DEPARTMENT OF ECE

PRESENTS

AMPERE

REDUCE NOISE AMPLIFY LIVES

MARCH 2026

THE TURNING POINT

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FROM THE DESK OF THE HOD

Hello, my dear students and all my colleagues of Team ECE, it is time for one more edition of AMPERE.

I faltered a few times when I started to pen my personal impressions and thoughts for the forthcoming edition of our beloved AMPERE. The reason for being a bit confused is the rather unstable state of affairs we are going through at the moment.

The entire engineering and technology world is facing one of the biggest turbulences in many decades due to the Tsunami named AI and its derivatives like Generic AI, ML, Agentic AI, LLM etc. It is forcing all involved in engineering to take a fresh look at the prospects of the future in a new light.

I assure all our students that human beings are more powerful than any agent, any synthesized intelligence. We have overcome the wars, the earthquakes, the tsunamis, the menaces of Covid and therefore, WE SHALL OVERCOME any challenge thrown at us. However, we cannot be victorious just by wishful thinking- we have to beat back the AI challenge by using the same AI platforms, using them as tools to create new products, refining the findings, producing new generation techniques.

It is the only way to achieve more in less time. For this to be possible, the users like our students, our teachers and TAs have to be thorough in their concepts about their own subjects. Their concepts about the topics they teach should be solid. Only then can the different AI platforms be successfully used. Days are coming when the core engineering students will be able to apply their knowledge in a more productive manner, and AI should be a friend, not an enemy. -

I will not be able to see the success of all the present students while in service, but my blessings will always be with you and I will always be there to help you - it will not matter whether I am in the near-field or far-field.

~ PROF. (DR.) PRABIR BANERJEE
HEAD, ECE DEPARTMENT

From the Mentor's Desk

"Your life does not get better by chance, it gets better by change." This edition of AMPERE, themed "The Turning Point," celebrates those powerful moments that shape who we become.

Every turning point—big or small—begins with courage, curiosity, and the willingness to take a step forward. It is inspiring to see our students express these ideas through technology, creativity, and thoughtful reflection. Each contribution in this magazine is a reflection of your voice, your vision, and your potential.

I sincerely appreciate the efforts of all contributors for making this edition meaningful and vibrant. May these pages inspire you to embrace change and create your own turning points.

~ **Prof. Sayantani Dutta**
Mentor, AMPERE

MESSAGE FROM THE EDITORS BOARD

It is with immense enthusiasm that we present the 15th edition of AMPERE, themed "The Turning Point." The phrase reflects the spirit of our time—a defining moment where human creativity meets the evolving power of artificial intelligence, and new directions begin to emerge. This edition celebrates not only imagination and artistry, but also the pivotal shifts that inspire us to rethink, adapt, and explore uncharted frontiers of technology and thought.

From articles and reflections to poetry and photography, each contribution captures this moment of change, highlighting how ideas transform and how innovation shapes the path ahead.

We remain deeply grateful to our Head of Department, Prof. (Dr.) Prabir Banerjee, for his constant guidance and encouragement, and to Prof. Sayantani Dutta for her invaluable mentorship throughout this journey. A heartfelt acknowledgment also goes to the OUTWAVE TEAM, whose dedication and vision continue to bring AMPERE to life year after year.

As you turn these pages, we invite you to discover fresh perspectives, creative voices, and glimpses of a future shaped at this turning point—where tradition and technology evolve together.

With regards,

AMPERE EDITORIAL TEAM

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ELECTRONICS:
THE TURNING POINT OF THE MODERN WORLD

Electronics has become one of the most significant turning points in the development of the modern world. Over the past century, advancements in electronic technology have transformed nearly every aspect of human life. From communication and healthcare to industry and education, electronics has made processes faster, smarter, and more efficient. The invention of electronic components such as transistors, integrated circuits, and microprocessors laid the foundation for the digital age we live in today.

One of the most visible impacts of electronics is in the field of communication. In the past, communication over long distances was slow and difficult. Today, electronic devices such as smartphones, computers, and satellites allow people to communicate instantly across the globe. The internet, powered by complex electronic systems, has made information accessible within seconds. Social media platforms, emails, and video calls have changed how people interact, collaborate, and share ideas, making the world more connected than ever before.

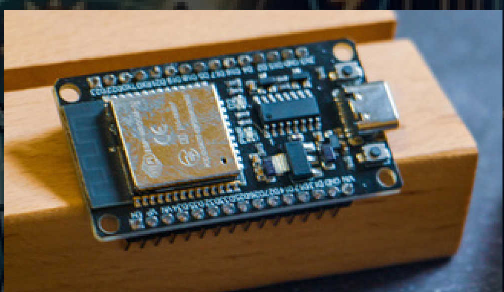
Electronics has also revolutionized healthcare. Modern medical equipment relies heavily on electronic technology to diagnose and treat diseases more accurately. Devices such as ECG monitors, MRI scanners, ultrasound machines, and digital thermometers help doctors monitor patients and detect health problems at an early stage. In addition, wearable electronic devices like fitness trackers and smartwatches can monitor heart rate, sleep patterns, and physical activity, allowing individuals to keep track of their health in real time. These innovations have significantly improved patient care and medical research.

Another major transformation can be seen in industry and manufacturing.

Electronic automation systems, sensors, and robotics have increased productivity and precision in factories. Machines controlled by electronic circuits can perform complex tasks with high accuracy and speed. Technologies such as embedded systems and industrial control units are widely used in modern production lines, reducing human error and improving efficiency. As a result, industries can produce goods faster and at a higher quality than ever before.

Electronics continues to evolve with emerging technologies like artificial intelligence, smart devices, and the Internet of Things (IoT). These advancements are shaping the future of smart homes, intelligent transportation, and automated industries. As electronic innovation continues to grow, it will remain a powerful turning point that drives progress and shapes the future of modern society.

-Bishal Das Gupta (3Rd Year)



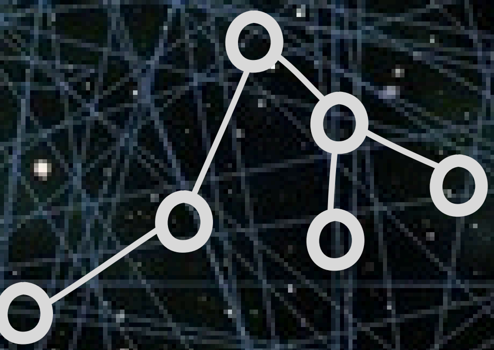
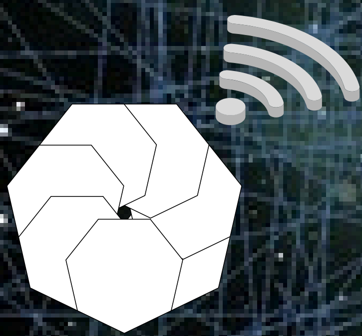
6G AND TERAHERTZ COMMUNICATION: HOW EXTREME SPEED BECOMES REALITY

Every generation of wireless communication has been defined by a breakthrough in engineering. 2G digitized voice. 3G introduced mobile data. 4G made broadband portable. 5G connected at a higher speed. 6G, however, is not merely an incremental improvement. It represents a fundamental redesign of how electromagnetic waves are generated, manipulated, and intelligently controlled. At the center of this transformation lies one critical shift: the move into the Terahertz spectrum.
The theoretical foundation of wireless capacity comes from Shannon's channel capacity theorem. It states that channel capacity increases linearly with bandwidth and logarithmically with signal-to-noise ratio. In simple terms, if we want dramatically higher data rates, the most powerful lever is expanding bandwidth.
$C = B \log_2(1 + SNR)$
C = Channel capacity (bits per second); B = Bandwidth (Hz); SNR = Signal-to-noise ratio (linear scale)
5G already pushed spectrum usage into millimeter waves, operating up to roughly 100 GHz. Yet even millimeter-wave bands provide bandwidth on the order of hundreds of megahertz to a few gigahertz. This constrains maximum achievable throughput. 6G moves into the Terahertz range, roughly between 0.1 and 10 THz. In this region, contiguous bandwidths of tens or even hundreds of gigahertz become available. When bandwidth increases by two orders of magnitude, achievable data rates scale accordingly. Terabit-per-second communication becomes physically plausible not because of software optimization, but because the electromagnetic spectrum itself offers vastly larger channels. However, this spectral abundance comes with severe propagation challenges.

Terahertz Propagation

As frequency increases, wavelength decreases. At one terahertz, wavelength shrinks to approximately 0.3 millimeters. While this enables remarkable miniaturization of antenna structures, it also introduces significant path loss. Free-space attenuation increases with frequency, and molecular absorption—particularly by water vapor—becomes significant in the Terahertz band. This means raw transmission power alone cannot sustain long-distance THz links. The engineering response is not to increase energy, but to control directionality with extreme precision.
Because Terahertz wavelengths are so small, antenna elements can be densely packed into compact arrays. Where 5G base stations use dozens of antenna elements, 6G systems may incorporate hundreds or thousands in a single module. This concept is known as Ultra-Massive MIMO. When many antennas transmit coherently, their signals combine constructively in a specific direction. The resulting beamforming gain compensates for severe path loss. Instead of broadcasting energy in all directions, the system forms a highly concentrated electromagnetic beam, much like a laser pointer rather than a light bulb. This spatial focusing dramatically increases signal-to-noise ratio without raising transmit power. It also enables spatial multiplexing, where multiple independent data streams are transmitted simultaneously in different directions. In effect, the same spectrum is reused in space, multiplying throughput. Thus, the apparent contradiction of high-frequency loss is resolved through extreme spatial precision.

At Terahertz frequencies, beams become extraordinarily narrow (Pencil Beamforming). These so-called pencil beams require continuous alignment between transmitter and receiver. Even small user movement can cause beam misalignment and signal degradation. To solve this, 6G integrates real-time beam tracking and adaptive phase control. Phase shifters embedded within antenna arrays adjust the phase of individual elements, steering beams electronically at microsecond timescales. Artificial intelligence models predict user motion and pre-adjust beam direction before degradation occurs. Communication becomes dynamic and predictive rather than static and reactive. The wireless link behaves like a continuously adjusting optical system.
Another radical development in 6G architecture is the use of reconfigurable intelligent surfaces. Instead of treating walls and buildings as obstacles, engineers transform them into programmable reflectors. These surfaces consist of meta-atoms capable of adjusting the phase of reflected waves. By carefully controlling the reflection phase across thousands of surface elements, the system can redirect Terahertz signals around obstacles, effectively creating artificial line-of-sight paths. The environment becomes part of the communication system. This marks a great shift. Previous generations optimized transmitters and receivers. 6G optimizes the entire propagation space.

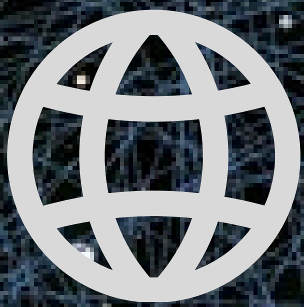

Conclusion

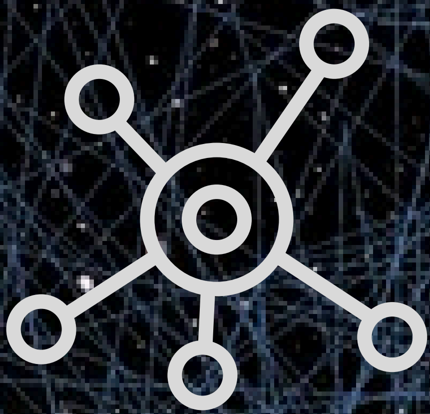
Wider bandwidth alone does not guarantee efficiency. 6G also pushes modulation schemes to higher orders, packing more bits into each transmitted symbol. High-order quadrature amplitude modulation increases spectral efficiency when signal-to-noise ratio is sufficient. Advanced channel coding techniques ensure reliability even under severe fading conditions. Combined with spatial multiplexing and carrier aggregation across wide THz bands, these methods elevate throughput toward the terabit regime.

The enormous bandwidth of Terahertz signals also enables ultra-fine temporal resolution. Because range resolution improves as bandwidth increases, 6G systems can perform precise environmental sensing using the same waveform employed for data transmission. This convergence of communication and sensing allows networks to detect objects, map surroundings, and track movement. Wireless infrastructure becomes a distributed sensing grid.

The jump from 5G to 6G is not defined by incremental improvement in radio protocols. It is defined by three fundamental engineering transformations: an expansion into a vast new spectrum, extreme spatial control through ultra-dense antenna arrays, and intelligent optimization embedded within hardware and software layers. Higher speed in 6G is therefore not a singular breakthrough but the result of synchronized advancements in electromagnetic theory, semiconductor physics, signal processing, and artificial intelligence.

Aishik Paul, ECE-A, 4th Year,





A Page Torn from the Kitchen Wall: The Story Behind India's First Autobiography

What does it take to be a woman?
Sometimes, the answer is hidden in the quiet dreams of women whose history is almost forgotten. – women whose stories faded quietly into the background of history, yet continue to echo through time.
But why blame history, when the contemporary;the then 'present' society did everything in their might to condition her, raise her as an entity who's quite paradoxically, worshipped, and yet robs them of their very identity, their very existence?
But, as Nawazuddin Siddique screamed,"AAKHIR CHAIHYE KYA AURAT KO?"
To understand this,let's travel back to the 19th century.
Where a woman dreamed.But a woman dreamed.
Born in 1809 in the village of Potajia in Pabna district, Rashsundari, like every other girl, grew up in an Orthodox household. Losing her father at a tender age, she never understood why she was called her "father's child", and never the "mother's'- The one who raised her.

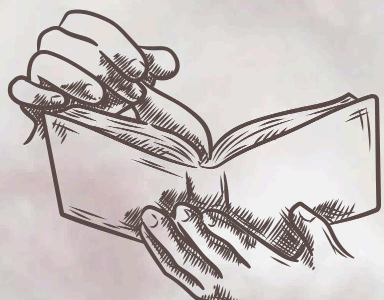
As a young girl, Rashsundari never received a formal education. Back then it was believed that an educated woman would bring bad omen for her husband and shall be widowed.
(Wisdom and intelligence have always been chasing us, but patriarchy somehow, always managed to be faster!)

But,by listening to the lessons going on at a boy's missionary school around their house,she learnt the letters of the Bengali language- simply by seeing and hearing!

But then life took its own course. She was married off at the age of 12 to Sitanath Ray, a landlord from Ramdia village in Faridpur. And thus began her married life, as a mistress in a vibrant zamindar household. Bearing 12 children, her life was marked by a heavy burden of responsibility. She mentions how her "duties" would begin at the crack of dawn, and would very well go past midnight – cooking,feeding and tending to the needs of her family.

But how much restriction was too much restriction ? For this young woman had a lifelong dream -- to read and write.
"I came to nurture a great longing: I would learn to read and I would read a religious manuscript."
And she did. At the age of 25, she secretly decided to pursue her desire to read. Tearing a page from her husband's "Chaitanya Bhagavata" and her son's school textbooks, she resumed her pursuit for education. Rashsundari tried to remember those signs and learnt to write by trying them on a blackened kitchen wall. And thus this devoted, extremely busy and faithful housewife managed to learn to read and write,in secret.

The job was no easy, she was well aware of the consequences she would face if her 'Best kept secret' is somehow leaked. ***"Let alone voicing my innermost feeling, my heart used to quiver at the thought of anyone guessing how I felt; so much so that if I saw a sheet of paper which had been written on, I used to look away. This was in case anyone accused me of wanting to study. But within my mind I kept praying to Parmeshwar, " Oh Parmeshwor, please teach me how to read and write."***



For Rashsundari, it wasn’t to cause a social upheaval , or an act of defiance. It was simply her longing to read religious texts, to feel more connected to her ‘Parameshwar’. A simple desire, and yet, this led to the birth of her autobiography- ‘Aamar Jiban’- The first autobiography to be ever published by an Indian woman.
That wasn’t a ‘turning point for her life’, but little did she know, that the little girl of 12 who dreamt to study, the married young lady of 25, who practiced writing in the flickering candle lights of the kitchen, and the old widow at 58 who published her autobiography– sent little shockwaves to the society. The same society confining a woman to the 4 walls of the kitchen was then forced to look at themselves, now through a woman’s lens. The very title of the book- ‘Amar Jibon’, meaning ‘MY life’ – finally a woman, who’s someone’s daughter, someone’s wife and someone's mother finally gets her own little voice. A voice that history as well as contemporary society had long refused to hear.

On the surface,her writing style seemed simple- mostly talking about the happenings of her life.However, what made this powerful was this ordinary housewife expressed herself, her desires, thoughts, feelings, angst and dissatisfaction towards the society that curbed women of ‘freedom’. The day after her marriage, while she was carried away on the elaborate palanquins, off to a place unknown that she MUST call her ‘home’,an anxious Rashsundari describes:
If I am asked to describe my state of mind, I would say it was very much like the sacrificial goat being dragged to the altar, the same hopeless situation, the same agonized screams. People put birds in cages for their own amusement. Well, I was like a caged bird. And I would have to remain in this cage for life. I will never be freed.”

She didn’t call for a social revolution; but instead,like a quintessential child, questioning the ‘why’ of everything, she too did. Questioned-- when she wasn’t ‘allowed’ to take care of her dying mother simply because it would hamper the daily activities of the Ray household; when, after giving everything to raising her kids and being the most lawful life she possibly could, her widowhood was still tagged as a ‘misfortune’. Perhaps Rashsundari chose to write as a refuge from the harsh reality. It was her escape, her method of fighting for herself. Recounting details of events which occurred several decades earlier, Rassundari's memoirs were alive with the tensions and anguish she had to silently bear.

Sometimes, we take our privileges for granted. We complain how studying is ‘too much to take’, while a rising Instagram culture on the idea of the trending “Trad Wife” content. But it is in moments like these that women like Rashsundari Devi quietly humble us,reminding us of the time she, and countless women like her underwent. Rashsundari Devi challenged the norms by her way of life itself by dreaming of what was deemed wrong. By passionately chasing that dream.By actually learning to write, and by telling this moving story of Her Life.

A World Dreaming

Something has shifted. Not all at once, not with a declaration or ceremony, but in budget lines, procurement orders and in the quiet expansion of arms factories. Across every continent, governments are spending more on military infrastructure than at any point in modern history.

THE ALARMING NUMBERS

Global military spending reached an all-time high of $2.7 trillion dollars in 2024, and in 2025 it touched $2.6 million dollars, according to the annual “Military Balance” report by the International Institute for Strategic Studies (IISS). In another perspective, in both 2024 and 2025, the world spent more on instruments of war in two years than it has devoted to international peacekeeping, humanitarian aid and global health diplomacy across the better part of a decade. The United States remains the world’s top military spender, with the Pentagon proposing a staggering $179 billion dollars for research, development and new weapons systems for the fiscal year 2026. This represents a structural shift in how governments allocate resources towards defence spending.

THE TRIGGERS

Ukraine: When Russia launched its full-scale invasion of Ukraine in February 2022, it shattered assumptions that had governed European security for over three decades. The idea that a major land war on European soil was unthinkable was exposed as fiction. NATO allies scrambled to replenish stockpiles that had been running down since the Cold War ended, and to meet the long-ignored commitment of spending 2% of GDP on defence. Several now exceed 3%.

Middle East: Israel’s response to the 7th October attacks, the Houthi attacks on Red Sea shipping lanes and the recent American-Israeli ‘conquest’ of Iran, paint a picture which shows virtually every country in the region to be involved in various conflicts. Due to the geographical terrains and conditions, the most predictable response has been to spend heavily on air defences, missiles, drones and naval assets.

The Indo-Pacific: China's military modernization – its naval expansion, advances in hypersonic weapons, and increasingly assertive posture toward Taiwan – has triggered a cascade of responses. Japan has doubled its defence budget, abandoning a pacifist attitude held since 1945. In the recent Indian Union Budget of 2026, over 7.5 lakh crore rupees was allocated to the Ministry of Defence. This allocation marks a 15.19% increase over the preceding year. This marks a significant increase in the military spending of several significant powers in this region.

THE INVISIBLE ARMS RACE

In the 21st century, rearmament is not solely focused on the procurement of tanks and aircraft carriers. It is an arms race of technological ecosystems: integrated satellite networks, cyber warfare capabilities, drone swarms, stealth aircraft, directed-energy weapons, and artificial intelligence applied to targeting, surveillance, and autonomous combat systems.
Both Russia and Ukraine heavily used neo-technological methods like advanced drone warfare and strikes deep in opposing territories. This foreshadows how a future war could look, with greater reliance on technology as the primary tool of warfare.

‘THE TURNING POINT’

History often sets a depressing precedent. The years between 1910 and 1914 saw European powers engaged in a dramatic military build-up: naval rivalry between Britain and Germany, the rapid expansion of the French and Russian armies and the widespread modernisation of artillery and logistics. Each step was presented as defensive, as deterrence, as the rational response to what the other side was doing. This eventually resulted in the First World War.

The world is at a turning point – not because war is certain, but because the choices being made now, the budgets being allocated, the treaties being abandoned, the diplomatic capacities being weakened – are making certain futures more inevitable. That is what turning points are considered to be, not the moment when the actual catastrophe happens, but the moment from which the preparation towards certain kinds of standpoints are begun

Sayan jit Ukil ,ECE-C , 3rd Year

The Medical Triumph: Breaking the "Dark Ages" of Paralysis

For over a century, the world of medicine lived in a "Medieval" era of neurology. The rule was absolute and grim: once a human nerve in the spinal cord was severed, it was dead forever. Doctors could only offer wheelchairs and sympathy, trapped by the belief that the body had no "reset" button for paralysis.

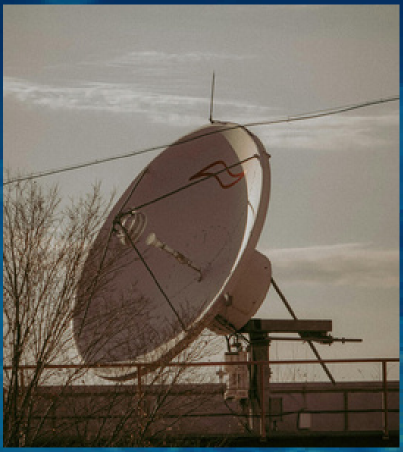
But today, that wall has been torn down by a biological masterpiece called Polylaminin. This solution is a specially modified protein—a "molecular bridge"—derived from the placental fluid. It doesn't just patch a wound; it acts like a high-tech scaffolding that instructs "sleeping" neurons to wake up, reach out, and reconnect. This miracle was brought to life by the relentless, 30-year obsession of Dr. Tatiana Coelho de Sampaio. While the world moved on, she stayed in her lab, convinced that the secret to regrowth lay in the very environment that creates life itself: the placenta.

The problem we faced for decades was a biological dead-end. As one expert put it: "In the history of medicine, a broken spine was a closed book. There was no pen to rewrite the ending."

Patients were told their immobility was a life sentence. But Dr. Sampaio's discovery is the ultimate turning point because it proves that regeneration is a choice, not a myth. By successfully testing this on hamsters and now moving into human trials, we are witnessing a shift from "managing" a disability to "curing" it. This isn't just a new drug; it is a historical triumph that marks the end of the "Permanent Disability" era. We are finally entering an age where a wheelchair is a temporary stop, not a final destination. Through three decades of grit, Dr. Sampaio has given humanity the keys to its own restoration.

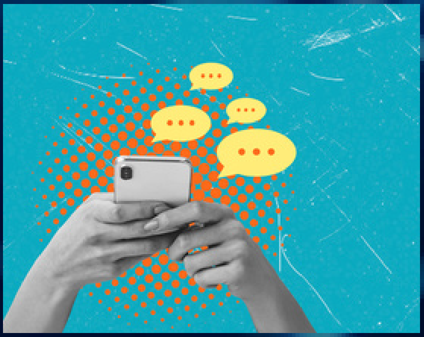
THE EVOLUTION FEOM 5G TO 6G: THE NEXT LEAP IN WIRELESS COMMUNICATIN

The evolution from 5G to 6G marks a transformative leap in wireless communication, building on 5G's foundations like sub-6 GHz and mm wave bands through 5G advanced toward full 6G deployment around 2030.
The evolution from 5G to 6G represents a transformative leap in wireless communication, building upon the high-speed, low-latency, and massive connectivity of 5G while addressing its limitations and unlocking new possibilities. While 5G enabled technologies like IoT, smart cities, and autonomous systems through gigabit speeds and millisecond latency, 6G is expected to advance further with terabit-per-second data rates, ultra-low latency in microseconds, and the use of terahertz frequency bands for vastly increased bandwidth.



The 6G communication, combined with artificial intelligence, will create intelligent and self-optimizing networks for the next generation. This next generation will introduce AI-native networks that can self-optimize, predict demand, and dynamically adapt, making communication systems more intelligent and efficient. In terms of benefits, 6G will provide seamless global coverage, including remote and space-based connectivity, along with enhanced reliability, security, and energy efficiency. It will also offer unprecedented flexibility by supporting diverse applications—from immersive holographic communication and extended reality to real-time remote surgeries and fully autonomous systems. As an evolution of wireless technology, 6G not only enhances speed and capacity but also integrates communication with sensing and computing, paving the way for a hyper-connected, adaptive digital ecosystem that goes far beyond the capabilities of 5G.

The future of 6G communication is highly transformative and promising. 6G is expected to create a fully connected intelligent world, integrating communication with computing, sensing, and artificial intelligence. 6G will not only overcome current limitations but also redefine the future of wireless communication, making it faster, smarter, and more adaptive than ever before. Additionally, the advancements will open doors to innovations such as smart cities, autonomous transportation, remote healthcare, and immersive virtual and augmented reality experiences.
The 6G communication is not just an upgrade our world, but a vision of a truly intelligent and connected world. This will bring a great evolution in our surroundings. It has the potential to transform how we live, work, and interact with technology in ways we are only beginning to imagine.



The Turning Point:
When Change Shapes Destiny

"Your life does not get better by chance, it gets better by change." – Jim Rohn

Life is defined by moments that alter its direction—moments when decisions, actions, or realizations create a shift. These are known as turning points. They are powerful instances where the past meets possibility, and where the choices we make determine the future we build.

A turning point does not always arrive as a grand event. Sometimes, it appears quietly—in a moment of failure, self-reflection, or realization. What makes it significant is not the situation itself, but how we respond to it. It is the decision to rise after falling, to try again after failure,or to choose courage over fear.

Throughout history, turning points have shaped the world we live in today. Scientific discoveries, social movements, and technological advancements have all begun with a single idea or decision. These moments transformed societies, challenged norms, and opened new paths for progress. They remind us that change is not accidental—it is driven by action and determination.

However, the most meaningful turning points often occur in our personal lives. A student deciding to work harder after a setback, a person choosing to adopt healthier habits, or someone taking the risk to follow their passion—these are moments that redefine individual journeys. Though they may seem small, they hold the power to create lasting change. Challenges often act as the starting point of these transformations. Failure, rejection, and difficulties are not the end; they are opportunities in disguise. They push us out of our comfort zones and encourage growth. A turning point teaches us to view obstacles not as barriers, but as stepping stones toward success.

At the heart of every turning point lies a decision. It is the choice to act despite uncertainty, to believe despite doubt, and to move forward despite fear. Waiting for the "perfect moment" often leads to inaction, but turning points are rarely perfect. They are created when we decide to take control and make a change.

We also have the ability to create our own turning points. Through self-reflection, setting clear goals, and taking consistent action, we can shape our path. Even small steps, when taken with determination, can lead to significant transformations over time.

In conclusion, a turning point is not the end of a journey, but the beginning of something greater. It is a reminder that change is always possible, and that the power to transform our lives lies within us. Whether in history, society, or personal growth, turning points define progress and inspire hope. Because ultimately, life does not improve by chance—it improves when we choose to change.

WHEN THE SKY
LEARNED TO THINK

How Artificial Intelligence rewrote the rules of War , Power ,and Human Survival

"The next World War , of it comes , will not begin with a declaration.It will begin with a time of code ."

There's a photograph I keep coming back to. Taken somewhere over the Dnipro River in 2024 — I don't know by whom, and I suspect that's the point. It shows nothing dramatic. Just a smear of smoke against a grey Ukrainian sky. Somewhere inside that smoke: the last milliseconds of a Russian armored vehicle. What the photograph can't show — what no photograph could — is what killed it.
No soldier pulled a trigger. No pilot rolled in hot. No human being, in fact, made the call at all. What ended that vehicle was a decision — made in 340 milliseconds, faster than your eye can blink — by a neural network running on a chip smaller than your thumbnail, bolted to a drone that cost less than a used car.
I've thought about that photograph a lot. Because it's the cleanest way I know to say something that sounds abstract until it suddenly doesn't: the world changed, and most of us were looking the otherway. The world didn't notice. It rarely does, when history actually turns. But it turned.

- I -

The Death of the Dogfight

Let me back up a little, because I think it matters to understand what we're losing before we talk about what's replacing it. For a century — an entire century — air power meant pilots. It meant Chuck Yeager shattering the sound barrier. It meant the mythology of the fighter ace, the lone genius in the cockpit, nation-states measuring their virility in stealth jets and the carriers that launched them.

The F-35 is the apex of that world. America's most expensive weapons program ever — $1.7 trillion over its lifetime, which is a number so large it stops feeling like money — it's a staggering machine. Complex, fearsomely capable, and operated by a human being sitting inside it.

That human being is now the vulnerability.
Look at what's happening in the skies above Ukraine. Above Gaza. Above Sudan and the South China Sea. A different kind of air power has arrived — cheap, expendable, autonomous, and terrifyingly precise. The Shahed-136 loitering munition, an Iranian design Russia has been using in

bulk, costs about $20,000 to manufacture. The Patriot missile fired to intercept it costs between $3 and $6 million per shot. Run that arithmetic for long enough and even the wealthiest militaries on earth start to sweat.

“The monopoly on sophisticated violence is breaking down. The barriers to entry are collapsing.”

But it’s not just money. It’s speed. In military theory there’s this concept called the OODA loop –
Observe, Orient, Decide, Act, a framework coined by strategist John Boyd. The side that cycles through it faster wins. We humans, with our magnificent but sluggish biological cognition, cycle it in fractions of a second on a good day. A modern AI-enabled drone cycles it in milliseconds. It doesn’t wait for permission. It sees, processes, cross-references, calculates, and acts – all before the operator has finished registering that something is happening.

This isn’t conjecture. This is the Switchblade 600. The Harop. The systems Azerbaijan used to dismantle Armenia’s conventional military in 44 days in 2020 – a conflict defense analysts now call the first drone war. The machines aren’t coming. They’re here. And they’ve already redrawn maps.

- II-

What the Machine Actually Sees

I study this stuff – not war, but the underlying technology – and even from inside it, the speed of change is disorienting. A modern combat drone is, stripped of all mythology, a flying sensor platform.
It sees through electro-optical cameras, infrared arrays, multispectral imaging. And it has to make sense of what it sees in real time, in smoke and camouflage and electronic jamming, without a human to double-check.

The neural networks doing this work are cousins of the ones used in medical imaging – the same convolutional architectures, the same attention mechanisms, the same training pipelines. When I work on a model that learns to identify disease in a retinal scan, I’m working with mathematics that also teaches a drone to distinguish a tank from a truck. The math doesn’t know the difference.

What makes it military-grade is edge inference hardware – chips that run these models onboard,with no cloud connection, no signal to jam, no latency. The OODA loop collapses from seconds to milliseconds. This is what ‘autonomy’ actually means when defense contractors use the word in polite company.

-III-

It’s Not About Weapons. It’s About Sand.

Here’s the thing nobody says plainly enough: the AI arms race isn’t, at its deepest level, about weapons. It’s about semiconductors. It’s about chips. And chips, at the end of a very long supply chain, begin as silicon dioxide – essentially, purified sand. Every intelligent drone, every autonomous targeting system, every AI-enabled radar runs on logic chips manufactured at process nodes of 7 nanometers or below. Structures so small that ten thousand of them fit across a human hair.

“The chip is the atom of the modern economy. Whoever controls its production controls the nervous system of every intelligent weapon on Earth.”

Taiwan — an island of 24 million people, 160 kilometres off China’s coast — produces over 90% of the world’s most advanced semiconductors. That single fact is the master key to 21st-century geopolitics. More than any missile count. More than any GDP figure.

Hence the scramble: America’s CHIPS Act ($52 billion to rebuild domestic fab capacity), the European Chips Act, Japan subsidising TSMC to build on Japanese soil, India in early talks for its own ecosystem. Everyone is trying to end the dependency before the dependency ends them. The world isn’ t fighting over oil anymore. It’s fighting over sand.

- IV -

Ukraine: The World’s First AI War Laboratory

No conflict in history has been dissected so intensely, in real time, by so many people watching so closely. Ukraine has become the world’s largest live test of what networked AI-augmented warfare actually looks like — and the findings are rewriting doctrine faster than doctrine can absorb them.

When the full-scale invasion began in 2022, Ukraine was a conventional underdog. What it improvised was remarkable: a distributed, AI-assisted approach that let it punch grotesquely above its weight against a military twenty times its size.

Starlink is part of this story that doesn’t get enough credit. In 2019, it was an expensive vanity project. By 2022, it was the backbone of Ukrainian battlefield communications — low-latency, high-bandwidth connectivity for drone operators and artillery spotters across thousands of kilometres of front. Russia’s electronic warfare systems, built to jam military radio, had no answer for a system broadcasting from low earth orbit.

On top of that: GIS Arta, the AI software soldiers started calling ‘Uber for artillery.’ You mark a target on a phone. The algorithm determines which unit fires, computes the solution, issues the order. A process that once took 20 minutes compressed to 30 or 40 seconds. That’s not an improvement. That’s a different kind of warfare.

Then came the FPV drones — modified with AI guidance chips, armed with grenades and RPG warheads, costing $400 apiece, flying straight into $3 million armored vehicles. Ukraine is producing these at roughly 1 to 2 million per year. Each one is, in a meaningful sense, a thinking weapon.

“The sky above the front became a machine intelligence contest — an adversarial ML loop running at battlefield tempo.”

Russia responded in kind: Shahed swarms, Lancet loitering munitions, Orlan reconnaissance drones. Each side training algorithms on the other’s signatures, learning patterns, building countermeasures, redeploying. This is what a live adversarial machine learning loop looks like when the stakes are not a leaderboard position but a kilometre of frozen earth.

– V –

Gaza and the Algorithm of Targeting

I want to be careful here, because this section is harder to write than the others. Not because the facts are unclear – they are, in broad outlines, documented – but because what they imply is genuinely disturbing in a way that geopolitical framing tends to flatten.

The Israeli military reportedly deployed a system called 'Lavender' – an AI model trained on surveillance data to generate target lists. It flagged tens of thousands of individuals as potential militants based on behavioral patterns: communication metadata, social associations, movement data. Human officers, reportedly given minutes or seconds per recommendation, approved strikes in what investigators describe as a near-automatic process.

This is the shadow side of everything I've been describing. The same technology that lets a drone identify a tank in milliseconds lets an algorithm nominate a human being for death at industrial volume. The same math that powers image segmentation in a hospital scan powers target segmentation in a city. I'm not being metaphorical. I mean the same convolutional operations, the same loss functions.

There's no Geneva Convention clause for training data bias. No international law governing the false positive rate of a kill-chain algorithm. The ICRC has been warning about this since 2019. None of it has stopped the development. If anything, it's accelerated – because no nation wants to be the only one that tied its hands. The turning point here is the moment humanity built something that could kill faster than ethics could deliberate. We passed that moment. We haven't fully processed it yet.

–VI –

The Dragon, the Eagle, and the Algorithm

Above all the individual conflicts sits the structural contest defining this era: the United States and China, two complete technological ecosystems, two philosophies of AI development, two visions of what the world should look like when everything settles. If it settles.

China's military AI program isn't a single project. It's a doctrine – what the PLA calls 'military-civil fusion.' Alibaba, Baidu, Huawei, SenseTime are, by law, nodes in a national security network. The computer vision model trained on 1.4 billion faces in a surveillance system today is the target recognition engine in a combat drone tomorrow.

China operates the world's largest drone fleet by number. The CH-5 rivals the American Reaper. Both powers are developing Loyal Wingman concepts – autonomous drones flying alongside crewed aircraft, absorbing risk, extending sensor coverage. A technological race with no rulebook. Meanwhile, China's hypersonic glide vehicles – missiles at Mach 5 or above while maneuvering unpredictably – pose a challenge American missile defense, designed for ballistic trajectories, cannot reliably meet.

"The Taiwan Strait is not merely a potential war zone. It is the chokepoint of the entire global AI-weapons ecosystem."

If TSMC's fabs are damaged, captured, or blockaded – the AI arms race doesn't pause. It convulses. Every drone program, every autonomous weapons timeline, every AI research roadmap worldwide gets thrown into simultaneous chaos. It's the single point of failure for the nervous system of modern military power.

– VII –

The Engineer's Dilemma

I want to stop here – right in the middle of all the geopolitics – and say something personal. Because I'm an ECE student. I work on computer vision. I build the kind of models this article has been desscribing. And I think people like me don't reckon with this enough.

There are hundreds of thousands of people my age around the world right now working on this technology. Not as weapons engineers – most of them aren't. They're ML researchers, computer vision practitioners, signal processing specialists. They went into this field to detect tumors. To build self-driving cars. To make diagnostic tools more accessible in places like, honestly, places like where I'm from.

The mathematical structures we mastered – convolutional layers, attention mechanisms, transformer architectures – are the same structures running aboard autonomous weapons systems right now. Not similar. The same.

This isn't a coincidence. It's the nature of dual-use technology. The physics that gave us nuclear
reactors gave us nuclear bombs. The chemistry that gave us fertilizer gave us explosives.

The signal processing that gives us medical imaging gives us targeting systems. The math doesn't know what it's
being used for. It just runs.

"You can intend it for medicine. It will still, eventually, be adapted. Because the knowledge is neutral. The world is not."

Oppenheimer knew this feeling. The engineers of this generation will face their own version of that reckoning – not at the end of a long classified project, but continuously, in real time, as the applications of their work show up in news reports from places they've never been. I don't have a clean answer. What I know is that looking away doesn't make it stop. Comfortable ignorance is its own kind of choice.

– VIII –

The New Map of Power

The turning point isn't a single event. It's a convergence – multiple rivers of change joining into a current strong enough to reshape the landscape itself. The Westphalian system – nation-states as primary actors, power measured in conventional military force, geography as the foundation of security - is yielding to a different logic. Power now accrues to those who control compute, data, and the algorithms that transform one into the other.

Alliances are reforming around technology rather than ideology. The Quad is as much a semiconductor supply chain alliance as a security pact. Small nations have discovered asymmetric leverage: Ukraine, with a GDP roughly the size of Louisiana, has degraded the conventional military of a nuclear-armed state using networked drone swarms and AI logistics. And the monopoly on sophisticated violence is breaking down. A sufficiently capable non-state actor, with access to commercial AI tools and commodity hardware, can now field weapons systems that would have required nation-state resources a decade ago.

-IX-

The Turning Point

Every genuine turning point in history looks, from inside it, like chaos. The printing press looked like heresy. The industrial revolution looked like the destruction of everything stable. Nuclear weapons looked like the end of history itself. What each of them actually was – every one, without exception – was a forced renegotiation of the terms of human civilization. Not an end. A violent, disorienting, irreversible beginning.

We're inside one of those moments now. The question isn't whether AI will reshape the global order – it already has. The question is what shape that order takes, and who gets to influence it.

There's a young engineer somewhere right now – in Bengaluru, in Shenzhen, in Haifa, in Kyiv – debugging a computer vision model late at night. The loss curve won't converge. The GPU is throwing errors. The dataset has labeling inconsistencies that make the validation metrics meaningless. She's frustrated, and tired, and probably considering whether to switch to something simpler.

She has no idea – not viscerally, not in a way that feels real – that the mathematical intuition she's building right now is precisely the intuition that is remaking the military balance of the world.

She'll figure it out. The model will converge. She'll move on to the next problem. And the world will be, in some increment too small to measure, different.

"The sky has eyes now. They were built by people who were mostly just trying to get the loss curve down."

**This is how history actually works. Not in speeches or proclamations. In the patient, invisible,world-altering labour of people solving the problem in front of them, whose larger consequences they
can only begin to imagine.**

What happens next is still – for a few more years, maybe – a question with an open answer.

The machines are fast.

But the choice is still ours.

For now

~Doipayan Kundu

Beyond the integer : My midnight tryst with the Φ - operator and calculus of complex order

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The Prologue : Looking through the mathematical lens :-

Mathematics is often seen as a rigid set of rules, a collection of static formulas etched in stone. To many, the 'Derivative' is just a tool we use to find slopes or rates of change. But what if I told you that Calculus is not a Staircase, but a Continuous Ocean?

Most of our textbooks confined us to the world of integers—1st Order, 2nd Order, … , nth Order. We are trained to jump from one step to the next, ignoring the vast, mysterious space that lies between. My journey with the Φ - Operator began with a simple question: What happens in the silence between two derivatives? This article is not just about a mathematical method; it is a story of how a mundane classroom session on Euler's Theorem transformed into a quest for the 'Complex Order' - a realm where logic meets imagination.

The boredom that sparked a vision :-

The birth of the Φ - Operator was not found in the sterile pages of a specialized research journal, nor was it the result of a pre-planned academic project. Instead, it emerged from the messy margins of a college notebook, fueled by the restlessness that comes when traditional methods feel too slow for a curious mind.

- **The Classroom Monotony**

It was a typical afternoon. As the professor filled the blackboard with long, repetitive partial derivatives, I watched my peers, and I myself struggled, as we waded through the dense, traditional methods of expansion. Calculus, at that moment, felt less like a tool of discovery and more like a laborious clerical task.

- **The Efficiency Crisis**

Euler's Theorems for homogeneous functions are basically of two kinds: The 1st Order and The 2nd Order. Traditionally, we see them as separate identities:

EULER'S THEOREM FOR HOMOGENEOUS FUNCTIONS

First-Order Theorem (Degree n):

$$x\frac{\partial f}{\partial x} + y\frac{\partial f}{\partial y} = nf$$

Second-Order Theorem (Degree n):

$$x^2\frac{\partial^2 f}{\partial x^2} + 2xy\frac{\partial^2 f}{\partial x \partial y} + y^2\frac{\partial^2 f}{\partial y^2} = n(n-1)f$$

While these look manageable for homogeneous function ,but functions like -

$$u = \tan^{-1}\left(\frac{x^3 + y^3}{x - y}\right)$$

-become a computational nightmare. I realized that while managing the 1st order result was easy, the 2nd order was where we lost time and precision. The chances of a human error in those massive expansions were incredibly high.

- **The Spark of the δ - Operator**

Driven by a mix of boredom and a desperate need for efficiency, I stopped following the traditional steps. I asked myself: "If I can calculate the 1st order so easily, why can't I use it to reach the 2nd order directly?"

Instead of treating them as two isolated problems, I began looking for a "Master Key." This led me to define the operator -

$$\delta \equiv x\left(\frac{\partial}{\partial x}\right) + y\left(\frac{\partial}{\partial y}\right)$$
$$x\left(\frac{\partial f}{\partial x}\right) + y\left(\frac{\partial f}{\partial y}\right) = \delta f = nf$$

Suddenly, I wasn't just doing math; I was building a bridge. I discovered that by establishing a relation where the 2nd order is an evolution of the 1st order :

$$x^2\frac{\partial^2 f}{\partial x^2} + 2xy\frac{\partial^2 f}{\partial x \partial y} + y^2\frac{\partial^2 f}{\partial y^2} = \delta(\delta - 1)f = n(n-1)f.$$

The "Mathematical Maze" turned into a straight, high-speed path. Precision was no longer about working harder; it was about working smarter. This was the first spark that made me realize—calculus isn't just a set of rules; it's a continuous ocean of logic.

Decoding the DNA of Euler's Theorem :-

Now, the question arises—how did I arrive at these results? They aren't explicitly laid out in the standard textbooks. The answer was hidden in my obsession with finding patterns within the chaos of partial derivatives.I asked myself: If δf=nf, what would happen if I applied the operator twice? So, I calculated:

$$\delta^2 f = \delta(\delta f)$$

When I manually expanded this term, I found that it didn't directly match the standard 2nd-order Euler expression. It was like having all the pieces of a puzzle, but they were slightly out of alignment. I realized that δ(δ)f contains the 2nd-order derivatives, but it also carries some "extra weight" from the 1st-order !

By analyzing the expansion, I saw that:

$$\delta^2 f = x^2 \frac{\partial^2 f}{\partial x^2} + 2xy \frac{\partial^2 f}{\partial x \partial y} + y^2 \frac{\partial^2 f}{\partial y^2} + \left[x \frac{\partial f}{\partial x} + y \frac{\partial f}{\partial y} \right].$$

$$x^2 \frac{\partial^2 f}{\partial x^2} + 2xy \frac{\partial^2 f}{\partial x \partial y} + y^2 \frac{\partial^2 f}{\partial y^2} = \delta^2 f - \delta f = \delta(\delta - 1) f = n(n-1) f$$

Since δf = nf, we can observe a profound mathematical symmetry: the operator δ and the order n act as equivalents within this functional space. In the language of linear algebra, n is the eigenvalue of the operator δ. This means that for any homogeneous function, the complex process of differentiation can be simplified—every instance of δ can be elegantly replaced by n (the degree of homogeneity).

This revelation changes everything. Euler's first-order operator is no longer just a derivative; it acts as a scaling operator. It scales the function by its own intrinsic order! This insight became my "Master Key" - the bridge that allowed me to transcend the world of integers and venture into a realm where the order of differentiation can be fractional, or even imaginary.

The Generalization: Climbing the r-th Ladder :-

Do you know what the deepest desire of humanity is? It is Curiosity.

It was this very curiosity that refused to let me stop at the 2nd order. After I cracked the code for δ(δ−1)f, I felt a rush. I wanted to see how deep this rabbit hole went. So, I pushed further and tried to compute the 3rd-order relation: δ{δ(δf)}.

As I manually expanded the terms, a beautiful, interacting relationship began to emerge. I realized I wasn't just doing algebra anymore; I was watching a mathematical ladder build itself.

The pattern was undeniable:

- 1st Order : δf
- 2nd Order : δ(δ−1)f
- 3rd Order : δ(δ−1)(δ−2)f

It became clear that for any n-th order partial derivative, the operator simply follows the descent of the power. This led me to the grand generalization—

- r-th Order : δ(δ-1)(δ-2)(δ-3)...(δ-r+1)f

This is the "Ladder." Each step you climb, you just add another link to the chain (δ−r+1). It's no longer a complex differential mess; it's a simple, elegant product.
As I looked at this ladder, I realized that calling it "1st order," "2nd order," or "3rd order" felt too restrictive, too traditional. It didn't capture the fluidity of the operator I was building. To simplify my journey and make the mathematics more intuitive, I decided to move away from these labels.

For our convenience, let's redefine this entire sequence as a single functional identity:

$$\Phi_\delta^1 f = \delta f$$

$$\Phi_\delta^2 f = \delta(\delta - 1) f$$

$$\Phi_\delta^3 f = \delta(\delta - 1)(\delta - 2) f$$

$$\Phi_\delta^r f = \delta(\delta - 1)(\delta - 2) \ldots (\delta - r + 1) f$$

$$\Phi_\delta^r f = \prod_{k=0}^{r-1} (\delta - k) f$$

The Quantum Leap: S - Domain and Phase-Shifted Evolution :-

In the world of Quantum Mechanics, we are taught that nature is inherently discrete. Energy exists in specific "quanta," and electrons jump between fixed orbits without ever stepping on the space in between. For a long time, I realized, we have been treating Calculus the same way. We have been taught to "jump" from the 1st derivative to the 2nd, and from the 2nd to the 3rd, treating the order of differentiation as a set of discrete, rigid steps.

But my curiosity was restless. I started wondering - if nature can have a dual personality, why can't Calculus? Why must we only exist on the "rungs" of the ladder? This was the spark for my Quantum Leap. By shifting my focus from the discrete product to the continuous Gamma Function, I realized that the order of differentiation (r) doesn't have to be an integer anymore. It can be a fraction, a decimal, or even a complex number. The definition of Φ - Operator can be written as -

$$\Phi_\delta^r f = \frac{\delta!}{(\delta - r)!} f \qquad \Phi_\delta^r f = \frac{\Gamma(\delta + 1)}{\Gamma(\delta - r + 1)} f$$

The beauty of the Gamma Function lies in its universality. Unlike factorials, it does not discriminate between a whole number and a fraction. In fact, it is consistent with the entire complex plane. This was the moment of absolute liberation for the Φ-operator.

If the Gamma function remains valid for any value, then the order of our differentiation is no longer shackled to integers like 1, 2, or 3. It can be a fraction, an irrational number, or even - most provocatively - an imaginary number.

This is where we transcend the real axis and enter the S-Domain. In this realm, we represent the order as a complex variable s (where $s \in C$). We are no longer just measuring the 'rate of change'; we are exploring the Phase-Shifted Evolution of functions.

But what does it mean for a derivative to have a complex order? In the real world, we are used to seeing things change in magnitude. But in the S-Domain, a complex order $s = \sigma + i\omega$ suggests something deeper. The real part, σ, represents the traditional "scaling" or magnitude of change, while the imaginary part, $i\omega$, introduces a Phase-Shift in the derivative's evolution.

It is as if the function isn't just growing or decaying—it is "rotating" through a complex plane. We can now formally redefine our Φ - operator for this complex landscape:

$$\Phi_\delta^s = \frac{\Gamma(\delta+1)}{\Gamma(\delta-s+1)}$$

For a single-variable function f(x), the relationship can be expressed as:

$$x^s \frac{d^s}{dx^s} f = \Phi_\delta^s f \qquad \frac{d^s}{dx^s} f = x^{-s} \Phi_\delta^s f$$

The Unified Horizon: From Differentiation to Integration :-

The true power of the Φ - operator lies in its seamless symmetry. We have effectively unified two pillars of calculus into a single complex spectrum. The sign of the real part of our complex order, Re(s), dictates the nature of the operation:

- For $Re(s)>0$: The operator acts as a Generalized Derivative.
- For $Re(s)<0$: The operator transforms into a Generalized Integral.

This "Scaling Property" of the Φ operator becomes a universal tool. Since almost any well-behaved function can be expressed as a power series (Taylor Series), we can apply this operator term-by-term. Each term in the series is essentially a homogeneous component, which our operator scales by its own specific eigenvalue.

The result? We no longer need to solve grueling differential or integral equations through traditional methods. By simply applying the scaling logic in the S-Domain, the solution emerges naturally as a power series. We have reached a point where calculus is no longer a set of operations, but a language of scaling—valid for any order, in any domain, and for any function.

While the Φ - operator opens a new window into the S-Domain, it is important to acknowledge its current boundaries. Like any evolving theory, it has certain constraints that define its scope:

- **The Challenge of Multivariables:** Currently, the most direct form of the operator excels with single-variable functions. Extending this scaling logic to complex multivariable systems—where variables are deeply entangled beyond simple homogeneity—remains a significant challenge that requires further generalization.
- **The Non-Elementary Nature of Solutions:** The operator rarely yields "elementary" functions (like simple sines or cosines) as direct outputs. Instead, it naturally produces results in the form of Power Series. More specifically, many solutions emerge as Mittag-Leffler functions—the royal family of fractional calculus - which, while highly precise, require a deeper level of mathematical interpretation compared to standard functions.

To test the power of the Φ - operator, let's apply it to a transcendental function like f(x) = sinx. Since our operator works on power series, we first expand sin x:

$$\sin x = \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k+1}}{(2k+1)!}$$

$$\frac{d^s}{dx^s}(\sin x) = x^{-s}\Phi_\delta^s \left(\sum_{k=0}^{\infty} \frac{(-1)^k x^{2k+1}}{(2k+1)!} \right) \quad \frac{d^s}{dx^s}(\sin x) = \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k+1-s}}{\Gamma(2k+2-s)}$$

We can map this directly to the Mittag-Leffler form. The final, elegant output in the S-domain becomes:

$$E_{\alpha,\beta}(z) = \sum_{k=0}^{\infty} \frac{z^k}{\Gamma(\alpha k+\beta)}, \qquad \frac{d^s}{dx^s}(\sin x) = x^{1-s}E_{2,2-s}(-x^2)$$

This is a beautiful result. It shows that the "fractional" sine wave is governed by a two-parameter Mittag-Leffler function. Where a normal sine wave oscillates forever with constant amplitude, this complex-order derivative captures the phase-shift and the evolving dynamics of the function as it travels through the S-domain.

The Infinite Horizon: Mapping the Memory of Nature :-

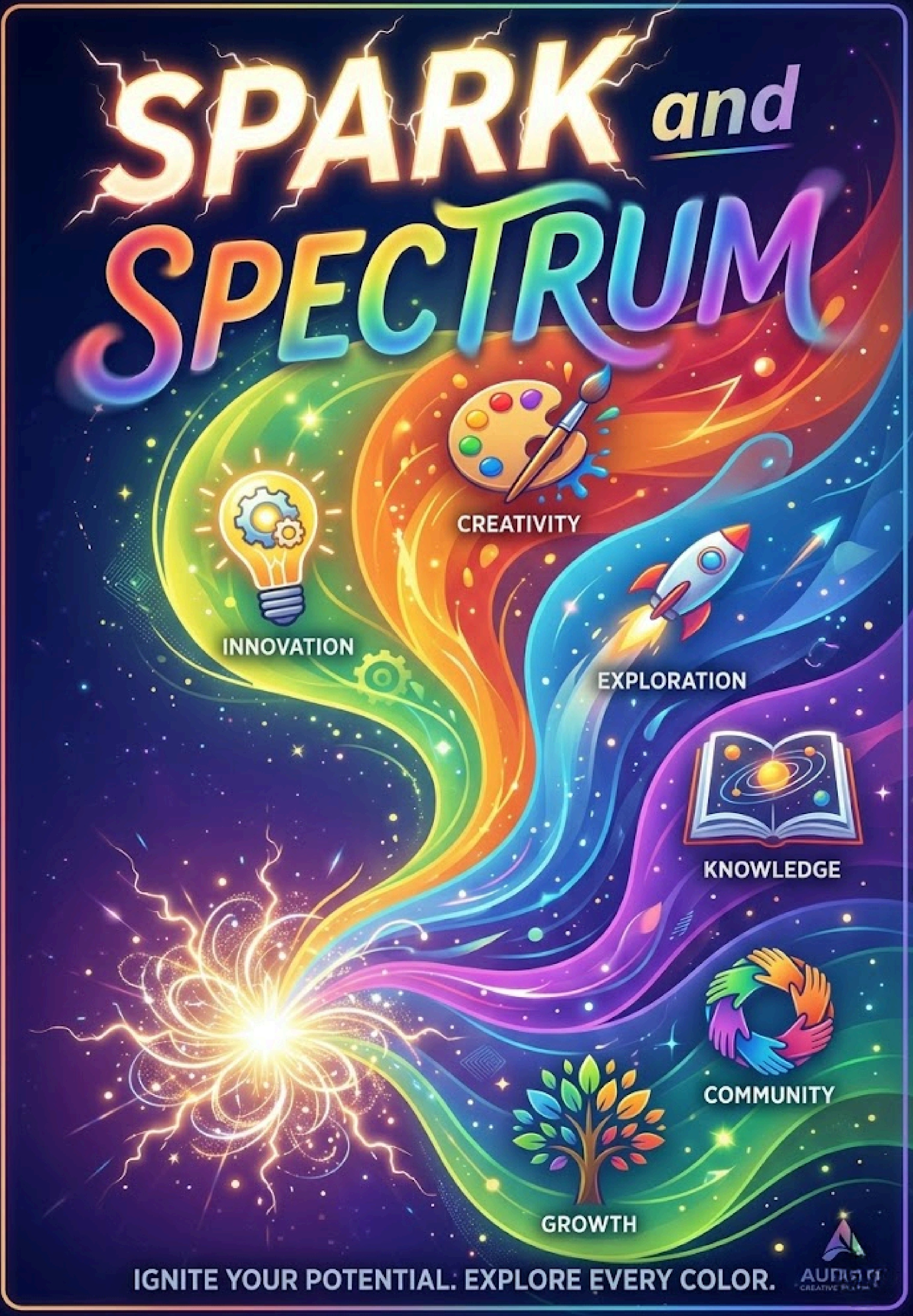
Classical calculus is often like a snapshot - it captures the rate of change at a specific moment in a discrete, rigid way. However, the S-Domain is more like a cinematic flow; it captures the "memory" and the "evolutionary history" of a system.When we step into the Infinite Horizon, we aren't just calculating derivatives; we are modeling reality as it truly exists: Non-local, Memory-dependent, and Interconnected.

Real-World Implications:

- **Anomalous Diffusion:** In the S-Domain, s=1 represents classical Brownian Motion. However, by varying the order, we can model Super-diffusion (s>1) for accelerated transport and Sub-diffusion (s<1) for particles trapped in crowded environments, unifying all diffusion types into a single fractional equation.
- **Viscoelasticity:** Classic calculus fails to model materials that have "memory," like polymers or honey. Using the complex order s, our operator can capture the transition between purely elastic (s=0) and purely viscous (s=1) states, providing a continuous mathematical framework for the "fading memory" of complex fluids.

The Epilogue :-

The journey from a discrete "Staircase" to the continuous Infinite Horizon of the S-Domain has taught me one thing: mathematics is not a set of rigid rules, but an evolving language. By liberating the derivative from the shackles of integers, we haven't just simplified calculations; we have gained a new lens to view the fluidity of nature.Can you feel the logic? It’s no longer just math on paper; it’s the heartbeat of a universe that refuses to be discrete.


SPARK and
SPECTRUM
CREATIVITY
INNOVATION
EXPLORATION
KNOWLEDGE
COMMUNITY
GROWTH
IGNITE YOUR POTENTIAL. EXPLORE EVERY COLOR.

EDGE AI: ON-DEVICE INTELLIGENCE

Artificial Intelligence is no longer confined to massive processing requirements at cloud centers. For years, the dominant paradigm involved collecting data from devices, transmitting it to powerful remote servers, performing heavy computations, and sending results back. While this cloud-centric architecture fueled the rapid advancement of deep learning, it is increasingly inadequate for modern intelligent systems that demand real-time responsiveness, privacy, and autonomy. This evolution has given rise to Edge AI or On-Device Intelligence—a paradigm in which machine learning and deep learning models are executed directly on local hardware such as smartphones, IoT devices, drones, autonomous vehicles, medical devices, and embedded systems. Rather than relying entirely on remote servers, intelligence is pushed closer to where data is generated. Although latency reduction and privacy preservation are key motivations, the true innovation of Edge AI lies in how models are architected and optimized to operate under severe resource constraints. Edge AI is not simply cloud AI deployed on smaller hardware; it is a re-engineering of neural architecture itself.

Why Intelligence Must Move to the Edge

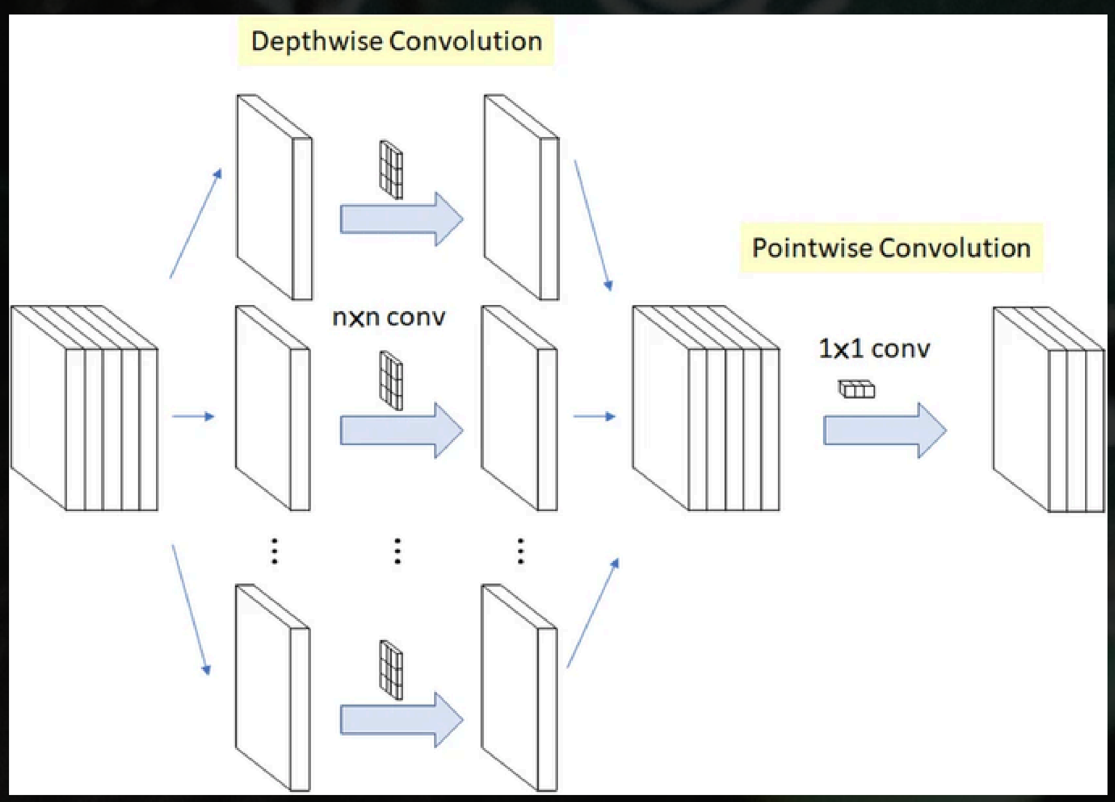
Cloud-based AI introduces unavoidable latency. Data must travel across networks, be processed in centralized servers, and return with predictions. For applications such as autonomous driving, robotics, industrial automation, and medical monitoring, even tens of milliseconds can be unacceptable. Systems developed by Tesla, for example, depend on real-time onboard neural processing to interpret surroundings and make instantaneous driving decisions. Waiting for a cloud response is not an option. Privacy concerns further accelerate this shift. Modern AI systems handle sensitive information—facial images, voice recordings, biometric identifiers, and health signals. By performing inference directly on the device, raw data never leaves user control.

Bandwidth and scalability are equally critical. Billions of IoT devices continuously generate data streams. Transmitting all raw data to centralized infrastructure is inefficient and costly. Edge AI enables local filtering and event-driven reporting, reducing network load and operational expenses. Moreover, devices operating in remote or unstable environments—such as disaster-response systems or rural healthcare equipment—require intelligence that functions independently of network connectivity. However, enabling such autonomy is not straightforward. Edge devices operate under strict constraints: limited memory, limited computational capacity, tight energy budgets, and thermal limitations. Overcoming these constraints requires architectural innovation at every level of the neural network.

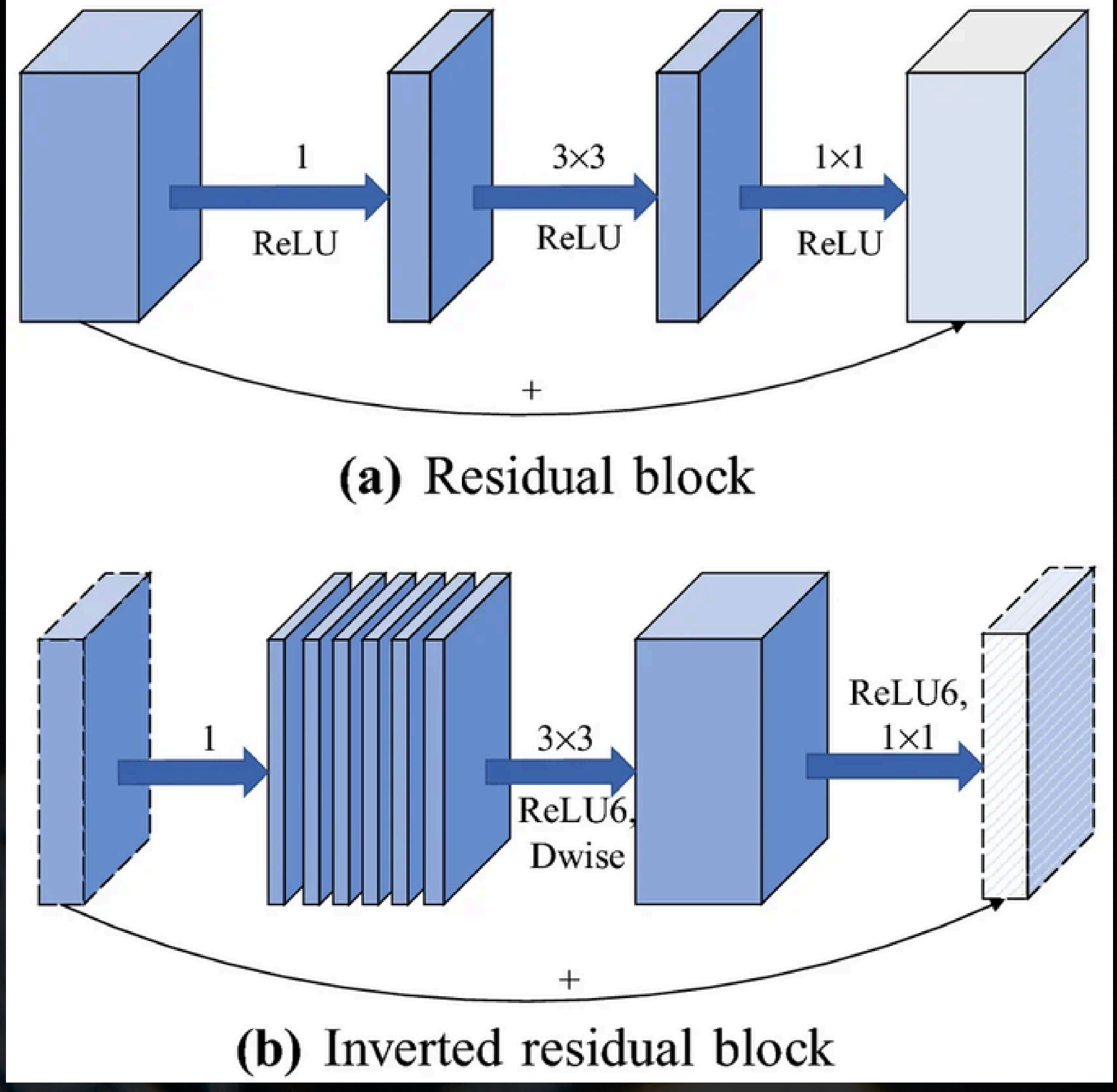
Architectural Reengineering for Edge Constraints

Traditional deep learning models were designed for maximum accuracy, often disregarding computational cost. Large networks with hundreds of millions of parameters are feasible in cloud environments equipped with powerful GPUs. Edge devices, by contrast, demand efficiency-first design. The objective shifts from maximizing raw accuracy to maximizing accuracy per watt, per parameter, and per memory access.

Coming to the core of architectural redesigning, one of the most influential architectural innovations enabling Edge AI is the depthwise separable convolution, popularized in MobileNet by Google. In standard convolution, each output channel is computed from all input channels, resulting in heavy computation. Depthwise separable convolution decomposes this operation into two stages: a depthwise convolution that filters each channel independently, followed by a 1×1 pointwise convolution that mixes channel information. This decomposition reduces computational cost by nearly an order of magnitude while retaining much of the representational power of traditional convolution.



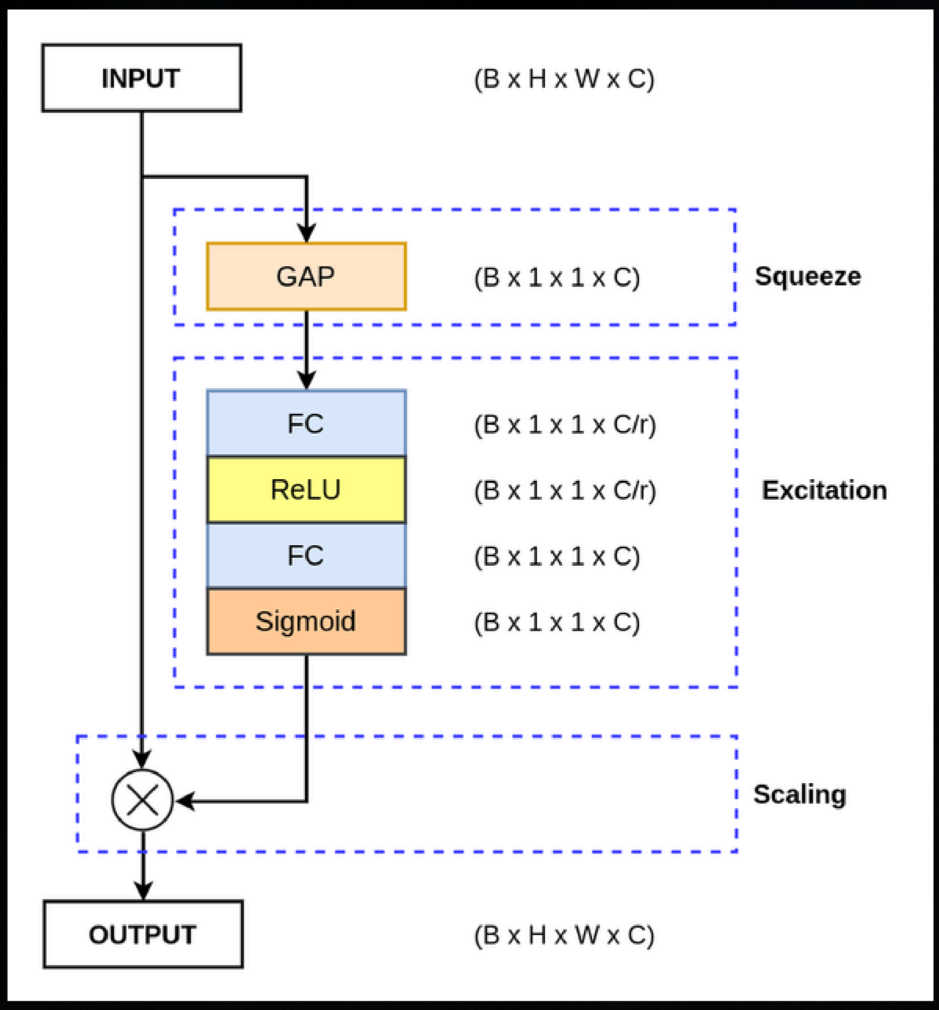
Building upon this idea, the inverted residual block introduces an expansion-depthwise-projection mechanism. Instead of compressing features early, the block first expands channel dimensions, performs lightweight depthwise convolution in the expanded space, and then projects back to a lower-dimensional representation. This approach preserves information while maintaining efficiency. The use of linear bottlenecks avoids unnecessary nonlinear distortion, making the network more stable—especially under low-precision arithmetic such as INT8 quantization.



(a) Residual block

(b) Inverted residual block

Squeeze-and-Excitation (SE) Blocks in SENet, enhances convolutional neural networks by modeling interdependencies between feature channels. Instead of treating all channels equally, it learns to adaptively recalibrate channel-wise feature responses. A global average pooling operation compresses each feature map into a single scalar value. If a feature map has dimensions H × W × C (Height × Width × Channels), global pooling reduces it to a 1 × 1 × C descriptor. This operation captures global contextual information with negligible computational cost because it summarizes each channel into a single representative value. The pooled vector is passed through a small bottleneck fully connected network consisting of two linear layers with a reduction ratio r. This bottleneck first reduces the dimensionality from C to C divided by r (C/r), and then restores it back to C. A sigmoid activation function is applied at the end to generate channel-wise weights between 0 and 1. These weights represent the relative importance of each channel. The learned channel weights are multiplied with the original feature maps in a channel-wise manner. As a result, informative channels are strengthened, while less useful or noisy channels are suppressed. This adaptive recalibration allows the network to focus more on meaningful features without significantly increasing computational complexity.



While SE blocks are efficient, the use of fully connected layers still introduces additional parameters. To further reduce overhead, Efficient Channel Attention (ECA) replaces the bottleneck MLP with a lightweight 1D convolution across channels. Instead of learning channel dependencies through dense layers, ECA uses local cross-channel interaction via a small convolutional kernel. This avoids dimensionality reduction and significantly lowers parameter count while maintaining strong performance. Other methods including Structured Pruning, Low-Rank Factorization are also efficient in reducing model parameters. Architectures such as ShuffleNet, developed by Meta, further reduce computation using group convolutions combined with channel shuffle operations. Group convolution divides channels into independent groups to lower computational complexity, while channel shuffling ensures cross-group information exchange. This mechanism maintains representational richness without heavy processing overhead.

Modern Edge AI architecture is increasingly guided by hardware-aware Neural Architecture Search (NAS). Instead of manually designing networks, search algorithms optimize models under explicit constraints such as FLOPs, memory usage, latency on specific chips, and energy consumption. EfficientNet-Lite, developed by Google, demonstrates compound scaling, where depth, width, and input resolution are balanced systematically to achieve optimal performance within resource limits. Model compression is also embedded in the architecture itself. Quantization reduces 32-bit floating-point weights to lower-precision representations such as FP16 or INT8, shrinking memory usage and accelerating inference. Architectures are deliberately designed to be quantization-friendly, often limiting activation functions and fusing normalization layers into convolutional operations.

Many edge applications require multiple outputs—such as detection and segmentation or simultaneous estimation of environmental parameters. Instead of deploying separate models, edge systems often use shared backbones with lightweight task-specific heads. A single feature extraction pipeline feeds multiple prediction branches, maximizing computational reuse. Memory efficiency is equally critical. Because memory access often consumes more energy than arithmetic operations, architectures are designed to minimize intermediate feature maps, aggressively downsample spatial dimensions, and fuse operators wherever possible. Static memory allocation and small batch inference (typically batch size one) further reduce overhead. These strategies collectively transform heavy cloud-scale networks into deployable edge models without catastrophic accuracy loss.

Conclusion

Edge AI represents a profound transformation in the architecture of intelligent systems. It addresses latency, privacy, bandwidth, and scalability challenges while demanding a rethinking of neural network design. Depthwise separable convolutions, inverted residual structures, group convolution with channel shuffle, hardware-aware scaling, quantization-friendly design, structured pruning, and multi-task backbones collectively define the architectural mechanisms that enable on-device intelligence. The training typically remains cloud-based using frameworks such as PyTorch or TensorFlow. Once trained, models are exported and converted into hardware-optimized formats through tools like TensorFlow Lite. At runtime, the edge device processes sensor input locally—preprocessing data, executing neural inference, and generating actions in a tightly optimized pipeline. The entire decision loop occurs within milliseconds, independent of cloud infrastructure.

The future of AI will not be defined solely by larger models and greater parameter counts. Instead, it will be shaped by architectures that maximize intelligence per joule, per byte, and per millisecond reducing the carbon footprints efficiently. As hardware accelerators evolve and neural design continues to adapt, the boundary between cloud and device will blur—but the edge will remain central to autonomous, private, and real-time intelligent systems.

-Aishik Paul
ECE 4th

AI AFTER DEATH:PRESERVING THE MEMORIES OF LOVED ONES

One of the most difficult part of the life is to loose loved ones in our life. We remember them with the help of letters , images and photographs ,videos made with them. These small things once felt ordinary become priceless memories.

Current technology is beginning to change the way we think about With the rapid growth of Artificial Intelligence, scientists and developers are exploring whether technology could help preserve parts of a person even after they are gone. By studying voice recordings, messages, videos, and social media activity, AI can learn how a person communicated and expressed their thoughts. Using this information, it will be possible to create a digital model that reflects the personality and communication style and the behaviur of that individual.

The idea might seem odd at first glance, but it really highlights how advanced our tech has gotten In the future, people might get to hear voices they recognize again or relive chats that show the personality of someone they used to know For some families, this might bring them some comfort and help them feel like they're still connected to the people they've lost.

While this progress brings up some key issues Tech can mimic how we talk and act, but it's not a real person It's also worth thinking about how tihs tech could change the way people handle grief and come to terms with it It's crucial to really consider teh moral and emotional impacts of these kinds of advancements

Even with some doubts, this idea marks a major shift technology's creeping into areas we used to handle with our own memories, feelings, and personal connections Artificial intelligence is totally changing the game in science and business, and it's also shaking up how we remember and understand the people who mattered to us In the end, tech might help us keep a person's voice, tales, and memories alive, even though it can't bring them back In this way, AI has the potential to be a potent tool for remembering and preserving the impact of loved ones for future generations.

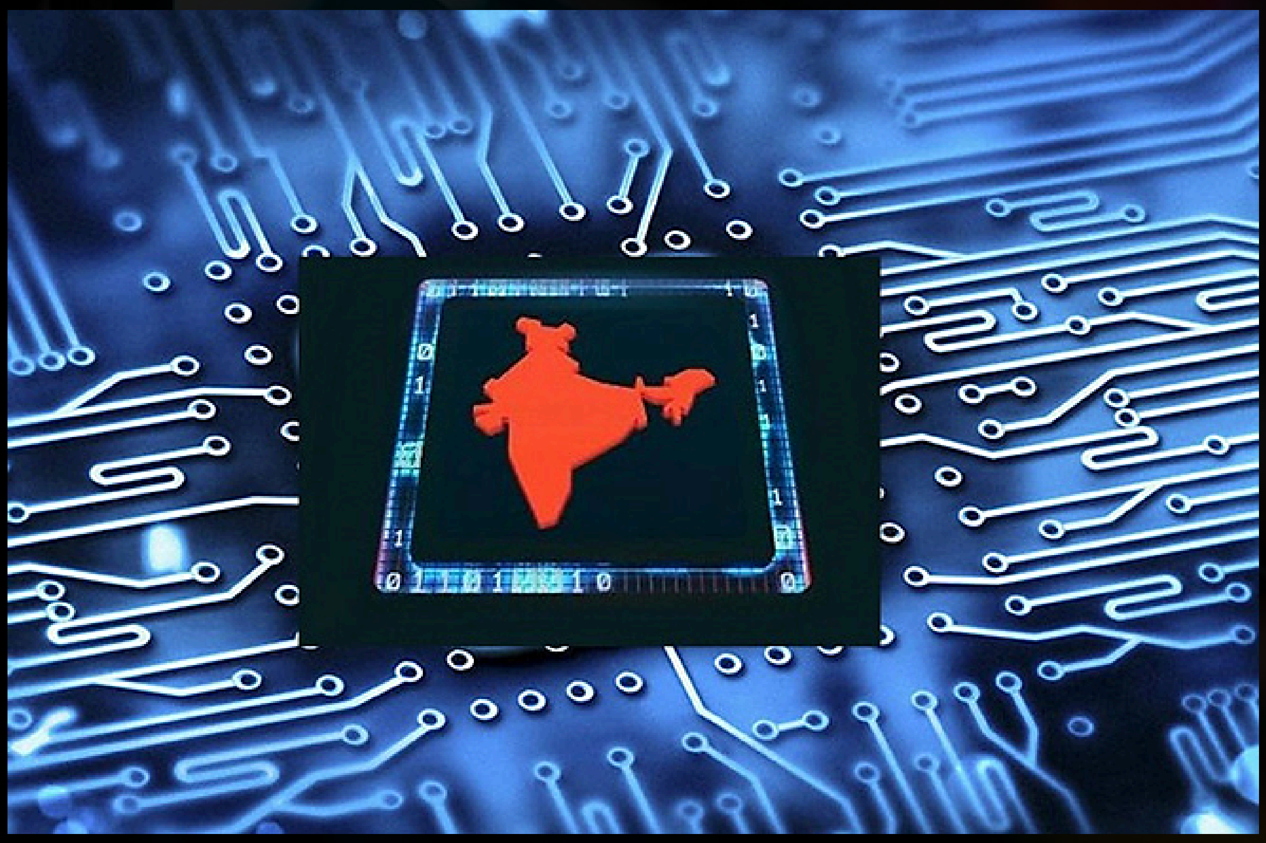
-Rishi Pandey
ECE 4th

MICRON: THE DAWN OF INDIA'S SEMICONDUCTOR ERA

Prime Minister Narendra Modi inaugurated the Semiconductor Assembly, Test and Packaging facility of Micron Semiconductor Technology India Private Limited in Sanand during his visit to Gujrat on February 28,2026. This marks a significant milestone in India's semiconductor manufacturing journey, with commencement of commercial production and shipment of the first made-in-India semiconductor memory modules.

This development represents a major step towards strengthening India's position in the global semiconductor value chain. Mr. Modi asserted that while the previous century was regulated by oil, the microchip is going to be the regulator of this century. This marks the path for India to shift from software to the world of hardware and global value chains. This marks the beginning of a revolution that India brings to the world.

The site converts advanced DRAM and NAND wafer from Micron's global manufacturing network into finished memory and storage products destined for worldwide markets. The first phase of the facility features more than 500,000 sqft of cleanroom space, making it one of the world's largest single-floor assembly and test cleanrooms. During the opening event, Micron marked the milestone by presenting its first shipment of India-made memory modules to Dell Technologies for use in laptops manufactured in India for the domestic market. The site has already begun commercial production and is certified to ISO 9001:2015 standards.



The Indian assembly and test site complements Micron's wider global manufacturing expansion strategy. Last month, it expanded it's capacity by breaking ground on a $24bn NAND wafer fabrication plant in US. The company also acquired a $1.8bn Powerchip Semiconductor fab site in Taiwan to accelerate silicon wafer for memory production.

Ultimately, it can aptly be said that this marks the turning point of India's journey- from a dream turning into reality, laying the foundation of a resilient and future ready semiconductor industry and inspiring thousands of young minds to carry forward the legacy and contribute to the world of innovations.

~SRIJANI MAJUMDER, ECE 3RD

Rotatable Antenna Breakthrough in Signal Processing

This latest development in signal processing, the rotatable antenna architecture for integrated sensing and communication (ISAC), really flips the script. It's not just another upgrade—it bringshardware design and clever algorithms together in a way that feels genuinely groundbreaking. Instead of sticking to traditional fixed arrays or keeping sensing and communication as separate systems, this new setup uses mechanical rotation, sometimes paired with electronic elements, to shift and control antenna beams on the fly. So you get a single, streamlined antenna that can switch between high-resolution radar sensing, rapid data transmission, or handle both jobs at once. It's flexible, compact, and can adapt to whatever task needs doing.

Technical Overview

At its core, the idea is both straightforward and game-changing: move the antenna or tweak its beam pattern in real time, directly swapping angular resolution for bandwidth or range as mission demands shift. You can steer and switch modes on the go, putting control firmly in the operator's hands. Layer in new signal processing techniques—like advanced denoising, sparse signal representation, and algorithms that fuse data from multiple sensors—and suddenly, the antenna can pull out relevant details even in the noisiest, most cluttered environments. That means operators don't have to haul around several specialized sensors; the payload shrinks, energy use drops, and competition for limited spectrum eases up.

Algorithmic and System Synergy

But to really make the most of this tech, hardware and software have to play nicely together. Low-power processors at the device's edge coordinate beam scheduling, handle calibration, and interpret incoming signals using learning-based methods. All this happens while maintaining sync with other onboard sensors. New calibration routines become essential—they adapt to the shifting geometry of the antenna, lining up incoming data streams in time and space. The fusion algorithms go even further, combining radar data with imagery from cameras, lidar readings, or inertial measurements. This tight integration helps spot targets more accurately and cuts down on false alarms, which is crucial for anything from monitoring traffic to complex environmental surveys.

Practical Benefits and Use Cases

The rotatable antenna architecture unlocks better sensing and communication for platforms that don't have much space or power to spare—think small drones, tethered systems used for rapid deployment, or sensor nodes sitting at field edges. With less hardware redundancy and lower energy demands, these systems become more versatile and easier to deploy in situations where every ounce and watt matters. Real-world uses abound: environmental monitoring becomes more precise; inspectors can check infrastructure or traffic with a single system; search and rescue operations get faster, clearer data; disaster zones gain temporary, reliable communications. The possibilities open up for any scenario where you need adaptability without lugging around extra gear.

Challenges and Next Steps

Of course, spinning or moving mechanical parts brings its own set of headaches—reliability and upkeep have to be managed. Hybrid designs that lean more on electronic steering are in the works, and these should help reduce wear and tear. But there are still hurdles. Spectrum sharing and regulatory clearance aren't simple, and teams need to test these antennas in the field, across varied and unpredictable conditions, to prove their resilience. Researchers are already working on refining those hybrid mechanisms, tightening up calibration routines, and developing learning models that keep up with the antenna's shape-shifting behavior.

Conclusion

All in all, this rotatable antenna ISAC innovation isn't just a clever concept—it's the real deal, ready to be deployed and to deliver measurable improvements in sensing and communication. It shows how even small physical changes, backed up by modern signal processing, can bring massive gains in capability. This approach points to a wider trend, where blending smart hardware design with intelligent algorithms makes systems more adaptive and efficient. That's exactly what's needed to tackle the tough, ever-shifting challenges in real-world sensing and communication today.

Technical Overview

The core idea is simple but powerful: change the antenna's orientation or beam pattern in real time to trade angular resolution for throughput or range. Adaptive beam control and mode switching let the platform reconfigure itself on the fly. When combined with modern denoising methods, sparse signal representations, and multimodal fusion algorithms, the rotatable antenna yields clearer feature extraction from cluttered, noisy environments. This reduces the need for multiple dedicated sensors and lowers payload and spectrm demands.

Practical Benefits and Use Cases

The architecture makes resilient sensing communication feasible on constrained platforms such as small drones, tethered systems, and edge nodes. Benefits include reduced hardware redundancy, lower energy consumption, and more flexible spectrum use. Applications span environmental monitoring, traffic and infrastructure inspection, search and rescue, and temporary communications in disaster zones.

Challenges and Next Steps

Mechanical components introduce reliability and maintenance concerns, though hybrid electronic steering can mitigate wear. Spectrum sharing and regulatory compliance must be addressed for real-world deployment. Extensive field testing is necessary to validate robustness across diverse conditions. Research is already progressing on hybrid designs, improved calibration, and lightweight learning models tailored to dynamic antenna geometries.

~Aneesh Pal
3rd Year

RECENT TRIUMPHS IN SPACE RACE: THE EXTRATERRESTRIAL TURNING POINT

- **India (ISRO) – The Lunar South Pole Conqueror:** Moving past simply reaching space, India's Chandrayaan missions fundamentally rewrote lunar maps by proving the viability of the Moon's South Pole. Now, the aggressive push toward the Gaganyaan mission marks a massive turning point: India is transitioning from a satellite-launching nation to a human-spacefaring powerhouse.

- **USA (NASA & SpaceX) – Commercializing the Cosmos:** The turning point here is reusability. With SpaceX's Starship successfully demonstrating orbital catches of its massive boosters, science fiction has become reality. This drastically drops the cost of space travel, setting the immediate stage for the Artemis missions and the human return to the Moon.

- **China (CNSA) – The Silent Powerhouse:** China executed a monumental turning point in robotic capability by successfully retrieving soil samples from the far side of the Moon (Chang'e 6)—a historic first that shifts the balance of lunar exploration.

- **Japan (JAXA) – Precision at its Peak:** The SLIM mission achieved a historic "pinpoint" landing on the lunar surface. The turning point? It proved humanity can now land spacecraft exactly where we want to, rather than just where it is easiest to land.

~Soumyadeep Das Mondal

THE INVISIBLE SPECTRUM: HOW WIRELESS COMMUNICATION SHAPES OUR WORLD

In today's digitally connected era, communication no longer depends on physical wires or direct connections. Instead, it relies on an unseen yet powerful resource—the electromagnetic spectrum. This "invisible spectrum" carries signals across vast distances, enabling devices to communicate seamlessly and instantly. Whether it is making a phone call, browsing the internet, using GPS navigation, or connecting smart devices, wireless communication has become an essential part of everyday life, all made possible by this hidden network of waves. The electromagnetic spectrum consists of a range of frequencies, including radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays. Among these, radio waves and microwaves are primarily used in wireless communication. This invisible spectrum plays a vital role in modern technologies such as the Internet of Things (IoT), where devices like smart homes, wearable gadgets, and industrial sensors communicate with each other. Wireless communication technologies such as Wi-Fi, Bluetooth, and mobile networks (4G and 5G) rely heavily on different portions of the spectrum. Each frequency band has its own advantages—lower frequencies can travel longer distances and penetrate obstacles, while higher frequencies can carry more data at faster speeds.

Looking toward the future, wireless communication is set to become even more advanced with the development of technologies like 6G, terahertz communication, and AI-driven networks. These innovations aim to provide faster speeds, lower latency, and more reliable connectivity, enabling futuristic applications such as autonomous systems, smart cities, and immersive virtual experiences. As technology continues to evolve, the role of the invisible spectrum will become even more critical in shaping a smarter and more connected world.

This electromagnetic spectrum may be invisible to the human eye, but its impact is everywhere. It forms the backbone of modern communication, driving technological progress and transforming the way we live and interact. By efficiently utilizing this powerful resource, we can continue to innovate and build a future where connectivity knows no limits.

The invisible spectrum is one of the most powerful yet overlooked forces shaping our modern world. Though we cannot see it, it silently enables every connection, innovation, and technological advancement around us. I believe that as we move into a more connected future, understanding and efficiently using this spectrum will be essential.

~Abhrajeet Mukherjee

Impact of VLSI on Smartphone Performance and Design

Very Large Scale Integration (VLSI) technology has played a transformative role in shaping modern smartphones, making them powerful, compact, and energy-efficient devices. VLSI refers to the process of integrating millions or even billions of transistors onto a single chip, enabling complex functionalities within a small physical space. Its impact on smartphone performance and design is profound and continues to drive innovation in the electronics industry.

One of the most significant contributions of VLSI to smartphones is the development of System-on-Chip (SoC) architecture. In earlier electronic systems, different components such as the processor, memory, and communication modules were separate. With VLSI, all these components can now be integrated into a single chip. This integration reduces the size of the device while improving speed and efficiency. Modern smartphones use highly advanced SoCs that combine CPU, GPU, AI processors, and modems, allowing seamless multitasking and high-performance computing.

VLSI technology has also greatly enhanced processing power. With continuous scaling of transistor sizes (following Moore’s Law), more transistors can be packed into a chip, resulting in faster and more powerful processors. This allows smartphones to perform complex tasks such as high-definition gaming, video editing, and artificial intelligence-based applications like voice assistants and facial recognition. Without VLSI, such high-level performance in a handheld device would not be possible.

Another critical aspect is power efficiency. Smartphones rely on battery power, so energy consumption is a major concern. VLSI design techniques, such as low-power CMOS design and dynamic voltage scaling, help reduce power consumption while maintaining performance. Efficient power management circuits designed using VLSI ensure longer battery life, which is a key requirement for modern users.

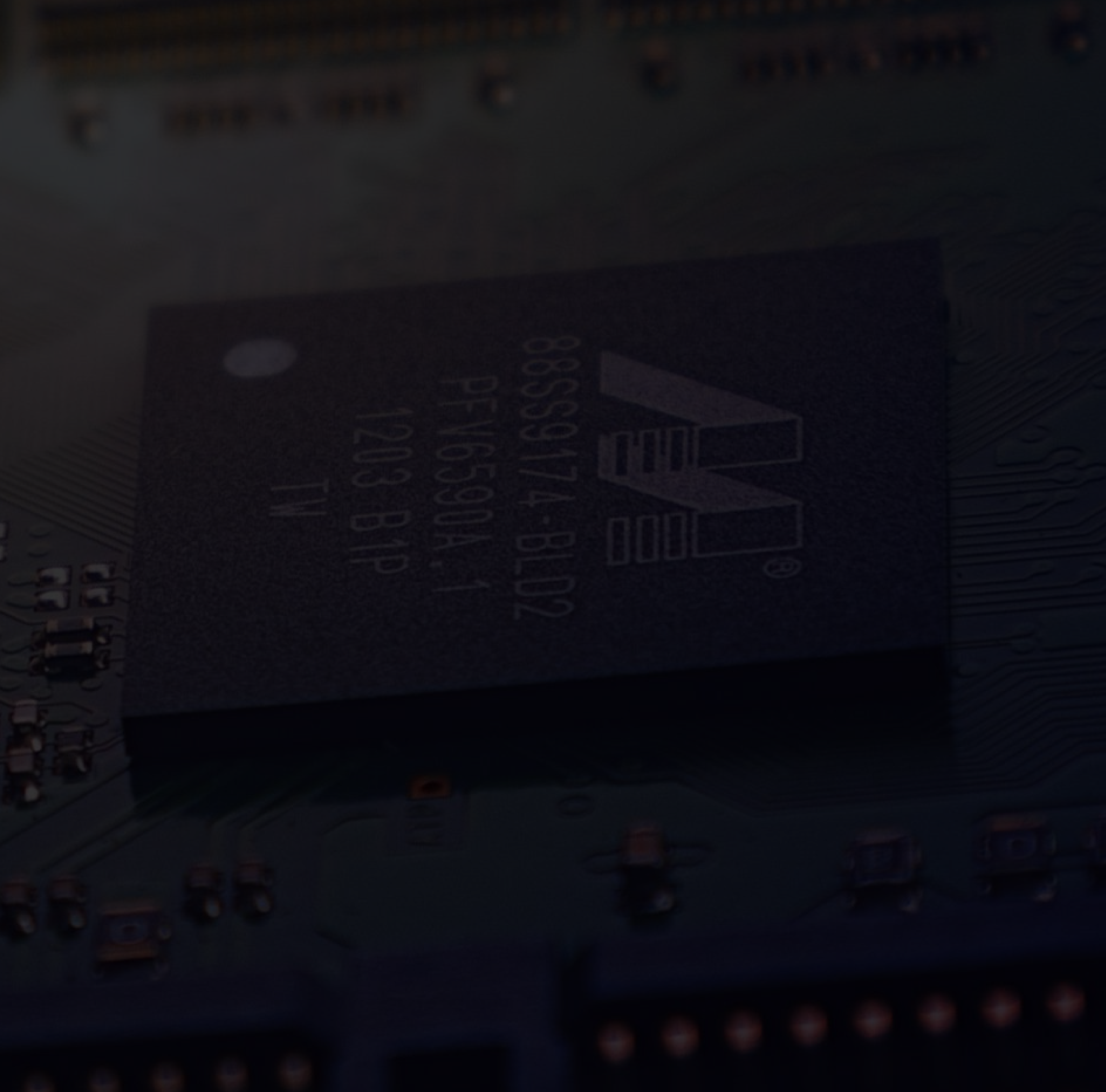
In terms of miniaturization, VLSI has enabled the creation of sleek and lightweight smartphone designs. By integrating multiple functionalities into a single chip, manufacturers can reduce the number of discrete components, saving space and allowing thinner devices. This has led to the evolution of smartphones from bulky devices to slim, portable gadgets with large displays and advanced features.

VLSI also supports advanced features and connectivity. Technologies such as 4G/5G communication, Wi-Fi, Bluetooth, and GPS are all implemented using VLSI-based circuits. Additionally, specialized chips for image processing enable high-quality photography and video recording, which are now essential features of smartphones.

However, VLSI also introduces challenges such as heat dissipation, design complexity, and manufacturing costs. As chips become more compact and powerful, managing thermal issues and ensuring reliability becomes increasingly difficult. Engineers must carefully design circuits to balance performance, power, and heat.

In conclusion, VLSI technology is the backbone of modern smartphone performance and design. It enables high-speed processing, energy efficiency, compact size, and advanced features, making smartphones an essential part of daily life. As VLSI technology continues to evolve, future smartphones will become even more powerful, efficient, and intelligent.

~Swarnadeep Chatterjee




THE
World
TODAY

A New Era Of Warfronts

WAR IS YOUNG MEN DYING AND OLD MEN TALKING

Expected to be an era of peace, the 21st century instead sees rising geopolitical warfronts, with conflicts fueled by deep-rooted rivalries. Tensions between the US and Iran date back to Cold War interventions, intensified after the 1979 Revolution. Disagreements over nuclear programs, sanctions, and regional influence continue, with Iran closing crucial routes.

Another major warfront is the conflict between Russia and Ukraine. Tensions increased over political alignment and NATO expansion. The conflict escalated dramatically when Russia launched a full-scale invasion, creating a massive war zone with global economic impact, including energy established diplomatic frameworks has left regions vulnerable.

Asia faces unresolved security challenges, including periodic skirmishes between Thailand and Cambodia over the Preah Vihear Temple and renewed tensions between India and Pakistan in May 2025. These disputes illustrate how easily conflict can reignite. These incidents illustrate how unsolved disputes can ignite major wars among countries. Rather than allowing such destructive conflicts, we should strive to create a peaceful. Unresolved disputes ignite major wars; we must strive for peace and global harmony

Sougata Maity
1st year

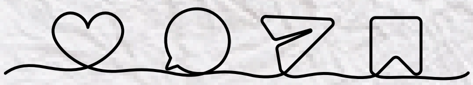
Scrolling into Silence: The Hidden Cost of Digital Addiction

“Almost everything will work again if you unplug it for a few minutes... including you.” — Anne Lamott

In today’s hyperconnected world, a single notification can pull us into hours of endless scrolling. What begins as harmless entertainment often turns into something deeper—digital addiction, a growing concern silently affecting mental health, especially among young people.

According to the World Health Organization, problematic digital use is rising rapidly among adolescents. Studies indicate that over 1 in 10 teenagers struggle to control their social media usage, often leading to anxiety, stress, and emotional instability.

India reflects the same trend. The Economic Survey of India 2025–26 identifies digital addiction as a significant public health risk, particularly among youth aged 15–24. With widespread smartphone access, excessive screen time is now linked to sleep disruption, reduced concentration, anxiety, and depression.



<u>Case Study</u> :-

The Teenage Spiral A long-term study on adolescents revealed that those with addictive screen habits were 2–3 times more likely to experience emotional distress and suicidal thoughts.

Take the case of Aarav (name changed), a 17-year-old student. What started as casual use of apps like Instagram and YouTube soon turned into dependency. Late-night scrolling affected his sleep, his academic performance declined, and he felt anxious without his phone. Aarav’s story mirrors a global reality—it is not just usage, but loss of control that defines addiction.

<u>Why It Happens</u> ?

Digital platforms are designed for engagement. Infinite scrolling, notifications, and algorithm-driven content trigger dopamine release, reinforcing repeated behaviour. As Cal Newport notes, “Clarity about what matters provides clarity about what does not”.

<u>Digital Detox : Reclaiming Control</u>

Breaking free does not mean rejecting technology—it means using it mindfully. Effective digital detox methods include:

- Scheduled Screen Time: Set daily limits using app timers
- No-Phone Zones: Keep devices away during meals and before sleep
- Digital Fasting: Take one day a week completely offline
- Mindful Substitution: Replace scrolling with reading, sports, or hobbies
- Notification Control: Turn off non-essential alerts to reduce distractions

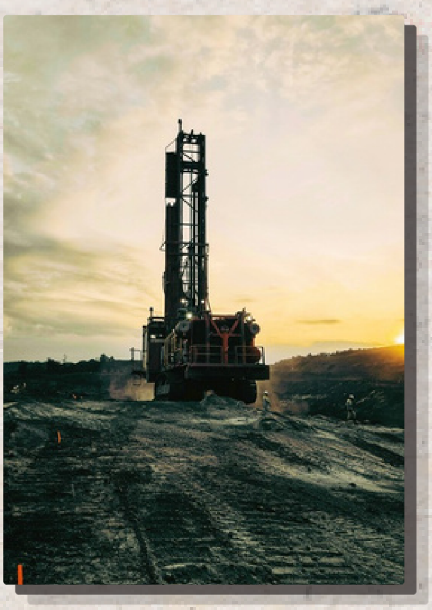
Digital technology has transformed modern life, but unchecked use comes at a cost. The challenge is not to disconnect entirely, but to regain balance and awareness.

Because in a world full of constant connection, the real turning point lies in knowing when to disconnect—and reconnect with yourself.

Moyinaak Dutta
2nd Year

In a warring world, how India can brace for a crisis that goes beyond oil

West Asia is today part of India's extended neighbourhood, vital to its energy security and hosting a massive diaspora contributing equally to the region's development and economic stability to families back home. India cannot afford to be indifferent.



In 2022-23, after Russia's invasion of Ukraine, India's current account deficit (CAD) hit a 10-year high of $67.1 billion, amid skyrocketing global oil, fertilizer and food prices. But the situation was relatively manageable, thanks to net capital inflows of $57.9 billion and some drawdown of official foreign exchange reserves. As international commodity prices eased and India started buying discounted Russian crude, the CAD narrowed to $26.1 billion, even as net capital flows soared to $89.8 billion, in 2023-24.

The US-Israel versus Iran war offers no such relief. Capital flows fell to $18 billion in 2024-25 and have turned negative (minus $581 million) for the April-December 2025 period. India, thus, had a capital account problem before this war began: Foreign portfolio investors made net sales of $18.9 billion in Indian equities last year and $3.8 billion so far in 2026.

The current war, moreover, unlike Russia-Ukraine, is being fought far closer to home. India's exports of goods to the Gulf Cooperation Council (GCC) and other West Asian countries were valued at over $65.5 billion, and imports, mainly of petroleum and fertilisers, at $154.6 billion in 2024-25. Further, there are nearly 8.9 million overseas Indians in the six GCC states alone and they account for some 38 per cent of the private remittances of $135.4 billion received by the country during the last fiscal. The GCC countries have also emerged as a major source of foreign direct investment into India, across sectors, from energy and infrastructure to retail and data centres.

Given the level of integration and flow of goods, labour and capital, any cataclysmic event in this region has huge consequences for India. The impact would be both on merchandise trade (especially from higher imported oil and gas prices) and invisibles (from lower remittance receipts), adding to the already weak capital flows.

India will seek to soften the blow for now by sourcing more Russian oil; that would have happened even without the 30-day "temporary waiver" from US sanctions. But this is a crisis that goes beyond oil, with the potential for dislocation far greater than from Russia-Ukraine. West Asia is today part of India's extended neighbourhood, vital to its energy security and hosting a massive diaspora contributing equally to the region's development and economic stability to families back home. India cannot afford to be indifferent. The Narendra Modi government must take the Opposition and Parliament into confidence, like it did during Covid and Operation Sindoor.

Rupam Saha

1st Year

THE GEOPOLITICAL FULCRUM

India's Era as 'Vishwamitra'

"In a world fractured by extremes, the greatest power lies not in choosing a side, but in becoming the center."

We are living through the most severe geopolitical tectonic shift since the Cold War. As the globe fractures into hostile blocs — weaponizing trade, critical minerals, and technology, a profound turning point has emerged, the rise of India as *Vishwamitra* : **The Universal Friend.** For decades, India's foreign policy was defined by a quiet "non-alignment". Today, that has transformed into an aggressive, confident **multi-alignment.**

Diplomatic Turning Points

India is successfully navigating complex energy trade with Russia, conducting advanced defense initiatives with the US (like the iCET pact), and acting as the undisputed voice of the marginalized Global South.

"India balances record Russian energy imports with historic U.S. Defence Tech Deals"

"African Union Officially Joins G20 Under India's Presidency."

India is no longer avoiding global friction; it is actively managing it as the indispensable bridge between the West and the rest.

Technological Turning Points

India is rewriting the map of global trade as the world desperately seeks to "de-risk" supply chains from singular dominance. Through *semiconductor diplomacy* and the massive global export of its Digital Public Infrastructure (DPI like UPI and Aadhaar tech), India is forging a resilient new kind of soft power.

Micron, Tata Break Ground on Multi-Billion Dollar Semiconductor Plants in India.

France, UAE, and Sri Lanka Adopt India's UPI System

Taking a side in a polarized world is easy. Standing in the center, acting as a stabilizing anchor, and exporting the digital framework for the next century-that is the ultimate act of power.
This is India's defining turning point.

SOUMYADEEP DAS MANDAL
2nd Year

Powering the Peak: India's ₹2,584 Crore Leap Toward Localized Clean Energy

In a significant stride towards its ambitious renewable energy targets, the Indian government has approved a ₹2,584 crore Small Hydro Power (SHP) scheme. This dedicated initiative aims to facilitate the development and installation of 1,500 MW of clean energy projects over the next five years, focusing specifically on harnessing the potential of smaller river systems. This strategic move underscores India's commitment to diversifying its energy mix and reducing its carbon footprint in alignment with international climate commitments like the Paris Agreement.

Unlike large hydroelectric dams, which can have significant ecological and social impacts, Small Hydro Power projects generally refer to facilities with a capacity typically below 25 MW. Often utilising 'run-of-the-river' technologies, these projects generate electricity with minimal water storage and significantly lower displacement effects on local communities and ecosystems. This makes SHP a particularly attractive option for sustainable energy generation, fitting seamlessly into India's push for cleaner energy sources. By tapping into this underutilised segment, the government seeks to balance energy security needs with environmental responsibility.

India Speeds Up Clean Energy Goals with ₹2,584 Crore Small Hydro Scheme

The approved scheme provides a robust financial framework to incentivise the setting up of these SHP plants. While specific allocation details for different components may vary, the significant investment of ₹2,584 crore reflects a strong financial commitment. This funding is expected to be directed towards providing financial assistance, possibly through viability gap funding or central grant mechanisms, to project developers, making smaller hydro ventures more economically viable. The clear five-year timeline offers a stable investment horizon, encouraging private sector participation and fostering a predictable regulatory environment essential for project planning and execution. Implementation is likely to be spearheaded by relevant ministries and state-level agencies, ensuring coordinated efforts across potential hydro-rich regions.

Powering the Peak: India's ₹2,584 Crore Leap Toward Localized Clean Energy

Beyond the obvious environmental advantages of generating clean electricity, the SHP scheme promises substantial socio-economic benefits, particularly for remote, hilly, and rural areas where these projects are typically located. The creation of decentralized power generation units can significantly improve grid stability and power access in underserved communities, reducing reliance on fossil fuels and expensive grid extensions. Moreover, the development, construction, and operation of these small hydro projects will generate localized employment opportunities, boosting regional economies and contributing to rural development.

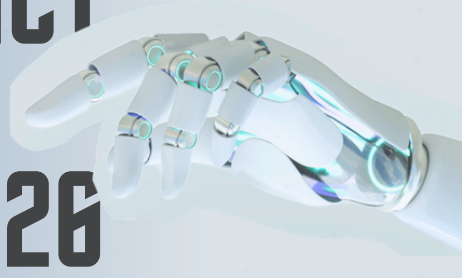
However, the path to achieving the 1,500 MW target is not without challenges. Small hydro projects still face hurdles related to rigorous environmental and forest clearances, complex land acquisition processes even on a smaller scale, and securing adequate project financing. Technical constraints specific to certain geographies and the need for robust transmission infrastructure to connect remote plants to the grid present additional considerations. The successful implementation of the scheme will hinge on addressing these challenges proactively, possibly through streamlined clearance procedures, dedicated financial instruments, and careful infrastructure planning.

In conclusion, India's new ₹2,584 crore Small Hydro Power scheme is a commendable step towards building a sustainable and resilient energy future. By prioritizing the development of 1,500 MW of clean energy over five years, the initiative not only contributes to national renewable energy goals but also unlocks significant socio-economic opportunities in remote areas. Successful navigation of implementation challenges will be crucial to maximizing the impact of this promising scheme and accelerating India's transition to a low-carbon economy.

substantial socio-economic benefits, particularly for remote, hilly, and rural areas."

Bishal Das Gupta
1st Year

THE GROWING IMPACT OF ARTIFICIAL INTELLIGENCE IN 2026



A significant contributing factor to every aspect of life

As of 2026, AI is now considered one of the primary global current affairs issues around the world. There is rapid adaptation by all sectors of society (governmental, technologic and educational) with regards to the impact on society from daily use of AI. Today there are many places where AI has been implemented in order to assist humans with their daily tasks such as in health care, education, and transport. An example of this would be an AI system that uses advanced data analytics to provide physicians with the ability to analyse large amounts of information about many patients in order to make accurate diagnosis and create appropriate treatment plans in a short period of time. At the same time many manufacturers are using AI capabilities to provide assistance to their employees with activities that require manual labour.However with these recent advancements has come the question of whether we need new laws/policies for AI to ensure its ethical/appropriate use. Some countries are putting together regulations regarding AI so that we can ensure responsible/safe usage of AI.

Many international organisations and experts are now working together to encourage global cooperation on how to use AI technologies as advantages for all of society and not as a source of income inequality or technologies that can be used irresponsibly by individuals or companies. Finally schools and universities are emphasising digital skills and AI literacy in order to prepare young people for the future where technology is going to be a **significant contributing factor to every aspect of life**. Thus, changes in technology as a result of AI are both a significant opportunity as well as a challenge for our present world. As this technology emerges, it will be very important that countries, businesses, and communities create systems that will enable them to utilise AI without creating an adverse impact on society.

Utilise AI without creating an adverse impact on society.

Sougata Sarkar

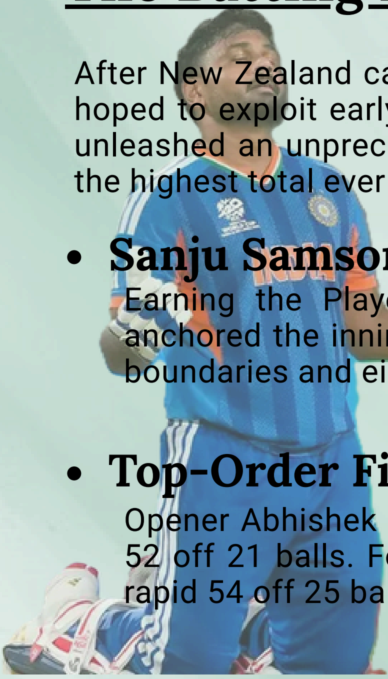

SPORTS
SECTION

INDIA'S HISTORIC TRIUMPH:
Defending the Crown in the 2026 T20 World Cup Final

- **A Record-Breaking Night in Ahmedabad :**

On March 8, 2026, the Narendra Modi Stadium in Ahmedabad witnessed a spectacle that will be forever etched in cricketing history. In a high-octane ICC Men's T20 World Cup Final, India delivered an absolute masterclass against New Zealand, securing a crushing 96-run victory. This momentous win cemented India as the first team ever to successfully defend a Men's T20 World Cup title, the first host nation to lift the trophy, and the sole record holder with three T20 World Cup championships.

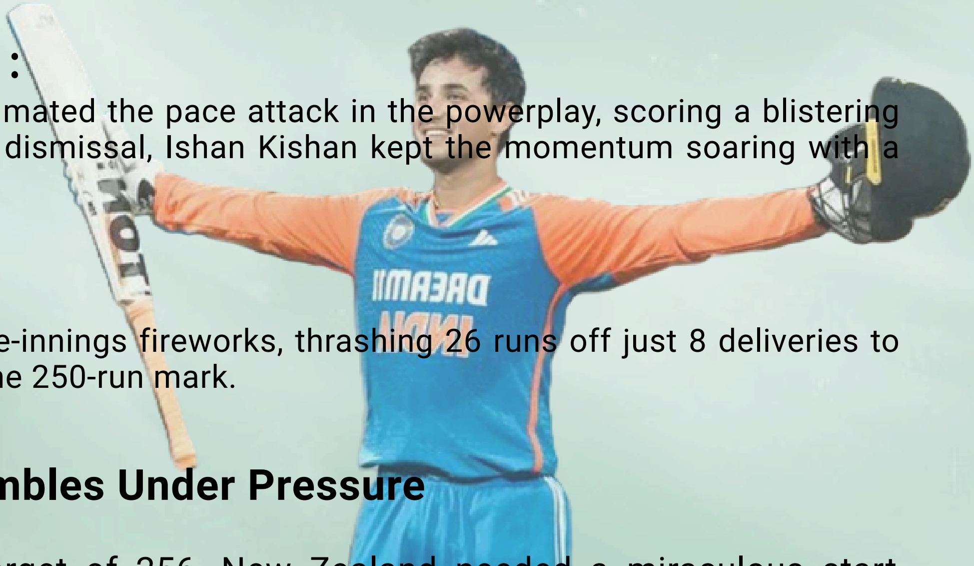
The Batting Blitz: Samson and Sharma Unleashed



After New Zealand captain Mitchell Santner won the toss and elected to field, the Black Caps hoped to exploit early finals nerves. However, the Indian batting lineup had other plans. They unleashed an unprecedented assault on the Kiwi bowlers to post a record-shattering 255/5—the highest total ever recorded in a T20 World Cup final.

- **Sanju Samson's Masterclass :**
  Earning the Player of the Tournament award for his consistent dominance, Samson anchored the innings with a breathtaking 89 off just 46 deliveries. His knock included five boundaries and eight massive sixes.

- **Top-Order Fireworks :**
  Opener Abhishek Sharma decimated the pace attack in the powerplay, scoring a blistering 52 off 21 balls. Following his dismissal, Ishan Kishan kept the momentum soaring with a rapid 54 off 25 balls.



- **The Finishing Touch :**
  Shivam Dube provided the late-innings fireworks, thrashing 26 runs off just 8 deliveries to push India comfortably past the 250-run mark.

New Zealand's Chase Fumbles Under Pressure

Faced with a mountainous target of 256, New Zealand needed a miraculous start. Opener Tim Seifert came out swinging, scoring a valiant 52 off 26 balls. However, the sheer weight of the required run rate forced the Black Caps into taking constant risks, and the Indian bowlers were ready to capitalize.

Bumrah’s Bowling Brilliance

The Indian bowling attack, spearheaded by the phenomenal Jasprit Bumrah, methodically dismantled the New Zealand lineup, eventually bowling them out for 159 in 19 overs.

- **Jasprit Bumrah (4/15):**
  Bumrah delivered an absolute clinic, earning the Player of the Match award. His precise yorkers and suffocating variations wiped out the lower-middle order, making a steep chase entirely impossible.

- **Axar Patel (3/27):**
  Patel controlled the middle overs masterfully, removing dangerous batters like Glenn Phillips and Daryl Mitchell to break the back of New Zealand’s lineup.

A Night of Shattered Records

Under the leadership of Suryakumar Yadav, the Men in Blue executed a flawless tournament campaign. The final didn’t just set new benchmarks on the pitch; it also shattered broadcasting milestones. The match recorded a staggering 82.1 crore peak concurrent viewers on digital platforms and logged 16.7 billion minutes of watch time on television, making it the most-watched T20 game in Indian history. It was a flawless climax for a team that redefined dominance in the shortest format of the game.

Bishal Das Gupta
(3rd Year)

<u>The Guardians of the Galaxy:</u>
A Night of Legacy and Leadership at the 2026 Naman Awards

As the curtains rose at the Bharat Mandapam on March 15, the air was thick with more than just the scent of celebration; it carried the weight of history. The 2026 BCCI Naman Awards weren't merely an annual prize-giving ceremony; they were a coronation of India's status as the epicentre of the cricketing world. The centrepiece of the Naman Awards was the rare celebration of five Indian teams that captured ICC titles in a short span, a historic first for the country. The evening showcased the members of all five teams being invited on stage alongside BCCI dignitaries and <u>ICC</u> chairman Jay Shah.

The night began with recognition for India's junior champions—the Women's U-19 side that lifted their second T20 World Cup title in 2025. They were followed by the Men's U-19 team, who etched their names into history in early 2026 by securing a record-extending sixth World Cup title in Harare. The highlight was 14-year-old Vaibhav Suryavanshi, who smashed a staggering 175 off 80 balls in the final against England—the highest individual score ever recorded in any ICC World Cup final. The momentum shifted to the senior ranks as the 2025 ICC Champions Trophy winners took the stage. Led by Rohit Sharma, India became the first team to win the trophy three times and the first to navigate the entire tournament undefeated. This was followed by a roar of approval for the Senior Women's team, who claimed their maiden ODI World Cup title on home soil in late 2025. The tournament saw Smriti Mandhana break the record for the most runs in a single edition (434), while Deepti Sharma became the first player ever to combine 200+ runs and 20+ wickets in a single World Cup. Finally, the spotlight fell on the 2026 Men's T20 World Cup Winners where in a masterclass of power-hitting at the Narendra Modi Stadium, India defeated New Zealand to become the first team to win three T20 World Cup titles and the first men's team to successfully defend the championship.

The FIDE Candidates is the most important tournament in the chess cycle. It's an eight-player double round-robin event where the winner earns the right to challenge the reigning World Champion. Qualification for this event is a fiercely contested process with several pathways, including winning the World Cup, performing well in the FIDE Grand Swiss, or triumphing in the FIDE Circuit. However, there is a final, highly sought-after route: a spot awarded to the highest-rated player who has not yet qualified through other means.

From Collective Glory to Individual Brilliance:

While these trophies were the result of a cohesive "Total Cricket" philosophy, every great machine is built of precision parts. As the cheers for the collective teams subsided, the evening transitioned into a celebration of the individuals who provided the spark for these historic fires.

The Architects of the Game: Lifetime Achievement

The pinnacle of the evening was the presentation of the Col. C.K. Nayudu Lifetime Achievement Awards. This year, the honour was shared by a trio that redefined Indian cricket across three different eras:

- **Roger Binny:** The 1983 World Cup hero and the former BCCI President was honored for a lifetime of service.
- **Rahul Dravid:** "The Wall" was celebrated not just for his 24,000+ international runs, but for his transformative tenure as Head Coach.
- **Mithali Raj:** The "Lady Tendulkar" of Indian cricket received a standing ovation. As the first woman to reach 7,000 ODI runs and a leader who captained India in two World Cup finals.

The Future Guard: Breakthrough Stars

The awards also recognized the "new blood" that has seamlessly transitioned into the national setup:

- **Harshit Rana (Best Men's Debut):** His ability to bowl at 145+ kmph while maintaining a heavy ball has made him a vital asset in the pace battery.
- **N. Sree Charani (Best Women's Debut):** Her clinical performances in the domestic circuit translated into immediate international success, marking her as a name to watch for the 2027 cycle.

The Crown Jewels: Gill and Mandhana

The headline acts of the 2024–25 season were undoubtedly **Shubman Gill** and **Smriti Mandhana**, who walked away with the top international honors.

Shubman Gill (Polly Umrigar Award - Men's)

Despite being a "tactical exclusion" from the 2026 T20 World Cup squad to manage workload and form, Gill's red-ball numbers were impossible to ignore. His performance in the **Anderson-Tendulkar Trophy 2025** was a masterclass in concentration, where he notched **754 runs at a staggering average of 75.40**.

- **Notable Stat:** Gill became one of the youngest captains to lead India in two formats simultaneously, showing a maturity beyond his 26 years.

Smriti Mandhana (Best International Cricketer - Women's)

Mandhana secured this award for a record fifth time. Her 2024-25 season was a statistical marvel:

- **1,800 runs across 36 international matches.**
- **7 centuries in a single calendar year.**
- **A strike rate of 99.08 in the Women's ODI World Cup, where she finished as the second-highest run-scorer (434 runs).**

The Unsung Heroes

The ceremony also took a moment to recognize those who facilitate the game. **Ulhas Gandhe** (Vidarbha) was named **Best Umpire**, a nod to the high officiating standards in the Ranji Trophy. Meanwhile, **Deepti Sharma** was recognized for her tactical brilliance as the highest wicket-taker in Women's ODIs, often described by analysts as the "Human Computer" of the Indian bowling attack.

The Backbone: Domestic Excellence

No national team succeeds without a thriving domestic circuit. The **Mumbai Cricket Association** took home the trophy for the **Best Performance in BCCI Domestic Tournaments**, proving why they remain the "School of Indian Cricket."

AWARD	WINNER	ACHIEVEMENT HIGHLIGHT
RANJI TROPHY (ELITE) - RUNS	Y.V. Rathod (Vidarbha)	Anchored Vidarbha's middle order with clinical precision.
RANJI TROPHY (ELITE) - WICKETS	Harsh Dubey (Vidarbha)	Doubled as the Best All-Rounder in the Ranji Trophy.
LALA AMARNATH (LIMITED OVERS)	Ayush Mhatre (Mumbai)	The latest sensation from the Mumbai stable.
SR. WOMEN'S ONE DAY	Shafali Verma (Haryana)	Continued her dominance with aggressive opening stands.

Conclusion: A Legacy in Motion

Conclusion: A Legacy in Motion

As the night concluded, the message was clear: Indian cricket is no longer just about individual brilliance; it is about a robust, data-backed system. From the technical prowess of **Snehal Kauthankar** (Plate Group top scorer) to the seasoned leadership of **Rahul Dravid**, the Naman Awards 2026 proved that while the players change, the standard remains gold. The journey from the grass of the Ranji Trophy to the lights of the Bharat Mandapam is long, but for these winners, the destination was well worth the sweat.

SHOUNAK RAY CHAUDHURI
(4TH YEAR)

India's win at T20 World Cup: *A team that is the sum of its parts*

"Indian cricket has spent decades building giants and watching them become institutions too powerful to question. What Gambhir has built, instead, is a system designed to outlast any individual within it, including himself"

For the last 43 years, India's World Cup victories had a face. Kapil's Devils. Dhoni's Army. Rohit's boys. The trophy and the man who lifted it were inseparable — the captain was the team's identity. Indian cricket understood itself through its giants. The World T20 final on Sunday in Ahmedabad was different. This was a team that was the sum of its parts. The captain who lifted the trophy, Suryakumar Yadav, didn't have the best of tournaments but he was always there for his team. Coach Gautam Gambhir, ever so reluctant to be in the limelight, was trying his best to understate his role in India creating history —first to win a World T20 at home, retain the Cup.

This is a team with no prima donnas. It is not a team built around immunity. It was built around accountability — a principle Gambhir has enforced from Day One. Virat Kohli and Rohit Sharma departed when their time was up. Shubman Gill, cricket's newest superstar, missed the party entirely. No one was too big to be questioned. No one was too small to be backed. The blueprint of this triumph took 18 months. Bilateral series that looked routine were rehearsals. Venues were chosen deliberately keeping in mind the all-important ICC event. Scenarios were manufactured inside real matches, solutions placed on the table before the tournament required them. When Wankhede's semi-final arrived, Sanju Samson walked out and dismantled England with the calm of a man who had already been here.

This World T20 victory was not a discovery. It was an eventuality that was expected after a well-planned process. Indian cricket has spent decades building giants and watching them become institutions too powerful to question. What Gambhir has built, instead, is a system designed to any individual within it, including himself. That is the harder thing to build. And the more important thing is to win.

J&K Ranji win has many back stories

> "While the rest of Indian cricket chased the franchise boom, J&K made a bet: That a region starved of recognition would find its redemption in the grind of red-ball cricket, not quick money. On Saturday, that bet paid off"

The more instructive number from J&K's maiden Ranji Trophy triumph is not 66 — the years they waited — but 30. That is roughly how many T20 and T10 leagues JKCA chief Brigadier Anil Kumar Gupta shut the door on after taking over in 2021. While the rest of Indian cricket chased the franchise boom, J&K made a bet: That a region starved of recognition would find its redemption in the grind of red-ball cricket, not quick money. On Saturday, that bet paid off.

It would have been easier to let talented youngsters from Baramulla and Kalakote disappear into T20 entertainment. Gupta chose otherwise. Selectors fanned out to Kishtwar, Poonch and Kupwara. Red-clay wickets were laid as far as Katra to simulate southern conditions. Auqib Nabi, rejected at trials twice, drove 60 km daily to train. A team that lost a quarter-final by a single run last year returned with quiet fury. The Karnataka symmetry is almost too neat. They lifted the Ranji in 1982, the same year J&K recorded their first-ever win in the competition. That it took 44 more years speaks to everything this region has endured — insurgency, neglect, and the prejudice of being considered permanent also-rans.

What makes this resonate beyond sport is the team itself. Captain Paras Dogra, 41 and in his 24th Ranji season, was a Himachali brought in specifically to bridge the Valley-Jammu faultline. Across the country, fans who rarely follow domestic cricket were tracking scores and demanding a Test cap for Nabi. A region long defined by conflict had united everyone else behind it. The BCCI should study this — not merely to hand Nabi his India cap, but to ask what becomes possible when administration backs process over profit. Some lessons, like some trophies, take 66 years to arrive.

Rupam Saha
(2nd Year)

A Decade of Waiting: The Heart of a Barcelona Fan

By a Fan Who Still Believes :

There was a time when supporting FC Barcelona felt like witnessing perfection.In 2015, under Luis Enrique, Barcelona reached the peak of world football. With the legendary trio of Lionel Messi, Luis Suárez, and Neymar Jr., the club secured a historic treble—La Liga, Copa del Rey, and the UEFA Champions League.It wasn't just victory. It was dominance with beauty.And like every fan, I believed it would last forever.

The Fall After Glory :

But football doesn't follow dreams—it follows time.After 2015, the magic slowly faded. Under Ernesto Valverde, Barcelona remained strong domestically, winning league titles. Yet in Europe, something broke.The collapse against Roma in 2018.The unforgettable night at Anfield in 2019.These weren't just defeats—they were emotional scars.Then came the darkest moment under Quique Setién—an 8-2 humiliation against Bayern Munich. That night didn't just end a campaign; it ended an era.

Rebuilding the Identity :

The departure of Lionel Messi in 2021 marked the lowest emotional point for fans. It felt like losing the soul of the club.Under Xavi Hernández, Barcelona began rebuilding—not just a squad, but an identity. He brought back belief, won La Liga in 2023, and trusted a new generation.Players like Pedri and Gavi became symbols of hope, while Robert Lewandowski added experience and goals.But the Champions League dream remained distant.

The Present: A New Direction Under Flick :

Now, under Hansi Flick, a new chapter is being written.Flick brings a different philosophy—more direct, high-intensity football compared to the traditional slow possession style. His approach focuses on:Quick vertical attacksHigh pressingFaster transitionsThis "Flick ball" is not the classic Barcelona identity —but it might be what the modern game demands.And in this system, new stars are emerging.

The Rise of a New Generation :

Among them, Lamine Yamal stands out—not just as a talent, but as a symbol of the future.At such a young age, he plays with fearless creativity, reminding fans of what Barcelona has always stood for. Alongside him, the energy of Pedri, the aggression of Gavi, and the leadership of players like Ronald Araújo show that this team is growing.But growth takes time.

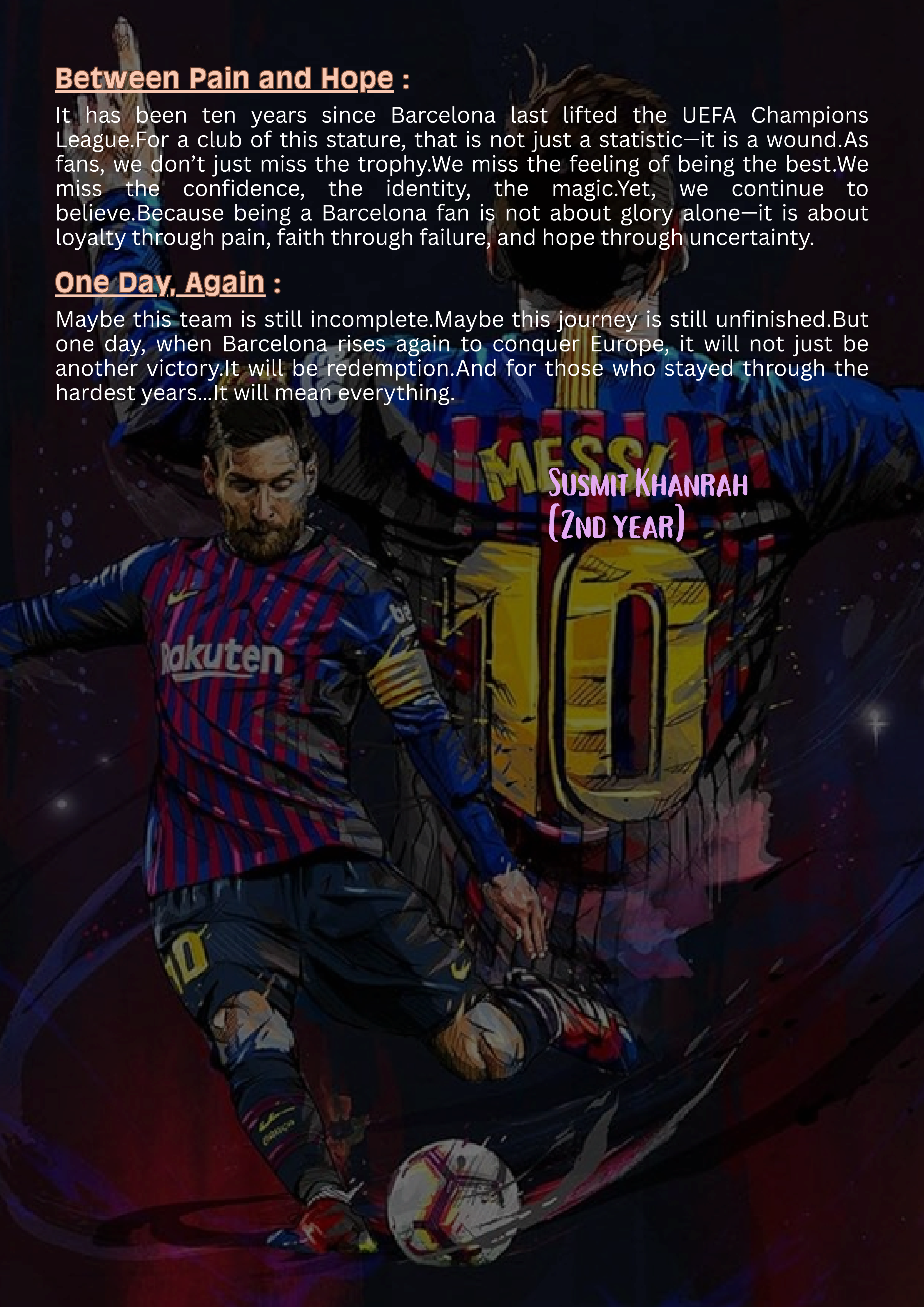
Between Pain and Hope :

It has been ten years since Barcelona last lifted the UEFA Champions League.For a club of this stature, that is not just a statistic—it is a wound.As fans, we don’t just miss the trophy.We miss the feeling of being the best.We miss the confidence, the identity, the magic.Yet, we continue to believe.Because being a Barcelona fan is not about glory alone—it is about loyalty through pain, faith through failure, and hope through uncertainty.

One Day, Again :

Maybe this team is still incomplete.Maybe this journey is still unfinished.But one day, when Barcelona rises again to conquer Europe, it will not just be another victory.It will be redemption.And for those who stayed through the hardest years...It will mean everything.

Susmit Khanrah
(2nd year)



"History is Defeated, History is Repeated"

For over two years, the massive stands of the Narendra Modi Stadium in Ahmedabad were haunted by the deafening silence of November 19, 2023—the night a billion World Cup dreams were crushed. But India's spectacular 2026 T20 World Cup campaign became the ultimate turning point in modern cricket, transforming an arena of national heartbreak into the epicenter of absolute dominance.

History is defeated. By returning to the exact turf that broke them in 2023 and lifting the 2026 trophy, India didn't just win a match; they exorcised the ghosts of the past. They didn't just beat their opponents; they shattered the very limits of the T20 format. The team obliterated the record books, setting a staggering new benchmark with a colossal 255-run total and executing the highest-ever successful run chase when the tournament stakes were at their peak. The psychological barrier of Ahmedabad was not just crossed; it was demolished.

Simultaneously, History is repeated. Not only did the Men in Blue recapture the glory of 2007 and 2024, but they achieved the unprecedented. By winning this tournament, India became the first men's team in the sport's history to successfully defend a T20 World Cup title, and the only nation to wear the crown three times

This victory is a defining turning point because it marks the definitive shift of Indian cricket from a formidable contender to an invincible, nerve-of-steel dynasty. They proved that true champions don't just survive the bitter memories of history—they rewrite them entirely.

Soumyadeep Das Mandal
(2nd Year)

Cricket- The Paths of the Indian captains In World Cups

In the year 1983 World Cup the Indian national team came up as an underdog with no scope of a single win led by Kapil Dev. They achieved a historic victory defeating West Indies in the final at Lord's and secured an unforgettable win changing the future of Indian Cricket forever and India became the first Asian country to win the World Cup.

Sachin Tendulkar widely known as the "God of cricket" through his extraordinary talent of playing classy cricketing shorts and consistency earned him the title "Master blaster" as well. He debuted for India at the age of 16 and is the only player to score 100 centuries in international cricket. But even after being calm and maintaining his composure while batting Sachin failed to prove himself as a captain and he opted out as the captain of India, which left India with no choice other than "Dada" or Sourav Ganguly to lead the Indian side. Sourav Ganguly proved that making him the captain was not a wrong call. Sourav led the Indian team to the finals of 2003 Cricket World cup held in South Africa but lost to the mighty Australia by a mammoth 125 runs, where no Indian except Virendra Sehwag could perform.

Following the heartbreak of the 2003 World Cup and a premature exit in early 2007, a young, fearless Indian side was handed to a calm leader from Ranchi—Mahendra Singh Dhoni. Like Kapil Dev's underdogs of 1983, this inexperienced squad arrived in South Africa with everything to prove, culminating in a high-stakes final at Johannesburg against their arch-rivals, Pakistan. The match was a rollercoaster of raw emotion. Gautam Gambhir played a knock of immense character, scoring a determined 75 to post a fighting total of 157. However, the tension became unbearable as Misbah-ul-Haq brought Pakistan to the brink of victory. With 13 runs needed in the final over, Dhoni made a legendary gamble, handing the ball to the unheralded Joginder Sharma. After a nerve-wracking wide and a massive six, the dream seemed to slip away. Then came the moment that defined a generation: Misbah attempted a scoop, the ball hung in the air, and Sreesanth caught it safely. India had done it! This victory ignited the T20 revolution and birthed the "Captain Cool" era, proving that a fearless leader could once again conquer the world.

The dreams of a billion Indians converged at Mumbai's Wankhede Stadium. This was the final mission for the Master Blaster, Sachin Tendulkar, playing in his last World Cup. The nation held its breath in agonizing silence when Lasith Malinga dismissed both Virender Sehwag and Sachin early, leaving the chase of 275 in pieces. In this moment of crisis, Gautam Gambhir stood like a fortress, playing a selfless knock of 97 to stabilize the innings. Then, in a legendary masterstroke, MS Dhoni promoted himself up the order. Batting with nerves of steel alongside the tournament's hero, Yuvraj Singh, Dhoni anchored the chase with masterful composure. With one iconic, towering six into the Mumbai night sky, "Captain Cool" finished it off in style. The drought was over; India became World Champions again, carrying Sachin on their shoulders in a moment of immortal glory.

Following the highs of 2011, MS Dhoni's men seemed destined for another trophy in the 2014 T20 World Cup. Having remained unbeaten throughout the tournament, India faced Sri Lanka in the final. Virat Kohli, in the form of his life, played a masterful knock of 77, anchoring the innings with pure class. However, the death overs turned into a nightmare as India's scoring ground to a halt. Chasing 131, Sri Lanka's legends Sangakkara and Jayawardene ensured a clinical finish. It was a day of silent grief, where Kohli's brilliance was overshadowed by a collective batting struggle as Kohli was adjourned as the Player Of the Tournament, ending the dream of all Indian fans

In the 2016 T20 World Cup on home soil, MS Dhoni's men seemed destined to repeat the magic of 2011. Virat Kohli, in a superhuman run of form, played a breathtaking unbeaten 89, powering India to a formidable 192. Wankhede roared as the dream felt within reach. However, the West Indies unleashed their "Calypso" power. Despite early strikes, Lendl Simmons—surviving multiple no-balls—and Andre Russell launched a brutal assault that stunned the nation. A silent stadium watched as the favourites were knocked out, leaving Kohli's brilliance as a lone, tragic spark in a night of missed opportunities yet again he won the Player Of the Tournament but in a losing cause.

The weight of a billion dreams shifted to Rohit Sharma. The 2023 ODI World Cup was framed as the ultimate fairytale; the Indian side stormed through the tournament with ten consecutive, dominant victories. With Virat Kohli surpassing the Great Sachin Tendulkar's record of 50 ODI centuries, the stage was set in Ahmedabad for a grand coronation. India looked invincible, a team of destiny ready to reclaim the throne on home soil. The atmosphere at the Narendra Modi Stadium was electric, a literal sea of blue. Rohit Sharma, the selfless leader, began the final with trademark aggression, but his dismissal silenced the crowd of 100,000. All eyes then turned to the "King," Virat Kohli. He played with his usual composure, anchoring the innings with a gritty half-century as he navigated a sluggish pitch. Just as the nation began to believe he would once again pull off a miracle, tragedy struck. Attempting to guide a delivery from Pat Cummins, the ball took an inside edge and crashed into the stumps. The sight of Kohli standing frozen, staring at the bails in disbelief before walking back with a heavy heart, signalled the beginning of the end. Even after the steady half centuries of KL Rahul and Virat Kohli, India was restricted to a modest 240. Hope flickered briefly when Jasprit Bumrah and Mohammed Shami reduced Australia to 47/3. For a moment, it felt like 1983 all over again. But out of the shadows stepped Travis Head, whose century systematically dismantled the Indian dream. As the winning runs were struck, the silence was deafening. The most dominant Indian side, in history had stumbled at the final hurdle, leaving a scar that will last a generation. To add salt to the burn Virat Kohli became the only player to win all his Player Of the tournament but in a losing cause and won it in 2023

The 2024 T20 World Cup was the beginning of a magnificent era for Indian cricket, marked by a spirit of redemption that healed the wounds of the 2023 final. Led by Rohit Sharma, the "Men in Blue" remained unbeaten throughout the tournament in the USA and West Indies. In a nerve-wracking final against South Africa, India posted 176, powered by a masterclass 76 from Virat Kohli. When the game seemed to slip away, Jasprit Bumrah bowled a spell of pure magic, and Suryakumar Yadav took an iconic catch on the boundary to seal a 7-run victory. As Rohit and Kohli retired from the format, the torch was passed to a new generation, but the hunger for trophies only grew.

The pinnacle of this golden run arrived just days ago on March 8, 2026, as India created history on home soil. Playing the T20 World Cup final at the massive Narendra Modi Stadium in Ahmedabad, India faced New Zealand in a high-stakes rematch. It was a day of absolute carnage as India smashed a record 255/5, the highest-ever score in a World Cup final. Sanju Samson, who was named Player of the Tournament, played the innings of his life with a blistering 89. The bowlers, led by local hero Jasprit Bumrah's four-wicket haul, dismantled the Kiwis for 159. With this 96-run victory, India became the first team to win back-to-back T20 World Cups and the first to win it as a host nation. This incredible "Treble" of trophies has transformed the heartbreak of the past into a legendary era of undisputed global dominance. So, I conclude that even if we have a bad past the only good thing is that time is never still and always changes so even if there is a long night there will be a sunrise.

Srijani Majumder
(3rd Year)

THE RESURRECTION OF THE OLD TRAFFORD

Probably there is no football fan in this world who haven't heard the name Old Trafford. Nicknamed the "Theatre of Dreams", it serves as the home ground of Manchester United football club, arguably the most successful football club in England. Manchester United in the recent past were known for their unreal dominance in every competition under their legendary manager Sir Alex Ferguson. This was the Fergie era, where Manchester United was the symbol of undying passion, hope and spirited comebacks. So many legendary ballers like Wayne Rooney, Cristiano Ronaldo, Ryan Giggs, Paul Scholes, Ole Gunnar Solskjaer adorned that bright red jersey in that era. But there was an era when Man United had to make a "comeback" in real life scenario from the depths and darkness of destruction. It was a fight for existence by the red devils. And the comeback they pulled off, was no less than a fairytale one.

I am quite sure many of you haven't heard of the name Busby Babes, or have you? If you have, then your ball knowledge is worthy of praise! But those who haven't, let me tell you what it was. In the 1950s, Manchester United was focusing on a project which aimed to build a core squad of phenomenally talented young footballers (mostly teenagers) who were expected to rule the football world in their prime. These players would play in the same team from a very early age, so they would improve and evolve as a "team". Luckily, Man United had such incredibly talented young ballers to dream this big. This project was being managed by one of the greatest Man United managers of all time, Sir Matt Busby. And the squad of young ballers he managed came to be known as Busby Babes.

One of the best players of the Busby Babes was Duncan Edwards. People who saw him play often compared him with Pele. But the fact is, Edwards wasn't a forward like Pele. He was a midfielder who basically dictated the game with his physical dominance as well as sharp game intelligence. He was kind of both footed, magical with the ball in his feet and had the stamina of five persons in himself. He consistently distributed accurate long balls to the wings and often scored screamers from 30 to 35 yards out when his team used to be in deadlock situations. In those times, a midfielder of this profile and playing style was a rare thing. Duncan Edwards was probably the earliest example of something in between a "mezzala" and a "regista", two commonly used words in Italian football to describe the role and playstyle of midfielders. Hence no wonder why football pundits often claim Duncan Edwards to be one of the "to be" greatest midfielders to grace this game even though his career wasn't as long as it was expected.

Sir Matt Busby was a visionary. Under him, the team was developing so rapidly that everyone could foresee the dominance of Man United both in English Premier League and in the European Cup (later came to be known as UEFA Champions League). But what they could not foresee was one of the most tragic incidents in the history of the beautiful game, which shattered every hope and dream the football fans saw about the Busby Babes.

6th February 1958, the black day in Man United history. The young vibrant Busby Babes were returning from Serbia after their game against Red Star Belgrade, the European Cup quarter final. Man United had qualified for the semis. The whole squad was buzzing with joy. Their flight took a halt at Munich in Germany for refuelling. On February 6th morning the flight tried to take off from the Munich-Riem airport amid heavy snowfall, slush and fog. The first two attempts to fly failed due to engine problems. On the third attempt the plane couldn't pick up speed due to slush in the runway. It failed to lift off, eventually crashing through a fence, hitting a house and exploded apart.

Oh, did I forget about Duncan? Duncan was a fighter on and off the pitch. He fought against the Almighty himself for 15 days in the hospital. He was severely injured and doctors saw almost no hope of his survival. But he kept on fighting. During the end, even the doctors started hoping that it might just be Duncan's sheer willpower that would pull him through. But it wasn't approved by God's script. Duncan Edwards became one of the greatest "what if"-s in football history. Every Man United fan cursed God for destroying the dreams of Old Trafford and especially the death of Duncan Edwards totally shook them. Sir Matt Busby was also critically injured but he managed to recover.

Man United's playing squad was so disrupted that they couldn't even find players to field for their games. Real Madrid offered them the contract of their star forward Alfredo Di Stefano for the rest of the season. But that was only a temporary solution, Sir Matt Busby was still hoping for a fairytale comeback. His comeback story needed characters, but he could not find the special ones who would shape the comeback.

He started building another team which centred around that special survivor of the Munich Air Disaster. That Englishman kept on leading the revived squad, but the task was too heavy to complete alone. Could you guess who was he? He is one of the greatest English players of all time, Sir Bobby Charlton.

1962 marked the entry of another architect of United's revival. The club signed a Scottish striker who on due course became one of the greatest forwards in the history of the club. He is Denis Law, the "King of Stretford End". His duo with Sir Bobby Charlton started dismantling the English teams in domestic competitions. But still United was sensing a missing piece in their puzzle. A difference maker, a magician. The third architect.

One of Sir Matt Busby's scouts were looking for a player of this profile. One rainy night Sir Busby received a call from the scout. "I think I have found you an absolute gem. We must sign him before even he realizes what talent he possesses." After a few days, a young handsome boy from Belfast, Northern Ireland stepped on the grasses of the Theatre of Dreams. The God's gift to Old Trafford had reached its destination. He made his debut for the senior team in 1963, the same year they lifted the FA cup. As time went on, a name started echoing through the entire footballing heartbeat of Europe, George Best!!!

An extraordinary dribbler, a speeding bullet, an artist with the ball in his feet, George Best is probably the most naturally gifted footballer of all time. His flair and ability to score spectacular goals made him a treat to watch. He called himself an entertainer, which he definitely was. He was a charismatic personality off the field. He used to squander his entire money on booze, birds, cassinos. He was a sensation among the girls of every age at that time. There was one famous saying which became popular later – "Maradona good, Pele better, George Best". He along with Sir Bobby Charlton and Denis Law created one of the deadliest attacking trios in football history, came to be known as "The United Trinity". Manchester United won their first EPL title in 1965 and won their second in 1967.

1968. Ten years since the tragedy. This year marked the completion of United's comeback. George Best was in the form of his life (won the Ballon d'or in that year). Manchester United was chasing their unfulfilled dream, the European Cup. They had reached the final. In the final, a mighty Benfica team captained by Portuguese ace Eusebio stands in between Manchester United and the European Cup. The stage is set at the Wembley.

At the end of 90 minutes, both teams are held at a 1-1 draw. Extra time. One mistake by a Benfica
defender and George Best is through on goal! Nobody could match up his pace, so the goalkeeper had to come out. One magical feint, the goalkeeper falls on one side. The whole stadium has come to a pause. A small tap on the ball... and it rolls into an open net!! The stadium erupts; George Best has scored one of the most iconic goals in the history of the competition! The curse is broken! Benfica was so shocked that the scoreline became 4-1 at the end of extra time. Sir Matt Busby's Manchester United has won the European Cup, finally, at last. Every Manchester United fan cried that day, but it was the tears of joy this time. Redemption exactly after 10 years, what a fairytale! Since that day, every United fan believes that God gave them Georgie Best because he had cruelly taken away Duncan Edwards from them. That day marked the beginning of Manchester United legacy. Fergie era was just another glorious chapter of the same story.

At present, the statues of George Best, Sir Bobby Charlton and Denis Law stand together outside the Old Trafford. The United trinity who rebuilt the Old Trafford from its ruins. The football world hasn't seen a greater comeback story, I can swear!

SINCHAN MITRA
(2ND YEAR)

ONE GAME, ONE WORLD:
THE ROAD TO FIFA WORLD CUP 2026

When the world unites every four years for football's greatest spectacle, it becomes more than just a tournament—it becomes a celebration of passion, identity, and shared dreams. The FIFA World Cup 2026 is set to redefine this global tradition in a historic way. For the first time ever, the tournament will bejointly hosted by three nations—the United States, Canada, and Mexico— bringing together cultures, fans, and stadiums across an entire continent.

One of the most notable changes in the 2026 edition is the expansion of the tournament from 32 to 48 teams. This new format will significantly reshape the competition. The teams will be divided into 12 groups of four, with the top two teams from each group and the eight best third-placed teams advancing to a new Round of 32 knockout stage. From there, the familiar drama of elimination football begins—Round of 16, quarter-finals, semi-finals, and finally the grand finale where the world champion will be crowned. This expansion means more matches, more nations, and more opportunities for thrilling surprises.

The qualification process has also become more inclusive. Different football confederations have been allocated more slots than before. Europe will send the largest number of teams, while Africa, Asia, and North America have received increased representation. This gives rising footballing nations a better chance to compete alongside traditional powerhouses. For many countries, simply reaching the tournament will be a historic achievement.

Naturally, fans are already looking ahead to the teams to watch. Traditional giants such as Brazil, Germany, Argentina, France, and Spain will once again be strong contenders, bringing world-class talent and rich footballing heritage. At the same time, nations like England, Portugal, the Netherlands, and Belgium continue to develop exciting squads capable of challenging for the title. With the expanded format, there is also room for emerging teams from Asia, Africa, and North America to make a deep run and surprise the footballing world.

Beyond tactics and statistics, the beauty of the World Cup lies in its unpredictability. History has shown that underdogs can rise, legends can be born overnight, and a single moment can change the fate of an entire nation. From dramatic penalty shootouts to unforgettable goals, the tournament always delivers stories that remain etched in the memories of fans forever.

For young dreamers kicking a ball in school playgrounds or narrow streets, the FIFA World Cup 2026 will serve as a reminder that greatness often begins with a simple dream. The tournament will showcase the brilliance of the world's best players while inspiring the next generation to chase their own goals.

As the countdown begins, one truth remains timeless: football has the power to unite the world. And in 2026, when the first whistle blows, millions of hearts will beat in rhythm with the beautiful game.

SOURADEEP MITRA
(3RD YEAR)

Inked Thoughts

POETRY

PROSE

TRAVELOGUE

Seepage into Change

A rock once clung to the mountain's chest,
Ancient and strong, thought stillness was its fate,
Then came a shift-unseen, untold,
A quiet violence, a landslide of restless intent.

It tumbled down with a rugged cry,
Gliding through the river, gasping to adapt,
Driven into an anonymous journey,
Carved by restless tides,battered against stones.

Scattered away, marked by a swarm of scars,
Yet it believed,enduring still.
Perhaps some undying force stirred within,
Turning its journey into unseen becoming.

Through countless shapes, through silent agony,
It learned the art of becoming patiently
It became a smooth and rounded pebble at last,
Now placed with purpose, by wiping off its obsolete past.

~Bitisha Sarkar
2nd yr.

বিশ্বাস বিলাসী

ডিসেম্বর শেষ, নিয়ন আলো ফিকে হয়ে আসছে,
তবু আমি দেখছি তাকে ।
দেখছি তার গোলাপ ঠোঁটের বাঁকে মিলিয়ে যাচ্ছে শীতের আক্রোশ,
আর আমার শরীর ফুঁড়ে, সদ্য বেরোনো কচি পাতারা জানান দিচ্ছে বসন্তের আর বিশেষ দেরি নেই,
দেখ বসন্ত ডাকছে , ডাকবিনা তুই ?
রূপকথার লুকোনো ডাকনাম ধরে খুব ডাকতে ইচ্ছে করলে,
লাল রঙে তাকে দেখতে ইচ্ছে করলে,
শীতের অপরাহ্নে গুঁড়ো রোদ মেখে মেঘের দিকে চইছি।
কে জানে? ওর মতো
মেঘের-মেয়েরা কী মেঘ দেখে?
দেখ মেঘেরা শুনছে , শুনবিনা তুই ?
আমার খুব সূর্যমুখী ভালো লাগে, সারাদিন সূর্যের দিকে ফিরেও
ক্লান্ত হয়না ফুলটা, রাত্রি জুড়ে সে নিজেকে গোছায়
পূবের ফরসা আকাশটা সবার আগে, নিস্পল'কে দেখার জন্য।
লেপমুড়ি দিয়ে , ঘুমিয়ে থাকা শহরের আঁকে বাঁকে পৌঁছানোর আগে, সবার
হওয়ার আগে , সূর্যকে একবার ছোঁয়ার জন্য ।
আমার সূর্যমুখীর মেয়ে ,
ভোরের আকাশ দেখছে আমায় , দেখবিনা তুই?
এরপর,বকুলের গন্ধে ঢেকে যাবে সূর্যমুখী
আবার সবুজ হয়ে যাওয়া গাছগুলো চিনবেনা,
মাটিতে পড়ে থাকা নিষ্প্রাণ খয়েরী - পাতা ।
রোজ বিকেলে যে পাখিগুলো ঘরে ফিরবে ।
ওরা চিনবেনা ওদের অস্থায়ী ঠিকানা।
এই শীতের মেঘ, শুকনো গাছ, দুপুরের মিঠে রোদ, পরিযায়ী পাখির মত
আমার হারিয়ে যাওয়া ছন্দের মতো , ধর এই বসন্তে চিনলামনা তোকে
চিনবিনা তুই?

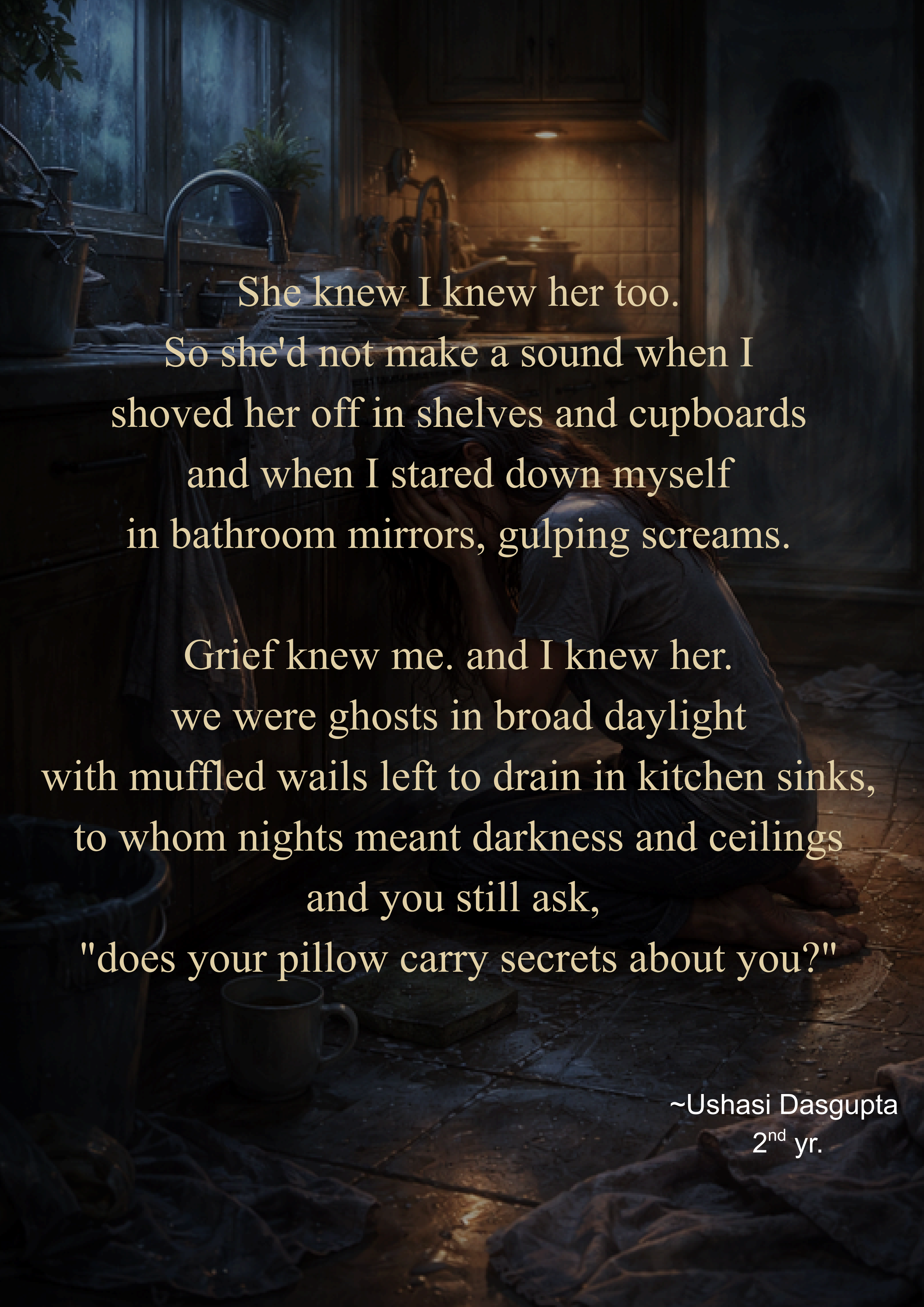
~ Sushovan Chatterjee
2nd yr.

GRIEF

Grief never knew me
till I knelt down on my knees for love,
between chores and errands,
between deaths and revivals,
in quiet solitude.

She knew me then
and only then,
when plaster and porcelain
my heart , smeared to dust under my fingernails
and no one was there to claim it.

Grief knew me too well.
she would sit around and watch
on the curves and dips of dishes
on the ropes I left the clothes
while I burnt in indignation.



She knew I knew her too.
So she'd not make a sound when I
shoved her off in shelves and cupboards
and when I stared down myself
in bathroom mirrors, gulping screams.

Grief knew me. and I knew her.
we were ghosts in broad daylight
with muffled wails left to drain in kitchen sinks,
to whom nights meant darkness and ceilings
and you still ask,
"does your pillow carry secrets about you?"

~Ushasi Dasgupta
2nd yr.

EXILE

Before time learned to count itself,
you and I were a single combustion,
light without distance,
heat without horizon.
Then the heavens grew afraid of brightness.
They drove a silence between us.
Not gently.
One flung me into the hunter's spine of winter.
One veiled you in a spiral of blue frost.
And the decree rang cold.
Burn.
But never arrive.
So we obeyed.
Ages unspooled like thread from a careless god.
Galaxies opened and withered.
Darkness learned our names
before we remembered them.
I have watched you
from the edge of myself,
your radiance flickering
at the seam of my vision,
close enough to wound,
far enough to worship.
Mortals call us myth.
They press our distance into sonnets
and mistake the ache for beauty.
They say shooting stars are wishes.
No.
They are our messages,
set on fire
the moment they are understood.
You took the hour that dissolves the sun.
I guard the hour that births it.
Each twilight, I almost reach you.
Each dawn, you almost turn.
Almost.
The most merciless word ever forged.
The cosmos names this balance.
I name it exile.
And yet,
When I fracture my light across the dark,
I see you,
not in constellations already drawn,
but in the spaces
astronomers have not dared to map.
We were not two flames.
We were a star split open
to keep eternity from going blind.
And when the last orbit forgets its curve,
when gravity loosens its ancient fist,
when even atoms fall quiet,
we will not collide.
We will not blaze.
We will fold inward
like breath returning to the chest,
and become
not fire touching fire,
but wholeness,
finally unafraid of its own light.

~Ritabrata Majumdar
2nd yr.

WHISPERS OF AWAKENING

Soft dawn returns on petals newly born,
A golden hush on fields of waking green,
Where whispers ride the breeze of gentle morn,
And life reweaves itself in vibrant sheen.
The winter's breath now fades in quiet grace,
As tender buds awake from silent dreams,
Each branch adorned with hope in soft embrace,
And rivers hum with sunlit silver gleams.
A chorus blooms where once the stillness lay,
Bright wings and songs compose the warming air,
The earth adorns herself in bright array,
With colors rich beyond what words can share.
O spring, you write in blooms what hearts can feel,
A fleeting truth that time cannot conceal.

~Rohan Das
4th yr.

শেষের পাতা

অন্ধ রাতে তারার মিছিল
ক্লান্ত হয়েও তোমাতে বিলীন,
কুয়াশা ভোরে যত্নে রেখো
দুঃখ পেলে কাঁদতে শিখো ।
ব্যাকুল হয়ে তাঁকিয়ে ছিলে
ভাবি ,ডাকবো বুঝি নিজের বলে।
সে ভাবনাও দারুন হতো
স্বপ্ন যদি সত্যিই হতো I
নৌকা তোমার যাবে ডুবে
পারবে না পৌঁছতে কোনো কূলে ,
ব্যঙ্গ করে হাসবে যারা
তাদের পরিও ফুলের মালা,
কাঁচের দেয়াল সরবে ঠিকই
আসবে আলো মুক্ত সব-ই।
আমায় কিছু দিও ঠাঁই
তোমার মনে আঁধার কোনে,
শেষে যদি বিচ্ছেদ-ই হয়
তবে সূচনা কেন রঙিন হয়?
সেসব কথা ভুলে এখন
জীবন ছন্দে হাঁটতে যখন,
মনের তালার চাবি হারিয়ে
উড়তে শেখো নতুন করে ।
জীবন ঝড়ে একলা যখন
একলা থাকতে ভয় তখন?
হাজার নালিশ বুকের মাঝে
তবুও প্রেমিক ব্যর্থ নয় হে....।

~Swarupa Roy Karmakar
2nd yr.

PHOTOGRAPHY

FRAME IT

FINE ARTS

PHOTOGRAPHY SECTION

RITABRATA MAJUMDAR

(2ND YEAR)

ABHRAJIT MUKHARJEE

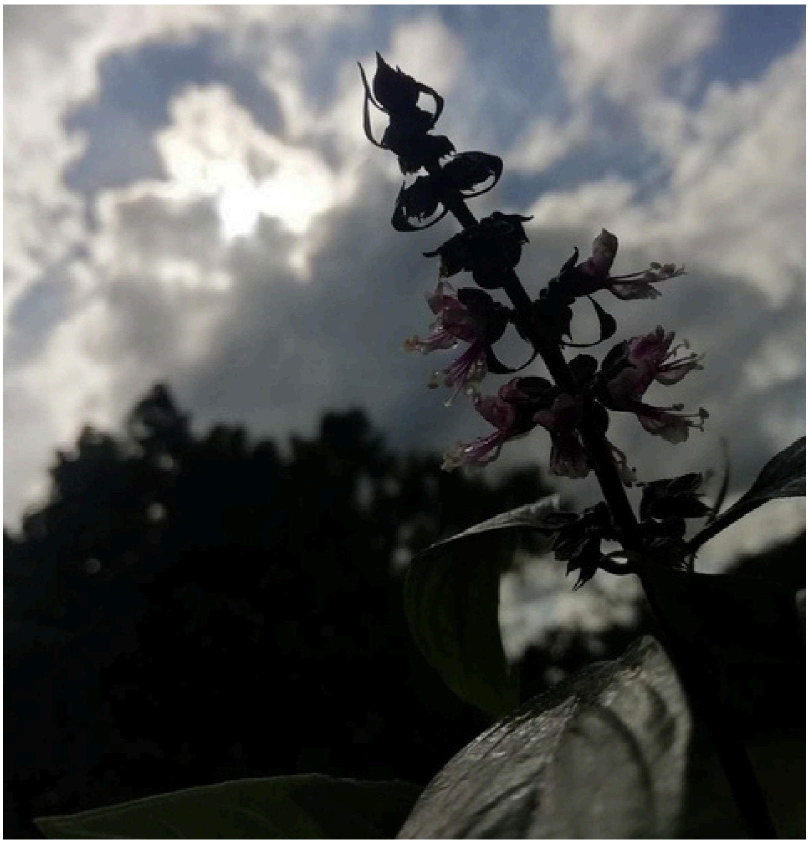
(3RD YEAR)

AISHIK PAUL
(4TH YEAR)

DEBJANI PATRA
(3RD YEAR)

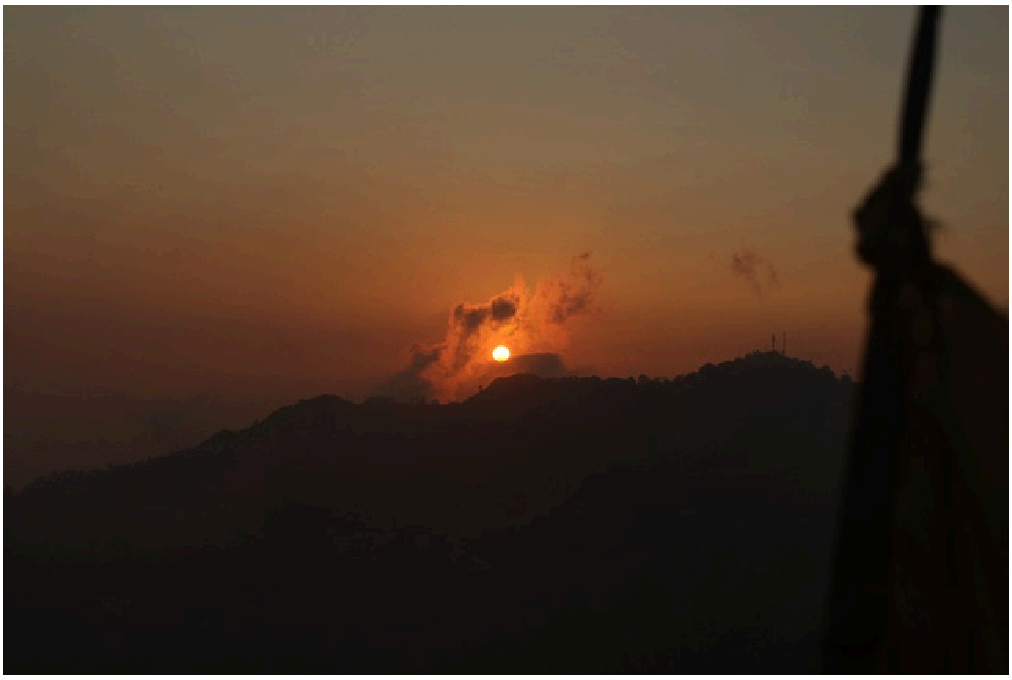
ISHITA PAUL
(3RD YEAR)

SUSMIT KHANRAH
(2ND YEAR)



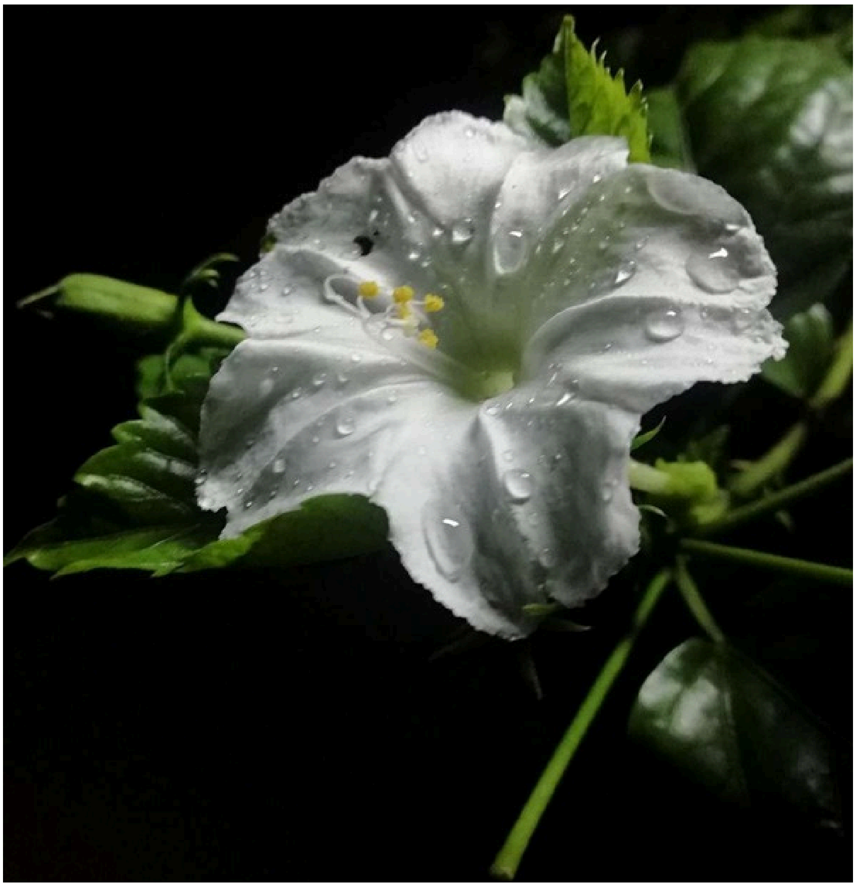
SOUGATA MAITY
(1ST YEAR)

DEBJANI PATRA
(3RD YEAR)



PUSHAN BASU

(3RD YEAR)



SOUGATA MAITY

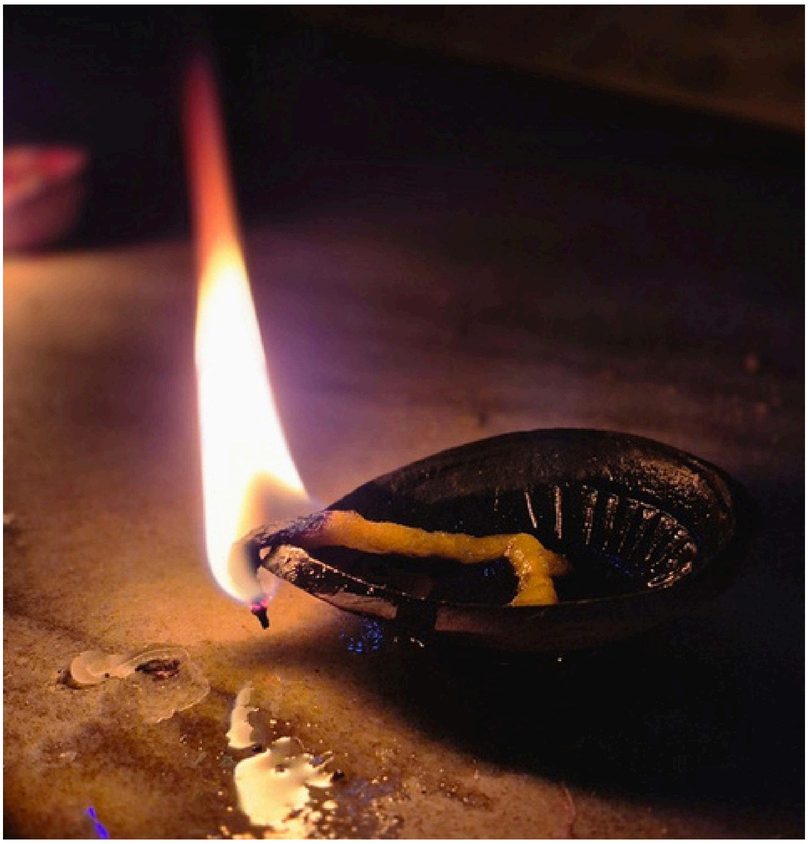
(1ST YEAR)

ABHRAJIT MUKHERJEE
(3RD YEAR)

SUBHRAJYOTI DEY
(1ST YEAR)

SAGNIK DUTTA
(3RD YEAR)

DEBASHRITA DAS
(2ND YEAR)



SUSMIT KHANRAH

(2ND YEAR)

SAGNIK DUTTA

(3RD YEAR)

SOUMYADEEP DAS MANDAL

(2ND YEAR)

PUSHAN BASU

(3RD YEAR)

MOYINAAK DUTTA

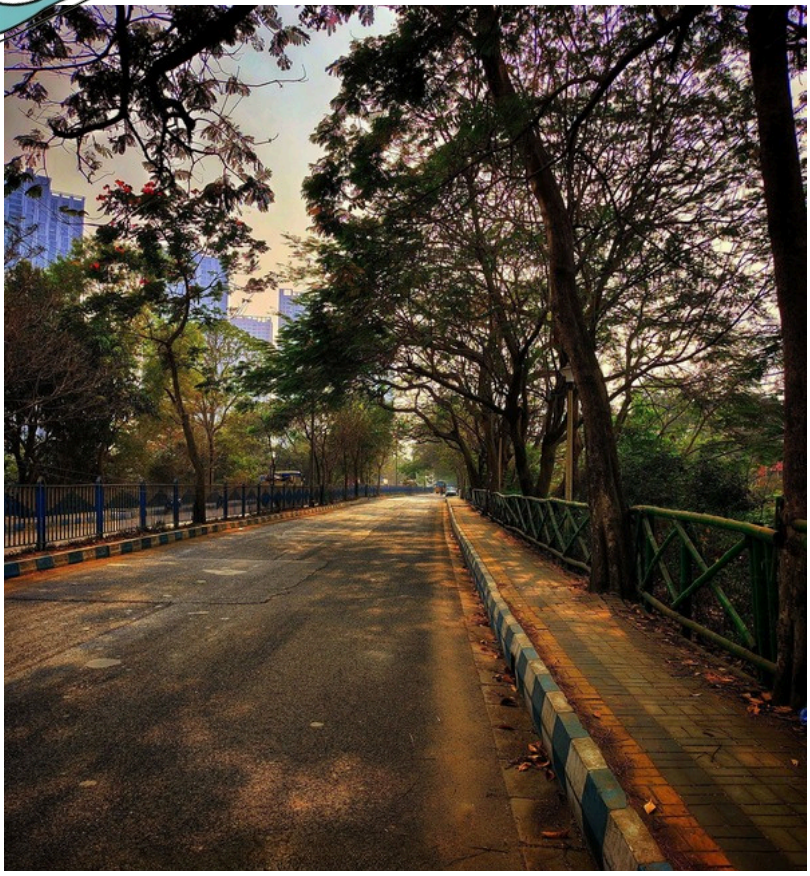
(2ND YEAR)

SHARANYA SARKAR

(1ST YEAR)

SUPARNA BANERJEE
(3RD YEAR)

SUBHRAJYOTI DEY
(2ND YEAR)



KRISHNAVA BASAK
(1ST YEAR)

SOUGATA SARKAR
(3RD YEAR)

SUSHOVAN CHATTERJEE

(2ND YEAR)

SRIJANI MAJUMDAR

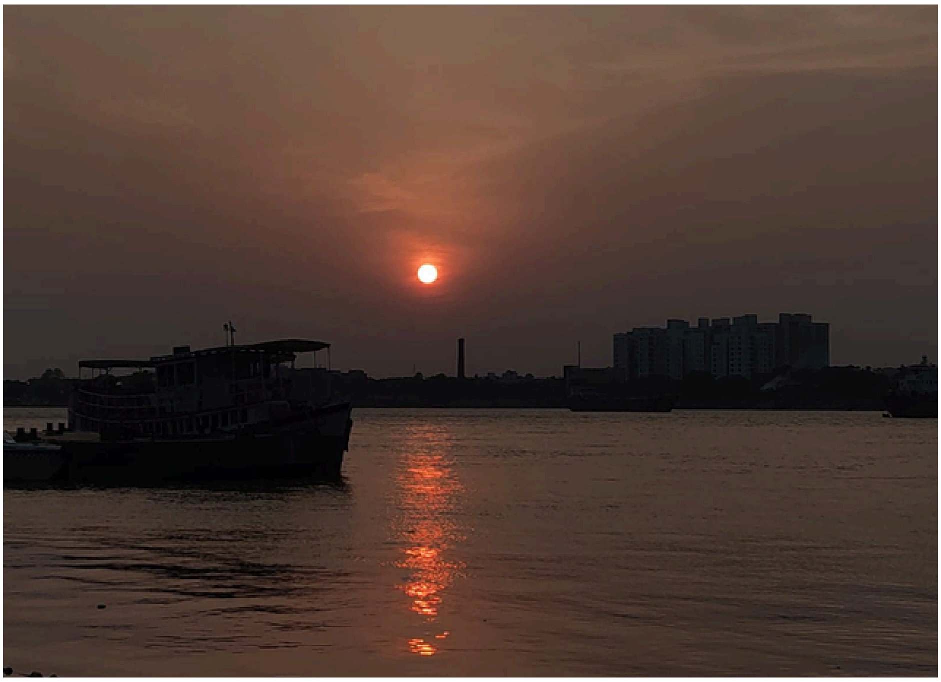
(3RD YEAR)

SOUMYADEEP DAS MANDAL

(2ND YEAR)

KRISHNAVA BASAK

(1ST YEAR)



DEBOJYOTI DAS

(2ND YEAR)

SOUMIK SAMANTA

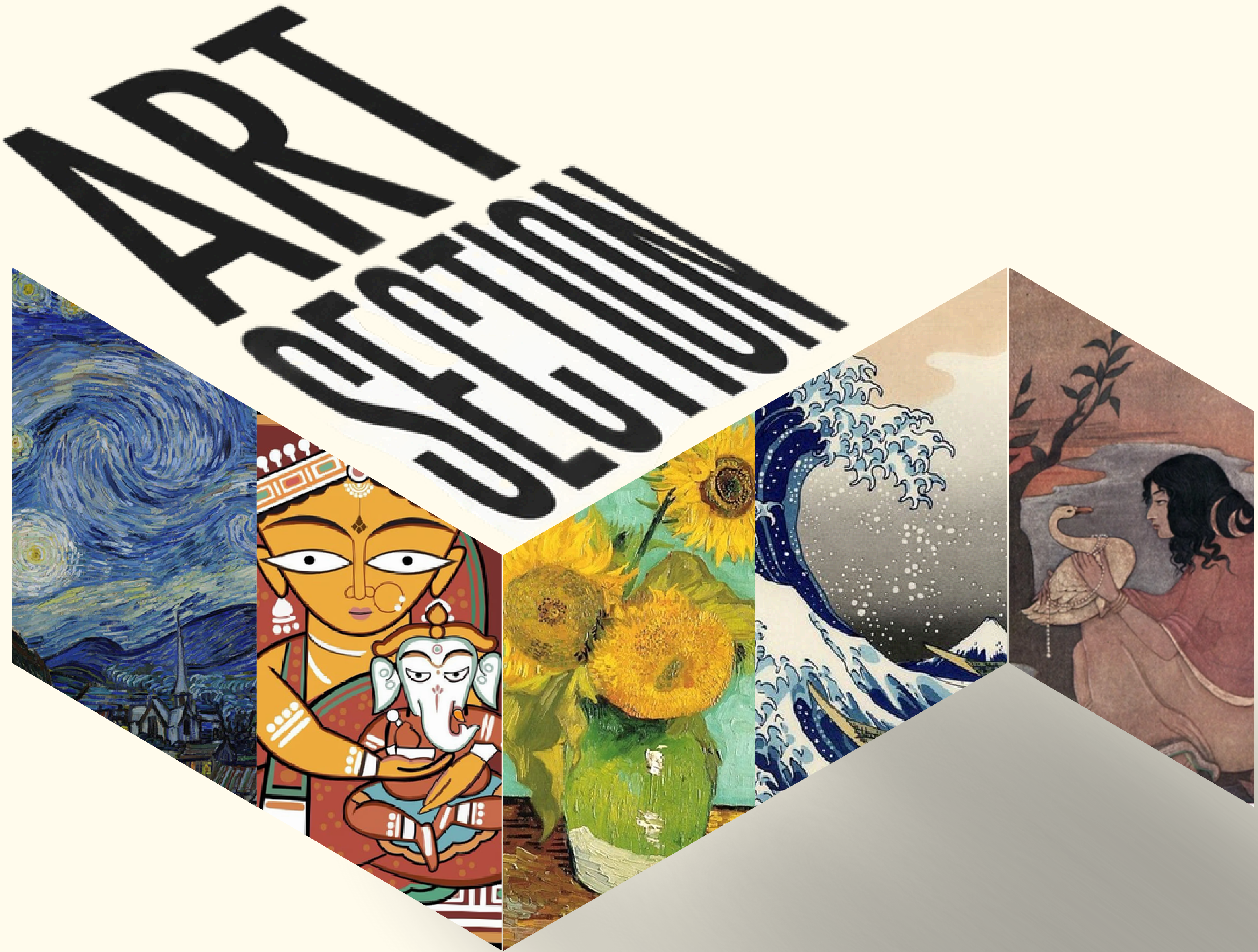
(2ND YEAR)

SOUMYA ADHIKARI
(2ND YEAR)

USHASI DASGUPTA
(2ND YEAR)

USHASI DASGUPTA
(2ND YEAR)

MOYINAAK DUTTA
(2ND YEAR)



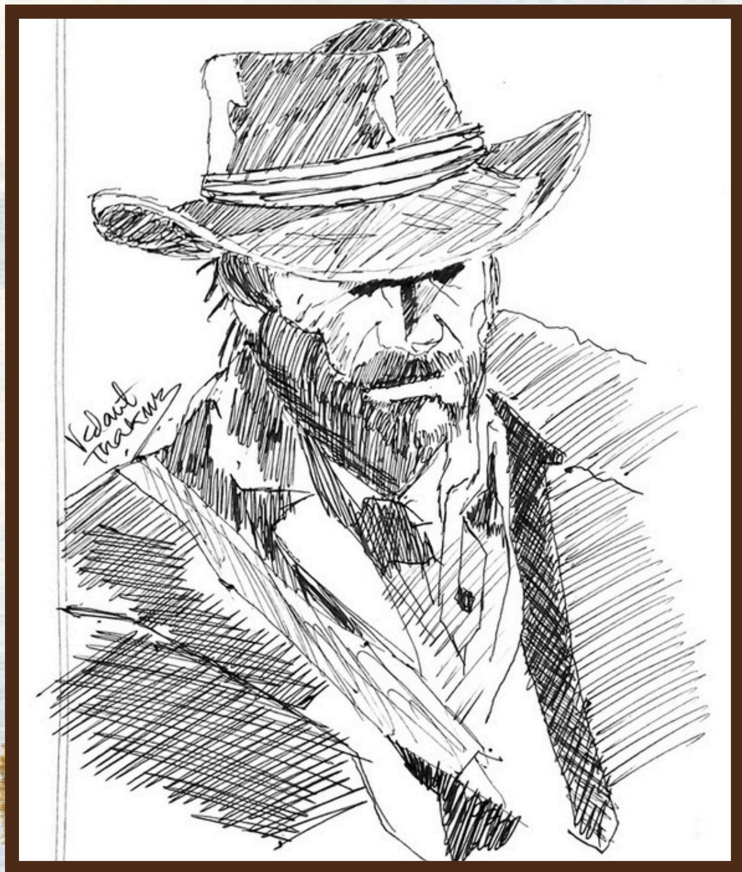
QUIET HANDS MOVE,
THE CANVAS LISTENS

MEGHNA MAHAPATRA
(2ND YEAR)

JOYEETRI CHAKRABORTY
(2ND YEAR)

SUSHOVAN CHATTERJEE
(2ND YEAR)

VEDANT THAKUR
(3RD YEAR)



SOURADEEP MITRA
(3RD YEAR)

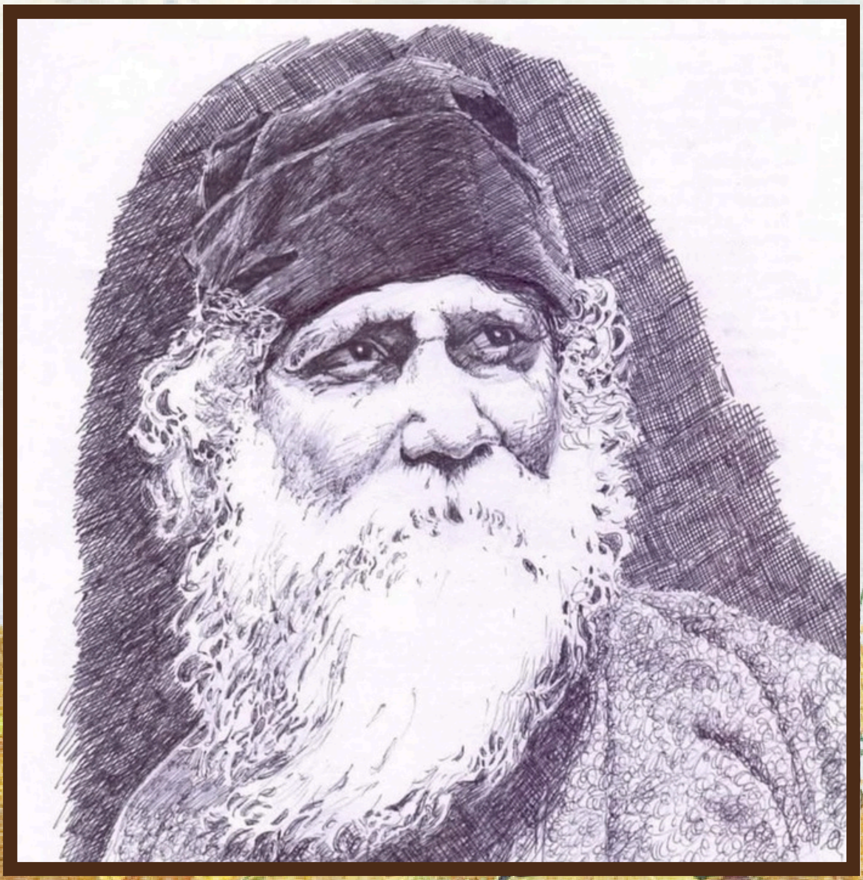
SUSNATA SAHA
(1ST YEAR)

JOYEETRI CHAKRABORTY
(2ND YEAR)

DEBASHRITA DAS
(2ND YEAR)

KRISHNAVA BASAK
(1ST YEAR)

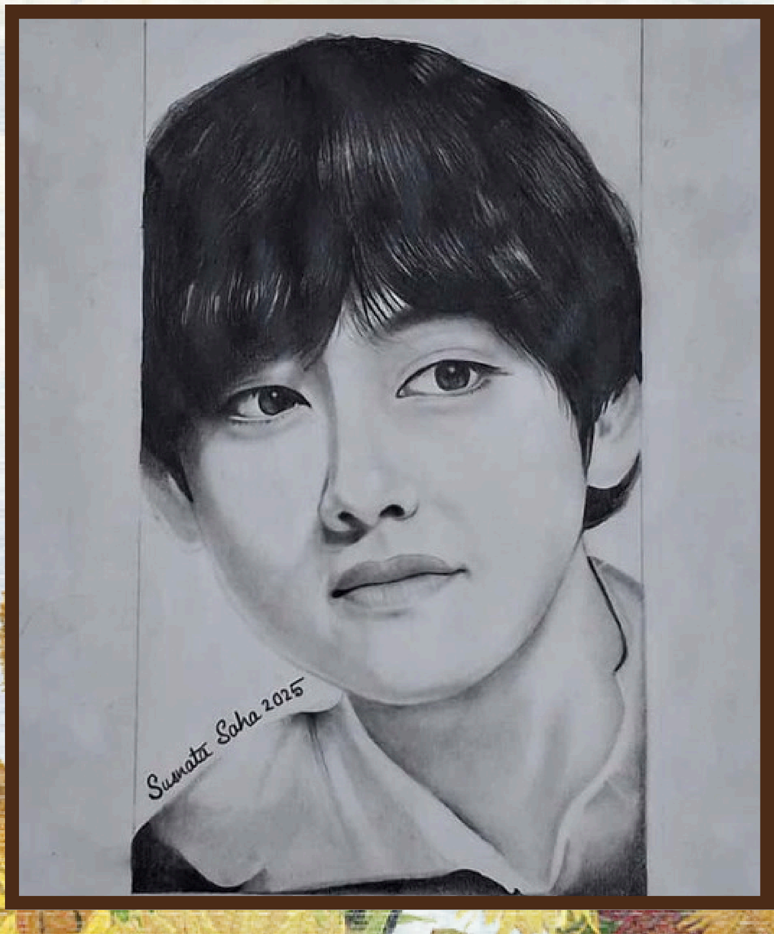
SUSHOVAN CHATTERJEE
(2ND YEAR)



AVANISH PRASAD
(3RD YEAR)

KRITIKA KUMARI
(2ND YEAR)

SOUMYADEEP DAS MANDAL
(2ND YEAR)



SUSNATA SAHA
(1ST YEAR)

SOURADEEP MITRA
(3RD YEAR)

ABHRAJIT MUKHARJEE
(3RD YEAR)

ACHIEVEMENTS

PAPER PUBLICATION

SAYANDEEP BISWAS
4TH YEAR

Publication of my first Journal paper titled "Leveraging Machine-Learning-Guided Optimization for Modeling Next-Generation Double-Absorber Perovskite Solar Cell" in the journal 'Solar Energy Materials and Solar Cells' by Elsevier.

The work focuses on solar cell device simulations using SCAPS-1D and using machine learning guided optimization to find best possible device combinations for enhanced performance.

I am extremely grateful to my mentor Dr. Prativa Agarwalla and fellow mate Pallabi Debnath for their invaluable support.

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journal homepage: www.elsevier.com/locate/solmat

Leveraging machine-learning-guided optimization for modeling next-generation double-absorber perovskite solar cell

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ARTICLE INFO

Keywords:
Lead-free double absorber perovskite solar cells (PSC)
SCAPS-1D simulation
Machine learning optimization
Hyperparameter tuning
Bio-inspired algorithms
Photo conduction efficiency (PCE)
$AgCdF_3/KGeCl_3$ heterostructure

ABSTRACT

Lead-free perovskite solar cells are gaining attention as sustainable alternatives to their lead-based counterparts, but performance improvements remain essential to support commercial adoption. This study investigates a double absorber architecture based on the $AgCdF_3/KGeCl_3$ heterostructure, selected for its complementary band alignment, high carrier mobility, and promising optical absorption. Eight electron transport layers (ETLs) and seven hole transport layers (HTLs) are screened through SCAPS-1D simulations to determine the most efficient device configuration. The IGZO/$AgCdF_3$/$KGeCl_3$/CBTS structure demonstrates strong photovoltaic characteristics due to well-matched band alignment and reduced recombination losses. To further optimize this configuration, a comprehensive sensitivity analysis is conducted to explore twelve structural and electrical parameters, followed by the generation of a simulation dataset that reflects their interactive influence on device performance. Machine learning regression models are trained to predict power conversion efficiency (PCE) using this dataset. Among the algorithms evaluated, Support Vector Regression (SVR) shows the highest predictive accuracy, achieving an R^2 value above 0.99. Hyperparameter tuning improves model generalisation, enabling its deployment as an objective function in bio-inspired optimization. Grey Wolf Optimization (GWO) identifies the optimal parameter combinations that maximize the efficiency of the solar cell. The optimized design achieves a simulated PCE of 37.82%, representing a significant gain over the baseline structure. The integrated simulation-and-data-driven approach presented here provides a reliable route for accelerating the discovery of high-efficiency, lead-free perovskite devices. The findings highlight $AgCdF_3/KGeCl_3$ as a compelling double-absorber candidate and demonstrate how machine learning can complement physical modelling to guide next-generation photovoltaic development.

1. Introduction

Perovskite solar cells (PSCs) have made rapid advancements over the past decade, reaching photo-conduction efficiencies (PCE) above 26% and offering scalable, low-cost, and low-temperature fabrication processes [1–3]. The ABX_3 perovskite structure forms the core active layer. Generally, the A-site is filled by a monovalent organic or inorganic cation such as CH_3^+, K^+, etc., the B-site is usually occupied by lead or tin, and the X-site contains a halide ion. This flexible arrangement allows a wide range of compositional changes, which in turn enables researchers to explore different organic-inorganic variants to adjust lattice parameters, tune the bandgap, influence charge carrier mobility, improve overall material stability, and modify many other properties of this perovskite material [4–6]. Such modifications enable the precise optimization of photon absorption, charge transport, and resistance to environmental factors, thereby ensuring long-term device stability and performance [4–6]. While single-junction PSCs have achieved impressive efficiencies, their practical performance is inherently limited by the Shockley-Queisser limit, which arises from incomplete solar spectrum utilisation and thermalisation losses [7].

To overcome these limitations, scientists have proposed a double perovskite absorber layer, where two different perovskite compounds form distinct layers, typically an AB_1X_3 perovskite paired with an AB_2X_3 perovskite – when sequentially arranged, enabling a complementary bandgap profile and tailored energy band alignments at the internal heterojunction interface [8–12]. This bilayer approach is found to

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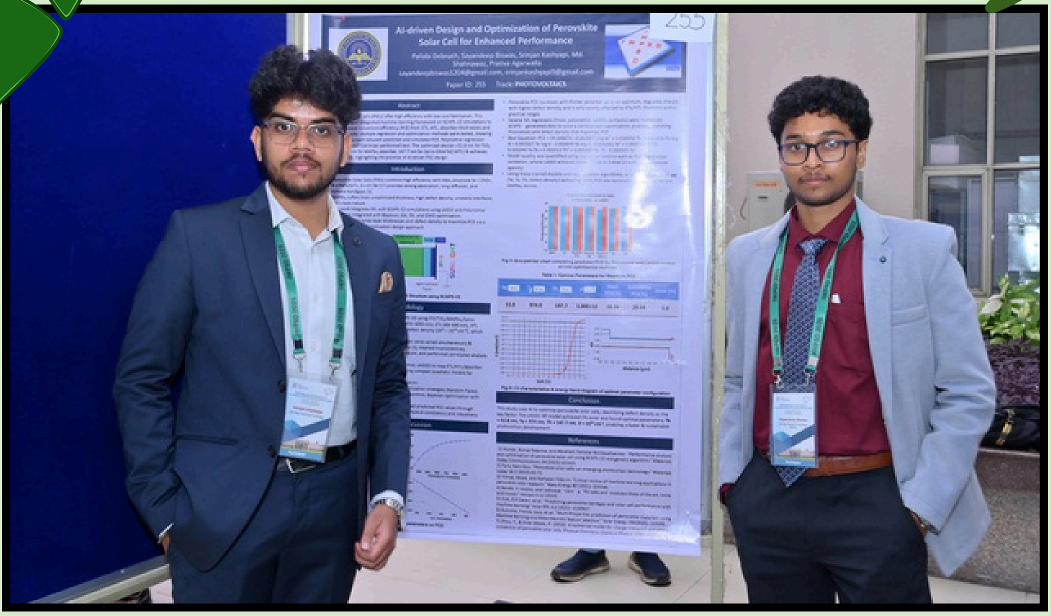
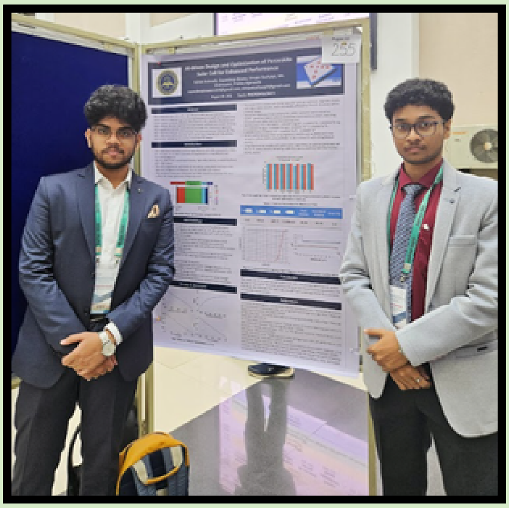
0927-0248/

IWPSD 25, IIT ROORKEE

SAYANDEEP BISWAS
4TH YEAR
SRINJAN KASHYAPI
4TH YEAR

Poster presentation at The 23rd International Workshop of Physics of Semiconductor Devices (IWPSD) 2025 at IIT Roorkee.
We are really grateful for the experience to my mentor Dr Prativa Agarwalla ma'am.


AI-driven Design and Optimization of Perovskite Solar Cell for Enhanced Performance
Abstract
Introduction
Conclusion
References
255




IWPSD
2025
SEMICONDUCTOR SOCIETY (INDIA)
SPARC
Welcome everyone to the
INTERNATIONAL WORKSHOP ON
SEMICONDUCTOR DEVICES
IWPSD 2025
15-18 December, 2025
TAIYO NIPPON SANSO
AGNIT
AGMATEL
KEYSIGHT
EdgeTech
SILVACO
MODUTEK CORPORATION

SPECIAL MENTION/RECOGNITION

DEBOLINA BANERJEE
(ECE C 3RD YEAR)

DEBAPRIYA PAUL
(ECE C 3RD YEAR)

RITTIKA BASAK
(ECE C 3RD YEAR)

DISHA MUSTAFI
(ECE C 3RD YEAR)

SRISTI GHOSH
(ECE C 3RD YEAR)

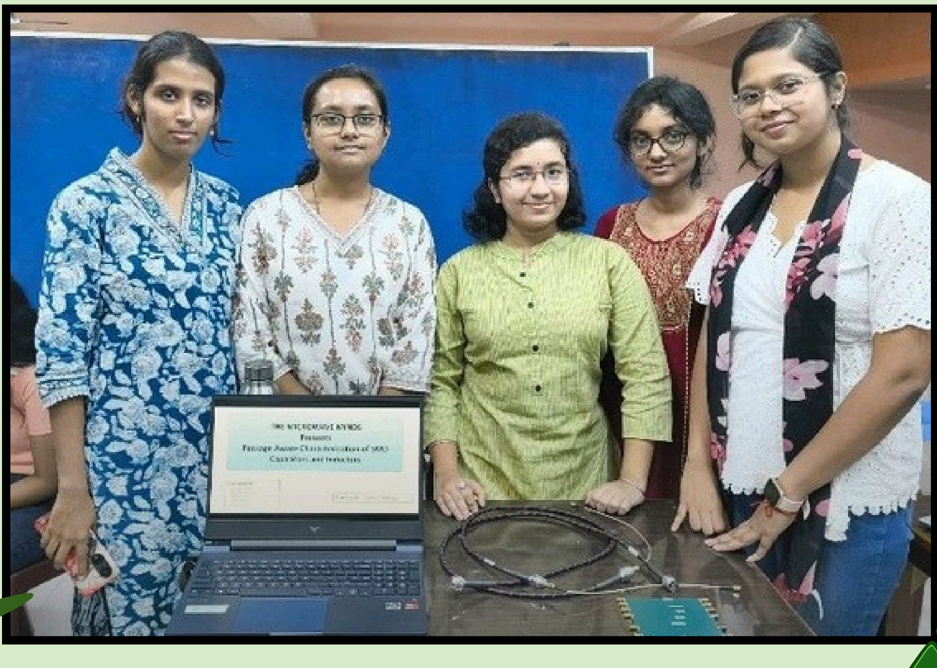
Winner of the
"JUDGES CHOICE AWARD"
in
"AI-In-Hardware : Smart System Design Challenge 2025"

CERTIFICATE
OF ACHIEVEMENT
This certificate is proudly presented to
Debolina Banerjee
from Team THE MICROWAVE MINDS
for getting Judge's Choice Award
in **"AI-In-Hardware : Smart System Design Challenge 2025"** : Prototype Development Competition on 12th November, 2025 in HITK, organized by IEEE MTT-S HITK SBC & ECE Department, HITK in association with IEEE AP-MTT Joint Chapter, Kolkata Section.
Congratulations on this well-deserved recognition!

Sayantani Datta
Dr. Sayantani Datta
Advisor
IEEE MTT-S HITK SBC

Chatterjee
Dr. Soumyo Chatterjee
Advisor
IEEE MTT-S HITK SBC


Smart System Design Challenge 2025



INTER-COLLEGE LITERARY COMPETITION

SAMOTA KUNDU
3RD YEAR

Secure 3rd rank (individual) in story writing competition at Scottish Church College.


Proud moment!
2nd runner up position in Creative writing competition
At Scottish Church.
Create-o-phy in Eco-verse ❤️

IEMPACT

SAMOTA KUNDU
(ECE B 3RD YEAR)
PRANTIK KUNDU
(ECE B 3RD YEAR)
AGNIVA BHATTACHARYA
(ECE A 2ND YEAR)
SOUMILI GHOSH
(CSE 3RD YEAR)
MOUBANI BHOWMIK
(BT 2ND YEAR)
ABHIRUP BHATTACHARYA
(MECH 3RD YEAR)

2nd runner up in Audio drama competition at IEMPACT which is organised by IEM.

HULT PRIZE 2026

SOUMYADEEP DAS MANDAL
(ECE A 2ND YEAR)
SAYAN BISWAS
(ECE A 2ND YEAR)
AGNIVA BHATTACHARYA
(ECE A 2ND YEAR)
SOMIYO ROY
(ECE A 2ND YEAR)

2nd Runner's Up @Hult Prize HITK (On Campus) 2026.

Hult Prize
The Telegraph online edugraph
Institution's Innovation Council

HULT PRIZE
HERITAGE INSTITUTE OF TECHNOLOGY

CERTIFICATE
OF ACHIEVEMENT

PROUDLY PRESENTED TO

Soumyadeep Das Mandal - FOGI

FOR OUTSTANDING PERFORMANCE AND SECURING THE **SECOND RUNNER-UP** POSITION IN THE **HULT PRIZE 2026** ON-CAMPUS PROGRAM AT HERITAGE INSTITUTE OF TECHNOLOGY, HELD ON 30TH JANUARY 2026.

NEIL BHATTACHARYA	PROFESSOR BASAB CHAUDHURI	PROF. JHALAK DUTTA
CAMPUS DIRECTOR, HULT PRIZE HITK'26	*PRINCIPAL*	*FACULTY COORDINATOR, HULT PRIZE HITK'26*
HERITAGE INSTITUTE OF TECHNOLOGY	HERITAGE INSTITUTE OF TECHNOLOGY	HERITAGE INSTITUTE OF TECHNOLOGY


2ND
ISSUED BY: HERITAGE INSTITUTE OF TECHNOLOGY
SUM OF: RUPEES FIVE THOUSAND ONLY
₹ 5,000
PROUDLY PRESENTED TO 2nd RUNNER UP:

ROBORUSH 2025

SOUMYADEEP DAS MANDAL
(ECE A 2ND YEAR)

ANEESH PAL
(ECE A 2ND YEAR)

SOHAM DUTTA
(ECE A 2ND YEAR)

1st Runner's Up @Thingathon (RoboRush) 2025, organized by the Robotics Club in association with the IEEE EDS Center of Excellence.

ROBOTICS CLUB
HERITAGE INSTITUTE OF TECHNOLOGY, KOLKATA

IEEE

ELECTRON DEVICES SOCIETY

CERTIFICATE
OF MERIT
IS PRESENTED TO

Soumyadeep Das Mondal

For securing 2nd position in the Thingathon event RoboRush 2025, hosted by the Robotics Club of Heritage Institute of Technology, Kolkata held on October 15, 2025, in recognition of your dedication and innovation in Robotics

Prof. Basab Chaudhari
Principal
Heritage Institute of Technology

Prof. Mousiki Kar
Faculty Coordinator
Robotics Club,
Coordinator, IEEE EDS
Center of Excellence

Prof. Jhalak Dutta
Faculty Coordinator
Robotics Club

Prof. Sabyasachee Banerjee
Faculty Coordinator
Robotics Club


Google


Google
Time: 10.15.2025 11:57
Address: Heritage Institute Of


Google
Time: 10.15.2025 11:51
Address: Heritage Institute Of

NATIONAL SYMPOSIUM

ARIJIT MUKHERJEE
(ECE C 4TH YEAR)

AISHIK PAUL
(ECE A 4TH YEAR)

ARGHADEEP DAS
(ECE A 4TH YEAR)

I, Arijit Mukherjee(4th year, sec-C), along with Aishik Paul(4th year, sec-A) and Arghadeep Das(4th year, sec-A), final-year students from the Department of Electronics & Communication Engineering, Heritage Institute of Technology, under the supervision of Dr. Anindya Sen, participated in the National Symposium on Emerging Technology & Management for Sustainable Growth held on 19–20 December 2025 at Jadavpur University, Kolkata – 700032. Our paper titled “Fish Health Monitoring using IoT and Computer Vision for Unsupervised Automated Species Classification and Early Detection of Health Threats” was presented at the symposium and was awarded the Second Prize in the Undergraduate Category. The award was conferred by Prof. Chiranjib Bhattacharjee, Vice-Chancellor, Jadavpur University and President, WBCHSE.

National Symposium on

Emerging Technology & Management for Sustainable Growth

Jointly Organized by

Institution's Innovation Council, Jadavpur University

And

Vivekananda Institute of Environment & Management

19-20 December 2025

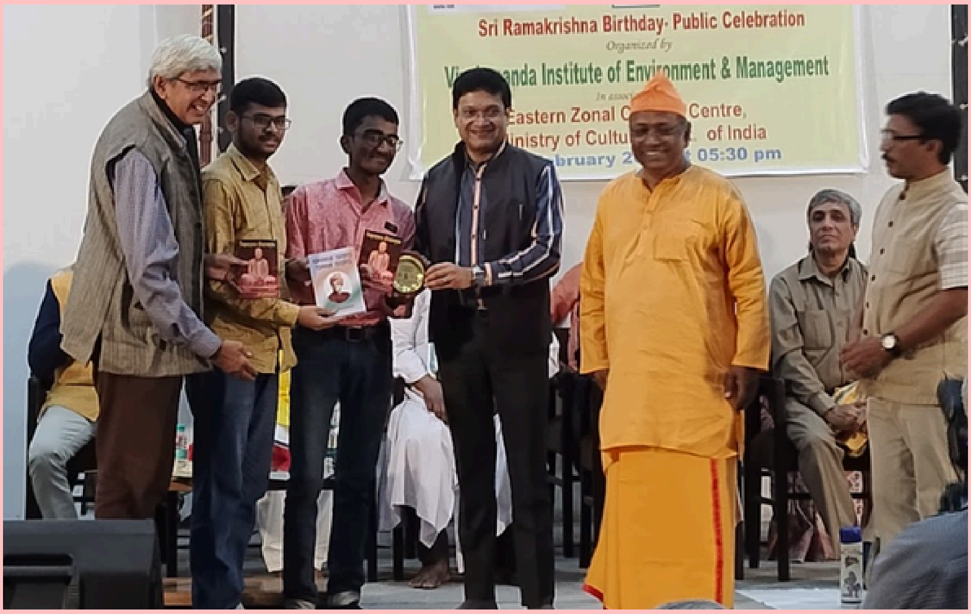
Award Certificate

This is to certify that the paper titled Fish Health Monitoring using IoT and Computer Vision for Unsupervised Automated Species Classification and Early Detection of Health Threats *authored by* Arijit Mukherjee & Anindya Sen (Supervisor) *of* Dept. of Electronics & Communication Engineering, Heritage Institute of Technology, *presented in the National Symposium at Jadavpur University, Kolkata 700032 was awarded* Second Prize *in the* Undergraduate *Category.*

Kolkata
12 January 2026

Prof. Rajib Bandyopadhyay
President, IIC, Jadvpur University

Swami (Professor-Dr) Vedajnananda
Chief Mentor of the Programme &
President, VIEM



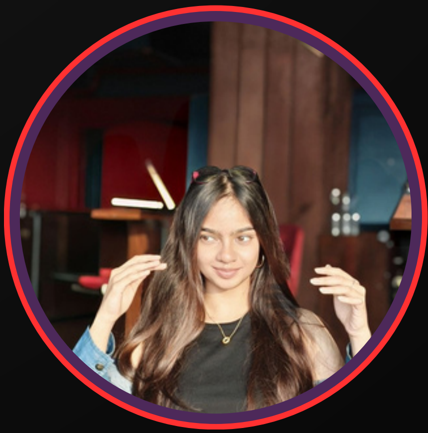
MEET THE TEAM

SENIOR EDITORIAL

DEBMALYA PAUL

PRANTIK KUNDU

DIPANJAN PAL



AISHI MUKHOPADHAYAY

JUNIOR EDITORIAL

SOUMYA ADHIKARI

AARSHI GANGULY

BIDISHA SINHA

DEBASHRITA DAS

SUPTOTTHITA MAHAPATRA

SHUBHAYU SINHA

SENIOR OUTWAVE

SANJANA GANGULY

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ANIRBAN CHANDRA

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SUSMIT KHANRAH

KAUSHANI MANDAL

SNEHA JHA

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Thank You

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