IIT Madras
Indian Institute of Technology Madras

Cooperation for Sustainable Development

IIT Madras & AARDO Scholarships

PROJECT: IA- 000101

USE OF LOCALLY AVAILABLE BIOMASS FOR COOKING AND ENERGY APPLICATIONS

Project Nature: Experimental and theoretical

Project Description and Objectives:

Energy conversion using locally available biomass fuels in rural areas for cooking and energy applications such as heating, electricity production and so on.

Reference articles or other materials to be read by prior to applying:

Power plant engineering text books

PROJECT: IA- 000102

DEVELOPMENT OF REGION SPECIFIC CLIMATE CHANGE ADAPTATION STRATEGIES: A SPECIAL FOCUS ON RURAL REGIONS OF ASIA AND AFRICA

Project Nature: Interdisciplinary

Project Description and Objectives:

This project focuses on developing region-specific climate change adaptation strategies tailored to the unique needs of rural regions in Asia and Africa, which are particularly vulnerable to the effects of climate change. Recognizing the distinct environmental, economic, and social challenges these areas face, the project seeks to create localized solutions that enhance resilience and sustainability.

The approach begins with comprehensive assessments to analyze the specific climate risks, vulnerabilities, and existing adaptation measures in selected rural communities across these continents. By engaging local stakeholders—including farmers, community leaders, and policymakers—the project ensures that the strategies developed are culturally and contextually relevant, integrating both innovative technologies and traditional knowledge. The project will develop targeted adaptation strategies that address critical issues such as water management, agricultural practices, disaster preparedness, and ecosystem preservation. These strategies will then be piloted in select rural communities to assess their effectiveness and scalability.

Additionally, the project aims to promote knowledge sharing by facilitating the exchange of best practices and lessons learned between communities, regions, and countries, thereby enhancing broader adaptation efforts across similar environments. Ultimately, the goal is to empower rural communities in Asia and Africa to better cope with the impacts of climate change, ensuring the protection of their livelihoods and ecosystems for future generations. Objectives 1. To identify the specific vulnerabilities of rural regions in Asia and Africa using the General Circulation Model outputs and the historical observed data of rainfall and temperature. 2. To analyze the patterns of temperature changes, precipitation variability, extreme weather events, and their effects on local agriculture and water resources. 3. To develop the region-specific adaptation strategies based on the identified vulnerabilities. These strategies will integrate traditional knowledge with modern scientific approaches, focusing on sustainable agriculture, water management, and disaster risk reduction.

Reference articles or other materials to be read by prior to applying:

Power plant engineering text books

PROJECT: IA-000103

SUSTAINABLE BATTERY RECYCLING - WASTE TO WEALTH CREATION IN EMERGING ECONOMIES

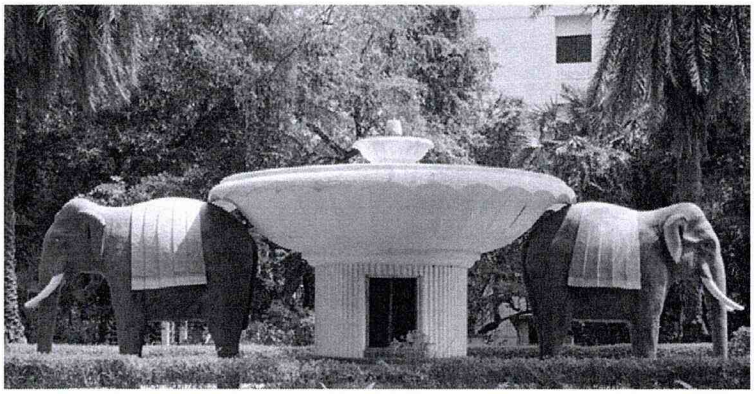
Project Nature: Experimental & Interdisciplinary

Project Description and Objectives:

Our world is facing a rapidly growing demand for batteries, with conservative projections that predict over 250 million electric vehicles (EVs) will be on the road by 2030. For manufacturing 1 million electric cars with a 200-mile range using the state-of-art NCA type cathode material, we would need to lock up ~10 and ~50 kilo tonnes of cobalt and nickel, respectively. These critical raw materials are of vital importance to the nation's economic and strategic interests, which, without adequate and effective recycling and reuse strategies, would constitute a waste colossal manner. This project is therefore aimed at developing new recycling approaches for spent lithium-ion batteries to regenerate active materials, extract critical raw materials, and reuse them in fresh battery systems without compromising performance to ensure a sustainable and economically viable energy future. We also aim to leverage in-situ and operando characterization techniques to understand the evolution of the structure-property-performance relationship of these battery materials when subjected to these novel battery recycling process conditions

Reference articles or other materials to be read by prior to applying:

Battery Recycling, Critical Materials in Batteries Muralidharan, Nitin, et al. "Lithium Iron Aluminum Nickelate, LiNixFeyAlzO2—New Sustainable Cathodes for Next-Generation Cobalt-Free Li-Ion Batteries." Advanced Materials 32.34 (2020): 2002960.
https://drive.google.com/open?id=1gVmI8GuBr4MKJctrv3KfcE6DxMBB6TQj



PROJECT: IA-000104

NOVEL DRIP IRRIGATION SYSTEM

Project Nature: Research for prototype development

Project Description and Objectives:

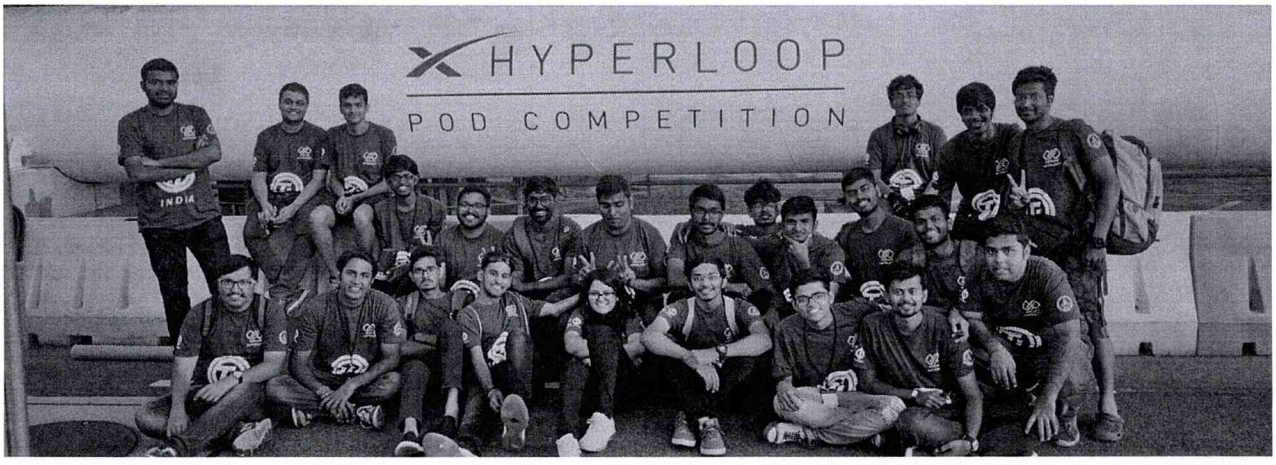
The present project plans to design a novel drip irrigation system that would reduce the evaporative losses from water from the soil surface. The envisaged design would introduce a porous cavity attached at the end of the drip nozzle, which has to be submerged in the soil, into which the drip nozzles would discharge their drops. The porous cavity would then act as local water storage from which the roots of plants can get water on their demand. Since the cavity is closed and submerged under the soil surface, there would hardly be any evaporative losses. The study would involve designing the porosity and permeability of the porous cavity, the size of the porous cavity, and the drip rate for various water uptakes by plants that would maximize the water uptake by plants and minimize the evaporative water losses.

Modeling of water uptake by plants, percolation through the porous cavity, and supply from the drip nozzle would be attempted to optimize the system. Experiments would be conducted, and prototypes would be fabricated to determine the effectiveness of the optimised design.

Reference articles or other materials to be read by prior to applying:

Lee, T. S. (Ed.). (2012). Water quality, soil, and managing irrigation of crops. BoD–Books on Demand.

Russo, D., Laufer, A., Silber, A., & Assouline, S. (2009). Water uptake, active root volume, and solute leaching under drip irrigation: A numerical study. Water resources research, 45(12).



PROJECT: IA-000105

DESIGN AND DEVELOPMENT OF A FOLDABLE STRETCHER FOR USAGES IN REMOTE AND INACCESSIBLE AREAS

Project Nature: Design and Development leading to a Product

Project Description and Objectives:

We are keen to make a proposal on Foldable Stretcher. Our initial estimate is over a time period of 2 to 2.5 years. Expected deliverable will be at least four foldable designs of stretcher made of materials like steel, aluminium, composite and wooden/bamboos with carrying capacity of 90 to 110 kg with dimensions around L (Excluding Handles) = 1.85 m, B = 0.60 to 0.75 m, T = less than 0.010 m; and L (Handles) = 0.300 m.

PROJECT: IA-000106

DEVELOPMENT OF NOVEL AGROWASTE BASED SUSTAINABLE PRODUCTS USING 3D PRINTING

Project Nature: The project involves materials design and analysis/characterization for the effective use of modern automotive applications. Involves experimental and numerical studies.

Project Description and Objectives:

Advanced 3D printing is widely used to make complex-shaped parts, and the project involves using sustainable agro-waste-based materials ready for printing. Sustainability demands in various sectors require using recyclable and low-energy-consuming materials to make engineering parts. The project is focused on this.

More information:

https://www.archmatdesiitm.com/

PROJECT: IA-000107

DIGITAL HEALTH SOLUTIONS FOR RURAL DEVELOPMENT: A POLICY FRAMEWORK TO IMPROVING HEALTHCARE ACCESS AND OUTCOMES

Project Nature:

The project will integrate knowledge from digital transformation, value creation, digital health, and healthcare service delivery. A policy proposal (framework) that outlines strategies for rural healthcare improvement through digital health initiatives, considering socio-economic factors and infrastructure limitations.

Project Description and Objectives:

In many rural regions, healthcare access is limited due to a lack of infrastructure, medical professionals, and financial resources. With the rise of digital technologies, there is an opportunity to bridge this gap. The project aims to offer a policy proposal (framework) by offering a sustainable, scalable solution for rural healthcare, improving health outcomes while supporting rural development.

Project Description and Objectives:

Analyze rural healthcare challenges and design policies that promote digital health as a means of rural development. Develop a framework (e.g., public-private partnerships model for digital transformation in healthcare) to scale the digital health solution and support for healthcare access in rural areas. A policy proposal that outlines strategies for rural healthcare improvement through digital health initiatives, considering socio-economic factors and infrastructure limitations. Conducting surveys and collecting data to analyze the social and economic impact.

Expected outcome:

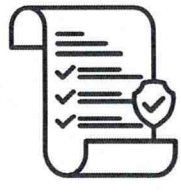
Recommendations for policymakers on how digital transformation in healthcare can be scaled to other rural regions.

Other Reference Materials:

https://drive.google.com/open?id=1JRRqkLnkYcwSDNxtLbSTHYwSYkoA4Reh,
https://drive.google.com/open?id=1Mfy7Gu0zlM3uBJ7KTX03YgGncTMcc0v-,
https://drive.google.com/open?id=1JWQecGhgd3rV5feC4HIvUVgJpbbvPPCl







PROJECT: IA-000108

SUSTAINABLE COMPOSITES FOR ENGINEERING APPLICATIONS USING ADDITIVE MANUFACTURING

Project Nature:
The project involves the development of complex-shaped engineering products made of sustainable materials and the evaluation of their damage-tolerant properties.

Project Description and Objectives:

Sustainable materials from agro wastes will aid in circular economy and protect the environment if efficiently used. With the UN Guidelines to meet the Sustainable Development Goals, every country is taking steps to use environmentally friendly materials. This project looks into the effective utilization of agricultural waste for value-added applications by developing a methodology using advanced 3D printing.

PROJECT: IA-000109

NOVEL RECYCLING APPROACHES FOR REGENERATING SPENT LITHIUM ION BATTERY MATERIALS

Project Nature: Experimental
The project involves the development of complex-shaped engineering products made of sustainable materials and the evaluation of their damage-tolerant properties.

Project Description and Objectives:

Our world is facing a rapidly growing demand for batteries, with conservative projections that predict that over 250 million electric vehicles (EVs) will be on the road by 2030. For manufacturing 1 million electric cars with a 200-mile range using the state-of-art NCA type cathode material, we would need to lock up ~10 and ~50 kilo tonnes of cobalt and nickel, respectively. These critical raw materials are of vital importance to the nation's economic and strategic interests, which, without adequate and effective recycling and reuse strategies, would constitute a waste colossal manner. This project is therefore aimed at developing new recycling approaches for spent lithium-ion batteries to regenerate active materials, extract critical raw materials and reuse them in fresh battery systems without compromising performance to ensure a sustainable energy future.

Other Reference Materials:

https://www.sciencedirect.com/science/article/pii/S1369702120303060
https://drive.google.com/open?id=1EjN4K7ETU8l3RzkJZPOZpvEIZ6xM0UpY

PROJECT: IA-0001010

FLEXIBLE CERAMICS FOR THE FABRICATION OF NANOGENERATORS FOR HARVESTING MECHANICAL ENERGY

Project Nature: Experimental

Project Description and Objectives:

To develop flexible ceramic membranes of technologically relevant ceramics to fabricate nanogenerators for harvesting mechanical energy and converting to electrical energy to power small-scale devices.

The work involves developing methodologies for fabricating flexible ceramic membranes and also selecting appropriate materials based on their properties for use in developing nanogenerators. The work involves knowledge of materials, ceramics in particular, and some basic understanding of electrical engineering.

Other Reference Materials:

https://pubs.acs.org/doi/10.1021/acsnano.0c09803,
https://www.nature.com/articles/s41528-017-0007-8,
https://www.sciencedirect.com/science/article/abs/pii/B9780128217092000049
https://drive.google.com/open?id=10-drayZou-CynoCUV0JGs5hnBmUfgZGh

PROJECT: IA-0001011

ADDITIVE MANUFACTURING OF ADVANCED TECHNICAL CERAMICS FOR SPACE AND NEXT GENERATION COMMUNICATION NETWORKS

Project Nature: Experimental

Project Description and Objectives:

To work on additively manufacturing ceramic components for space and next-generation communication networks and optimizing process parameters, additive manufacturing of technical ceramics is still in a premature state, and parametric optimization is needed to realize the technological potential of the technique. Our idea is to identify a couple of intricate and difficult-to-fabricate technical ceramic components both in the space sector and as well as communication sectors, such as 5G and 6G, and understand the role of processing parameters in the fabrication of such components. The work will involve design, materials processing, interest in 3D printing, and design of components.

Other Reference Materials:

https://www.sciencedirect.com/science/article/pii/S0079642520301006.
https://www.sciencedirect.com/science/article/pii/S0955221923005605

PROJECT: IA-0001012

ELECTRIFICATION OF MATERIALS TOWARDS PRODUCTION OF NEW MATERIALS AND NEW SCIENCE

Project Nature: Experimental

Project Description and Objectives:

We have recently established the Rishi and Jyotsna Raj Center for Electrification of Materials, and we are interested in hiring students for this center (but registered under the Dept of Metallurgical and Materials Engineering). The objective of the work would be to develop new techniques and use existing techniques in the center such as flash sintering. Ultra-fast sintering and developing new materials, new science, and possibly also fabricating 3D components/near-net shaped components at extremely small time scales.

Other Reference Materials:

https://www.sciencedirect.com/science/article/abs/pii/S0955221918305442

PROJECT: IA-0001013

ENGINEERING THERMOELECTRIC MATERIALS FOR WASTE HEAT HARVESTING AND ENERGY SUSTAINABILITY

Project Nature:

Mostly experimental, but computational aspects can be added based on the interest/background of the candidate

Project Description and Objectives:

Energy sustainability is one of the major key technological challenges in this 21st century. In recent years, growing awareness and alarming concern for the environment and renewable energy supplies have revitalized advances in materials engineering and technologies for energy conversion. Thermoelectric (T.E.) devices, with their potential to reversibly convert waste heat into useful electricity, propound the likelihood of an all-solid-state technology for power generation, refrigeration, temperature stability, and control. The T.E. material's performance is evaluated in terms of a dimensionless figure of merit, zT. Boosting the electrical transport properties and suppressing the thermal transport is critical to realizing a high zT. However, these transport properties are interlocked and confront a bigger challenge in improving the thermoelectric energy conversion efficiency.

Recent advances in this field of T.E. offer unprecedented opportunities for designing and fabricating increasingly complex material systems with tunable transport properties (zT > 1). The present project is concerned with applying novel strategies and principles to designing and creating novel material systems, especially on chalcogenide-based materials with enhanced T.E. properties, with close feedback from theoretical and computational studies.

Other Reference Materials:

https://bhuvaneshsrini.wixsite.com/bhuvanesh

PROJECT: IA-0001014

DIGITAL TWIN OF ROLLING ELEMENT BEARING

Project Nature:

FEM, analytical modelling, and validation by experiments

Project Description and Objectives:

The candidate is supposed to prepare a digital twin of the rolling element bearing using FEM and analytical modeling (using Matlab or Python). Further, s/he must validate it by acquiring vibration data from an existing test rig. It will be used to predict the remaining useful life (RUL) of the bearing.

Other Reference Materials:

https://drive.google.com/openid=17Bn958IGzJ5dk_e49OAIWdS0YRuArpUZ,
https://drive.google.com/openid=1IWJQx3K26VWqt9POJuKhOhefseQHsN1p,
https://drive.google.com/open?id=18QajFCrNYEYwnDWnccykCq1Lx12bQcap

PROJECT: IA-0001015

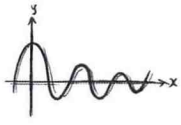
DNA UNDER FORCE AND TORQUE

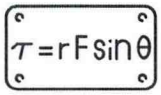
Project Nature: Theory plus Computation

Project Description and Objectives:

DNA has been one of the most studied molecules in biology, chemistry, and physics because of its central role in the working of all life. Which contains a genetic code through its base sequence alphabets: Adenine (A), Cytosine (C), Guanine (G), and Thymine (T); however, since the discovery of the double helix of DNA, there is now a general unanimity that DNA sequences modulate the double helix physical properties along the genome. Also, it became evident that sequence-dependent statistical-mechanical properties play a crucial role in multiple situations, such as nucleosome positioning, DNA looping, and protein-DNA interactions, to name a few. This project focuses on mathematical modeling of double-stranded nucleic acids (dsDNA, dsRNA, DNA-RNA hybrid). The goal is to develop or use (already developed models such as cgNA+) multiscale statistical mechanical models to demonstrate the sequence-dependent variations in the mechanical properties of DNA and better understand the numerous biological phenomena that appear in DNA mechanics.

One can target to pursue single/multiple objectives as described below: (I) Establish a computational framework (within the cgNA+ model) to obtain energy-minimizing configurations of DNA fragments (of different lengths and sequences) under force and torque. Further, use the developed framework for a large ensemble of sequences and discover new sequences. (II) Perform full atom molecular dynamics (MD) simulation for a few DNA fragments under simple loadings and compare the MD statistics with modeling results developed in the above objective. (III) To include electrostatic interactions explicitly in the modeling and develop a refined theory and computational framework. (IV) Apply the above-developed theory for modeling nucleosome wrapping, explore the complete transition from fully wrapped to fully unwrapped configurations, and investigate the role of electrostatic interactions and end-loadings. (V) Perform full atom MD nucleosome simulations and compare them with theory/modeling results. (VI) Scan the human genome based on the sequence-dependent mechanical properties and perform clustering.




Reference article webpage links:

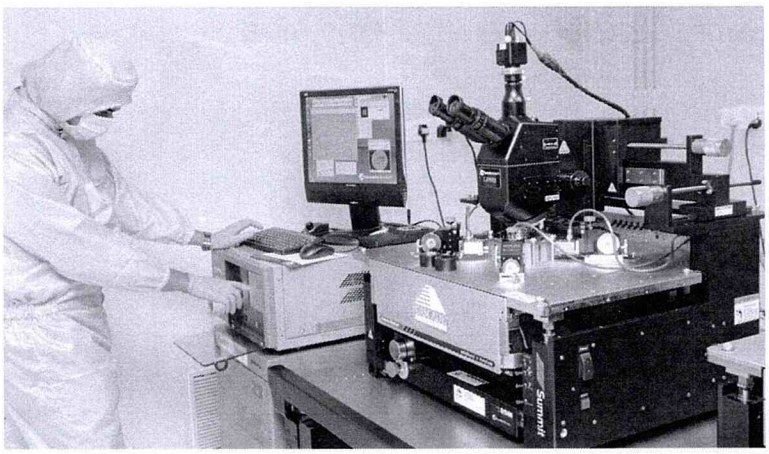
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.122.048102
https://pubs.rsc.org/en/content/articlelanding/2022/cp/d2cp03553g

A group web page containing multiple related articles:

https://lcvmwww.epfl.ch/research/cgDNA/

Other Reference materials

https://drive.google.com/open?id=19K7blN2eBNAVMhb4n1bRXC_0PHhDNmla,
https://drive.google.com/open?id=1EbaGhTwYahuDL7ByFs0gLTr00CPbhdIK,
https://drive.google.com/open?id=19FJ9a6bscUBuTcvNXtxOD6LNZJXSn2yr



PROJECT: IA-0001016

LOW-COST INDIGENOUS OPTICAL SENSING AND SPECTROMETRY DEVICES THROUGH SCALABLE LASER MICROSTRUCTURING

Project Nature:

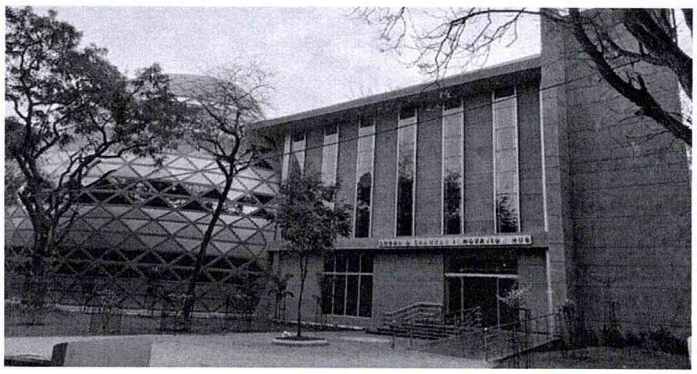
Experimental and lab work involving lasers, photonics, electronics and instrumentation, with some simulations

Project Description and Objectives:

Micromachining techniques have become indispensable tools in biomedical engineering, offering precise fabrication of microstructures and devices. Among these methods, femtosecond laser micromachining stands out for its ability to produce intricate features on various materials, including polypropylene film. This thesis explores the application of femtosecond laser micromachining to enhance the performance of biomedical devices through micromachining polypropylene film. Leveraging the unique characteristics of femtosecond laser pulses, such as ultrashort duration and high intensity, precise modifications can be made to polypropylene film, enabling the creation of microscale features with exceptional accuracy and reproducibility. The objectives of this study include identifying suitable polymer materials, optimizing laser parameters for surface patterning and functionalization, and evaluating the impact of surface modifications on biomedical applications. Through systematic experimentation and analysis, this research aims to contribute to the advancement of femtosecond laser micromachining techniques for biomedical engineering, paving the way for innovative solutions in medical device fabrication and tissue engineering.

Other Reference Materials:

Please go through this linked recent Master thesis -
https://drive.google.com/file/d/1nVfmKjPPw6db7j0FD1aH-XQmuMboTZKd/view?usp=drivesdk



PROJECT: IA-0001017

IN-SITU EXPLORATION OF FLEXOELECTRIC EFFECTS IN TRIBOELECTRIC NANOGENERATORS

Project Nature: Experimental research project

Project Description and Objectives:

The triboelectric nanogenerator (TENG) is a new, fast-growing, cost-effective power-generation technology that converts mechanical energy into electrical energy based on contact electrification and electrostatic induction. Indeed, it has the potential to fulfill the energy demand of the current times, where the use of micro-electronics sensors and energy-autonomous devices is growing fast. This master project will cover TENG devices' fundamental contact mechanics and electro-mechanical response. The main focus would be to investigate the underlying role of flexoelectricity in triboelectric nanogenerators experimentally. This would require developing an electro-mechanical test rig.
This master's project is part of a cutting-edge research project and thus requires high motivation, experimental, and strong analytical skills. It is a challenging project suited to motivated students who will enjoy a rewarding and highly interesting research project at the cutting edge. The successful candidate will closely work with a collaborative partner from the simulation and modeling side.

Reference articles or other materials to be read by prior to applying

1. Multiscale in-situ quantification of the role of surface roughness and contact area using a novel Mica-PVS triboelectric nanogenerator
2. In situ investigation of adhesion mechanisms on complex microstructured biological surfaces
3. Opportunities and Challenges in Triboelectric Nanogenerator (TENG) based Sustainable Energy Generation Technologies: A Mini-Review
4. 3D Printing and Rapid Replication of Advanced Numerically Generated Rough Surface Topographies in Numerous Polymers
5. Does Flexoelectricity Drive Triboelectricity?

Turn on screen reader support

Other Reference Materials

https://drive.google.com/open?id=1qCl0drfnS0qrjKL6Bjqhl3z1Ypx2zytx,%20
https://drive.google.com/open?
id=1rX31nDEBuTYb2qyz4NG9LpJONzsb4Kv3,%20https://drive.google.com/open?
id=1Jr64VHigWzrWbqdKYY1jOlrwlpKBUAW2

PROJECT: IA-0001018

SMARTPHONE INTEGRATED RAMAN SENSING FOR ON SPOT DETECTION OF COUNTERFEIT PHARMACEUTICALS

Project Nature: Device development

Project Description and Objectives:

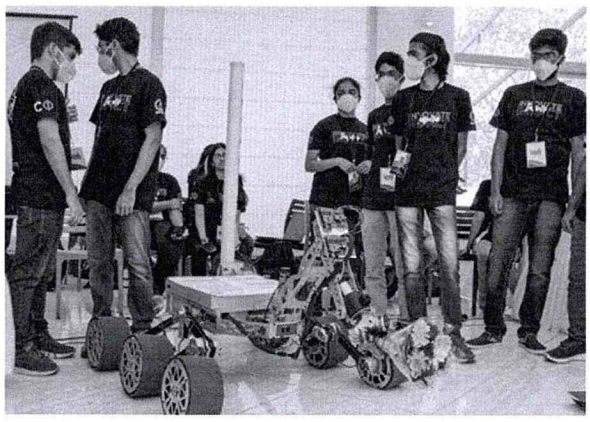
The project would focus on designing and developing a smartphone-integrated Raman spectrometer for real-time detection of counterfeit pharmaceuticals. It would involve creating a portable device or attachment that connects to a smartphone, enabling users to analyze and verify the chemical composition of drugs on-site. The work would also include testing and validating the system's accuracy, sensitivity, and reliability for pharmaceutical applications.

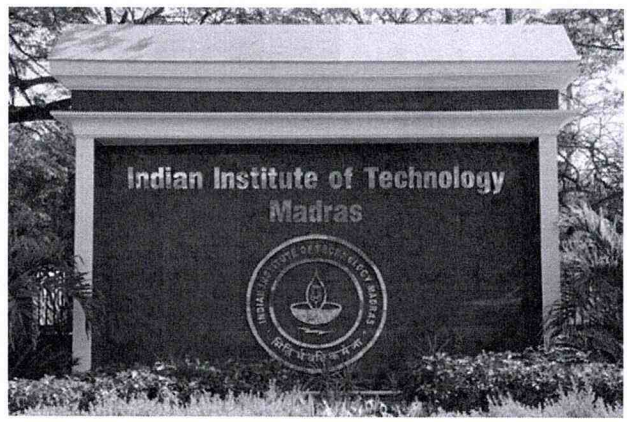
Reference articles or other materials to be read by prior to applying

1. Lewis, Ian R., and Howell Edwards. Handbook of Raman spectroscopy: from the research laboratory to the process line. CRC press, 2001.
2. Emmanuel, Neethu, Raji B. Nair, Bini Abraham, and Karuvath Yoosaf. "Fabricating a low-cost Raman spectrometer to introduce students to spectroscopy basics and applied instrument design." (2021): 2109-2116.
3. Dhankhar, Dinesh, Anushka Nagpal, and Peter M. Rentzepis. "Cell-phone camera Raman spectrometer." Review of Scientific Instruments 92, no. 5 (2021).
4. Bakker, Ingrid ME, Dana Ohana, and Bastiaan J. Venhuis. "Current challenges in the detection and analysis of falsified medicines." Journal of Pharmaceutical and Biomedical Analysis 197 (2021): 113948.

Other Reference Materials

https://drive.google.com/open?id=17Harrvf8Xf4d0ohxspSLyspS-LEZWE1s,
https://drive.google.com/open?id=1OA9DKzTRGRiXNKYuj_8y19cw-563dPka,
https://drive.google.com/open?id=10tQ11jT7NeJVK_FCrT9zK7RnUCmKBq_1





PROJECT: IA-0001019

AN IT ENABLED PLATFORM FOR DESIGN AND FABRICATION OF OPEN SOURCE TECHNOLOGIES (CROSSFYRE)

Project Nature: Research & Devolopement

Project Description and Objectives:

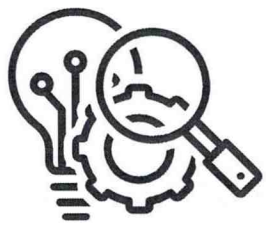
The proposed project aims to develop and implement innovative MINI DRYER technology using heat pump drying to address significant challenges in the preservation and value addition of agricultural produce in rural India. With approximately 35-40% of vegetables wasted due to short shelf life, this initiative seeks to empower small farmers by converting fresh produce into Ready to Cook (RTC) and Ready to Eat (RTE) products. This transformation not only enhances the shelf life of crops like tomatoes and onions but also provides better market value for farmers, reducing exploitation by middlemen.

Key objectives of the project include:

- Testing the Drying Technology: Implementing the MINI DRYER in agricultural households (0.5 acres and above) to replace non-hygienic drying methods currently in use.
- Addressing Moisture Issues: Trialing the dryers in high-humidity settings such as hotels and restaurants that struggle with food storage issues, particularly fungus formation.
- Conducting Pilot Studies: Disseminating three samples of the MINI DRYER to users for practical evaluation.
- Feedback and Iteration: Conducting user feedback surveys to validate and refine the technology, ensuring it meets the needs of rural producers.
- Through this project, we aim to enhance food security, reduce waste, and stimulate local economies by enabling value addition at the village level.

Other Reference Materials

https://rutag.iitm.ac.in/rutag/

PROJECT: IA-0001020

MINI DEHYDRATOR USING HPDS TECHNOLOGY

Project Nature: Research and Devolopement

Project Description and Objectives:

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- Feedback and Iteration: Conducting user feedback surveys to validate and refine the technology, ensuring it meets the needs of rural producers. Through this project, we aim to enhance food security, reduce waste, and stimulate local economies by enabling value addition at the village level.

Other Reference Materials
https://rutag.iitm.ac.in/rutag/

PROJECT: IA-0001021

ENERGY EFFICIENT ELECTRIC VEHICLES FOR FRUITS AND VEGETABLE VENDORS

Project Nature: Research and Devolopement

Project Description and Objectives:

The project focuses on the development of a battery-enabled e-vending cart designed to support fruits and vegetable sellers, particularly in peri-urban and rural areas. The primary goal is to enhance the mobility and ergonomics of existing pull carts, which require significant physical effort and are inefficient over long distances and uneven terrains. Traditional vendors face challenges with fatigue, limited customer reach, and maintaining the freshness of their perishable goods. This project aims to address these issues by integrating cold storage solutions and a battery-powered system into the cart, reducing dependency on fossil fuels and increasing vendors' daily productivity and earnings.

Key objectives include:

Design and Development: Creating a modular and all-weather e-cart with configurations for both three- and five-wheel designs. Stress Analysis: Using software to evaluate stresses in the modified product to ensure durability.

Design Modification: Analyze current design alternatives and choose suitable options to prepare engineering drawings.

Efficiency Improvement: Introducing an 'Imn' mechanism to optimize the cart's performance.

Pilot Study: Distribute ten e-cart samples among vendors and assess their performance.

Feedback and Refinement: Conduct a survey to gather user feedback and refine the product based on insights. This initiative not only improves ergonomics and mobility but also offers a scalable, eco-efficient solution for vendors, contributing to environmental sustainability.

Other Reference Materials:

https://rutag.iitm.ac.in/rutag/

PROJECT: IA-0001022

DESIGN, DEVELOPMENT, AND TESTING OF A SPRAY DRYER UNIT FOR ENHANCED JAGGERY PRODUCTION IN RURAL COMMUNITIES

Project Nature: Research and Devolopement

Project Description

The project aims to modernize the traditional jaggery production process in rural India, where the majority of the world's jaggery is produced. Despite its eco-friendly and nutritional advantages, the jaggery industry faces several challenges, including poor storability due to its hygroscopic nature and a shortage of skilled labor, which hampers productivity and quality. By adapting spray drying technology, the project will ensure that jaggery powder production is both scalable and integrated seamlessly into existing workflows in rural areas. Currently, local vendors are unaware of spray drying techniques, which are typically applied to other processes but not yet integrated with the continuous, time-sensitive jaggery production process.

Objectives:

Integration of Spray Drying in Jaggery Production: Establish a new workflow by incorporating spray drying as a subprocess in the traditional jaggery production process. This will be done through field visits and testing with sugarcane juice to ensure compatibility.

Design and Optimization of the Spray Dryer Unit: The rotary injector-based spray dryer will be designed using one-dimensional models for droplet transport and multi-phase CFD (Computational Fluid Dynamics) simulations to optimize performance and evaporation processes.

Fabrication and Testing: Build and test a prototype spray dryer unit to ensure the design meets functional and performance requirements.

Field Trials and Feedback: Conduct trials in rural settings, gathering feedback from local users to validate the system and make necessary improvements.

Pilot-Scale Implementation: Develop a pilot-scale system and implement it at actual jaggery production sites, allowing rural producers to benefit from improved automation, higher production rates, and enhanced product quality. This project will not only address labor shortages and quality control but also unlock the export potential of high-quality jaggery powder by improving storability and production efficiency.

Other Reference Materials:

https://rutag.iitm.ac.in/rutag/

PROJECT: IA-0001023

THE DEVELOPMENT OF SUITABLE EJH FOR FINE/ SUPERFINE MADURKATHI MAT HANDICRAFT AND KORAI SUPERFINE MAT HANDICRAFT TOWARDS PRODUCTIVITY AND DESIGN RANGE ENHANCEMENT

Project Nature: Research and Devolopement

Project Description

This project aims to revolutionize the traditional handicraft process of weaving Fine/Superfine Madurkathi Mats and Superfine Korai Mats, which is labor-intensive and time-consuming. Currently, weaving these mats takes between 12 to 45 days, requiring the intricate manual interlacement of superfine grass and warp yarn using traditional floor looms. The low productivity and high labor costs make this process unsustainable for artisans. To address these challenges, the project proposes the development of an Electronic Jacquard Handloom (EJH) equipped with 192/384 hooks. This modern technology can increase productivity by 4 to 5 times, reducing production time to 3-9 days and expanding the scope for more intricate designs and motifs.

Other Reference Materials:
https://rutag.iitm.ac.in/rutag/

PROJECT: IA-0001024

DEVELOPMENT OF NEXT GENERATION TEXTILE SPINNING AND WEAVING MACHINERY - FOR KERALA KHADI VILLAGE INDUSTRY BOARD

Project Nature: Research and Devolopement

Project Description

This project aims to improve the performance and ergonomics of traditional spinning and weaving machines, focusing on enhancing both machine efficiency and user experience. The current spinning machines, which rely on a tensioning mechanism, suffer from inefficiencies due to fluctuations in the transmission system. To address this, the project proposes developing a robust tensioning mechanism, adding some attachments to reduce physical strain on the users. For weaving machines, the focus is on simplifying user operations by introducing a rotary control mechanism instead of the current multimodal operation, which demands alternating linear movements.

This change is expected to streamline the weaving process and improve efficiency without significantly altering the existing machine structure. Additionally, the project will conduct a comprehensive ergonomic evaluation, including biomechanical studies of user movement patterns and joint conditions, to mitigate the health issues observed among elderly operators, such as chronic shoulder and back pain, as well as lower limb discomfort.

Objectives:

- **Design and Development**: Create solutions for improving the efficiency and ergonomics of spinning and weaving machines through technical modifications. Design Modification: Make necessary design modifications to optimize machine performance and reduce user strain.
- **Enhance Machine Efficiency**: Improve transmission systems, add tensioning mechanisms, and stabilize output using flywheels and governors.
- **Ergonomics Improvement**: Shift to foot pedal operations and reduce physical strain on users.
- **User-Centered Design:** Simplify weaving machine operations by implementing a rotary input mechanism.
- **Health Study:** Conduct a biomechanical evaluation and propose ergonomic modifications to prevent long-term health issues.
- **Pilot Study:** Conduct pilot studies to test the modified machines in real-world conditions and gather initial feedback from users.
- **Feedback and Refinement:** Gather user feedback and refine the designs based on insights to ensure the technology meets user needs and enhances productivity

Other Reference Materials:

https://rutag.iitm.ac.in/rutag/