



SANTHIRAM ENGINEERING COLLEGE

NANDYAL, ANDHRA PRADESH

Knowledge | Character | Progress

INSPIRE
INNOVATE
INCLUDE
IMPACT

WAVES

IDEAS FLOW FUTURES GROW

VOLUME 7

ISSUE 2

JANUARY - JUNE 2023

AY 2022 - 23

ELECTRONICS & COMMUNICATION ENGINEERING

CONNECTING IDEAS
EMPOWERING PEOPLE
SHAPING TOMORROW



INNOVATE



COMMUNICATE



TRANSFORM



LEAD

*Innovate
Communicate
Transform*

A BRIGHTER
TOMORROW
THROUGH
TECHNOLOGY



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ECE Events

*New Waves
Brighter Tomorrows*

EDITORIAL BOARD



WRITE
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INSPIRE
TOGETHER

*Ideas
Connect
People*



Editor-in-Chief :

Dr. Y. Malikarjuna Rao

HOD - ECE



Student Editor :

S. Ruksana



Editorial Team :

Department of ECE

STUDENTS
IDEAS
INNOVATION
PUBLISHED

ABOUT THE COLLEGE

Santhiram Engineering College (SREC) is sponsored by M/s Sri Shirdi Sai Educational Academy, Nandyal. SREC is established under the able guidance of Dr. M. Santhiramudu, Chairman in the year 2007 with a noble motto "Education for peace and progress". SREC is approved by AICTE, New Delhi; Recognized by UGC under 2(f) and 12 (B); Permanently Affiliated to JNTUA, Ananthapuramu; Certified to an ISO 9001:2015. The college is ranked as one of the Best Engineering Colleges of JNTUA, Ananthapuramu.

KNOWLEDGE
LEADS
TO A BRIGHTER
TOMORROW

EDUCATION
FOR PEACE
AND PROGRESS



ABOUT DEPARTMENT

DEPARTMENT OF ELECTRONICS AND
COMMUNICATION ENGINEERING

Anticipating the significance of the electronics and wireless communication realistic role in the society, industry and among the public, the Department of Electronics and Communication Engineering has been started carrying up its rationale since 2007 concentrating and imparting electronic & technological solutions in to the young minds of the Society. The Department was initially started with an intake of 60 seats since the opportunities are stupendous and the increase in demand for the production of engineers it is upgraded to 120 seats in 2008. Forecasting the tremendous growth & opportunities in VLSI, the Department also started a Master of Technology (M. Tech) program in VLSI System Design in the year 2011 with an intake of 12 seats. The department received an ISO 9001:2015 certification for its qualitative functioning.

The objectives of the department include: to produce quality engineers, indulge in research and promote the students to be active in entrepreneurship. The faculty has been involved in teaching and research in the diverse aspects such as Wireless Communications & Networking, Microelectronics and VLSI, Digital Image Processing and Antenna design. The department has state of the art laboratories. The faculty is entrusted to bring fine research, developmental and design experience into the classroom, ensuring that our students are being treated as professional engineers in all parts of global engineering and the scientific community.

The department extends its unwavering support for the growth of every student fulfilling their dreams. The department also extended its support to groom and nurture the qualities of teamwork, leadership, mutual understanding and co-ordination providing exposure to public and executive communication.

Technology
Empowers People

“ Signals
for a Smarter
Tomorrow



Our Vision

Emerge as a center for quality education in Electronics & Communication Engineering so as to create competent professionals.



Our Mission

M1

Offer quality programs in Electronics & Communication Engineering aimed at fulfilling the needs of society and industry.

M2

Impart skills and develop scientific temper to solve complex technological problems of current times.

M3

Nurture ethics, talent and entrepreneurship to inculcate professional development of students.

INNOVATE
COMMUNICATE
ENGINEER
EXCEL



LEARN



GROW



INNOVATE



CONTRIBUTE

OUR MOTTO

EDUCATION FOR PEACE AND PROGRESS

*Knowledge
Today
A Better
Tomorrow*



Vision

To become a nucleus for pursuing technical education and pool industrial research and developmental activities with social-conscious and global standards.



INSPIRE
INNOVATE
EXCEL



Mission

01

To provide Advance Educational Programs and prepare students to achieve success and take leading roles in their chosen fields of specialization.

02

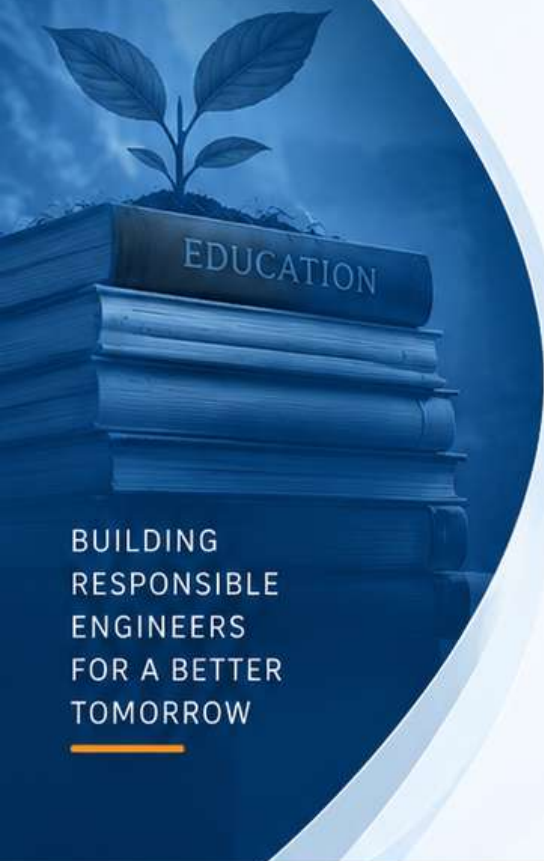
To establish postgraduate programs in the current and Advanced Technologies.

03

To establish an R&D Consultancy through developing industry institute interaction, building up exceptional infrastructure.

04

To propel every individual, realize and act for the technical development of the society.



BUILDING
RESPONSIBLE
ENGINEERS
FOR A BETTER
TOMORROW

*Together
for a Brighter Tomorrow*



SANTHIRAM ENGINEERING COLLEGE

NANDYAL, ANDHRA PRADESH
EDUCATION FOR PEACE AND PROGRESS

Learning
Today
for a Brighter
Tomorrow

Under Graduate PROGRAM OUTCOMES

- 1 Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2 Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3 Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4 Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5 Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 6 The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7 Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9 Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10 Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11 Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12 Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Engineers
for a Better
Tomorrow



LEARN



GROW



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CONTRIBUTE



Under Graduate - Program Educational Objectives (PEOs)

01

PEO1: Have in-depth knowledge in Electronics and Communication Engineering to innovate, design, and develop modern electronic systems.

02

PEO2: Sustain intellectual curiosity in professional career through life-long learning.

03

PEO3: Have strong work ethics, professional attitude, team spirit, leadership skills, and enterprising skills to serve industry and society.



Post Graduate - Program Outcomes

01

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

02

PO2: An ability to write and present a substantial technical report/document.

03

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.



Post Graduate - Program Educational Objectives (PEOs)

M. Tech. in VLSI Design Program, graduates will be able to:

01

PEO1: Identify and apply appropriate Electronic Design Automation software and electronic equipment to analyze, synthesize and evaluate to solve real-world problems in the VLSI domain to create innovative products and systems.

02

PEO2: Pursue research studies in the core or allied areas of the VLSI circuits and systems.

03

PEO3: Inculcate positive attitude, professional ethics, effective communication, and interpersonal skills to succeed in the profession exhibiting creativity and innovation through research and development both as a team member and leader.



SANTHIRAM ENGINEERING COLLEGE

NANDYAL, ANDHRA PRADESH
EDUCATION FOR PEACE AND PROGRESS

MESSAGES

CHAIRMAN MESSAGE



PRABODHINI of ECE Department. Exclusively meant for churning out the latent writing talent. I congratulate all the contributors for bringing out such a beautiful magazine. It bears immense potential to sharpening the students skills as part of their overall personality development. Good things remain good only because they are always scarce. It gives me immense pleasure to pen a few words as a prologue towards technical magazine PRABODHINI of ECE Department Exclusively meant for churning out the latent writing talent which bears immense potentiality of sharpening the students skills as part of their overall personality development.

Dr.M.Santhiramudu
Chairman/Founder

MD'S MESSAGE



I am pleased to learn that the department of Electronics and Communication Engineering will publish its technical magazine PRABODHINI this academic year (2022-23). This is a useful technical material and secondary skill development tool for students. I also commend the team's coordination and efforts in bringing this issue to light. I wish them all the best.

Mr. M. SivaRam
Managing Director

“

ONLY EDUCATION TO EVERY INDIVIDUAL WILL MAKE
EVERY INDIVIDUAL A CEREBRAL AND RESPONSIBLE CITIZEN

”



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WAVES

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*New Waves
Brighter Tomorrows*



PRINCIPAL'S MESSAGE



I am delighted to present the latest issue of WAVES, the Magazine of the Department of Electronics and Communication Engineering. A magazine is more than a compilation of articles; it is a platform that reflects the creativity, technical insight and vibrant spirit of our students and faculty. WAVES showcases their ideas, achievements and aspirations, and serves as a bridge between the present and the future.

I appreciate the earnest efforts of the Editorial Team, faculty members and students for their dedication in bringing out this issue. I am confident that WAVES will continue to inspire innovation, encourage knowledge sharing and strengthen the sense of belonging among our student community. I wish the department many more successful endeavors in the years to come.

Dr. M.V. Subramanyam
Principal



HOD'S MESSAGE



The Department of Electronics and Communication Engineering (ECE) strives to provide quality education that blends strong theoretical foundations with practical exposure. WAVES is a reflection of our department's rich academic culture, innovative mindset and the hidden talents of our students.

Our faculty members are constantly encouraging students to explore new technologies, take up challenging projects and participate in technical, cultural and social activities. I am proud of the enthusiasm and commitment shown by our students in contributing to this magazine.

I congratulate the editorial team for their sincere efforts and wish that WAVES continues to be a source of inspiration, knowledge and creativity for all readers.

Dr. Y. Mallikarjuna Rao
HOD-ECE





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TECHNOLOGY CATCHUP

Exploring emerging technologies driving innovation, shaping industries and creating a smarter, connected and sustainable future.



INNOVATE



COMMUNICATE



TRANSFORM



LEAD

*Innovate
Communicate
Transform*



A BRIGHTER
TOMORROW
THROUGH
TECHNOLOGY

01



5G & 6G Communication

High-speed, low-latency wireless connectivity for next-generation networks.

02



Massive MIMO & Beamforming

Improved capacity, coverage and spectral efficiency using advanced antennas.

03



Millimeter-Wave (mmWave)

Higher frequency bands for ultra-high data rates and advanced applications.

04



Software-Defined Radio (SDR)

Flexible and reconfigurable radio platforms controlled by software.

05



RFID & IoT

Low-power wireless connectivity for smart industries, healthcare, agriculture and logistics.

06



RF Energy Harvesting

Capturing electromagnetic energy for low-power electronics and sensors.

07



RF Sensing & Radar

Object detection, distance and velocity estimation for automotive, industrial and environmental applications

*New Waves
Brighter Tomorrows*



AI-Driven Smart Adaptive Image Restoration Framework for Enhanced Vision in Adverse Weather Conditions

WAVES
SREC TECHNICAL MAGAZINE

IMPROVING VISUAL CLARITY AND OBJECT RECOGNITION
THROUGH INTELLIGENT IMAGE ENHANCEMENT TECHNIQUES



Fog



Rain



Snow



Low Light

1. INTRODUCTION

Adverse weather conditions such as fog, rain, snow, and low-light environments severely degrade image quality, affecting visibility and reducing the performance of intelligent vision systems. Smart adaptive image restoration uses advanced AI techniques to enhance visual clarity, improve contrast, and recover lost details for reliable and accurate perception.

2. CHALLENGES IN ADVERSE WEATHER

- Low visibility and blurred scenes
- Scattering and absorption of light
- Loss of contrast and color information
- Noise and artifacts in captured images
- Reduced accuracy in object detection and recognition

5. OUR SOLUTION: SMART ADAPTIVE IMAGE RESTORATION

AI-driven adaptive models intelligently analyze weather conditions and restore images by enhancing details, removing noise, and improving contrast using deep learning.

KEY FEATURES

- Weather Condition Detection
- Adaptive Enhancement
- Detail Recovery
- Real-Time Processing
- Robust and Scalable
- Improved Object Recognition

BEFORE & AFTER RESTORATION RESULTS

FOGGY CONDITION



RESTORED IMAGE



RAINY CONDITION



RESTORED IMAGE



SNOWY CONDITION



RESTORED IMAGE



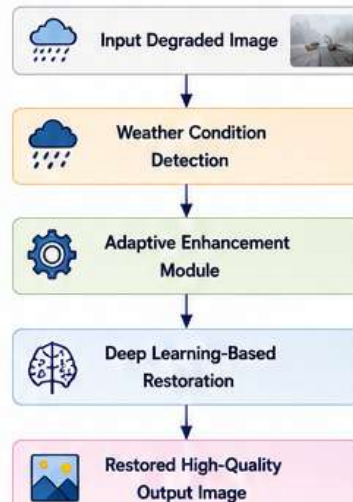
LOW-LIGHT CONDITION



RESTORED IMAGE



3. PROPOSED METHODOLOGY



4. TECHNOLOGIES USED

- Deep Learning (CNN, GAN, U-Net)
- Transformer Networks
- Attention Mechanisms
- Image Enhancement Algorithms
- High-Performance SoC / GPU

6. APPLICATIONS

AUTONOMOUS VEHICLES



Improves visibility and ensures safe navigation in fog, rain, and low-light conditions.

SMART SURVEILLANCE



Enhances surveillance video quality for accurate monitoring and threat detection.

INTELLIGENT TRANSPORTATION



Supports traffic monitoring, incident detection, and smart traffic management.

DISASTER MANAGEMENT



Provides clear visual information during natural disasters for faster response.

DEFENSE & SECURITY



Enhances object detection and situational awareness in harsh environments.

SMART CITIES & IoT

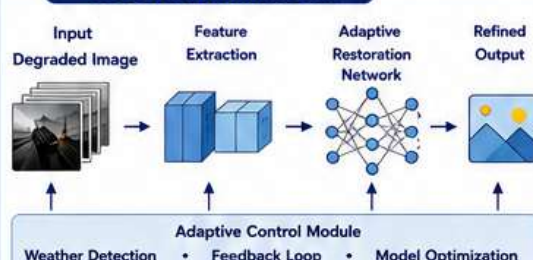


Supports IoT vision systems for environmental monitoring and smart city applications.

7. BENEFITS

- Enhanced image clarity and contrast
- Better object detection and recognition
- Improved accuracy in AI vision systems
- Real-time performance in harsh conditions
- Increased safety and reliability
- Suitable for edge and embedded systems

8. SYSTEM ARCHITECTURE



9. FUTURE SCOPE

- Integration with 6G and Edge AI systems
- Self-learning adaptive enhancement models
- Multi-weather and multi-spectral restoration
- Energy-efficient hardware acceleration
- Federated learning for distributed systems



Author : **KONDE AKHIL**
Reg No : **20X51A0430**

Department of Electronics & Communication Engineering
Santhiram Engineering College, Nandyal

“ RESTORING VISIBILITY,
ENHANCING INTELLIGENCE,
EMPOWERING THE FUTURE. ”

Hybrid CNTFET-Based Wireless Communication SoC Architecture for Energy-Efficient Next-Generation IoT Networks

Revolutionizing Future Wireless Connectivity Through Advanced Nanoelectronics and Intelligent System-on-Chip Design

1. INTRODUCTION

The rapid growth of Internet of Things (IoT) applications demands ultra-low power, high-speed and reliable wireless communication systems. Conventional CMOS technology is approaching its physical limits in terms of power dissipation and performance. Carbon Nanotube Field-Effect Transistor (CNTFET) technology overcomes these limitations by offering high mobility, low power, and excellent scalability.

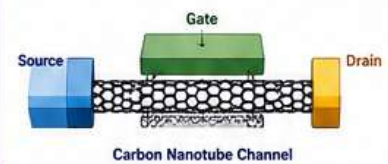
This article presents a Hybrid CNTFET-Based Wireless Communication System-on-Chip (SoC) architecture designed for next-generation IoT networks. The proposed SoC integrates RF transceiver, baseband processing, digital controller, and power management using CNTFET and CMOS hybrid technology to achieve optimum performance, energy efficiency, and compact design.



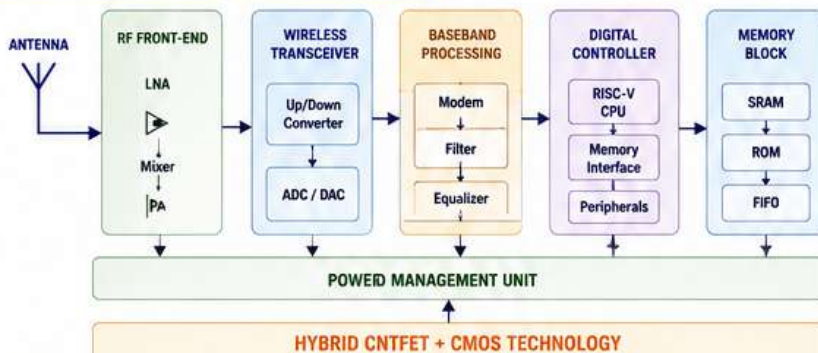
2. WHY CNTFET?

- ✓ Higher carrier mobility than CMOS
- ✓ Lower power consumption
- ✓ Better electrostatic control
- ✓ High current drive capability
- ✓ Excellent scalability for nanoscale
- ✓ Enhanced thermal stability

CNTFET STRUCTURE



3. HYBRID CNTFET-BASED SoC ARCHITECTURE



4. KEY FEATURES

- Ultra-Low Power Operation**
Hybrid CNTFET design reduces dynamic and leakage power.
- High-Speed Communication**
Supports multi-band wireless standards for IoT devices.
- Integrated SoC Solution**
Combines RF, analog, digital and memory on a single chip.
- Energy Efficiency**
Optimized power management for long battery life.
- Security and Reliability**
Built-in hardware security for safe IoT communication.

5. WORKING PRINCIPLE

- 1 The antenna receives/transmits signals from the IoT environment.
- 2 RF front-end conditions the signal.
- 3 Transceiver converts the signal to digital/analog form.
- 4 Baseband processor performs filtering, modulation, and error correction.
- 5 Digital controller manages overall operations and communication.
- 6 Power management unit ensures energy-efficient performance.

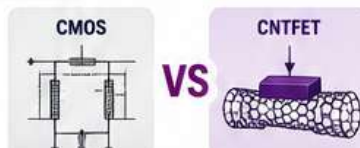


6. APPLICATIONS



7. ADVANTAGES OVER CMOS

- ↑ Higher Speed
- ↑ Lower Power
- ↑ Better Performance
- ↑ More Scalability
- ↑ Longer Battery Life



8. FUTURE SCOPE

- ◆ Integration with AI for intelligent IoT systems.
- ◆ Support for next-generation 5G/6G and beyond networks.
- ◆ Advanced nanoelectronics for sustainable computing.
- ◆ Development of self-powered IoT devices.
- ◆ Enabling smart, secure, and autonomous IoT ecosystems.



9. CONCLUSION

Hybrid CNTFET-Based Wireless Communication SoC is a promising solution for future IoT networks. It offers the perfect combination of high performance, low power, and compact design. This architecture will play a vital role in building intelligent, connected, and energy-efficient IoT ecosystems.



REAL-TIME OBJECT DETECTION IN ADVERSE WEATHER USING HYBRID CNN-TRANSFORMER NETWORKS

1. INTRODUCTION

Autonomous vehicles, intelligent transportation systems, surveillance networks, and smart city applications rely heavily on object detection technologies to perceive and understand their surroundings. While modern deep learning models achieve remarkable accuracy under normal conditions, their performance often deteriorates in adverse weather environments such as fog, rain, snow, haze, and low-light conditions. Reduced visibility, motion blur, and atmospheric distortions make object detection significantly more challenging, potentially affecting safety and reliability.

To address these challenges, researchers are exploring Hybrid CNN-Transformer Networks that combine the strengths of Convolutional Neural Networks (CNNs) and Transformer architectures. This innovative approach enables robust and accurate real-time object detection even in difficult environmental conditions.

2. THE CHALLENGE OF ADVERSE WEATHER

Weather conditions directly influence image quality and visibility. In foggy environments, objects appear blurred and lose contrast. Rain introduces streaks and reflections, while snow can partially obscure important visual information. Low-light conditions further reduce the ability of traditional computer vision systems to distinguish objects accurately.

These challenges often result in:

- ❌ Missed object detections
- ❌ False alarms
- ❌ Reduced detection accuracy
- ❌ Increased processing complexity
- ❌ Safety risks in autonomous systems

Therefore, developing weather-resilient object detection systems has become a critical research area in Artificial Intelligence and Computer Vision.

3. UNDERSTANDING CNN-BASED DETECTION

Convolutional Neural Networks (CNNs) have long been the backbone of object detection systems. Popular models such as YOLO, Faster R-CNN, and SSD utilize convolution operations to extract local image features such as edges, textures, and shapes.

ADVANTAGES OF CNNs

- ✓ Fast computation speed
- ✓ Strong local feature extraction
- ✓ Efficient real-time processing
- ✓ Suitable for embedded systems



However, CNNs primarily focus on local information and often struggle to capture long-range contextual relationships, especially in degraded visual environments.

4. THE RISE OF TRANSFORMERS IN COMPUTER VISION

Transformers were initially developed for Natural Language Processing but have recently revolutionized computer vision through architectures such as Vision Transformers (ViTs) and Swin Transformers.

Unlike CNNs, Transformers employ self-attention mechanisms that enable the model to analyze relationships among all image regions simultaneously. This allows better understanding of global context, even when parts of the image are degraded by weather effects.

BENEFITS OF TRANSFORMERS

- Capture long-range dependencies
- Better contextual understanding
- Enhanced robustness to environmental variations
- Improved feature representation



Despite their advantages, pure Transformer models often require high computational resources, making real-time deployment challenging.

8. CONCLUSION

Real-time object detection in adverse weather remains one of the most important challenges in modern computer vision. Hybrid CNN-Transformer Networks provide an effective solution by combining the fast feature extraction capability of CNNs with the powerful contextual understanding of Transformers. This synergy significantly improves detection accuracy, robustness, and reliability in challenging environments.

As autonomous systems continue to evolve, Hybrid CNN-Transformer architectures are expected to play a crucial role in enabling safer transportation, smarter cities, and more intelligent vision-based applications for the future.

ADVERSE WEATHER CONDITIONS



FOG



RAIN



SNOW

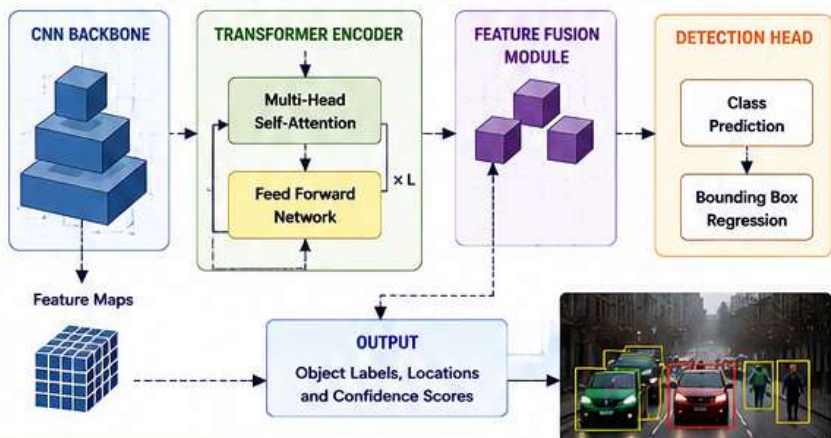


HAZE



LOW-LIGHT

5. HYBRID CNN-TRANSFORMER NETWORK



WORKING PRINCIPLE

- 1 Input image captured under adverse weather conditions.
- 2 CNN backbone extracts spatial features.
- 3 Transformer encoder analyzes global dependencies.
- 4 Feature fusion module combines local and global information.
- 5 Detection head identifies and classifies objects in real time.
- 6 Output includes object labels, locations, and confidence scores.



This hybrid approach significantly improves detection performance while maintaining real-time processing capability.

6. APPLICATIONS



AUTONOMOUS VEHICLES

Detect vehicles, pedestrians, cyclists, and road signs under fog, rain, and nighttime conditions.



SMART TRAFFIC MANAGEMENT

Monitor traffic flow and identify incidents during adverse weather.



INTELLIGENT SURVEILLANCE

Enhance public safety through reliable object detection in challenging environments.



INDUSTRIAL AUTOMATION

Enable robotic systems to operate accurately in outdoor industrial settings.



DRONE NAVIGATION

Support aerial monitoring and autonomous drone operations under varying weather conditions.



SMART CITIES

Provide weather-resilient monitoring systems for urban infrastructure and public services.

7. FUTURE SCOPE



Future research aims to integrate advanced attention mechanisms, multimodal sensors, and edge AI computing with Hybrid CNN-Transformer Networks. Combining visual data with radar, LIDAR, and thermal imaging can further enhance detection reliability.

Additionally, emerging technologies such as Federated Learning and Explainable AI can improve privacy, adaptability, and transparency in intelligent vision systems. The integration of lightweight Transformer architectures will also enable deployment on resource-constrained embedded devices.



Author: **SUNKU DEVIKA**

Regno : 21X51A04A5

Department of Electronics & Communication Engineering
Santhiram Engineering College, Nandyal



Small
Thoughts
Big
Changes

INSPIRATIONAL QUOTES

THINK
LEARN
GROW



“

“Mental energy is wasted
in caste disputes and village factions.”

SRI. MOKSHA GUNDAM VISVESVARAYA

”



DISCIPLINE
DEVELOPS
NATIONS



“

“Many new technologies come with
a promise to change the world,
but the world refuses to cooperate.”

HENRY PETROSKI

”



INNOVATION
NEEDS
PERSISTENCE



“

“Take up an idea, devote yourself,
struggle in patience,
and the sun will rise.”

SWAMI VIVEKANANDA

”



ARISE
AWAKE
ACHIEVE

*Let these words guide us
towards a brighter tomorrow...*



KNOWLEDGE
CHARACTER
SUCCESS

*Be the
Change...*



DEPARTMENT GALLERY

ELECTRONICS & COMMUNICATION ENGINEERING

WAVES

SREC TECHNICAL MAGAZINE

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01

ACADEMIC YEAR
2023-24

