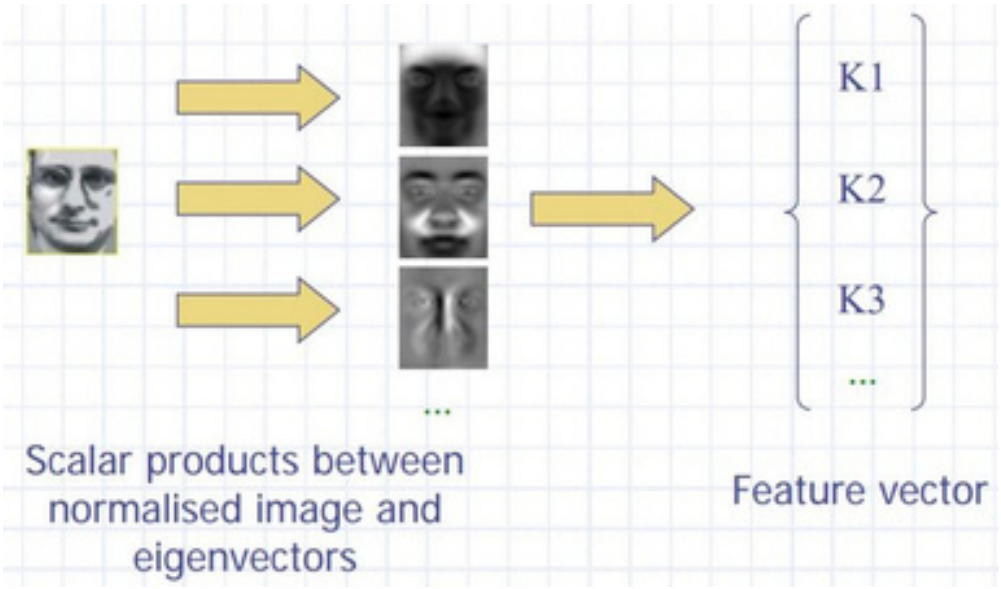


Figure 10.3: FisherFaces Model

Later during recognition, when you feed a new image to the algorithm, it repeats the same process on that image as well. It extracts the principal component from that new image and compares that component with the list of components it stored during training and finds the component with the best match and returns the person label associated with that best match component.

CONCLUSIONS

Eigenfaces is one of the simplest and oldest face recognition algorithms.

It is relatively fast compared to other techniques for classifying faces

The feature extractor must be retrained if large number of new faces are added to the system It is not accurate enough by itself and needs boosting methods for improvement.

FisherFaces Face Recognizer

This algorithm is an improved version of EigenFaces face recognizer. Eigenfaces face recognizer looks at all the training faces of all the persons at once and finds principal components from all of them combined. By capturing principal components from all the of them combined you are not focusing on the features that discriminate one person from the other but the features that represent all the persons in the training data as a whole.

This approach has drawbacks, for example, images with sharp changes (like light changes which is not a useful feature at all) may dominate the rest of the images and you may end up with features that are from external source like light and are not useful for discrimination at all. In the end, your principal components will represent light changes and not the actual face features.

Fisherfaces algorithm, instead of extracting useful features that represent all the faces of all the persons, it extracts useful features that discriminate one person from the others. This way features of one person do not dominate over the others and you have the features that discriminate one person from the others.

Below is an image of features extracted using Fisherfaces algorithm.

Fisher Faces

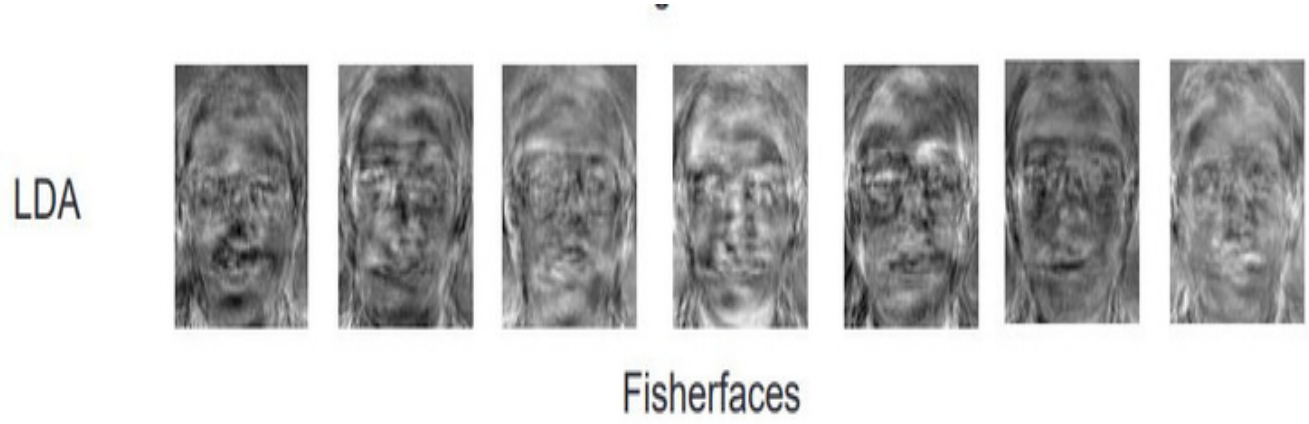


Figure 10.4: LBPH Algorithm

You can see that features extracted actually represent faces and these faces are called fisher faces and hence the name of the algorithm.

One thing to note here is that even in Fisherfaces algorithm if multiple persons have images with sharp changes due to external sources like light they will dominate over other features and affect recognition accuracy.

CONCLUSION

Fischerfaces yields much better recognition performance than eigen faces. However, it loses the ability to reconstruct faces because the Eigenspace is lost. Also, Fischer faces greatly reduces the dimensionality of the images making small template sizes.

Getting bored with this theory? Don't worry, only one face recognizer is left and then we will dive deep into the coding part.

Local Binary Patterns Histograms (LBPH) Face Recognizer

We know that Eigenfaces and Fisherfaces are both affected by light and in real life we can't guarantee perfect light conditions. LBPH face recognizer is an improvement to overcome this drawback.

Idea is to not look at the image as a whole instead find the local features of an image. LBPH alogrithm try to find the local structure of an image and it does that by comparing each pixel with its neighboring pixels.

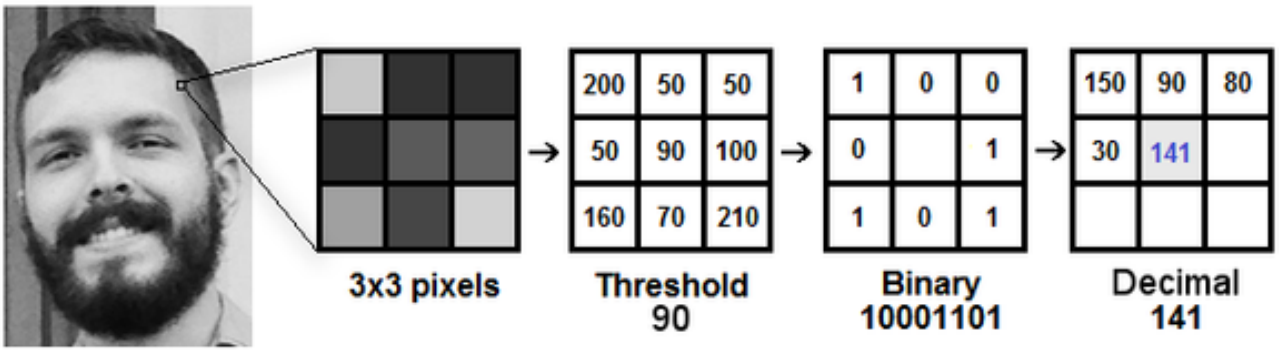


Figure 10.5: Diagram

Now you get why this algorithm has Local Binary Patterns in its name? Because you get a list of local binary patterns. Now you may be wondering, what about the histogram part of the LBPH? Well after you get a list of local binary patterns, you convert each binary pattern into a decimal number (as shown in above image) and then you make a histogram of all of those values. A sample histogram looks like this.

I guess this answers the question about histogram part. So in the end you will have one histogram for each face image in the training data set. That means if there were 100 images in training data set then LBPH will extract 100 histograms after training and store them for later recognition. Remember, algorithm also keeps track of which histogram belongs to which person.

Later during recognition, when you will feed a new image to the recognizer for recognition it will generate a histogram for that new image, compare that histogram with the histograms it already has, find the best match histogram and return the person label associated with that best match histogram.Operations in steps:

- **Convert facial image to grayscale.**
- Select a window of 3×3 pixels. It will be a 3×3 matrix containing the intensity of each pixel (0~255).
- Take the central value of the matrix and use it to threshold the neighboring pixels.
- For each neighbor of the central value (threshold), we set a new binary value. We set 1 for values equal or higher than the threshold and 0 for values lower than the threshold.
- Now, the matrix will contain only binary values (ignoring the central value). We need to concatenate each binary value from each position from the matrix line by line into a new binary value (e.g. 10001101). Note: some authors use other approaches to concatenate the binary values (e.g. clockwise direction), but the final result will be the same.
- Then, we convert this binary value to a decimal value and set it to the central value of the matrix, which is actually a pixel from the original image.
- At the end of this procedure (LBP procedure), we have a new image which represents better the characteristics of the original image.
- Extract histogram of the LBP patterns by dividing the image into a Grid.
- As we have an image in grayscale, each histogram (from each grid) will contain only 256 positions (0~255) representing the occurrences of each pixel intensity.

- Then, we need to concatenate each histogram to create a new and bigger histogram. Supposing we have 8×8 grids, we will have 8x8x256=16.384 positions in the final histogram. * The final histogram represents the characteristics of the image original image.

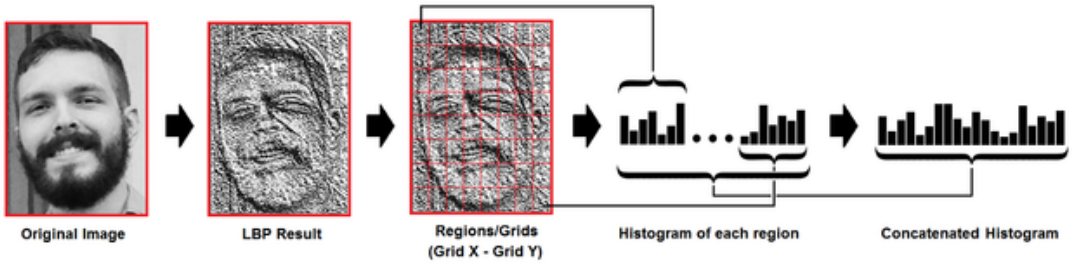


Figure 10.6: Diagram

Face images are compared by converting both into LBPH vectors and then calculating the distance between two histograms, for example: euclidean distance, chi-square, absolute value, etc. For ex, Euclidean distance can be calculated based on the following **formula:**

CONCLUSIONS

1. LBPH is one of the easiest face recognition algorithms.
2. It can represent local features in the images.
3. It is possible to get great results mainly in a controlled environment.
4. It is robust against monotonic gray scale transformations.

The theory part is over and now comes the coding part! Ready to dive into coding? Let's get into it then.

Coding Face Recognition with OpenCV

The Face Recognition process in this tutorial is divided into three steps.

1. Prepare training data: In this step we will read training images for each person/subject along with their labels, detect faces from each image and assign each detected face an integer label of the person it belongs to.
2. Train Face Recognizer: In this step we will train OpenCV's LBPH face recognizer by feeding it the data we prepared in step 1.
3. Testing: In this step we will pass some test images to face recognizer and see if it predicts them correctly.

This repository contains code for facial recognition using openCV and python with a tkinter gui interface. If you want to test the code then run train.py file

Technology used :

- openCV (Opensource Computer Vision)
- Python
- tkinter GUI interface
- OS
- datetime

Here I am working on Face recognition based Attendance Management System by using OpenCV(Python). One can mark thier attendance by simply facing the camera.

Attendance based on Face recognition:

Block diagram or work flow of this project may seem like this

Figure 10.8: Diagram

we train the algorthms with all the faces and compute their values in the database. When we track images, we detect faces and apply some image preprocessing techniques and feed this to algorthm then algorthm will compute the value of that faces and checks whether the face is present in face database or not. If presents, grant attendance in excel sheet.

User Interface:

Here we design an interface using tkinter module which consists of following components:

- Take images
- Train images
- Track images
- Enter ID, Name -> input_forms
- Notification, Attendace

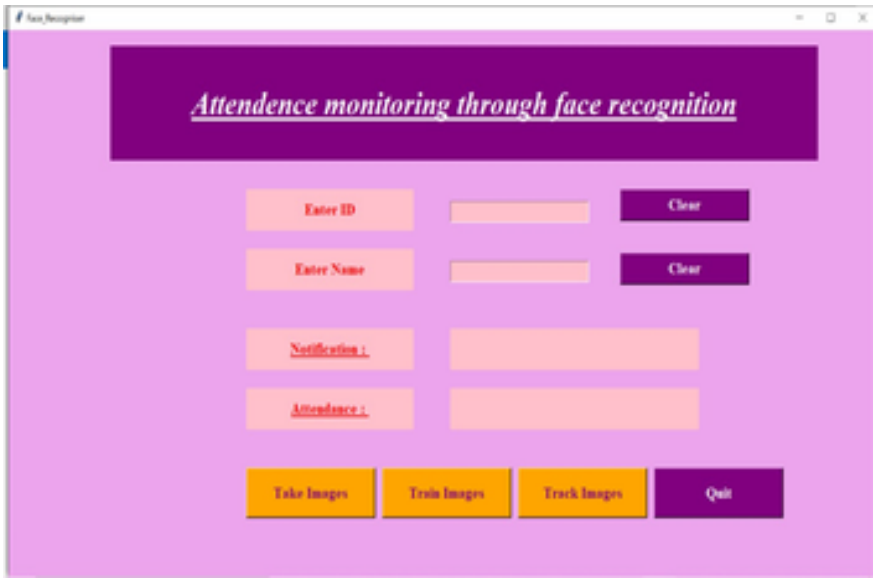


Figure 10.9: Diagram

Usage :

When we run train.py a window is opened and ask for Enter Id and Enter Name. After enter name and id then we have to click Take Images button. By clicking Take Images camera of running computer is opened and it start taking image sample of person.This Id and Name is stored in folder StudentDetails and file name is StudentDetails.csv. It takes 60 images as sample and store them in folder TrainingImage.After completion it notify that iamges saved.

After taking image sample we have to click Train Image button.Now it take few seconds to train machine for the images that are taken by clicking Take Image button and creates a Trainner.yml file and store in TrainingImageLabel folder.

Now all initial setups are done. By clicking Track Image button camera of running machine is opened again. If face is recognised by system then Id and Name of person is shown on Image. Press Q(or q) for quit this window.After quitting it attendance of person will be stored in Attendance folder as csv file with name, id, date and time and it is also available in window.

Conclusion:This topic plays a major role in shaping modern technologies. Students and researchers can explore new ideas and innovative solutions to contribute to the development of future electronic systems.