GANDHI INSTITUTE OF ADVANCED COMPUTER AND RESEARCH

RAYAGADA

(Approved by AICTE, Affiliated to SCTE&VT and BPUT - Odisha)

DEPARTMENT OF MECHANICAL ENGINEERING

THE MECHANICAL HORIZON

2022-23

Editorial Board

It gives us immense pleasure to present *The Mechanical Horizon*, the annual departmental magazine of the Mechanical Engineering Department. This publication stands as a reflection of the academic excellence, technical competence, and creative spirit of our students and faculty members.*The Mechanical Horizon* is a platform where knowledge meets creativity. Authored and edited by students and teachers, the magazine is published in English and showcases a comprehensive report of departmental activities. The magazine provides an opportunity for budding Mechanical engineers to express their innovative ideas, technical insights, research interests, and creative abilities. It encourages students to develop the habit of reading, writing, critical thinking, and professional communication — essential qualities for a successful engineer.

The Editorial Board comprises the Editor, Co-Editor, and Faculty Coordinators who work collectively to review and select quality contributions. We sincerely appreciate the enthusiastic participation of students and staff who contribute articles, technical papers, project summaries, site experiences, creative writings, and innovative ideas.This magazine not only documents the academic journey of the department but also serves as a source of inspiration for students to learn from the experiences and achievements of their peers. We hope that *The Mechanical Horizon* continues to motivate young minds to build not only strong structures but also strong ideas for the betterment of society.

Publisher

Gandhi Institute of Advanced Computer and Research, Rayagada

Message from Chairman

Dr. Chandra Dhwaja Panda

It is with great pleasure that I extend my heartfelt congratulations to the Department of Mechanical Engineering on the release of this year's edition of *Mechanical Horizon*. This magazine stands as a reflection of the department's unwavering commitment to academic excellence, innovation, and holistic development.

Mechanical engineering continues to be the backbone of industrial progress, driving advancements in manufacturing, automation, energy systems, and sustainable technologies. *Mechanical Horizon* captures this dynamic spirit through insightful articles, student innovations, and highlights of departmental activities that foster technical growth and creative thinking.

I am particularly pleased to see the emphasis on industry-academia collaboration, faculty development programs, and student participation in national and international forums. These engagements not only enhance learning but also prepare our students to meet real-world challenges with confidence and competence.

I commend the editorial team and all contributors for their dedication in bringing out this enriching volume. May *Mechanical Horizon* continue to inspire future engineers and serve as a beacon of knowledge and progress.

Message from Secretary

Mr. Manoj Kumar Palo

It gives me immense pleasure to present this edition of *Mechanical Horizon*, the annual magazine of our Mechanical Engineering Department. This publication is not just a compilation of articles and updates—it is a reflection of the creativity, innovation, and dedication of our students and faculty.

Over the past year, our department has continued to push the boundaries of knowledge and skill, embracing new technologies, fostering research, and encouraging hands-on learning. The spirit of mechanical engineering lies in solving real-world problems with precision and imagination, and I am proud to say that our students are embodying this vision with great enthusiasm.

I commend the editorial team, contributors, and all those who have worked tirelessly to bring this magazine to life. May *Mechanical Horizon* continue to inspire curiosity, nurture talent, and serve as a platform for sharing ideas that shape the engineers of tomorrow.

Let us keep striving for excellence, innovation, and teamwork—qualities that define not only our department but also the very essence of engineering.

Message from the Principal

Dr. Pratap Chandra Mishra

It is with great pride and joy that I extend my greetings to the readers of *Mechanical Horizon*, the annual magazine of the Mechanical Engineering Department. This publication reflects the vibrant academic culture, technical expertise, and creative spirit that define our institution.

Mechanical engineering, as a discipline, stands at the heart of innovation—transforming ideas into reality through knowledge, skill, and perseverance. Over the past year, our students and faculty have demonstrated remarkable commitment to excellence, embracing both traditional engineering principles and emerging technologies.

A magazine like *Mechanical Horizon* is more than a collection of words and images; it is a platform that showcases the intellectual pursuits, achievements, and aspirations of our department. I applaud the editorial team for their dedication and the contributors for their insightful articles and creative inputs.

I encourage all students to continue exploring, learning, and innovating, keeping alive the spirit of curiosity and problem-solving that drives engineering forward. May *Mechanical Horizon* inspire each reader to aim higher and contribute meaningfully to the progress of society.

Best wishes for continued success and excellence.

Message from the Head

Message from the Head of Department

Diploma in Mechanical Engineering

It gives me immense pleasure to extend my warm greetings to all readers of *Mechanical Horizon*, the annual magazine of the Department of Mechanical Engineering. This magazine serves as a creative platform for our students and faculty to express their technical insights, innovative ideas, and achievements.

Mechanical Engineering, being the foundation of industrial development, continues to evolve with advancements in automation, robotics, renewable energy, and smart manufacturing. Our department constantly strives to align academic learning with practical applications, nurturing students to become competent professionals and responsible citizens.

I take this opportunity to appreciate the editorial team and all contributors for their dedication and hard work in bringing out this edition. I also encourage our students to explore new technologies, engage in research, and uphold the values of innovation and teamwork.

Let *Mechanical Horizon* be a source of inspiration and knowledge that ignites curiosity and fosters a spirit of lifelong learning among our budding engineers.

Vision and Mission of the Institution

Vision

To become a globally recognized, value-driven educational institution committed to excellence in delivering quality education, nurturing students' inherent talents, and developing innovative professionals in technical and managerial fields, thereby equipping them to meet the future challenges of the global economy.

Mission

M_1: To deliver quality education through effective teaching–learning processes that foster academic excellence in technical and managerial disciplines.

M_2: To nurture students' inherent talents by encouraging creativity, critical thinking, innovation, and lifelong learning.

M_3: To develop competent and ethical professionals with strong values, leadership skills, and social responsibility.

M_4: To promote industry-oriented learning and research through collaboration, practical exposure, and adoption of emerging technologies.

M_5: To prepare globally competitive graduates capable of adapting to evolving challenges and contributing effectively to the global economy.

Vision & Mission of Department of Mechanical Engineering

VISION

To be a premier knowledge hub in mechanical engineering education, entrepreneurship, and industry engagement, producing skilled engineers ready to address industrial challenges.

MISSION

M1. To impart strong fundamental and advanced knowledge in mechanical engineering through effective teaching–learning practices and modern pedagogical methods.

M2. To promote innovation and entrepreneurship by encouraging creative thinking, problem-solving, and startup-oriented initiatives among students.

M3. To strengthen industry engagement through internships, industrial training, consultancy, and collaborative projects to enhance practical skills.

M4. To develop technically competent and ethical engineers with leadership qualities, professional integrity, and social responsibility.

M5. To equip graduates with industry-relevant skillsand adaptability to effectively address real-world engineering challenges.

CONTENT

SOLAR TRACKING SYSTEM

By Chotu Bagh, 3rd year

One of the most exciting topics in solar energy research is the development and implementation of solar tracking systems. These innovative technologies are designed to maximize the efficiency of solar panels by allowing them to follow the sun's movement throughout the day. By constantly adjusting their position, these solar tracking systems can increase energy output by up to 50 percent compared to fixed solar panels.

What makes solar tracking so fascinating is its potential for widespread adoption in both residential and commercial settings. While it may sound like a complex technology that only large-scale power plants can afford, there are actually various types of tracking systems available that are suitable for different applications. From single-axis trackers that move panels along one axis, typically from east to west, to dual-axis trackers capable of following both the sun's daily movement as well as its seasonal changes, there is a solution for every need. Aside from boosting energy generation, another advantage of using solar tracking

systems is their ability to prolong the lifespan of solar panels. By evenly distributing sunlight across the entire surface throughout the day, these systems prevent certain parts from being overworked while others remain underutilized. This leads to less wear and tear on individual cells and ultimately extends their operational life span.

Overall, as renewable energycontinues to play an increasingly important role in addressing climate change concerns, exploring new ways to improve its efficiency becomes paramount. Solar tracking systems have proven themselves as a viable option for not only enhancing electricity generation but also extending equipment longevity. As technology advances and costs decrease, we can expect even greater adoption of solar tracking systems in the future. One key advantage of solar tracking systems is their ability to maximize energy output throughout the day. Traditional fixed solar panels are stationary and are only able to capture sunlight at a fixed angle, typically facing south in the northern hemisphere. As a result, they are only able to generate optimal power during a limited period when the sun is directly overhead.

AUTOMATIC GATE ALARM WITH LIGHT

By Hemanta Suna, 3rd year

Automatic gate alarms with lights are becoming increasingly popular in both residential and commercial settings. These innovative devices provide an extra layer of security by alerting homeowners or property owners whenever someone attempts to enter the premises unauthorized. The alarm is triggered when the gate is tampered with or opened without the proper access code, while the accompanying light serves as a visual deterrent to would-be intruders. This combination of sound and light not only helps to deter potential burglars but also provides peace of mind for property owners who can rest easy knowing that their entrance is well protected.

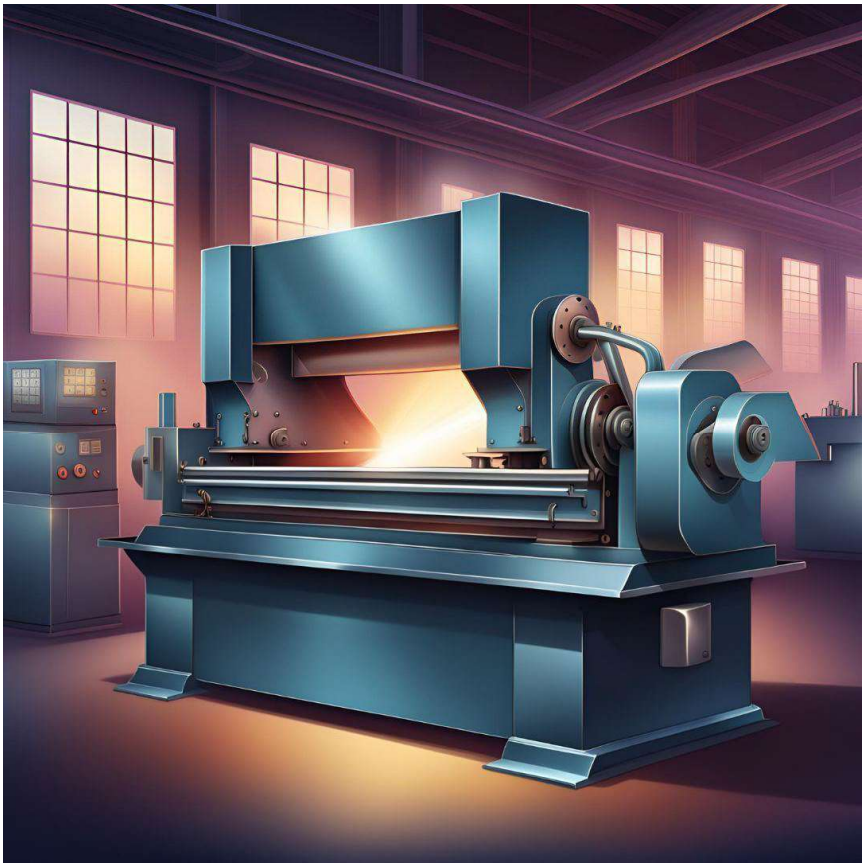
One of the key benefits of automatic gate alarms with lights is their versatility. They can be easily integrated into existing security systems, allowing them to work seamlessly alongside other monitoring devices such as CCTV cameras or motion sensors. In addition, these alarms can be programmed to send alerts directly to a homeowner's smartphone or through a central monitoring system, ensuring that any unusual activity at the entrance is brought to immediate attention. This real-time notification allows homeowners or property managers to take prompt action if necessary, whether it's contacting law enforcement or simply investigating what triggered the alert.

Furthermore, automatic gate alarms with lights can also serve as a useful tool for emergency situations. For example, in case of fire or medical emergencies on the property, these alarms can be activated manually from inside the premises to alert emergency responders that assistance is needed immediately. By combining an audible alarm with a flashing light that catches attention even at night, this system ensures quick response times and potentially life-saving interventions.

SHEET METAL BENDING MACHINE

By Khageswar Majhi, 3rd year

A sheet metal bending machine may seem like a simple tool, but its capabilities go beyond basic fabrication. In the ever-evolving field of mechanical engineering, these machines play a crucial role in shaping and molding various metal components and structures. From automotive body panels to intricate parts for machinery, sheet metal bending machines offer precision and efficiency that cannot be replicated by manual labor alone



One exciting aspect of these machines is their ability to create complex bends and shapes with minimal effort. With advancements in technology, manufacturers have developed sophisticated computer numerical control (CNC) systems that can program multiple axis movements with high accuracy. This means that engineers can now accurately produce intricate designs that were once thought to be impossible or time-consuming by using automated bending machines.

Furthermore, the integration of artificial intelligence (AI) in sheet metal bending machines opens up even more possibilities for the field of mechanical engineering. AI algorithms can analyse and predict issues such as material deformation or unwanted springback during the bending process, thus optimizing the efficiency and quality of production. By harnessing the power of AI, engineers can develop innovative solutions to improve the performance and reliability of sheet metal bending machines. This combination creates a dynamic environment where creativity meets technology in driving forward advancements in mechanical engineering.

In conclusion, sheet metal bending machines are an essential component within mechanical engineering as they provide precision, efficiency, and innovation for manufacturing processes. From enhancing complex bend formations through CNC systems to integrating AI algorithms for improved performance optimization, these tools are at the forefront of technological advancements within this field.

HUMAN GENERATED POWER FOR MOBILE ELECTRONICS

By Basuri Bhargav Kumar, 1st Year

Today's mobile devices have become an essential part of our lives, but their battery life often fails to keep up with our high usage demands. This is where the concept of human-generated power for mobile electronics comes into play. Imagine powering your smartphone or fitness tracker simply by walking, typing on your laptop, or even by your body heat. The potential for harnessing human energy to charge our devices is both innovative and sustainable.

One emerging technology in this field is piezoelectric materials. These materials can convert mechanical strain into electrical energy, meaning that every step we take could potentially generate power. Researchers are exploring ways to incorporate piezoelectric materials into shoe inserts or floor tiles to harness this untapped source of energy. Another interesting approach involves using thermoelectric generators that can capture and convert body heat into usable electricity. By embedding these generators in our clothing or wearable devices, they could turn our natural body heat into a continuous power source.

The concept of human-generated power for mobile electronics opens up exciting possibilities for a greener future where we are not solely reliant on traditional sources of electricity. It allows us to reduce our carbon footprint while simultaneously ensuring the uninterrupted use of our favourite gadgets. Moreover, it encourages users to be more conscious about their own energy consumption and physical activities as each movement counts towards charging their devices. In an era where technology has become an integral part of everyday life, this innovative solution offers a way to blend sustainability with convenience and efficiency.

HILLS TRAIN POWER GENERATION & AUTOMATIC RAILWAY GATE CONTROL

By Chaitana Nagabansha, 1st Year

In recent years, the concept of harnessing power from moving vehicles has gained significant attention. One fascinating application of this idea is the generation of electricity from trains running on hills. Traditional methods of electricity generation often involve non-renewable resources and produce harmful emissions.

However, by tapping into the immense kinetic energy generated by trains moving downhill, we can generate clean and sustainable power. This innovative technology could revolutionize the way we harness energy and pave the way for a greener future. Another aspect that plays a crucial role in ensuring smooth railway operations is automatic railway gate control.

As trains pass through different areas, it becomes essential to have an efficient system in place to manage railway crossings automatically without human intervention. By utilizing advanced technologies such as sensors, transmitters, receivers, and microcontrollers, these automatic gate control systems can accurately detect approaching trains and regulate the

opening and closing of gates accordingly. Implementing such systems not only enhances safety but also improves traffic flow by minimizing road congestion caused by manually operated gates.

In conclusion, developments in mechanical engineering continue to open up exciting possibilities for creating sustainable solutions and streamlining operations within our transportation infrastructure. From generating power using the motion of trains on hillsides to implementing automatic gate control systems along railways lines, these innovations hold immense potential for reducing our carbon footprint while enhancing efficiency and safety in our society's day-to-day activities.

CLUTCH

By Durga Dinesh Kumar Reddy, 1st year

Clutch mechanisms are a fundamental element of mechanical engineering, often overlooked but playing an essential role in various applications. From automobiles to industrial machinery, clutches serve as the vital link between power sources and driven components. These mechanical devices enable smooth engagement and disengagement of power transmission, allowing for efficient control and manipulation.

One fascinating aspect of clutch systems is their ability to transfer torque from one rotating component to another seamlessly. The mechanics behind this seemingly simple operation involve intricate designs that optimize performance while minimizing wear and tear. Engineers continuously explore innovative materials, such as ceramics and carbon fiber composites, to improve friction characteristics and increase durability. Moreover, the application of modern technologies has revolutionized clutch design in recent years. Electronic clutches have emerged as an alternative solution that offers enhanced control precision through automated engagement and disengagement mechanisms. This opens up possibilities for more sophisticated vehicle drivetrains and advanced automation systems in industries like manufacturing and robotics.

In conclusion, understanding the intricacies of clutch mechanisms is crucial for any aspiring mechanical engineer seeking comprehensive knowledge in the field. Exploring new

materials, embracing electronic advancements, and further refining these mechanical wonders can lead to significant improvements in various industries where power transmission plays a pivotal role. It is undoubtedly an exciting time for clutches – perhaps underappreciated but ever-evolving elements that keep our machines moving smoothly towards a better future.

CERAMIC DISC BRAKES

By Kartika Krusika, 1st Year

One of the most exciting advancements in brake technology in recent years has been the development of ceramic disc brakes. While traditional disc brakes use iron or steel rotors, ceramic disc brakes utilize ceramic materials such as carbon fibers and silicon carbide. This innovative design offers several advantages over conventional brakes.

First and foremost, ceramic disc brakes are known for their superior performance in terms of stopping power. The high friction coefficient of ceramic materials allows these brakes to provide quick and efficient stopping even at high speeds. Additionally, the lightweight nature of ceramics means that they contribute to overall weight reduction in vehicles, improving fuel efficiency.

Furthermore, one key advantage of ceramic disc brakes is their resistance to fade. Brake fade occurs when excessive heatgenerated during braking causes a decrease in braking performance. Ceramic materials have excellent thermal properties that can withstand extreme temperatures without compromising on brake performance. This ability to maintain consistent stopping power makes them particularly suitable for high-performance vehicles that require precise and consistent braking under demanding conditions.

In conclusion, the introduction of ceramic disc brakes has revolutionized the automotive industry by providing a more efficient and reliable alternative to traditional braking systems. With their enhanced stopping power, reduced weight, and resistance to fade, these advanced brakes offer improved safety and performance for both everyday drivers and automotive enthusiasts alike. As technology continues to evolve, it will be fascinating to witness further developments in this field that push the boundaries of what is possible with brake systems.

SHOT BLASTING

By Bikash Kumar Nayak

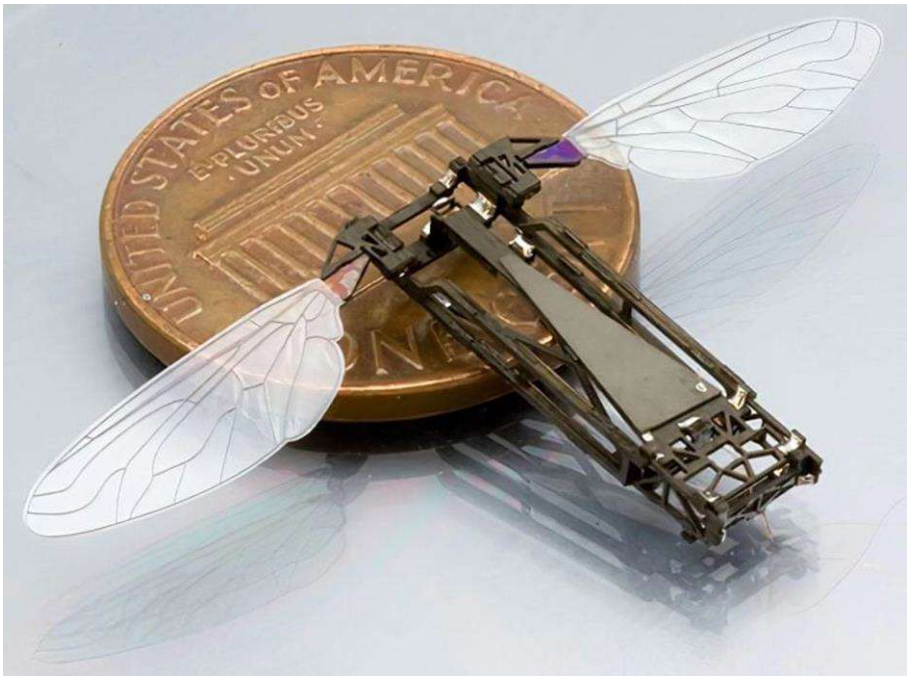
Shot blasting is a widely used technique in the mechanical engineering field that involves propelling small metallic or non-metallic projectiles at high speeds to clean, polish, or strengthen surfaces. This process offers several advantages over traditional methods such as sanding or grinding, including faster turnaround times and better surface finish. But beyond these obvious benefits, shot blasting also plays a crucial role in enhancing the structural integrity of materials by removing surface contaminants and residual stresses.

One area where shot blasting has proven especially valuable is in preparing metal surfaces for coatings and paints. The intense impact of the projectiles not only removes rust, scales, and impurities but also creates a roughened texture that facilitates adhesion of subsequent layers. Furthermore, shot blasting can be tailored to specific requirements by adjusting parameters such as projectile size, speed, and angle of attack. This versatility makes it an ideal choice for applications ranging from aerospace components to industrial machinery.

However, despite its widespread use and effectiveness, shot blasting does have some limitations that engineers need to consider. For instance, certain delicate materials may be susceptible to damage from the high-velocity projectiles during the cleaning process. Additionally, aerial coverage is another consideration; shot blasting typically produces overlapping patterns which can result in inconsistent removal rates across large surfaces. Addressing these challenges requires careful selection of appropriate equipment and techniques while adhering to industry best practices.

RESEARCHERS STUDY BUTTERFLY FLIGHT DYNAMICS TO CREATE SMALL AIRBORNE ROBOTS

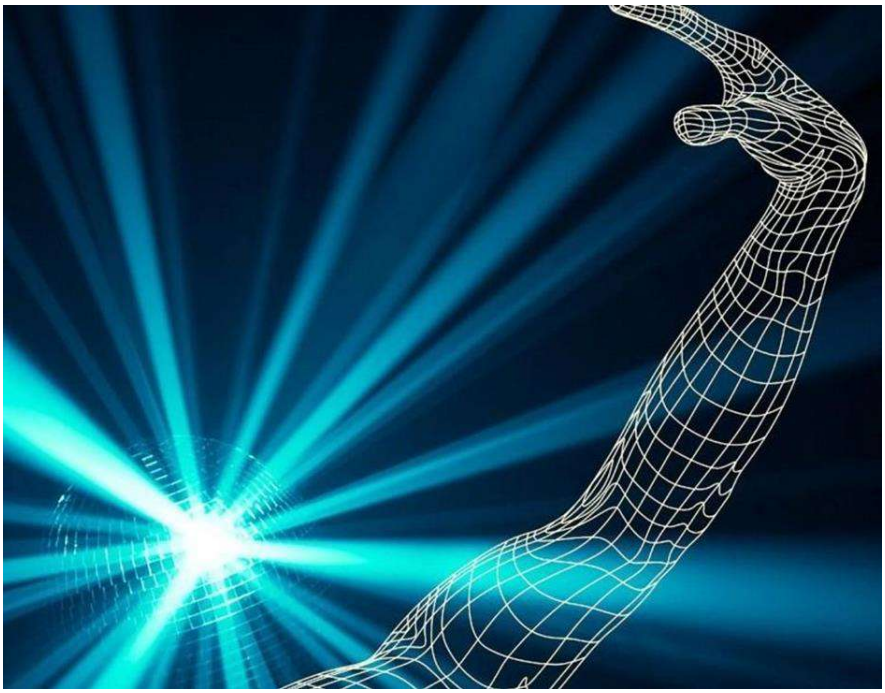
By Sridhara Dalei, 2nd year



Previously conducted studies have highlighted that the wings of insects have significantly less weight in comparison to the insect's body. Therefore, those academics determined that alterations in the spatial distribution of mass related to wing-flapping were not necessary to take into account when studying an insect's flight manoeuvrability and stability. Lin stated that they discovered the widely held belief to be invalid, at least in the case of insects like butterflies. We discovered that alterations in moment of inertia, a characteristic linked to mass distribution, are significant in insect flight, akin to how arm and leg movement is crucial for ice skaters and divers.

LIGHT ACTIVATED MUSCLE CELLS MAY ADVANCE BIOROBOTICS

By Sunil Tadingi, 2nd Year



Numerous robotic designs draw inspiration from nature, such as mimicking geckos to cling to walls, moving through water like tuna, and running across land like cheetahs. These designs imitate animals' behavior by utilizing engineered materials and hardware inspired by nature.

The team is the initial one to effectively activate skeletal muscle using light, offering a novel method to manipulate muscles without the need for wires. Advancing even more, Asada developed muscle fibers using a blend of hydrogel to create a 3-D muscle structure, then illuminated the tissue with light. The 3-D muscle, just like individual muscle fibers, is bent and twisted in regions illuminated by the light beams.

The muscle tissue responds to light and can move in many ways, potentially leading to the development of advanced, adaptable robots, which is currently the group's focus. A possible robotic device could entail endoscopy, a process where a camera is passed through the body to light up tissue or organs. Asada suggests that a robot built with light-sensitive muscle could potentially be compact and agile to move through narrow areas, such as the

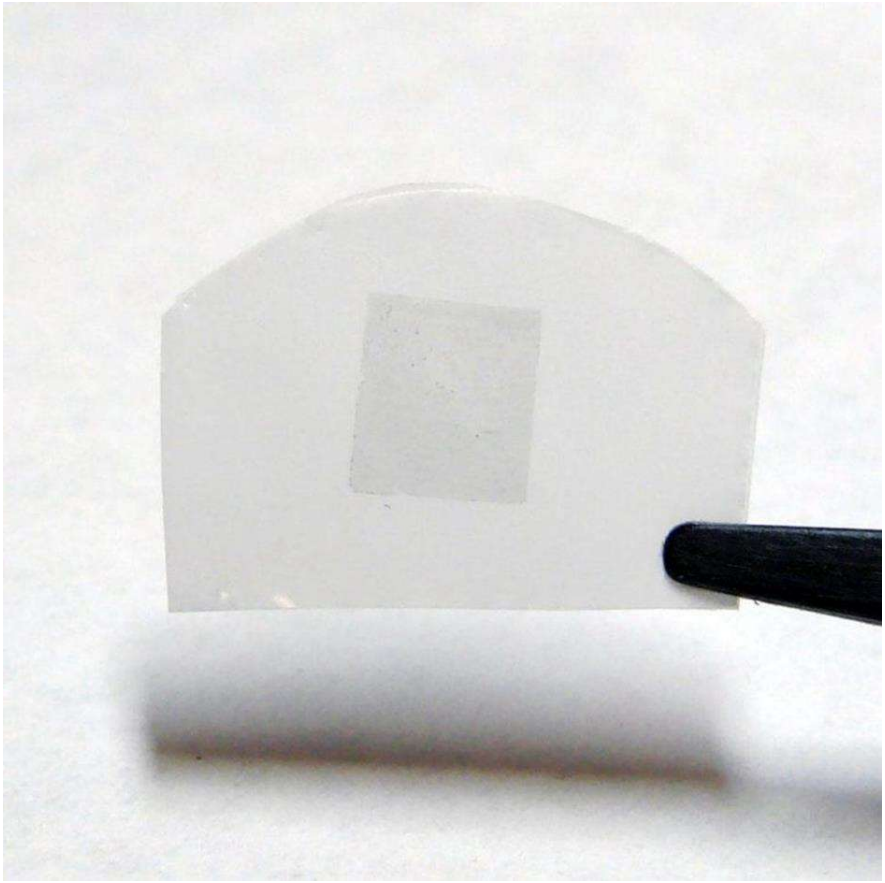
body's blood vessels. Asada believes that although it will take a while to create such a device, the group's findings show a good beginning.

Meanwhile, there could be a more instant use for both the engineered muscles and the microchip: Asada suggests that they could be utilized for testing drugs for motor-related illnesses. Scientists can cultivate muscle strips that are sensitive to light in several wells, observing their response to different drugs and measuring the strength of their contractions.

GRAPHENE MEMBRANES MAY BE USED TO FILTER WATER & BIOLOGICAL SAMPLES

By Biswajit Mahankuda, 2nd Year

Graphene's remarkable attributes have received a lot of attention, including its superior heat and electricity conduction and unmatched strength. When incorporated into a composite material, graphene can provide better bullet resistance than Kevlar. Prior studies have indicated that pristine graphene, consisting of carbon atoms in a honeycomb pattern, is one of the most impermeable materials known, making it perfect for use as a barrier film.

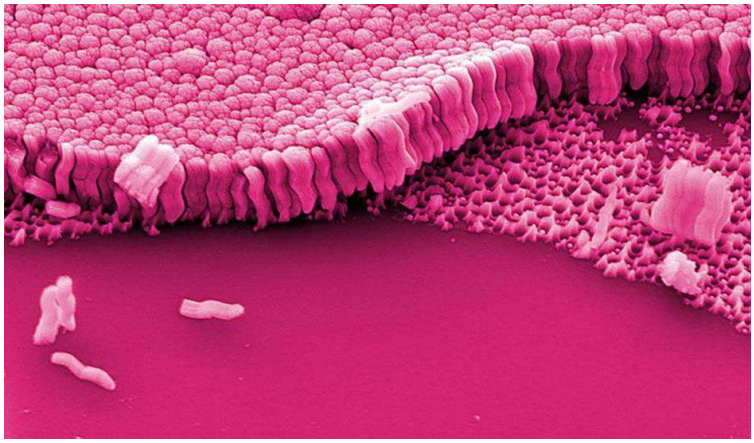


However, the substance might not be as indestructible as researchers previously believed. Scientists from MIT, ORNL, and other institutions have discovered that when they create large membranes from single sheets of graphene using chemical vapor deposition, the material contains natural imperfections, such as holes in its armor made of atoms. During the experiments, the scientists discovered that salts could move through the small pores of a graphene membrane, but larger molecules could not enter.

YALE ENGINEERS CREATE A NEW KIND OF METALLIC GLASS

By Susanta Naik, 2nd Year

Today, the study was released in Nature Communications. It was carried out by Yale's CRISP, led by Judy Cha and Jan Schroers.



Metallic glasses are a modern type of materials crafted from intricate, multi-component alloys. They possess the flexible malleability of plastics, along with the durability of metals. When metallic glasses transition from a liquid to a solid state, their atoms are arranged randomly and do not form crystals like regular metals. Cha stated that they found a different type of metallic glasses through the creation of extremely small metallic-glass rods, eliminating space for nuclei, known as "nucleus starvation," resulting in a new crystalline phase. The rods have a diameter of under 35 nanometers, which is over 2,000 times smaller than that of a human hair. Cha, who is employed at the Energy Sciences Institute on Yale's West Campus, stated that this allows us to regulate the amount of nuclei we offer in the sample. Despite the absence of nuclei, which goes against nature's norm, it creates a unique crystalline phase that is completely unfamiliar to us. It is a method for producing a fresh substance from the existing one."