# E-BREEZE

CALONICS'24

ZEPRA

IN ASSOCIATION WITH
RENEWABLE ENERGY- CLUB
&

INSTITUTION'S INNOVATION COUNCIL
(Ministry of HRD Initiative)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)
NAGAPATTINAM

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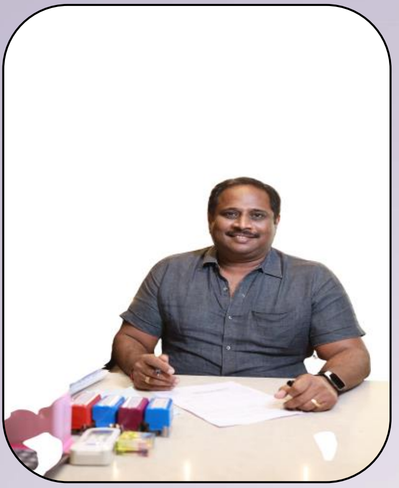


SHRI G. SHANKAR GANESH

JOINT SECERATARY

# MESSAGE FROM SECRETARY'S DESK

I FEEL PROUD TO HEAR THAT OUR EEE DEPARTMENT IS ORGANIZING A SYMPOSIUM AND COMING UP WITH A MAGAZINE ON THE OCCASION OF THE EVENT. THIS TYPE OF EVENT WILL GIVE THE BUDDING ENGINEERS, A PLATFORM TO SHOW CASE THEIR TALENTS AND LEADERSHIP QUALITIES. I WISH THE STAFF AND STUDENTS OF EEE DEPARTMENT A WONDERFUL SYMPOSIUM AND A GOOD LEARNING EXPERIENCE. I WISH YOU ALL SUCCESS.

Dr.S. RAMABALAN., M.E., PhD.,

# MESSAGE FROM PRINCIPAL

WARM AND HAPPY GREETINGS TO ALL. IT'S MY IMMENSE PLEASURE THAT EEE DEPARTMENT OF OUR COLLEGE IS ORGANIZING AN INTERNATIONAL LEVEL SYMPOSIUM CALONICS 24.

UNDER THE ABLE GUIDANCE OF OUR SECRETARY SHRI. S. SNTHILKUMAR, Jt.SECRETARY SHRI. S. SANKAR GANESH CONTINUES TO MARCH ON THE WAY OF SUCCESS WITH CONFIDENCE, SHARP, CLEAR TO STAY COMPETITIVE , SIGHTED VISION AND PRECISE AND DECISION MAKING OF HIM HAS BENEFITED OUR COLLEGE.

THIS SYMPOSIUM IS ON EFFORT IN THE DIRECTION TO GIVE AN EXPOSURE TO THE STUDENTS ON THE RECENT DEVELOPMENT IN ELECTRICAL AND ELECTRONICS ENGINEERING FIELD. THIS SYMPOSIUM ALSO PROVIDES A PLATFORM TO OUR STUDENTS TO EXHIBIT THEIR INHERENT WITH APPRECIATION THE HARD WORK, INVOLVEMENT AND EFFORT TAKEN BY THE TEAM OF FACULTY AND STUDENTS IN ORGANIZING THIS SYMPOSIUM.

I CONGRATULATE ALL THE CONCERNED WITH GRATITUDE AND WISH THE SYMPOSIUM

**Dr.V. MOHAN., M.E., PhD.,**

# MESSAGE FROM HOD

I AM GLAD THAT OUR DEPARTMENT IS ORGANIZING AN INTERNATIONAL LEVEL TECHNICAL SYMPOSIUM, CALONICS' 24 ON 2nd MARCH 2024 AND A GREAT NUMBER OF YOUNG BUDDING TECHIES FROM DIFFERENT PARTS OF THE WORLD ARE GOING TO MEET UNDER ONE UMBRELLA AND INDULGE IN DISCUSSING AND DELIBERATING ON VARIOUS TOP-NOTCH CONCEPTS IN HUMANIZING TECHNOLOGY. SCIENCE IS EXPONENTIALLY GROWING BY LEAPS AND BOUNDS AND WE HAVE TO KEEP OURSELVES ABREAST OF THE LATEST TECHNOLOGIES AND EMBRACE INTERDISCIPLINARY APPROACH. STUDENTS NEED TO PURSUE INTERDISCIPLINARY, MULTI-SKILLED AND APPLICATION-ORIENTED EDUCATION AFTER GRADUATION IN ORDER TO ENHANCE NOT ONLY THEIR EMPLOYABILITY OPPORTUNITIES BUT ALSO THE PROSPERITY OF THEIR FUTURE. THINKING OUT-OF-THE-BOX IS THE BASIC ROOT FOR ALL INNOVATIONS AND INVENTIONS. I STRONGLY BELIEVE THAT CALONICS'24 WOULD PROVIDE A WONDERFUL OPPORTUNITY FOR THE YOUNG MINDS TO VOICE THEIR OWN IDEAS AND VIEWS SO THAT THE FUTURE GENERATION WOULD BE BENEFITED. I WOULD SUGGEST THE SLOGAN "THINK AND LINK; LINK AND THINK" SHOULD DEVELOP INTERDISCIPLINARY RESEARCH WHICH IS THE MOST SOUGHT-AFTER ACTIVITY FOR THE BETTERMENT OF THE HUMAN KIND. I LIKE TO CONGRATULATE THE PARTICIPANTS, PAPER PRESENTERS, FACULTY MEMBERS AND ALL THOSE WHO HAVE CONTRIBUTED FOR THE SUCCESSFUL CONDUCT OF SYMPOSIUM.

MY SINCERE AND HEARTY WISHES FOR THE GRAND SUCCESS OF CALONICS' 24.

# VISION & MISSION OF THE INSTITUTE

| | |
|---|---|
| **Vision of the Institute** | Envisioned to transform our institution into a "Global Centre of Academic Excellence" |
| **Mission of the Institute** | 1. To provide world class education to the students and to bring out their inherent talents<br>2. To establish state-of- the-art facilities and resources required to achieve excellence in teaching-learning, and supplementary processes<br>3. To recruit competent faculty and staff and to provide opportunity to upgrade their knowledge and skills<br>4. To have regular interaction with the industries in the area of R&D, and offer consultancy, training and testing services<br>5. To establish centers of excellence in the emerging areas of research<br>6. To offer continuing education, and non-formal vocational education programmes that are beneficial to the society |

# VISION & MISSION OF THE DEPARTMENT

## VISION

The department is envisioned to produce globally competent electrical and electronics engineers.

## MISSION

• To impart the contemporary knowledge in the field of electrical and electronics engineering with high human values.

•To offer state of the art facilities for conducive learning and conducting research.

• To train the students for professional career and higher education by imparting self-learning and interpersonal skills.

# OBJECTIVES & OUTCOMES

## Program Educational Objectives

**PEO1:** Graduates will excel as engineering professionals and leaders in electrical engineering or becoming an entrepreneur or pursuing higher education.

**PEO2:** Graduates will demonstrate core competence to adapt themselves to the constantly evolving technologies and stay in line with industry advancements.

**PEO3:** Graduates will collaborate in multidisciplinary fields both as an individual and as a team member with a strong sense of professionalism and ethics.

## Program Outcomes

**1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**2. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

## Program Specific Outcomes (PSOs)

After the successful completion, the graduates will be able to

**PSO1**: Design, test and analyze electrical machines and utility systems.

**PSO2**: Design, develop and test analog and digital electronic circuits and systems.

**PSO3**: Develop, simulate and analyze the electrical and electronics systems using modern tools.

# CHIEF EDITOR'S CORNER

**Dr.T. SURESH PADMANABAN.,**

**Professor/EEE**

In the realm of engineering, comprehension flourishes when technical knowledge is presented through pictorial representation. Recognizing this editorial board has crafted a selection of handpicked info graphics. These visual aids serve as dynamic tools, engaging our readers and facilitating a deeper understanding of complex concepts. Join us on this thrilling journey as we are led by Dr.T.Suresh Padmanabhan himself through the captivating world of infographics, empowering our audience with knowledge and igniting a passion for discovery.

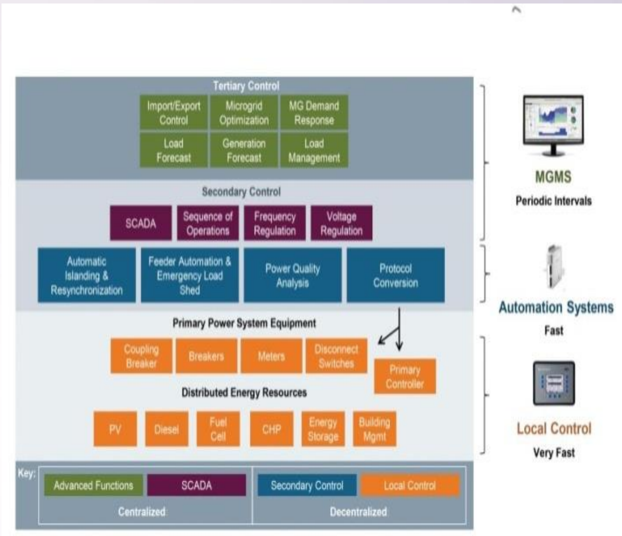
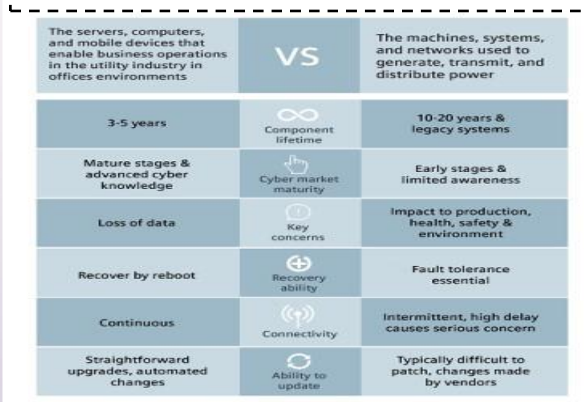



**Figure.1.Microgrid Management system (MGMS)**

Deep within the city's veins, a silent symphony hums. Colossal generators birth raw power, channelled through steel arteries. Watchful guardians monitor the flow, ensuring it reaches every corner, transformed from a roaring beast to the gentle hum powering our lives. A hidden magic, keeping the world's heart beating.



| | | |
|---|---|---|
| The servers, computers, and mobile devices that enable business operations in the utility industry in offices environments | VS | The machines, systems, and networks used to generate, transmit, and distribute power |
| 3-5 years | Component lifetime | 10-20 years & legacy systems |
| Mature stages & advanced cyber knowledge | Cyber market maturity | Early stages & limited awareness |
| Loss of data | Key concerns | Impact to production, health, safety & environment |
| Recover by reboot | Recovery ability | Fault tolerance essential |
| Continuous | Connectivity | Intermittent, high delay causes serious concern |
| Straightforward upgrades, automated changes | Ability to update | Typically difficult to patch, changes made by vendors |

Figure.2 Analogy between IOE & Internet

Across the digital landscape, IT engineers weave threads of data, meticulously maintaining the information superhighway. Meanwhile, their OT counterparts orchestrate the physical realm, ensuring the smooth flow of electrons through the intricate dance of transformers and transmission lines.

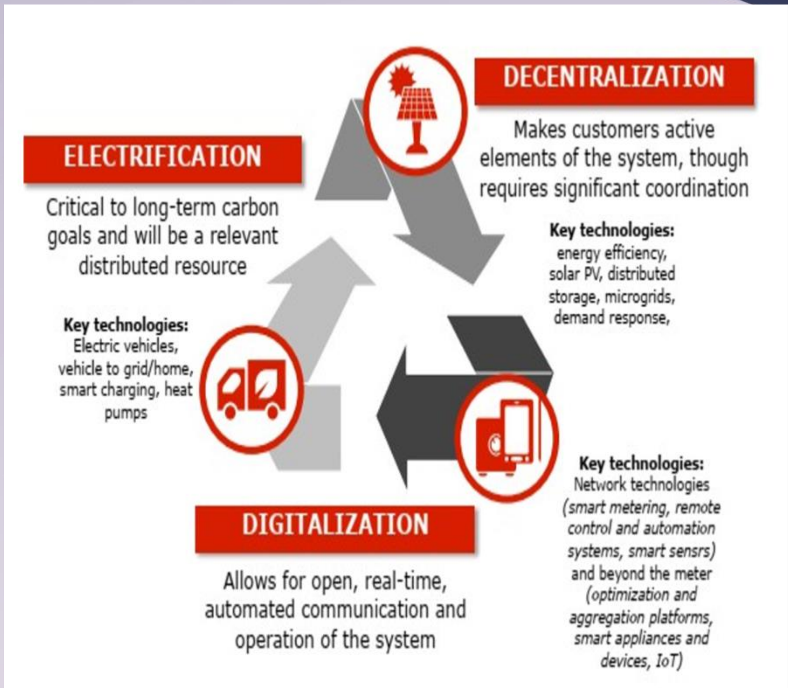



Figure.3. Future Electricity

The "Future Electricity" diagram depicts a three-pronged approach: electrification (replacing fossil fuels with electricity), decentralization (shifting to distributed power sources like solar panels), and digitalization (using smart technologies for grid management), all working together to shape a cleaner and more efficient future for electricity.

The diagram presents smart grid architecture, showcasing the information flow between various sources like sensors, meters, and control centres. This real-time data exchange, facilitated by servers, routers, and the cloud, enables intelligent management, optimization, and potentially bi-directional communication within the power generation system.

The diagram presents smart grid architecture, showcasing the information flow between various sources like sensors, meters, and control centres. This real-time data exchange, facilitated by servers, routers, and the cloud, enables intelligent management, optimization, and potentially bi-directional communication within the power generation system.

# ASSOCIATE EDITOR MESSAGE

Electrified Greetings, fellow EEE enthusiasts!

I'm Jasmine, a third-year student and Associate Editor for our departmental magazine. This issue wouldn't be possible without the unwavering dedication of my fellow editors and the invaluable guidance of our Chief Editor, Dr. T. Suresh Padmanabhan. We're also incredibly grateful to the entire department faculty, led by our esteemed Head of the Department, Dr. V.Mohan, for their constant support throughout this journey.

A special thank you goes to EGSPEC management and our department fraternity for recognizing the vitality of student publications and providing us with this exciting opportunity.

Within these pages, you'll discover a diverse and captivating collection of articles and projects showcasing the remarkable talent and innovation brewing within our department. Dive into the world of groundbreaking discoveries in electrical and electronics engineering, and be inspired by ideas that push the boundaries of our field.

Whether you're a seasoned professional or just embarking on your EEE journey, this magazine offers something for everyone. As you explore its content, I encourage you to be inspired, gain new knowledge, and perhaps even contribute your own voice in future editions.

Happy reading!

Sincerely,

JASMINE.R
*III-YEAR*
*Associate Editor – E-BREEZE*

# Performance analysis of high-power generation techniques and algorithms of solar photovoltaic systems with the renewable energy hybrid systems

**Mrs. S. Latha**

**Assistant Professor**

**Department of Electrical and Electronics Engineering**

**E.G.S. Pillay Engineering College, Nagapattinam.**

Energy crisis and increasing demand for energy is the most important issue in today's world as demand for electrical energy increasing over the years. Conventional energy sources like fossil fuels are not only limited but also hazardous to environment. The production of electrical energy using clean, renewable sources, such as solar energy, wind energy, etc. Owing to the usage of solar energy, it has become necessary to develop some methods for the better use of solar energy. This deals with the comparative analysis of various tracking technologies and also gives the performance analysis standalone systems with the hybrid renewable systems for the greater power generation from the non-conventional sources. The solar tracing can be achieved by a Arduino controller based method of solar tracking with Light dependent resistors are used as sensors to determine the start and stop point of tracker. The tracking systems may consist of dual axis tracking by using sensors and PIC. The LDR Based stepper motor control performance with PLC control and the MPPT algorithm provides the hybrid systems performance, the aforementioned equations were coded with MATLAB, compared to experimental data. The model is intended to be used as an optimization and design tool. An Adaptive Neuro Fuzzy Inference System (ANFIS) based controller has been designed and the system is analyzed in terms of the power generation and consumption. The results obtained are encouraging in terms of their stability.

My sincere and hearty wishes for the grand success of CALONICS' 24

# Robotic process automation in power sector

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Robotic Process Automation (RPA) is one of the several important techniques currently available for companies in search of performance improvement. The step forward in RPA is its association with Artificial Intelligence for more skilled robots. The Robotic Process Automation (RPA), technology which can be defined as the automation of processes imitating human actions, via Software robots and without requiring human intervention. In this way, it allows the development and creation of computer systems in which it is possible to completely integrate actions and tasks that the humans perform in their digital environment. Therefore, a robot (or bot) is provided by an RPA platform that contains the computational description of the process, and then the robot will be able to imitate human tasks in order to robotize them. This scenario is not different in Power Distribution Utilities, in which a multitude of complex processes must be executed over different data sources. Making such situation like power monitoring and detection even more complex, these processes are frequently regulated and subject to audit by external bodies. The robot analyzes a series of information from an energy consumption meter. The detection of possible behavior deviations in the meter data is made by comparison with its data series. The robot is capable of prioritizing the detected occurrences in the energy consumption data, indicating to the human Operator the most critical situations that require attention. With the improvement of the Robotic Process Automation Technology (RPA), the potential to optimize Processes all over the business world is growing significantly. While software developers work to build Customized solutions for in-house processes, the companies do not have to wait for such and can implement an RPA solution, which saves time and costs to the company. Due to the wide scope of its application, the process robotization is being widely used in different domains and sectors such as: energy, manufacturing, retail, analysis, aviation, oil and gas.

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# SiC MOSFETs: Enhancing Efficiency and Performance in Renewable Energy Systems

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Silicon Carbide (SiC) MOSFETs are transforming the landscape of renewable energy systems by offering significant advancements in efficiency, reliability, and performance compared to traditional silicon-based devices. This article delves into the critical role SiC MOSFETs play in optimizing photovoltaic (PV) inverters and wind turbine converters, which are pivotal components in solar and wind energy generation. The inherent properties of SiC, including higher breakdown voltage, superior thermal conductivity, faster switching speeds, and lower on-resistance, lead to marked improvements in energy conversion efficiency. These enhancements result in higher power densities, reduced system sizes, and lower cooling requirements, making SiC MOSFETs exceptionally suited for the stringent demands of renewable energy applications.

Moreover, SiC MOSFETs' ability to operate efficiently at higher temperatures and voltages, even in harsh environmental conditions, significantly enhances the robustness and longevity of renewable energy systems. This abstract highlight real-world examples and performance metrics to illustrate how SiC MOSFETs are facilitating the development of more compact, efficient, and durable power electronics. These advancements are crucial for the scalability and sustainability of renewable energy technologies, underscoring SiC MOSFETs' pivotal role in driving the global transition toward greener and more efficient energy solutions. Through this exploration, the article aims to underscore the transformative impact of SiC MOSFETs in shaping the future of renewable energy systems.

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# Integration of Matrix Converters in Wind Energy Conversion Systems: Enhancing Efficiency and Reliability

**Dr.P.J. Sureshbabu**

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This article investigates the integration of matrix converters in Wind Energy Conversion Systems (WECS), highlighting their technical advantages and impact on system performance. Matrix converters, which enable direct AC-to-AC conversion without intermediate DC links, present several benefits for WECS. These include enhanced efficiency due to the elimination of DC-link components, resulting in reduced power losses. The compact design of matrix converters minimizes the size and weight of the power conversion system, which is particularly advantageous for space-constrained applications like offshore wind turbines. Additionally, matrix converters offer improved reliability through fewer components and enhanced power quality with lower harmonic distortion. This technical abstract examines the operational principles, key advantages, and implementation challenges of matrix converters in WECS, supported by a case study on their deployment in offshore wind farms. The analysis underscores the potential of matrix converters to optimize wind energy systems, contributing to the advancement of sustainable energy technologies.

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# Improved Dynamic Response of a Single-Phase-Integrated KY Boost Converter with an MLI System of a DC-AC Converter in Motor Speed Regulation

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This research delves into the optimization of a KY boost converter-multi-level inverter (KBC-MLI) system tailored for AC motor loads. The KBC, a modified DC-DC boost converter, addresses issues related to current ripples inherent in canonical switching converters. The study employs both Proportional-Integral (PI) and Fractional Order Proportional-Integral-Derivative (FOPID) controllers to enhance the system's power output and reduce ripple voltages, focusing on the closed-loop control of the KBC-MLI system. The article introduces the PI and FOPID controllers, detailing their structures and functionalities. The study aims to bridge the research gap by emphasizing the application of motors in AC loads, showcasing the KBC-MLI system's adaptability. The proposed controllers are compared for their effectiveness in achieving reduced output current Total Harmonic Distortion (THD) and improved motor speed dynamic response. The system description includes an overview of induction motors (IMs) and their applications, emphasizing the importance of efficiency in electric drives. The study then explores the KBC-MLI system's configuration, featuring the PI and FOPID controllers in the closed-loop setup. The research work includes a detailed analysis of time-domain parameters, motor speed, and output current THD for both controllers. Experimental results, including hardware snapshots, voltage spectra, and power sharing in the cascaded inverter system, validate the simulation outcomes. The study concludes that the closed-loop FOPID-controlled KBC-MLI system outperforms its PI-controlled counterpart, exhibiting reduced output current THD and improved dynamic responsiveness. The article provides valuable insights for real-time machine tool applications and suggests potential future research directions, such as exploring KBC-MLI structures with fuzzy logic controllers.

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# The Synergistic Impact of Artificial Intelligence on the Future of Electric Vehicles

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As the Electric Vehicle (EV) landscape undergoes a significant metamorphosis, this technical article explores the profound influence of Artificial Intelligence (AI) on shaping the future of electric mobility. Focusing on key aspects such as predictive maintenance, autonomous driving, energy and battery management, safety enhancements, and broader ecosystem optimization, the article delves into how AI is propelling the EV revolution. Predictive Maintenance: The article unveils the revolutionary role of AI in predictive maintenance for EVs, exemplified by BMW's implementation. Through sophisticated algorithms analyzing sensor data, AI identifies potential issues proactively, reducing repair costs and enhancing overall vehicle reliability. This paradigm shift ensures EV owners experience peace of mind, confident in the optimal condition of their vehicles. Autonomous Driving: The realization of autonomous driving is explored as AI takes the wheel in navigating traffic, preventing accidents, and identifying optimal routes. Waymo's pioneering use of AI showcases its ability to handle complex traffic scenarios without human intervention, heralding an era of efficient and secure transportation. Energy and Battery Management: The article illuminates how AI optimizes energy usage and battery management in EVs. Analyzing data from sensors, AI enhances energy efficiency by optimizing air conditioning systems, adjusting power output, and suggesting energy-efficient routes. Tesla's use of AI in charging optimization exemplifies a seamless charging experience, addressing range anxiety. Enhanced Safety Features: Safety enhancements in EVs driven by AI are discussed, with AI-powered sensors and cameras detecting potential hazards and preventing collisions. Examples from Volvo's AI-powered collision avoidance systems showcase swift decision-making for heightened safety. AI Drives the EV Revolution: The article emphasizes the strategic placement of charging stations, personalized charging, battery technology advancements, manufacturing precision, and the autonomous revolution facilitated by AI. This sustainable trajectory reduces dependence on fossil fuels, promoting an eco-friendlier transportation system. Current AI-Powered Vehicles: While fully autonomous driving is under development, the article highlights the current capabilities of AI in today's vehicles. Lane departure warnings, adaptive cruise control, and automatic emergency braking are commonplace features, showcasing the potential for assisted driving.

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# ENERGY AUDIT IN INSTITUTES

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This Technical article provides a deep dive into the pivotal role of energy audits as a crucial component of overall energy management programs. The continuous process of energy management aims for long-term optimization of energy input and utilization to reduce costs. With a focus on electrical energy conservation, the article underscores the significance of utilizing available energy in an efficient manner. The paper begins by emphasizing the critical importance of electrical energy in our daily lives, powering essential appliances like computers, lighting, and more. The need for conservation becomes paramount, and energy audits emerge as a thinking tool to find ways to conserve energy effectively. The study primarily focuses on energy audits conducted in educational institutions, identifying a gap in existing literature related to this specific sector. The methodology adopted for energy audits is discussed, and the main types of energy audits are outlined: Preliminary Energy Audit, General Energy Audit, and Detailed Energy Audit. Preliminary Energy Audit: Described as a simple, quick assessment, this audit focuses on major energy supplies and demands. It involves data collection, brief interviews, and a review of utility bills to identify glaring areas of energy waste. General Energy Audit: Building on the preliminary audit, this more detailed assessment collects information on facility operation and evaluates energy conservation measures. Utility bills for an extended period are analyzed, and in-depth interviews provide insights into energy-consuming systems. Detailed Energy Audit: Also known as a comprehensive audit, this level delves into detailed engineering options, estimating energy input for different processes and formulating plans based on quantitative evaluations. The article highlights the synergistic impact of Artificial Intelligence on the future of electric vehicles, focusing on predictive maintenance, autonomous driving, energy and battery management, and safety enhancements. It outlines how AI is revolutionizing energy efficiency and conservation, contributing to environmental sustainability.

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# SMART GRID TECHNOLOGY

**Mr. V. Yokeswaran**

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The 20th-century electrical grid is undergoing a revolutionary transformation with the advent of smart grid technology. This article delves into the core principles and historical development of the smart grid, highlighting its potential to address the challenges of electricity supply in the 21st century. The smart grid employs two-way communications and intelligent devices to enhance the delivery network, with a focus on three key systems: infrastructure, management, and protection. Electronic power conditioning and control play pivotal roles in optimizing the production and distribution of electricity. As the smart grid represents a comprehensive response to electricity supply challenges, it is expected to contribute significantly to improving the overall efficiency of energy infrastructure. Notably, the deployment of smart grid technology, particularly in demand-side management, is anticipated to bring about transformative changes. The article traces the historical development of the electricity grid, from the installation of the first alternating current power grid in 1886 to the highly interconnected systems of the 1960s. It explores the challenges posed by peak demand and the evolution of peaking power generators. Developing countries like China, India, and Brazil emerge as pioneers in smart grid deployment in the 21st century. Modernization opportunities in the early 21st century are examined, with a spotlight on the integration of renewable energy and the shift from centralized to distributed power generation. Concerns over environmental damage and the desire to create a more robust energy grid further propel the adoption of smart grid technology. The article also explores early technological innovations that paved the way for smart grids, including automatic meter reading and the evolution of Advanced Metering Infrastructure. These innovations, coupled with the ability of smart meters to provide real-time monitoring, mark a significant advancement in demand-side management technologies.

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# Addressing the Challenges of IoT Device Behaviour Analysis through Location-Aware MUD Generalization

**K.Arthi and B.Jamuna**

**III Year EEE**

**E.G.S. Pillay Engineering College, Nagapattinam.**

***ABSTRACT***

*Analyzing the network behavior of IoT devices poses a significant challenge for security and identification, requiring solutions to learn normal device behavior and enforce rules accordingly. The Manufacturer Usage Description (MUD) offers a whitelist protection approach, defining authorized network behavior in a MUD file for use as a firewall mechanism. However, determining normal behavior is complicated, as the same IoT device with identical firmware may behave differently depending on its geographical location. We explore cases where location impacts device behavior and propose a method to generalize MUD files. Our approach involves processing MUD files from various locations to create a comprehensive version applicable universally. To support this research, we developed MUDIS, an open-source MUD Inspection System tool, and accompanying dataset, enabling visualization, comparison, and generalization of MUD files for researchers and IoT manufacturers alike.*

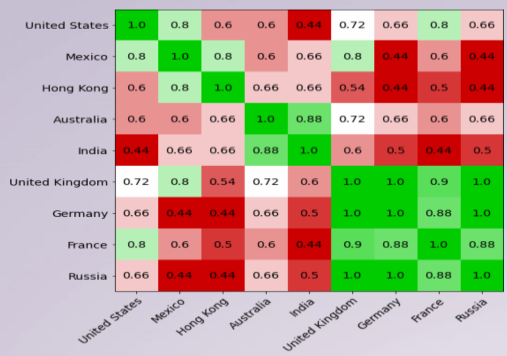
## INTRODUCTION

In the realm of IoT, the diversity among vendors contributes to variability in MUD files, especially when comparing captures from the same device across geographically close locations. Despite the absence of a dominant paradigm for device design, security, and identification in networks, our research highlights the influence of device location on network behavior. We observed that identical IoT devices with matching firmware exhibit distinct behaviors and communication patterns depending on their geographical placement, encompassing interactions with various domains, protocols, and ports. This study marks the first attempt to systematically consider location as a determinant of device behavior.

## MUD BACKGROUND

In our approach, Manufacturer Usage Description (MUD) serves dual roles. Firstly, it formalizes network behavior at the flow level, facilitating detailed analysis. Secondly, it functions as a security solution, aiming to enhance IoT device security by specifying appropriate traffic patterns. MUD, an Internet Standard, aims to mitigate IoT device attack surfaces by defining permissible traffic patterns. Any traffic deviating from this description is deemed malicious and can be blocked. Manufacturers provide these descriptions in MUD files, which comprise Access Control Lists (ACLs). Each ACE typically dictates an action, such as "accept" or "drop". As MUD operates on a whitelist principle, any traffic not matching an ACE is automatically dropped. The MUD manager component parses these files and installs corresponding ACL rules on network security devices, thus reducing the device's attack surface.

Manufacturers encounter challenges in creating comprehensive MUDs, considering parameters like third-party libraries, OS network behavior, and device functionality. To address these challenges, tools have been developed to generate MUD files from network captures or to acquire and learn them from wild-traffic using big data. These approaches assist in




scenarios where IoT vendors may lack the motivation or expertise to create MUD files.

## DEVICE LOCATION IMPACT ANALYSIS

Our dataset comprises network traffic data (pcap files) obtained from our lab's router and log files sourced from Ren et al. Our dataset includes 31 IoT devices (e.g., plugs, cameras, bulbs, etc.) situated physically or virtually across up to 14 countries via VPN. These devices fully utilize all available functionalities. Country selection for device activation aligns with those countries accessible during registration and provisioning in the IoT user's application.

We observed that, in most cases, device network behavior is dictated by the device's logical location (country chosen during provisioning) rather than its physical location (IP address as observed in the VPN). Further details can be found in the comprehensive technical report. Subsequently, we generated MUD files from the pcap data using MUDGEE. The resulting MUD files per country, along with a complete list of tested devices, are accessible at.

Figure 1: Cumulative Distribution Function (CDF) of MUD files similarity scores for all the devices in the dataset. Each similarity score is calculated by comparing two different locations MUD files of a device. Each device was captured in up to 14 locations.

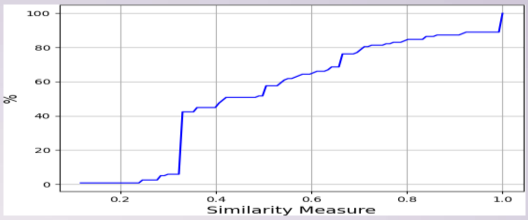



Figure 2: Heat map of similarity measure for the Yi camera, across ten different logical locations. The heat-map highlights that cross-region locations have lower similarity scores.

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# Renewable Energy-Based Charging Infrastructure for Electric Vehicles

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**ABSTRACT**

*This paper presents the Solar-Wind Charging Mechanism (SWCM) for electric vehicle (EV) battery packs, integrating solar photovoltaic (PV) modules and a wind generator. The SWCM significantly reduces reliance on fossil fuels, thereby minimizing CO2 and CO emissions. Renewable sources like wind and solar are modeled using a single diode model, with analytical modeling for wind energy generation. A MATLAB-Simulink simulation model is developed to study the I-V and PV characteristics of solar panels and various parameters of wind turbines. The system includes unidirectional DC to DC converters for PV modules and wind turbine, and bidirectional DC-DC converters for ten charging points, facilitating EV charging.*

## Introduction

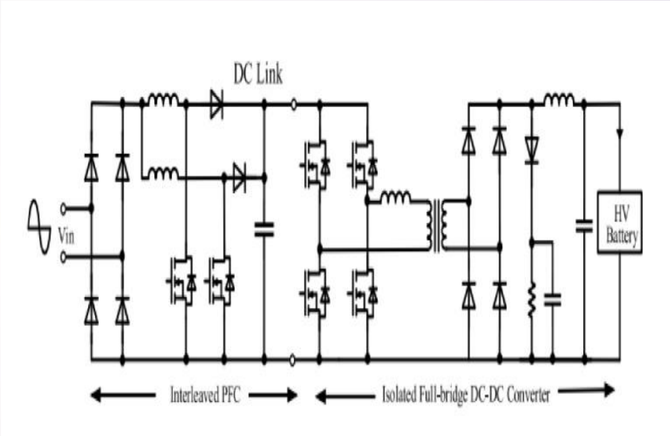
Electric vehicles (EVs) offer advantages in energy savings, environmental friendliness, and acceleration performance over traditional fossil fuel vehicles. However, range anxiety and efficient charging are key considerations for EV adoption. EVs are typically equipped with On-Board Chargers (OBCs) to facilitate charging.

## Existing System

Conventional circuits are used for EV charging, resulting in high power losses and occupying significant space.

## Proposed System

The proposed system employs a high-performance pulse controller for efficient charging, ensuring proper charging current flow to the battery.




## Operations

Conductive charging involves a direct electrical connection between the vehicle and charging inlet, offering different charging facilities such as Level 1, Level 2, and Level 3 charging. Conductive charging provides Vehicle-to-Grid (V2G) capability, reduces grid loss, maintains voltage levels, prevents grid overloading, and supports active and reactive power compensation using the vehicle's battery.

## ATmega16

ATmega16 is an 8-bit high-performance microcontroller with a 16 KB flash memory, 1 KB RAM, and 512 Bytes EEPROM. It operates at a maximum frequency of 16MHz.

## Solar Panel

A solar panel consists of interconnected solar cells packaged to generate electricity. Multiple panels are typically used in photovoltaic systems along with inverters and batteries.

## Battery

A battery converts chemical energy to electrical energy through voltaic cells. It consists of anode and cathode half-cells connected by an electrolyte.

## MOSFET

The power MOSFET is a field-effect transistor promising low input power levels and high switching speeds, enabling frequency increase in power electronic systems.

## MOSFET Driver

The IR 2110 is a high and low side driver with features like floating channel design, gate drive supply range from 10 to 20V, and under-voltage lockout for both channels.

## Pulse Width Modulation (PWM)

PWM offers advantages such as resistance to noise, less heat dissipation, and fast switching, making it suitable for high-frequency applications.

## Conclusion

The paper provides a comprehensive review of EV technologies, including charging methods and optimization techniques. It identifies research suggestions and emphasizes the need for manufacturing aspects in future investigations.

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# AN EFFICIENT OPTIMIZED MPPT FOR PV SYSTEM UNDER EXTREMELY FAST CHANGING IRRADIANCE – HYBRID HONEY BADGER OPTIMIZER

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**ABSTRACT:**

*Photovoltaic (PV) systems rely on efficient Maximum Power Point Tracking (MPPT) algorithms to optimize power extraction, especially under rapidly changing irradiance conditions. This paper introduces a novel approach termed Hybrid Honey Badger Optimization (HBO) for MPPT control, leveraging the natural oscillations of the converter for dynamic tracking improvements. Unlike traditional methods, the HBO method requires no additional sensors and combines MPPT principles with geometric control for enhanced performance. Validated through simulations and experiments, the proposed method demonstrates significant benefits for applications like wearable technology and electric vehicle*

## Introduction:

Solar energy conversion is pivotal in addressing global energy demands and environmental concerns. MPPT plays a crucial role in maximizing power output from PV cells under varying irradiance levels. The proposed HBO scheme offers a promising solution to expedite convergence time and enhance efficiency by integrating geometric optimization principles.

## Existing System:

Traditional MPPT methods like Perturb and Observe (P&O) and Incremental Conductance (INC) suffer from drawbacks such as inefficiency and slow tracking speeds. Intelligence-based approaches, though complex, offer improved efficiency but at higher costs.

## Proposed System:

To address the escalating demand for electricity amid environmental challenges, a novel MPPT approach based on Hybrid Honey Badger Optimization is proposed. This modified HBO algorithm accelerates convergence for effective power tracking. Solar energy, derived from sunlight interacting with the Earth's surface, underscores the significance of efficient MPPT techniques.

## Advantages of Proposed System:

The proposed HBO-based MPPT system offers superior tracking efficiency, simplicity, and minimal implementation requirements, making it suitable for diverse applications. Its silent operation and compact design further enhance its appeal.

## Requirements:

Hardware requirements include components like PIC16F microcontroller, VI measurement unit, and MOSFET-IRF, while software requirements involve Kiel and Embedded 'C'.

## Implementation Results:

Experimental results validate the effectiveness of the HBO-based MPPT system in achieving global peak power. Comparative analysis with conventional methods demonstrates superior efficiency and faster convergence.

## Conclusion:

The HBO-based MPPT approach, inspired by the foraging behaviour of Honey badgers, presents a robust solution for solar energy systems. Its superior performance in terms of efficiency and convergence speed underscores its potential for widespread adoption. Simulation comparisons with conventional methods affirm its efficacy in optimizing power output from PV system

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# SMART COCONUT HUSK PEELER MACHINCE

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## Abstract:

*A machine for removing coconut husk has been developed to extract test from the coconut seed coat. This process is crucial for producing high-value coconut products like dedicated coconut. Traditional methods involving manual labour are becoming obsolete due to a shortage of skilled workers. The aim of this project is to design and develop an automatic coconut husk remover machine to overcome the limitations of manual tools. The machine consists of components such as a testa remover unit, mounted on a frame with an electric motor as the power source and a speed-reducing unit. The test a remover features a circular cutter that rotates to penetrate the seed coat until the white flesh is exposed, with the removed test a collected at the bottom.*

***Keywords:-****Testa, Grater, Coconut brown skin*

## Introduction:

This project focuses on designing a machine to remove the brown skin from coconuts. The global coconut production accounts for 22.34% of agricultural output in India. High-value coconut products such as desiccated coconut and virgin coconut oil require the removal of this brown skin (test). Desiccated coconut powder, produced mainly in states like Karnataka, Tamil Nadu, Kerala, and Andhra Pradesh, caters to the food industry's needs. There is a growing demand for desiccated coconut powder, especially in urban areas and abroad. The removal of coconut brown skin is essential for various industries, including the oil industry, achieved through machines like coconut brown skin remover machines.

## Objectives:

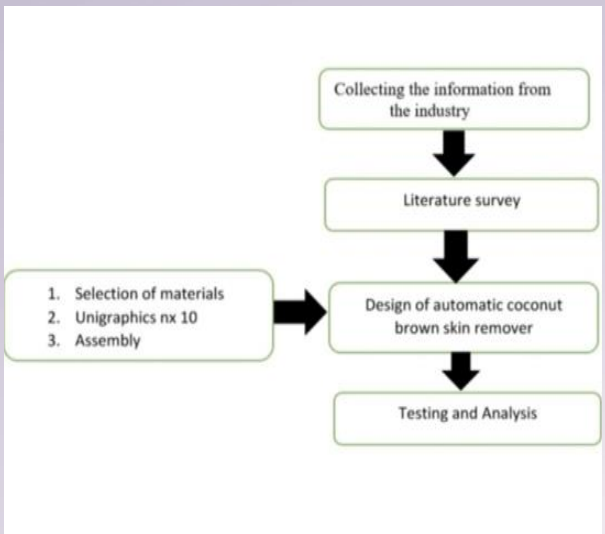
Enhance production efficiency by implementing advanced automatic peeling techniques to significantly diminish manual labour required for coconut brown skin removal, consequently minimizing associated labour costs and time expenditure.

## Working Principle:

The coconut brown skin remover machine utilizes a cutter with spikes to peel off the coconut's brown skin. An electric motor drives the cutter in a clockwise direction, while a tray holds the removed brown skin. As the coconut comes into contact with the cutting blades, the machine removes the brown skin. The coconut is collected in a bucket once the skin is entirely removed.

## Methodology:

The main components of the machine include a frame made of mild steel, a single-phase induction motor, a stainless-steel cutting plate, a steel tray, and a shaft for power transmission.




## Advantages:

Offering a transportable solution with simplified assembly and dismantling, this system not only reduces manpower and mitigates the risk of worker injury but also eliminates the need for skilled labour while ensuring effortless operation and maintenance.

## Applications:

Used in the desiccated coconut industry, this machine efficiently removes brown skin from coconut seed coats, a crucial step in preparing raw materials for the oil industry.

## References: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# ALCOHOL DETECTION BASED SPEED CONTROL DEVICE

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**ABSTRACT:**

*The abstract introduces an IoT-based in-vehicle alcohol detection and speed control system designed to address the issue of alcohol-related road accidents, particularly prevalent in Nigeria. The system utilizes an Arduino Nano microcontroller and MQ-3 alcohol sensor to continuously monitor blood alcohol concentration (BAC) through the driver's breath. It also includes speed control functionality to prevent excessive speeding. When BAC exceeds the legal limit, the system alerts authorities via SMS, contributing to enhanced road safety.*

***Keywords:*** *Accident Alcohol Detection, Arduino, IOTs, Speed Control.*

## INTRODUCTION:

The study proposes an effective method to tackle the rising number of road accidents due to drivers' alcohol consumption in Nigeria. Despite existing preventative measures, accidents persist, often caused by speeding and drunk driving.

## MATERIALS AND METHODS:

The research presents an IoT-based in-vehicle alcohol detection and speed control system using Arduino Nano, alcohol sensor, LCD display, and DC motor, BLE, and Blink Cloud Server for remote monitoring. The system continuously monitors blood alcohol concentration (BAC) using the MQ-3 sensor installed in the steering wheel.

## DISCUSSION:

The introduction highlights the global issue of alcohol-related accidents, particularly prevalent in Nigeria. It emphasizes the importance of accurate alcohol detection and the system's potential to mitigate accidents. Materials and methods detail the system components, circuitry, assembly, and testing procedures. Results showcase the system's functionality in detecting alcohol levels and ensuring vehicle safety. Discussion addresses the system's accuracy, limitations, and potential improvements, such as integrating GPRS for location tracking and speech recognition for user authentication.

Fig. 1. Hardware Setup

## CONCLUSION

In conclusion, the study presents a viable solution to combat drunk driving and reduce accidents. Future research suggestions include enhancing communication capabilities and integrating additional sensors for improved functionality. Overall, the proposed system offers promise in enhancing road safety and minimizing the adverse effects of alcohol consumption on driving.

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# Doping-Induced Performance Improvement in $ReS_2$ Field Effect Transistors: Exploring a Heterostructure with $In_2O_3$ Quantum Dots

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**ABSTRACT:**

*This study investigates the enhanced electrical and photoelectrical performance of a 2D/0D hetero-structure comprising In2O3 quantum dots (QDs) on a multilayer ReS2 field-effect transistor (FET). Characterization of In2O3 QDs reveals n-doping effects, leading to improved mobility attributed to electron transfer from In2O3 QDs. Channel migration of ReS2 and traps at the ReS2/In2O3 QDs interface contribute to additional performance enhancements, including reduced contact resistance, improved subthreshold swing, and increased photo responsivity. However, photo response speed is decreased*

## Introduction:

Transition metal dichalcogenides (TMDs) have garnered significant attention due to their remarkable electrical and optical properties compared to graphene. Unlike graphene, which lacks a band gap, TMDs exhibit an appropriate band gap in the range of 1–2 eV, making them suitable for various applications such as switching logic devices and photodetectors. Notably, TMDs like MoS2, WS2, and WSe2 display unique characteristics, with their band structure dependent on the number of layers. For instance, MoS2 transitions from a direct to an indirect band gap as its thickness increases, whereas ReS2 maintains a direct band gap regardless of the number of layers, making it advantageous for photon conversion efficiency.

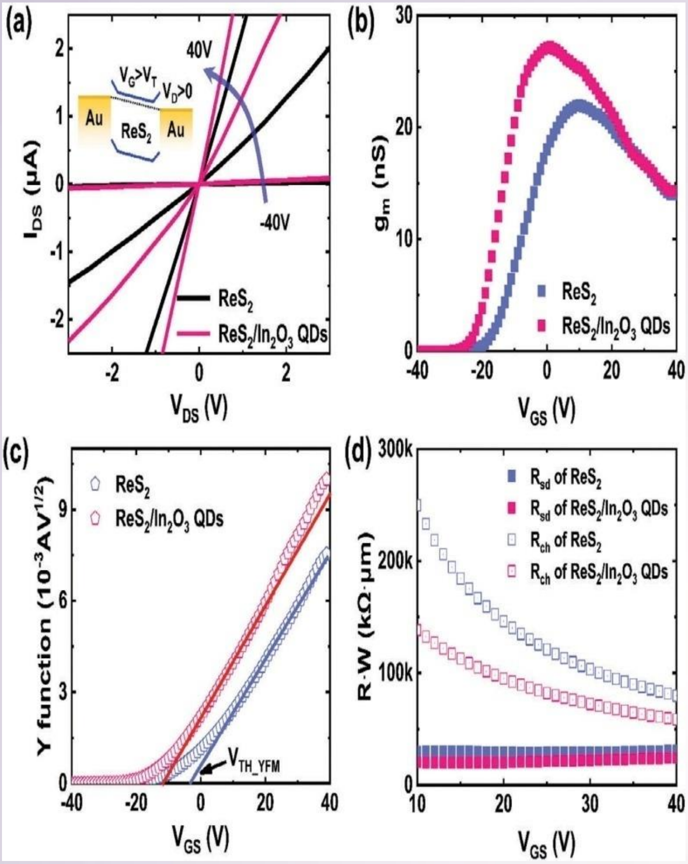
Despite its favourable properties, ReS2 faces challenges such as inferior mobility compared to MoS2. To address this limitation, researchers have constructed heterostructures using combinations of 0D, 1D, and 2D materials. These heterostructures, such as multilayer graphene/hexagonal boron nitride (h-BN)/ReS2 and ReS2 transistor decorated with CdSe–CdS–ZnS quantum dots (QDs), have shown improved electrical transport and photoelectric properties. Moreover, the size dependency of QD bandgap presents a strong advantage for tailored applications.

While research on 2D/0D systems has mainly focused on enhancing photodevice performance, recent trends have shifted towards cadmium-free quantum dots due to environmental concerns. InP and CuInSexS2−x are emerging alternatives to cadmium-based QDs, driving research in display and energy harvesting applications.

In2O3, a prominent semiconductor oxide, exhibits strong n-type semiconducting behaviour and finds applications in hybrid photodetectors and UV photodetectors. Despite the potential of size-dependent optical properties of In2O3 QDs, their applicability has received limited attention, especially in heterostructures with 2D materials. Given this context, the development of a hybrid system combining ReS2 and In2O3 QDs holds significant value. Unlike previous research focused solely on enhancing photoelectrical performance, this study aims to comprehensively investigate the improvement of electrical properties. The incorporation of In2O3 QDs enhances charge transport characteristics and photoresponsivity of ReS2 field-effect transistors, leading to improved mobility and higher on-current. Additionally, the study sheds light on channel migration induced by surface doping and underscores the environmental advantages of In2O3 QDs over cadmium-based alternatives, making them more suitable for commercial applications.

## Results and Discussion:

In2O3 QDs were obtained using the method adopted in our previous study Figure 1a depicts the transmission electronmicroscope image of separated In2O3 QDs, and the inset represents their distribution. The histogram shows a Gaussian




distribution with an average size of 3.0G nm. To characterize their op- tical properties, the absorption and photoluminescence spectra of In2O3 QDs were measured while dispersing them in ethanol. Figure 1b shows absorption/emission peaks observed at wave- lengths of 280 and 320 nm, respectively. As shown in the inset, the optical bandgap of QDs can be identified by extrapolating the linear portion of the Taut plot where the quantity ($\alpha$h$\upsilon$)2 is plot- ted against photon energy, incorporating the absorption coefficient$\alpha$, which is proportional to optical density and the energy of incident photons (h$\upsilon$). Consequently, the direct band gap of In2O3 QDs was observed to be 4.G4 eV, which is similar to that previously reported and significantly greater than the 2.58 eV indirect band gap of bulk In2O3.[2G]

Furthermore, the secondary electron cutoff and valence band regions obtained through UV photoelectron spectroscopy are presented in Figure 1c. These results were utilized to determine the work function and the va- lence band edge, respectively, through linear extrapolation. From the difference between the incident light energy (21.2 eV) and secondary cutoff energy (17.35 eV), the work function of In2O3 QDs was calculated to be 3.85 eV. Based on the valence-band re- gion, the energy gap between the Fermi level and valence-band maximum (VBM) level was evaluated to be 3.75 eV. Finally, the position of the VBM is determined to be 7.G eV as the sum of the previously obtained energy gap and the position of the VBM.[28].Therefore, In2O3 QDs have a wide bandgap and higher conduction band level compared to ReS2, which is sufficient to operate using an electron donor.

$$\mu_{FE} = \frac{g_m L}{C_{OX} V_{DS} W}.....................................(1)$$

Where *g represents* the maximum transconductance, List the channel length, W is the channel width, Cox is the gate oxide capacitance, and VDS is the drain bias voltage. μFE of ReS2/In2O3QDs device is calculated to be 4.13 cm2 V−1 s−1, indicating an improvement in μFE compared to that of the device without In2O3QDs (3.34 cm2 V−1 s−1). Furthermore, VT decreased from −3 to−11 V, which is evaluated using the constant current method at a current level of 100 nA. This variation is greater than the VT shift (−3 to −8 V) caused by light irradiation of the pristine ReS2 de- vice. The carrier concentration of 1.92 × 1012 cm−2 was included using the following equation

$$\Delta n = \frac{C_{OX} \Delta V_T}{q}...........................................(2)$$

SS, a crucial performance indicator of FET devices, was observed to improve from 4.1 to 3.7 V/decade after In2O3 QD doping. Additionally, Raman spectra of ReS2 samples with and without QDs were obtained to demonstrate the n-doping effect of In2O3 QD (Figure 2d). Owing to its low crystal symmetry, ReS2 exhibits numerous complex vibration modes (A1g, E2g, E1g) compared toother TMDs.[29] Among them, five distinct peaks were observed in the range 120–240 cm−1. The difference between the peak positions ≈135 and 150 cm−1 was 13 cm−1, indicating the known value of multilayer ReS2. After QD doping, the peaks shifted rightward by ≈3 cm−1. The observed red shift in the Ag-like mode can be attributed to electron doping,[30] which is related to the out-of-plane vibration mode.

The origin of n-doping effect and performance improvement by In2O3 QDs decoration can be explained using the energy band alignment of ReS2/In2O3 QDs (Figure 2e). Figure 1 shows the energy level diagram of In2O3 QDs, whose conduction band level is higher than that of ReS2, resulting in the electron charge transfer from In2O3 QDs to ReS2. When the two materials come into contact, the band is aligned to a type-I band alignment (straddling gap), and a small accumulation region forms on the ReS2 surface. This result is consistent with the previous I–V and Ra- man results.

Furthermore, high contact resistance between 2D materials and electrode metals posed a limitation in 2D-based devices. Sim-ilar to that of gold, the work function of ReS2 is 5.1 eV and exhibits a very slight Schottky barrier while in contact. Such fine Schottky characteristics were observed in the output curves of Figure 3a, and the Y-function method was performed to extract and com- pare the contact resistance before and after QD decoration. gm is plotted against the gate voltage (Figure 3b), and the Y parameter was calculated using the following equation:

$$Y = \frac{I_{DS}}{\sqrt{g_m}} = \sqrt{\frac{W}{L} C_{OX} \mu_0 V_{DS}} \cdot \left(V_{GS} - V_{T\_YFM}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

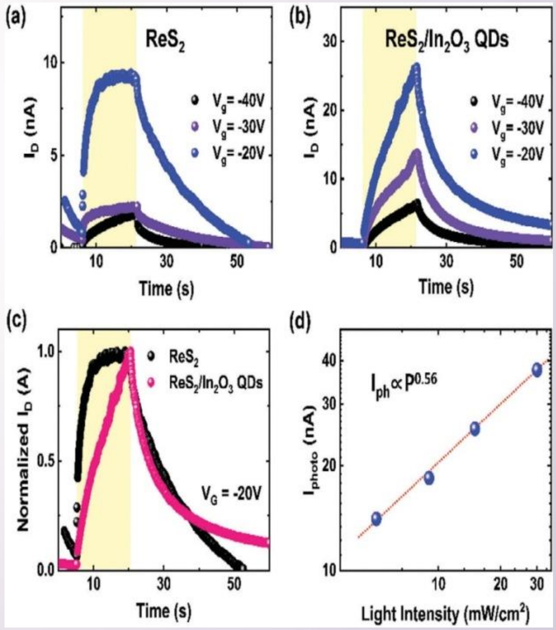
As shown in Figure 3c, the slope of the Y parameter versus gate voltage and the x-axis intercept were used to extract intrinsic field effect mobility (μ0) and threshold voltage ($\mu$T_YFM ), respectively. Assuming a negligible intrinsic mobility degradation factor $\theta_0$,contact channel resistance can be obtained usingthe following equations:

$$\theta \approx \frac{W C_{OX} \mu_0 V_{DS}}{L I_{DS}} - \frac{1}{V_{GS} - V_{T\_YFM}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$R_{sd} \approx \frac{\theta L}{\mu_0 C_{OX} W}, R_{ch} \approx R_{total} - R_{sd} \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

In the strong accumulation region, the contact resistance of the hybrid device was ≈24 kΩμm, which was slightly lower than that of the pristine ReS2 device (30 kΩμm). This improvement in contact characteristics is attributed to the Schottky barrier thin- ning effect between the electrode and channel. Contrastingly, the channel resistance significantly decreased from 80 to 59 kΩ·μm under the gate bias of 40 V. These advantages are in good agree-ment with the aforementioned high on-current and mobility

To understand the observed improvements in SS, channel migration was analyzed using a resistor network model for Re$S_2$ Figure 4a shows the resistor network model of 2D FET com- prising contact resistance by the Schottky barrier (RSB),




in- tralayer (R1…n) and interlayer resistances (Rint). In this multilayer model, the main current path is determined by the interaction of the Thomas–Fermi charge screening length and interlayer resistance.[ 33,34] Unlike typical silicon devices, the high interlayer resistance of ReS2 shifts the main conductive layer away from the gate oxide as the gate voltage increases. Therefore, the main current path is most affected by substrate scattering in the region near the threshold voltage. However, when the surface of ReS2 is doped with In2O3 QDs, the resistances of the channel's upper region are reduced, and the main current path is shifted to the upper region where the scattering effect of the substrate is smaller. This phenomenon corresponds to Figure 3b. The QD-decorated device turns on early and gm peak shifts to the negative direction. Hence, the main current path is formed at the upper region and does not pass through the bottom of ReS2. The In2O3 QDs affect the photo electronic characteristic show the time-dependent photo-response of the pro- posed devices under different gate biases. After QD decoration, photo responsivity increased from 151 to 432 A W−1 at VG = −20 V condition, which is a threefold enhancement. The improved photo response is because of the accumulation of photo generated electrons on the ReS2 surface in contact with the In2O3 QDs. However, this factor is greatly affected by the ReS2/In2O3 QD interface trap, thereby degrading the response time. From thenormalizedphotocurrentplot, theresponsetimein-creasesfrom1.04to7.98sowingtointerfacialtrappinga fterQDdecoration. Furthermore, the recovery time reduced from 19.1 to1G.7 s owing to fast recombination by the trap.

To further investigate these traps in ReS2/In2O3QD devices, the light intensity versus photo current was observed. These factors exhibited a positive relationship, and the photocurrentefficiency$\alpha$wasevaluatedas0.5Gbyfitti ngwiththefollowing power law:

$$I_{ph} = A \times P^{\alpha}$$

where Iph is the photocurrent, A is a scaling constant, and P is the light power. $\alpha$ represents the trap information in the photodetection system, and a value less than 1 indicates the occurrence of a photogating effect, i.e., there is energy loss owing to the trapping and recombination in the photocurrent conversion of light.

## Conclusion

In summary, In2O3 QDs possess a higher conduction band level, thereby acting as an electron donor for ReS2. In this study, by decorating In2O3 QDs on ReS2 field effect transistors, the electrical properties were observed to improve with the n-doping effect. The fabricated hybrid device exhibited performance improvements, such as increased mobility, reduced contact resistance, and improved SS. Compared to the non-decorated device, this hybrid device exhibited threefold photoresponsivity; however, the response speed was degraded. These results, when compared with other heterostructure-based ReS2 phototransistor studies listed in Table S1 (Supporting Information) of the supporting in- formation, demonstrate considerable improvements in both mobility and photo responsivity. Hence, n-doping with indium oxide QDs could be promising for improving the performance of various electronic devices, including ReS2 field effect transistors and photo detector

# Integration of vertical solar power plants into a future German Energy system

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## Abstract:

*In Germany's future energy system, wind and solar power meet over half of the yearly electricity demand. South-facing PV modules generate peak power at noon on sunny days, while east-west-facing vertical PV modules shift energy yield peaks to morning and afternoon hours. These vertical systems, implemented in agriphotovoltaic power plants, match conventional PV systems in energy yield per installed capacity. Despite a 4 to 5 times smaller power per area, dual land use with agriculture offers a technical potential comparable to half of Germany's primary energy demand. A simulation model using Energy PLAN for Germany 2030 with 80% CO2 reduction shows that an optimal share of around 80% vertical PV systems is effective without storage, and 70% with storage options. Vertical PV systems reduce the need for storage or gas power plant utilization, potentially cutting overall carbon dioxide emissions by up to 10.2 Mt/a without storage.*

## Introduction:

In 2015 at the United Nations Climate Change Conference in Paris the parties agreed to pursue efforts to limit temperature increase to 1.5 Compared to pre-industrial temperature [1]. In order to achieve this goal greenhouse gas (GHG) emissions must be reduced rapidly. Greenhouse gas emissions originate mainly from the use of energy, e.g. 85% in Germany [2]. Fortunately, wind and solar energy is abundant and available everywhere. Furthermore, costs for renewable electricity from wind and photovoltaic power plants have plummeted over recent years and today renewable electricity is less expensive than fossil fuel-based energy [3]. Unfortunately, wind and solar energy is not available all the time. Solar energy comes with distinct day-night and summer-winter cycles in electricity production. Future energy systems require large quantities of low-cost wind and photovoltaic electricity production together with flexibility from transmission lines, demand side management, energy storage and coupling of energy sectors [4–10]. Strong wind and photovoltaic excess capacities could result in so-called “self-cannibalisation”.

## Methods:

Energy yield distributions are generated using PVGIS [32]. Germany’s energy system is simulated using Energy PLAN from Aalborg University.

Solar energy yield distribution: In order to evaluate the impact of different solar module orientations on the energy yield distribution, the Photovoltaic Geographical Information System (PVGIS) from the Joint Research Centre of the European Commission is used [32]. All distribution data is generated for the year2015 in hourly distribution. A fixed elevation is used as the mounting type and crystalline silicon as the module type. System losses are given as 13%. In all cases the average energy yield is calculated at four different locations in Germany (Hamburg - North, Chemnitz - East, Munich - South, Saarbrucken - West).

## Energy system simulation:

In addition to the electricity yields from differently oriented solarsystems, a future energy system model forms the basis of the study. Theobjectives for the energy system are explained in more detail in thefollowing. To reduce GHG emissions, the reference year 1990 is set at1249 MtCO2eq/a (not including land use, land use change and forestry).The largest share of emissions, 83% (1037 Mt/a), is attributed to energy-related emissions, which are characterized by the burning of fossil fuels. Industrial processes account for 8% (97 Mt/a), agriculture for 6% (77Mt/a) and waste management for 3% (38 Mt/a) of CO2 emissions [33].Germany's previous climate targets were stated at 55% reduction compared to 1990, according to the Climate Protection Act 2019. In May2021, the law was updated and tightened to 65% CO2 reduction [29].

## Results:

In this section, the solar data are evaluated on the one hand, and the effects of changing solar module orientation on the 2030 energy system model are examined on the other hand.

## Conclusions:

In order to limit climate change to below 1.5 K, the large-scale increase of renewable energies in the German energy system is necessary. The most important sustainable sources of electricity are wind and solar power plants, whose variable electricity generation poses challenges for the current energy system in terms of security of supply, load management and storage and sector coupling. Typically, solar plants are installed with an inclination of about 20–35◦ to the south to achieve the highest annual electricity yield.

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# VARIATION OF PERFORMANCE PARAMETER OF LEAD ACID BATTERY POWERED ELECTRIC SCOOTER WITH REDUCTION IN REMAINING CHARGE

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**ABSTRACT**

*Lead Acid Batteries have been a staple in low-powered vehicles like electric scooters and cars for centuries. Despite being overshadowed by gasoline-powered vehicles for a time, advancements in electronics and battery technology have revived interest in electric vehicles due to pollution concerns and rising gasoline prices. Electric scooters, particularly those powered by lead acid batteries like the LY1200DQT-16F model, are gaining popularity again for their affordability. Performance parameters such as motor power, wheel power, torque, RPM, and speed were assessed using a Two Wheelers Chassis Dynamometer at various charge levels, decreasing by 5% increments. Results showed decreases of up to 71% in motor power, 79% in wheel power, 48% in maximum torque, 45% in maximum RPM, and 46% in maximum speed until the battery reached a 5% charge.*

**INTRODUCTION**

Lead acid batteries have been extensively used for centuries in various scientific applications such as low-powered locomotives, solar battery backups, and automobile lighting. Initially invented by Gaston Plante in 1860, lead acid batteries have evolved over time, with the most popular construction featuring red lead (Pb3O4) as an active material in the positive plate and litharge (PbO) in the negative plate. Each cell within a lead acid battery typically has a voltage of 2.12 V at full charge, allowing for versatile usage. While initially prevalent in early automobiles, the resurgence of electric scooters, exemplified by China's production of 34 million e-bikes in 2016, reflects a growing trend towards sustainable urban transport solutions. With projections indicating a significant urban population increase by 2050, alternative modes of transport such as e-scooters integrated with public transit systems offer potential for reducing car dependency and fostering sustainable mobility. However, concerns persist regarding the reliability of power, torque, and driving range in lead acid battery-powered vehicles. Testing conducted on scooters with lead acid batteries using a chassis dynamometer illustrates the variation in power and torque output at different battery charge levels. Despite their widespread use, literature often lacks clarity on the specific power, torque, RPM, and speed outputs of automobiles utilizing lead acid batteries.

**METHODS AND MATERIALS:**

Two-wheelers serve as primary modes of transportation in developing nations, with electric scooters gaining traction due to increased government subsidies and rising fuel prices. Lithium-ion and lead acid battery-powered scooters are the most common types, with lead acid options being more affordable for short-distance travel. However, the performance of lead acid battery-powered scooters at varying charge levels is often undocumented, leading to hesitancy among potential users. To address this gap, an experiment was conducted using a two-wheeler chassis dynamometer to assess performance parameters at different charge states. The dynamometer, capable of testing power up to 350 kilowatts, is manufactured by MAHA, Germany, and its technical specifications are outlined.

| | |
|---|---|
| Axle load | 1000 kg |
| Weight | 270 kg |
| Roller set rotating mass | approx. 150 kg |
| Roller diameter | 400 mm |
| Roller set dimensions (L x W x H) | 546 x 770 x 456 mm |
| Measurement principle | Flywheel test stand |
| Max. air pressure | 7 bar |
| Max. test speed | 320 km/h |
| Wheel power (dynamic) peak | > 350 kW |
| Max. tractive force | 6.5 kN |
| Measurement accuracy | |
| Wheel power measurement | +/- 2% from measured value |

**Maximum Speed Vs Remaining Charge in Battery Curve:**

Regarding the maximum speed of the scooter, the graphical analysis has become similar with Wheel RPM because both parameters are directly proportional. Maximum speed has plotted against remaining charge in battery. From the graph, the maximum speed has constant value of about 34 km/hr 100% charge condition to 35% charge condition. Again from 35% battery charge remaining to 25% battery charge the maximum speed value sharply decreases from around 34 km/hr to 18 km/hr. Then, the maximum speed value again remains constant at around 18 km/hr from 25% charge state to 5% charge state. Maximum speed has decreased to 46% of initial value till lowest charge condition.

**CONCLUSION:**

i.) If higher power of scooter is needed it should be operated in maximum charge condition i.e. up to until 70% charge remaining the scooter remains in high power delivery condition.

ii.) Generally, in a high torque requiring condition such as in steep road, the scooter has ridden easily until about 70% charge remaining condition after that the traction power of the scooter has decreased.

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# Step-Up fuzzy controlled DC-DC Switching Converter with Single Switch and Multi-Outputs Based on Luo Topology.

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## Abstract:

*This paper presents a novel approach to designing a step-up DC-DC switching converter with fuzzy control, utilizing a single switch and providing multiple output voltages. The proposed converter is based on the Luo topology, which offers advantages in terms of simplicity, efficiency, and versatility. By integrating fuzzy logic control, the system achieves robust performance in various operating conditions. The design and control methodology are discussed, followed by simulation results demonstrating the effectiveness of the proposed converter.*

## Introduction:

DC-DC converters play a crucial role in modern power electronics systems, facilitating efficient power conversion and voltage regulation. Step-up converters are particularly useful in applications where the output voltage needs to be higher than the input voltage. The integration of fuzzy logic control adds intelligence to the converter, enabling it to adapt to different operating conditions and enhance overall performance. In this paper, we propose a step-up fuzzy controlled DC-DC switching converter with a single switch and multi-outputs based on the Luo topology.

## Converter Design:

The proposed converter utilizes the Luo topology, known for its simplicity and efficiency in voltage conversion applications. By carefully selecting the components and configuring the circuit topology, we achieve a step-up conversion with minimal losses and high reliability. The single-switch configuration simplifies the control scheme and reduces component count, leading to cost-effective implementation.

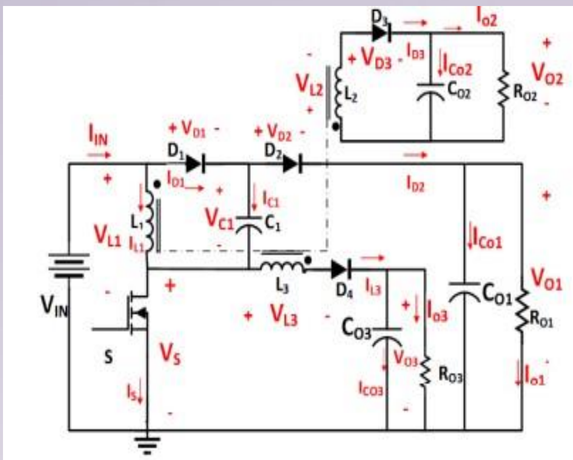
## Fuzzy Logic Control:

Fuzzy logic control is employed to regulate the output voltages of the converter and maintain stability under varying load and input conditions. Fuzzy logic allows for intuitive rule-based control, which can adapt to nonlinearities and uncertainties in the system. By defining appropriate linguistic variables and membership functions, the fuzzy controller can effectively regulate the output voltages while minimizing overshoot and settling time.

## Simulation Results:

Simulations are conducted to evaluate the performance of the proposed converter under different operating conditions. The converter demonstrates robustness and efficiency in achieving the desired output voltages with fuzzy control. Transient responses, steady-state characteristics, and efficiency are analyzed to validate the effectiveness of the proposed design.

## Circuit diagram:




## Conclusion:`

In this paper, we have presented a novel approach to designing a step-up fuzzy controlled DC-DC switching converter with a single switch and multi-outputs based on the Luo topology. By integrating fuzzy logic control, the converter achieves robust performance and adaptability to varying operating conditions. Simulation results confirm the effectiveness of the proposed design in terms of efficiency and stability. Future work may involve experimental validation and further optimization of the converter design for specific applications.

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# GRID TIED HIGH BIDIRECTIONAL CONVERTER BASED SOLAR CHARGING STATION

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## Abstract:

*The Grid-Tied High Bidirectional Converter-Based Solar Charging Station represents a pivotal advancement in renewable energy infrastructure, particularly in the context of electric vehicle (EV) charging and grid integration. This innovative system seamlessly harnesses solar energy through photovoltaic (PV) panels and efficiently converts it into electrical power using high bidirectional convert*

## Introduction:

In the pursuit of sustainable energy solutions, solar power stands out as a beacon of hope. Its abundance and cleanliness make it an ideal candidate for addressing our energy needs while mitigating environmental concerns. As the world moves towards renewable energy, the development of efficient solar charging stations becomes crucial, especially in the context of electric vehicle (EV) infrastructure. This article delves into the innovative concept of a grid-tied high bidirectional converter-based solar charging station, outlining its significance and potential impact.

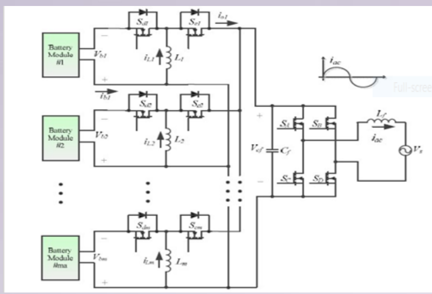
## The Need for Innovation:

Traditional solar charging stations often suffer from limitations, such as intermittency and lack of grid integration. Moreover, with the growing popularity of electric vehicles, there is a pressing need for charging infrastructure that can accommodate these vehicles efficiently while optimizing energy usage and grid interaction. Enter the grid-tied high bidirectional converter-based solar charging station, a revolutionary approach that addresses these challenges head-on.

## Key Components and Functionality:

At the heart of this solar charging station lies the bidirectional converter, a sophisticated device capable of seamlessly managing power flow between the photovoltaic (PV) array, the grid, and the electric vehicles. This bidirectional capability is crucial as it allows for optimal utilization of solar energy while providing flexibility in grid interaction. Additionally, advanced control algorithms ensure efficient energy conversion and grid synchronization, maximizing the station's performance.

## Block diagram:



## Applications and Benefits:

The applications of a grid-tied high bidirectional converter-based solar charging station are manifold. From providing clean energy for EVs to supporting grid stability through peak shaving and voltage regulation, the benefits are far-reaching. Moreover, the station's ability to integrate with existing grid infrastructure makes it a valuable asset in the transition towards a more sustainable energy ecosystem. By harnessing solar power efficiently and intelligently, these charging stations pave the way for a cleaner, greener future.

## Conclusion:

In conclusion, the grid-tied high bidirectional converter-based solar charging station represents a significant advancement in solar energy technology. Its ability to seamlessly integrate solar power with grid infrastructure while catering to the needs of electric vehicles underscores its importance in the quest for sustainable energy solutions. As we continue to embrace renewable energy, innovations like these will play a pivotal role in shaping the future of energy generation and consumption.

## References: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# Model Predictive Controller based High Gain Dual Input Single Output Z-Quasi Resonant (ZQR)DC/DC Converter for Off-Board EV Charging

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**ABSTRACT:**

*This study presents a multi-port model predictive controller-based non-isolated DC/DC power interface utilizing Z-Quasi Resonant (ZQR) network for off-board electric vehicle (EV) charging. Unlike conventional converters, this recommended converter boasts fewer switches, ensuring continuous current, high voltage gain, and minimal voltage stress on the converter switch, particularly up to 40% duty cycle due to the ZQR network. The proposed converter can seamlessly integrate additional input and output ports without compromising efficiency, enabling continuous operation even if one input source fails.*

## Introduction:

As electric vehicle deployment rises, charging infrastructure development becomes crucial. High-gain DC/DC converters are pivotal in reducing charging time anxiety, especially in hybrid renewable energy systems. The existing system relies on a non-isolated DC/DC power interface based on the ZQR network to combine various energy sources for EV battery charging.

## DC/DC Converters:

DC/DC converters are essential for power transfer and can be designed to be bi-directional. However, conventional converters suffer from drawbacks like slow charging, high voltage stress, reduced efficiency, and voltage gain.

## Objective:

To address these challenges, a ZQR converter utilizing a resonant tank interface fed with multiple power sources is proposed to enhance power quality and quantity. The aim is to develop a hybrid energy system integrating diverse renewable energy sources for improved performance.

## Proposed Multi-port Non-isolated ZQR:

The proposed converter accommodates grid and PV panel inputs, offering continuous current, high voltage gain, and minimal voltage stress on the converter switch, particularly up to 40% duty cycle. It finds application in off-board EV charging where high voltage gain is crucial.

## Model Predictive Control (MPC):

MPC is employed as a regulatory control mechanism utilizing an explicit dynamic model to calculate control moves, ensuring process variables follow predefined trajectories. The MPC controller model aims to enhance the gain of the proposed multi-port converter, offering advantages such as high efficiency, reduced PWM stress, and easy optimization using MATLAB tools for process simulation.

## Advantages:

The proposed system offers high efficiency, voltage gain, and reduced PWM stress. Additionally, the optimization problem can be efficiently solved using quadratic programming, with MATLAB tools simplifying process simulation.

## MPC Controller Model:

The MPC controller model enhances the gain of the proposed multi-port converter, integrating switches for hardware prototype implementation.

## References:

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# Small-Signal MOSFET Models for Analog IC Design.

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## ABSTRACT:

*The small-signal characteristics of MOSFETs play an important role in analog IC design. In this article, we learn how to model MOS transistors' small-signal behaviours. As we explained in a previous article, MOSFETs are essential to modern analog IC design. However, that article primarily focused on the large-signal behaviour of MOSFETs. Analog ICs normally use MOSFETS for small-signal amplification and filtering. In order to fully understand and analyze MOS circuits, we need to define the MOSFET's small-signal behaviour.*

## What is Small-Signal Analysis?

When we say "small-signal," what exactly do we mean? To define this, let's refer to Figure 1, which shows the output transfer characteristic of an inverter. The transfer characteristic of an inverter.

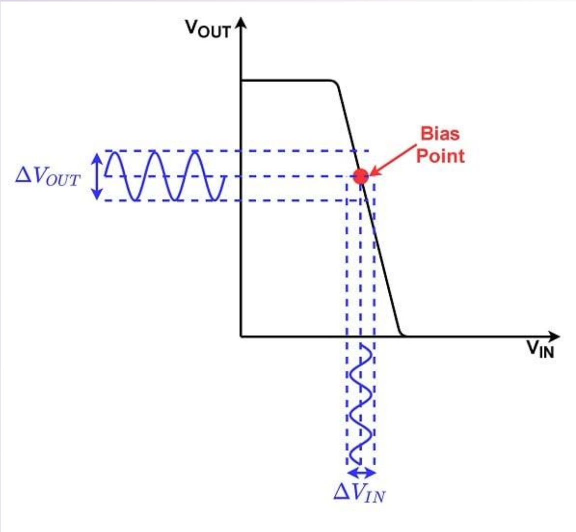



Figure 1. Transfer characteristic of an inverter.

Assume that:

VIN and VOUT are both DC voltages. The value of VIN means we're operating at the bias point (labeled in red).In small-signal analysis, we apply a very small AC signal (ΔVIN), on top of the DC bias voltage. The resulting output AC voltage is amplified based on the slope (–AV) of the transfer characteristic at the bias point:

$\Delta VOUT = -AV \times \Delta VIN$(Equation 1).

Note that –AV is only negative due to the slope's direction. We'll return to AV later in the article. For now, the important takeaway is that the bias point (large-signal behaviour) affects the amount of gain the output signal receives (small-signal behaviour).

**Small-Signal Parameters:** Before we model our circuit's behaviour, we need to define our parameters. The main small-signal parameters of a MOSFET are:

- Transconductance (gm).
- Output resistance (ro).
- Intrinsic gain (AV).
- Body-effect transconductance (gmb).
- The unity gain frequency (fT).

Excepting fT, which we won't discuss until we create our high-frequency MOSFET model, we'll define and derive each of the above terms in the coming sections. We'll start by looking at the I-V characteristic, transconductance.

**Transconductance:** As we already know, a MOSFET turns an input voltage into an output current. The ratio of the small-signal output current to the small-signal input voltage is known as the transconductance (gm). We can also think of transconductance as the derivative of the output current versus the gate-to-source voltage.The transconductance can be defined for the linear region as:

**Gm, Lin = δIDδVGS = δ (μCoxWL [(VGS− Vth) VDS − (VDS) 22]) δVGS = μCoxWLVDS(**Equation 2).

And for the saturation region, as:

**Gm, sat = δIDδVGS = δ [12μCoxWL (VGS − Vth) 2] δVGS = μCoxWL (VGS − Vth) (**Equation 3).

Where:

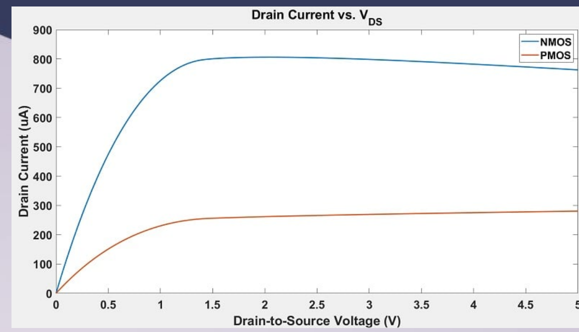
- ID is the drain current
- VGS is the gate-to-source voltage
- VDS is the drain-to-source voltage
- Vth is the threshold voltage
- μ is the transistor mobility
- Cox is the gate oxide capacitance
- W is the width of the transistor
- L is the length of the transistor.

These two equations lead us to a few interesting points:When in the linear region, the current gain of the transistor is dependent on the output voltage. It's not at all dependent on the input signal. This isn't ideal in practice, as the gain will change dramatically over the operation range.While in saturation, the transconductance is

## Output Resistance

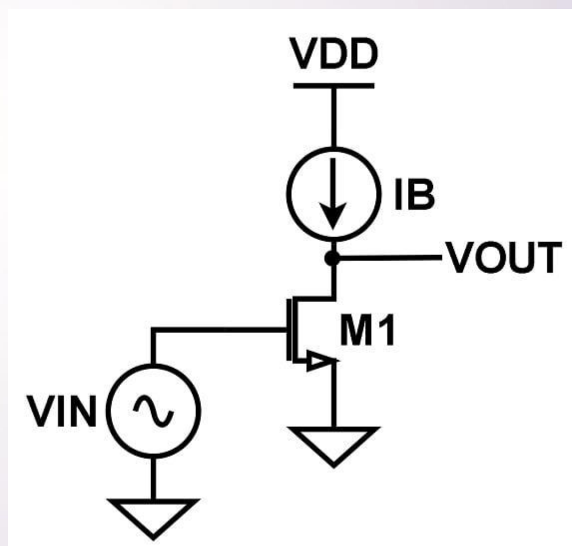
The next parameter of interest is the output resistance (ro). This is defined as the change in the transistor's drain-to-source voltage with respect to the drain current. We can find the output resistance by plotting the drain current versus VDS. The slope of the resulting line is equal to the inverse of ro.

Let's take a look at the plot in Figure 2. We first saw this figure in a previous article about MOSFET structure and operation, where it helped us compare the drain currents of NMOS and PMOS transistors.




A MOSFET has a small output resistance when in the linear region, and a large output resistance when in the saturation region. In the figure above, both the NMOS and PMOS transistor enter saturation at ~1.5 V.

**Intrinsic Gain:** Now that we know the output resistance and current gain of the transistor, we can calculate its maximum voltage gain. This is also known as the transistor's intrinsic gain (AV). To better understand the concept of intrinsic gain, let's examine the common-source amplifier configuration in Figure 3.




Since an ideal current source has an infinite resistance, the small-signal output transfer function for this circuit can be calculated as:

**ΔVOUTδVIN = δVDSδVGS = gmro = AV (**Equation 5).

From Equations 3 and 4, we can see that gm and ro are inversely related to the drain current. Using this knowledge, we can find an optimum value for the drain current that produces the largest gain possible for a single transistor—in other words, its intrinsic gain. For modern processes, the intrinsic gain is usually between 5 and 10.

**Body-Effect Transconductance:** The final small signal parameter we need to derive is the body-effect transconductance (gmb), which describes how the body effect influences the drain current. We can calculate this as:

$$Gmb = \delta ID \delta VBS = \delta ID \delta VTH \delta VTH \delta VBS = Gm\eta$$

Equation 6.

**Low- and High-Frequency Models:** Now that we've defined our parameters, we can build a circuit model that represents the small-signal operation of the transistor. Figure 4 depicts the small-signal behavior of a MOSFET at low frequencies.

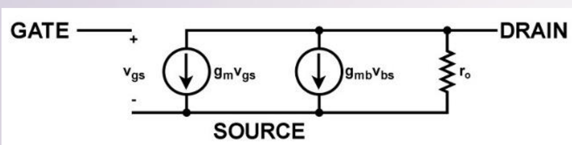
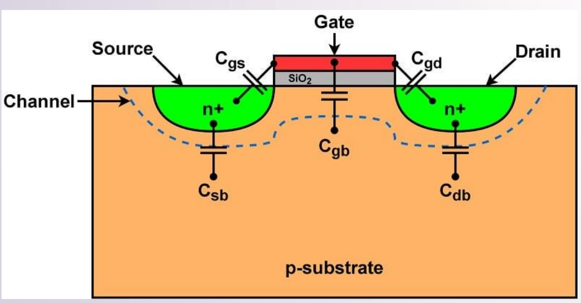


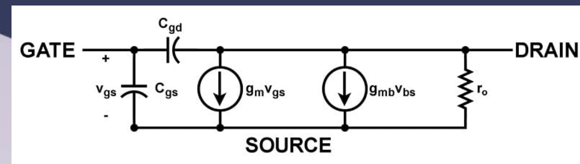

Figure 4. MOSFET small-signal model.




Represented above are:

- Cgs, the gate-to-source capacitance.
- Cgd, the gate-to-drain capacitance.
- Cgb, the gate-to-body capacitance.
- Csb, the source-to-body capacitance.
- Cdb, the drain-to-body capacitance.

The small-signal transistor model in Figure 6 includes all of these non-idealities except for the body capacitances.




**fT = gmCgs + Cgd ∝ VD,satL.**(Equation 7).

**Conclusion:** Small-signal MOSFET models play a pivotal role in the design and analysis of analog integrated circuits (ICs). These models provide a simplified yet accurate representation of MOSFET behavior under small variations around an operating point, essential for understanding circuit performance in applications such as amplifiers, filters, and oscillators. By incorporating parameters like transconductance, output conductance, capacitances, and body effect parameters, small-signal models enable designers to predict circuit behavior, optimize performance, and ensure stability. Whether utilizing models like the T-model or the hybrid-π model, engineers rely on small-signal MOSFET models to guide the development of high-performance analog ICs that meet stringent specifications and deliver reliable functionality in a wide range of applications.

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# Solar Panel Cleaning System using Arduino

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***Abstract:***

*Solar energy has attracted worldwide attention and is playing an essential role in providing clean and sustainable energy. The solar panel works by allowing the light into solar cells. The light that impacts on solar panel, the more power will be generated. Due to the inclination of the solar panel there is more liability that the dust or bird dropping will be built up. And the dirt is not cleaned just by rain. So the accumulation of dust on the surface of solar panel will decrease the amount of light and thus the efficiency of solar panel is impacted. Hence, they need to be cleaned on the daily bases to harness the capacity to its fullest. So it's necessary and important to clean the solar panel in order to protect and get more power output. Therefore, we have designed the automatic solar panel cleaner machine which will clean the panel by controlling the Arduino programming and improve the panel efficiency.*

***Index Terms* – Introduction, Objective, Block Diagram, Methodology, Advantages, Future Scope, Conclusion, Reference**

## INTRODUCTION:

The sun is the major source of natural sun light and solar energy is abundantly used. As the solar energy is nonextinguishable it is enough to supply the worlds energy demand but it is impossible because of the weather condition and dust problem thus the solar panel are used to convert the sunlight into the solar energy. The solar energy is also well known for not producing any pollution in the environment. It is also consider as abundantly used energy from the future point of view. The dust and bird dropping given an adverse effect on the efficiency of solar panel. Hence, this parameter is to be taken care off thus the project is developed in taking consideration the above parameter the system made is automatic solar panel cleaner for cleaning the panel. Previously cleaning method done manually and it was having adverse effect like risk of staff, damage of panel and poor maintenance etc. Thus, the amount of solar energy will be reduced. If the dust is accumulated on the panel. But after cleaning the panel with the solar panel cleaner, the efficiency of the panel will improve.

## OBJECTIVES:

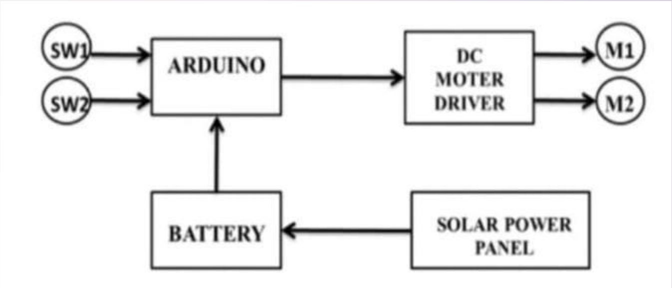
The aim of implementing a Solar Panel Cleaning System utilizing Arduino technology revolves around enhancing the efficiency and longevity of solar panels. Its primary objective lies in optimizing solar panel performance by diligently removing dust, debris, and other obstructions that hinder sunlight absorption. Through remote monitoring and control capabilities, users can conveniently oversee the system's operation and initiate cleaning cycles as needed, thereby promoting proactive maintenance practices.

## METHODOLOGY:

The effects of accumulated dust on the performance of the solar panels are observed by referring the results obtained by experimentation in dusty atmosphere of different levels. Also, an automatic cleaning system is employed to work as the auto cleaner which is equipped on the tilted solar panel is proposed. The design of the automatic cleaning system will have flexibility in order fix on different sizes of flat solar panels. In accordance with the dimensions of the inclined plate panel, the system consists of brushes driven by DC-motors through a threaded rod system. The movement of the brushes is controlled by signal generated by a microcontroller in accordance with the dust sensor which produces a rotational motion which is converted into linear motion through rod. The electrical power which is needed to drive the DC motor is supplied from the battery.

The methodology for developing the Solar Panel Cleaning System using Arduino involves several key steps. Initially, comprehensive research is conducted to gather extensive information about the software and hardware components utilized in the project. Following this, the basic prototype of the automated cleaning system is designed, considering factors such as efficiency and practicality. An essential aspect of the process involves selecting the appropriate microcontroller to govern the automatic cleaning robot, ensuring compatibility and functionality. Subsequently, the algorithm for the microcontroller is meticulously designed to enable precise control of the robot's movements, ensuring effective cleaning in the correct direction. Through these systematic steps, the development of the Solar Panel Cleaning System progresses, aiming to optimize performance and efficiency in maintaining solar panel functionality.


**BLOCK DIAGRAM:**




**ADVANTAGES:**

• Our residential solar panel cleaning systems can help you to increase the output by as much as the 5% to 30%.

• Sometime dust or other particles are long time placed on solar plate so it damages the aluminium strip of solar plate so we avoid this damage by this system.

• By this system we make the life of this plate longer than other plates

. • It has a low maintenance cost and also reduce human efforts.

• No requirement of heavy machinery.

**FUTURE SCOPE:**

**Moving Cleaning Smarter:** Systems that learn and adapt, almost like they have a mind of their own. We're talking about future setups that use fancy algorithms and AI to figure out the best times to clean solar panels. They'll take into account things like how dirty the panels are, what the weather's like, and even how much energy the panels are producing.

**Save Energy Where It Counts:** We're all about being green, right? So, future systems will be all about using less energy while still keeping those panels squeaky clean. Think of it as using smarter tech – like sensors that sip power and clever tricks to manage electricity better – all to make cleaning more efficient and eco-friendly.

**Keeping Tabs From Afar:** Wouldn't it be neat if you could check on your solar panels from anywhere? Well, that's where the future is heading. With snazzy wireless tech and Internet of Things gizmos, you'll be able to see how clean your panels are, get alerts when they need a scrub, and even schedule cleaning sessions – all from your phone or computer.

**Robots Everywhere:** Imagine little cleaning robots zipping around your solar panels, doing all the dirty work for you. These future bots will be super smart, knowing exactly where to go and how to get the job done without any help. And they'll talk to each other too, so they can work together like a well-oiled machine.

**Caring for the Planet:** One thing we can't forget is how our cleaning systems impact the environment. In the future, we'll see more eco-friendly solutions – things like using less water and chemicals

**CONCLUSION:**

Existing automatic cleaners are primarily designed for big arrays and are therefore unsuited for use on smaller arrays, such as residential rooftops. For individuals with limited space, this means that a smaller array can be installed, which is a significant benefit for those with smaller sites. Our technology can be used to connect solar panels to the roof. The solar panel cleaning system was originally built with the design requirements in mind. The following observations were observed once our working model was put to the test. The brush has a superb cleaning function, scrubbing the dust that was sticky in nature. It is less expensive to install and has a short payback period.

**REFFERENCE:**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# POWER SUPPLY NOISE REDUCTION


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## ABSTRACT:

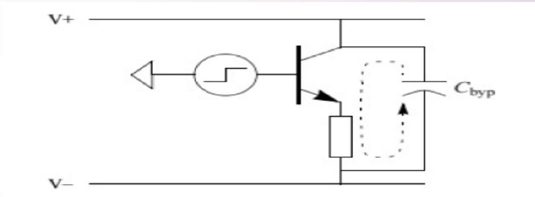
*Power supply noise reduction is a critical concern in electronic design, particularly as circuits become more complex and operate at higher frequencies. This paper explores various strategies to mitigate noise in power supplies, focusing on bypassing, decoupling, reducing inductance, damping, and the role of operational amplifiers.*


## INTRODUCTION:

Reducing power supply noise is a critical aspect of design, often presenting challenges when transitioning from theory to practical implementation. Real-world power supplies introduce imperfections leading to issues like noise and oscillations, demanding careful consideration and solutions beyond simplistic approaches. This paper delves into the complexities of power distribution, urging readers to adopt a foresighted approach.

## BYPASSING:

Bypassing and decoupling, although commonly employed, are often improperly implemented, exacerbating noise issues. Bypassing involves diverting high-frequency current through capacitors to minimize noise on the power supply. Successful bypassing requires accurately identifying load currents and providing low-impedance paths separate from the main circuit. Using multiple small capacitors in parallel is preferred to minimize equivalent series inductance.




## REDUCING INDUCTANCE:

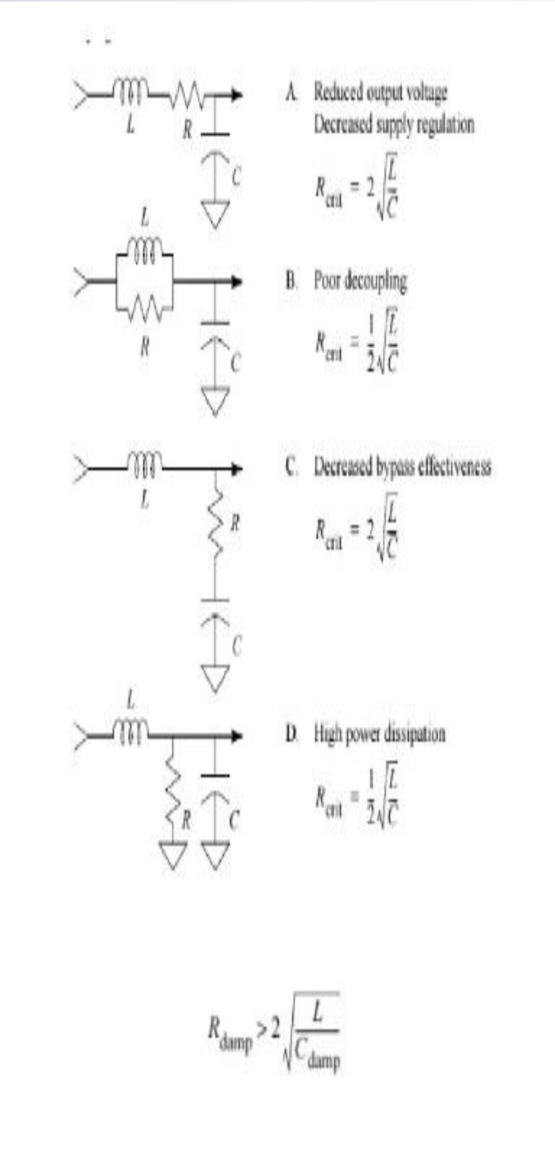
Reducing inductance is crucial for mitigating noise voltage. Techniques include enhancing regulator bandwidth or decreasing open-loop output impedance, though these may require custom designs. Increasing mutual coupling between power paths can offset induced voltages, reducing effective inductance.

**DECOUPLING:**

Decoupling is vital for isolating circuits from interference, achieved by minimizing shared supply traces or employing high-impedance elements in series. This complements bypassing and acts as a low-pass filter, enhancing regulator stability.

**DAMPING:**

The more seasoned individuals among us may recognize that challenges exist within this seemingly perfect scenario.

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# Predictive and Diagnostic Techniques in Breast Cancer Utilizing Machine Learning Algorithms.

**R. JASMINE**

**III Year EEE**

**E.G.S. Pillay Engineering College, Nagapattinam**

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## ABSTRACT

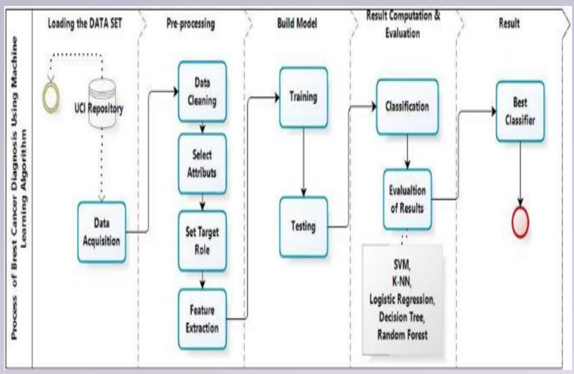
*Breast cancer remains a significant global health concern, with a rising number of deaths each year. It ranks as the most common cancer and the leading cause of death among women worldwide. Therefore, advancements in cancer prediction and diagnosis are crucial for improving patient outcomes and survival rates. Machine learning techniques have emerged as valuable tools in this endeavour, offering the potential for high-accuracy prediction and early detection of breast cancer. In this study, we applied five machine learning algorithms—Support Vector Machine (SVM), Random Forest, Logistic Regression, Decision Tree (C4.5), and K-Nearest Neighbours (KNN)—to the Breast Cancer Wisconsin Diagnostic dataset. Following the analysis, we conducted a performance evaluation and comparison of these classifiers. The primary goal of this research was to predict and diagnose breast cancer using machine learning algorithms and identify the most effective approach based on the confusion matrix, accuracy, and precision metrics. Our findings indicate that Support Vector Machine exhibited superior performance compared to the other classifiers, achieving the highest accuracy (97.2%).*

## INTRODUCTION

Breast cancer has surpassed lung cancer as the most prevalent cancer among women globally, with statistics from the International Agency for Research on Cancer (IARC) indicating a significant rise in cancer diagnoses over the past two decades. The number of cancer cases has nearly doubled from approximately 10 million in 2000 to 19.3 million in 2020, with projections suggesting a further 50% increase by 2040. Cancer-related deaths have also risen, reaching 10 million in 2020, accounting for more than one in six deaths worldwide. This underscores the urgent need for increased investment in cancer prevention and treatment. The integration of information and communication technologies (ICT) in medical practice, particularly in cancer care, is crucial for enhancing healthcare systems. Big data has played a transformative role in healthcare by enabling the analysis of vast amounts of complex data, aiding in decision-making, and ultimately improving patient care quality while reducing costs. Data mining algorithms, particularly those focused on classification and prediction, are instrumental in diagnosing diseases such as breast cancer. This paper compares the performance of five prominent classifiers—Support Vector Machine (SVM), Random Forest, Logistic Regression, Decision Tree (C4.5), and K-Nearest Neighbours (KNN)—in predicting and diagnosing breast cancer. The objective is to identify the most effective classifier based on metrics like confusion matrix, accuracy, precision, and sensitivity.

## METHODOLOGY

Our experiment aims to determine the most effective algorithm for breast cancer detection. We applied machine learning classifiers—Support Vector Machine (SVM), Random Forests, Logistic Regression, Decision Tree (C4.5), and K-Nearest Neighbours (KNN)—to the Breast Cancer Wisconsin Diagnostic dataset. We evaluated the results to identify the model with the highest accuracy. The proposed architecture is illustrated in Figure 1.




This methodology initiates with data acquisition, followed by pre-processing, which includes four steps: data cleaning, attribute selection, defining target roles, and feature extraction. The prepared data is utilized to construct machine learning algorithms for predicting breast cancer based on new measurements. To evaluate algorithm performance, we employ a train-test split method, where 75% of the labelled data is utilized for training the model and 25% for testing. After testing the models, we compare the results to identify the algorithm with the highest accuracy, thus determining the most predictive algorithm for breast cancer detection.

**MACHINE LEARNING ALGORITHMS:**

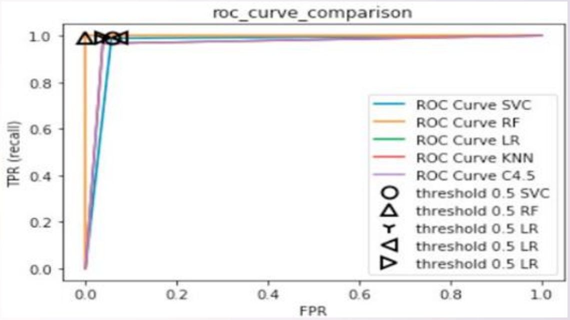
Machine Learning algorithms encompass various techniques for classification and regression tasks. Support Vector Machine (SVM) aims to find a hyperplane that best separates classes, Random Forests aggregates decision trees to mitigate overfitting, k-Nearest Neighbours (K-NN) assigns labels based on proximity to labelled points, and Logistic Regression estimates the probability of an outcome. Decision Tree C4.5 splits data based on conditions for predictive modelling. These methods offer diverse approaches for tackling different machine learning challenges.

**DATA ACQUISITION**

In our research, we utilize the Breast Cancer Wisconsin Diagnostic dataset sourced from the University of Wisconsin Hospitals Madison Breast Cancer Database. This dataset comprises features extracted from digitized images of breast cancer samples obtained through fine-needle aspiration (FNA). The attributes of the cell nuclei depicted in the images are derived from these features. The Breast Cancer Wisconsin Diagnostic dataset contains 569 instances, with 357 classified as benign and 212 as malignant, resulting in 2 classes (62.74% benign and 37.26% malignant). It encompasses 11 attributes represented as integers, including -Id, -Diagnosis, -Radius, -Texture, -Area, -Perimeter, -Smoothness, -Compactness, -Concavity, -Concave points, -Symmetry, and -Fractal dimension.

**CONCLUSION:**

Throughout this paper, all experiments involving machine learning algorithms were carried out utilizing the Scikit-learn library in conjunction with the Python programming language. Scikit-learn, also referred to as sklearn, is an open-source machine learning library tailored for Python. It encompasses a wide array of algorithms for classification, regression, and clustering tasks, such as support vector machines, random forests, gradient boosting, k-means, and DBSCAN. Notably, Scikit-learn is engineered to seamlessly integrate with popular Python numerical and scientific libraries like NumPy and SciPy.

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**Student Article (External)**

# COMPARISON OF PI AND PR CONTROLLER'S PERFORMANCE FOR THREE-PHASE GRID-CONNECTED VOLTAGE SOURCE INVERTER USING LCL FILTER

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**ABSTRACT**

*This paper presents analyzed performance comparison between PI and PR controllers for a three-phase grid-connected voltage source inverter using an LCL filter. In the comparison of both controllers, the PR controller shows superior performance than the PI controller, the modified PR controller involves the voltage and current controller this controller improves the transient response, and stabilize the disturbances effectively than the PI controller, but in case of unbalanced and balanced conditions each controller reduces the harmonic contents of the AC, improves the power factor of a system and the system performance. The theoretical verification and simulation validation of the proposed design guidelines are done to approve its effectiveness and robustness.*

***Keywords***
***Voltage source inverter, PI and PR controller, Grid connected system, PLL, LCL filter.***

## INTRODUCTION

The first electronics revolution began in 1948 when Bardeen, Britain, and Schockley invented the silicon transistor at Bell Telephone Laboratories. The invention is responsible for the majority of today's advanced electronic technology, and modern microelectronics has evolved from silicon semiconductors.

The purpose of this paper is to compare the PI controller's operation to that of its stationary reference frame equivalent, the proportional-resonant (PR) controller [1]. This approach, however, suffers from a wide range of switching frequencies and huge current ripples. In this study, a quasiproportional-resonant (Quasi-PR) current controller is devised for the CGCI. The models and parameter selection are thoroughly investigated. The Quasi-PR controller, unlike the proportional-integration (PI) current controller, decreases steady-state error [2]. In terms of steady-state magnitude and phase errors, PI control has limits. In addition, unlike PR control, PI control has limited harmonic rejection capabilities and can correct for low-order. Harmonics. Higher harmonic distortion of the output current and voltage performance is caused by imperfections in the current and voltage control scheme. PR control parameters (Kp, Ki, and! c) and filter parameters (Lf and Cf) are optimally tuned to achieve a very low current THD with reduced output voltage ripple and steady-state Error [3].

PI and PR controllers, the voltage feedforward effect is taken into account. The feed-forward effect is eliminated, and PR gains are fine-tuned to maintain dynamic performance. To retain the system's dynamic performance, the power feedforward is removed and the outer loop PI controller is tweaked [4]. Even though a proportional-integral (PI) controller is frequently utilized in classic rectifiers, poor sinusoidal input current monitoring is unavoidable. To attain a high gain, a proportional-resonant (PR) controller resonates at the fundamental frequency of input current, which can increase rectifier tracking performance [5]

## PROPOSED METHOD

## DESIGN OF PLL (PHASE LOCKED LOOP) AND LCL FILTER FOR 3-PHASE GRID-CONNECTED INVERTER

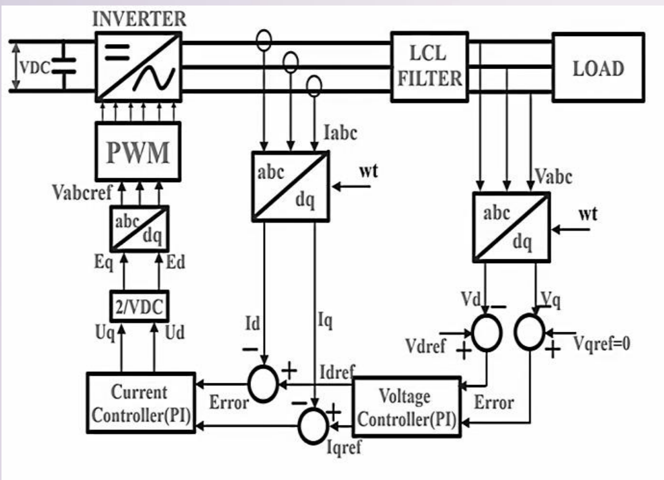



Figure 1. Block diagram of the proposed method.

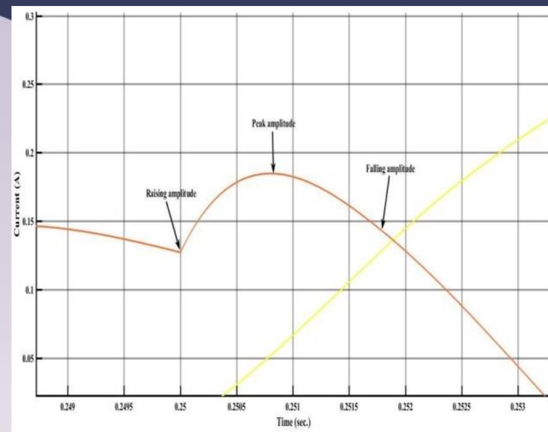
## SIMULATION AND RESULTS

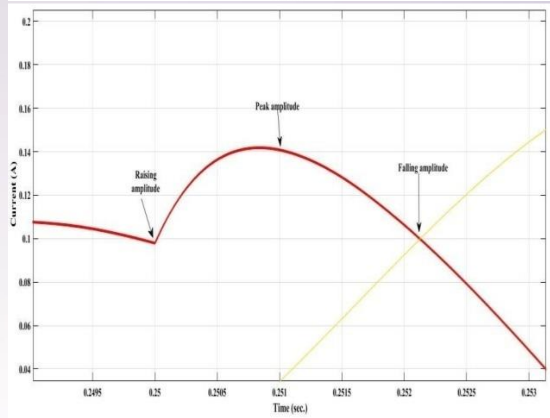
Table 1. System Parameters

| Parameters | Values |
|---|---|
| Dc voltage source | 500v |
| Resistance | 20e-3 |
| Inductance | 500e-6 |
| Capacitance | 100e-6 |
| Frequency | 50hz |
| Switching frequency | 10khz |
| Voltage controller values | $K_p = 0.1$, $K_i = 100$ |
| Current controller values | $K_p = 30$, $K_i = 300$ |

## LOAD ANALYSIS

Table 2. Transient Analysis




## CONCLUSION

This paper presents a comparison of PI and PR controllers for a grid-connected three-phase voltage source inverter using lcl filter, simulation results show that a PR controller is better than a PI controller. The comparison of both controllers in terms of load analysis, PR controller has good dynamic response compared to the PI controller due to integral term used in PR controller, and extra feedback signal in PR controller it controls the nature of the transient and steady-state error, stabilizes the disturbances fastly than PI controller and also reduces the harmonic content in case of a balanced and unbalanced load.

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# MAXIMIZING RENEWABLE ENERGY INTEGRATION: A HYBRID ENERGY STORAGE APPROACH FOR REGIONAL INTEGRATED ENERGY SYSTEMS

**Yulia Danilova**

**Volgograd State Technical University, Russia**

**Abstract:**

*Integrated energy systems (IES) are crucial for optimizing renewable energy utilization. This paper proposes a hybrid energy storage approach, combining pumped hydro storage (PHS) with battery energy storage (BES) within regionally integrated energy systems (RIES) with wind and solar power generation. The proposed method employs a two-layer optimization model to minimize total annual costs and daily operating costs. Case studies validate the effectiveness of the proposed model, demonstrating reduced system costs compared to single PHS or BES systems.*

***Keywords**: Integrated Energy System, Renewable Energy Integration, Energy Storage, Pumped Hydro Storage, Battery Energy Storage, Hybrid Energy Storage.*

## INTRODUCTION:

With the global focus on carbon neutrality and sustainable energy solutions, integrated energy systems (IES) have garnered significant attention for their potential to optimize renewable energy utilization. The seamless integration of various energy sources and storage technologies is crucial for enhancing supply stability and economic efficiency in energy systems. However, the inherent volatility and intermittency of renewable energy sources pose challenges to the reliability and stability of such systems. Addressing these challenges requires the effective coordination of adjustable resources within IES frameworks.

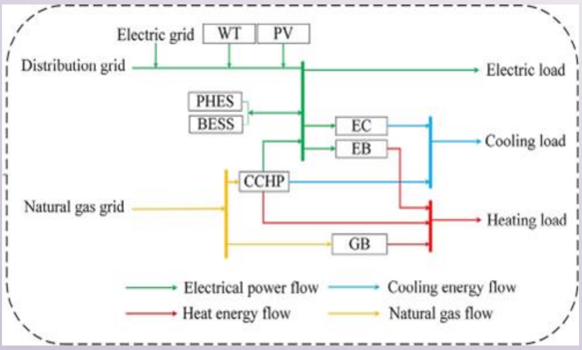


**Fig.1.**Structure diagram for the regional integrated energy system

## Energy Storage Technologies in Integrated Energy Systems:

Energy-storage devices play a pivotal role in mitigating the intermittency of renewable energy sources and enhancing the overall stability of integrated energy systems. These technologies can be broadly categorized into energy- and power-type storage, each with its unique characteristics and applications. Energy-type storage includes batteries, pumped hydro storage (PHS), and compressed-air energy storage, while power-type storage encompasses technologies like flywheels, supercapacitors, and superconducting-energy storage. While PHS remains a prominent choice for large-scale energy storage, emerging technologies such as lithium-ion batteries and compressed air are gaining momentum. However, challenges related to cost, energy density, and scalability hinder the widespread adoption of newer storage technologies.

## Optimization of Integrated Energy Systems:

Research efforts have focused on optimizing the operation of integrated energy systems, with particular emphasis on the coordination between different energy-storage devices. Hybrid energy storage systems, combining PHS with battery energy storage (BES), have attracted considerable attention due to their complementary characteristics. This paper proposes a novel hybrid energy storage structure for regionally integrated energy systems (RIES) incorporating wind and solar power generation. The proposed method employs a two-layer optimization model for planning and operation, aiming to minimize total annual costs and daily operating costs. Case studies demonstrate the efficacy of the proposed model, showcasing reduced system costs compared to single PHS or BES systems.

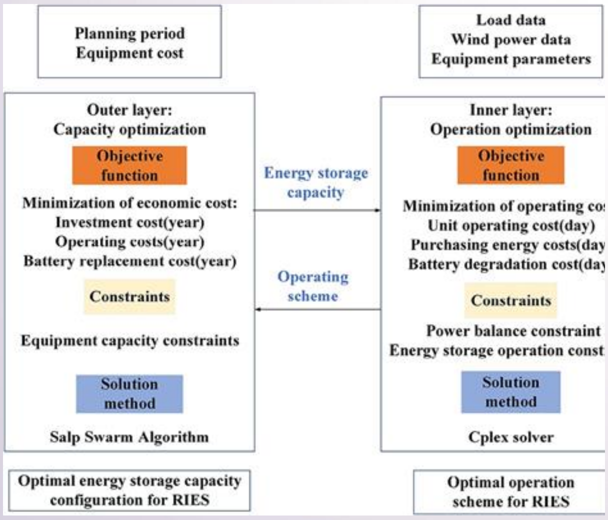


Fig.2.Programming of configuration-optimization

## Conclusion:

The integration of different energy-storage devices in integrated energy systems offers significant potential to enhance renewable energy integration, improve economic benefits, and optimize generation-load storage coordination. Hybrid energy storage systems, particularly combining PHS with BES, show promise in maximizing the synergistic benefits of different storage technologies. Continued research and development efforts are essential to address challenges and advance the adoption of hybrid energy storage solutions in regional integrated energy systems.

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# DEVELOPMENT OF IMPLANTABLE DEVICES; FROM AN ENGINEERING PRESPECTIVE

**R. NAVEEN RAJ**

**Volgograd State Medical University, Russia**

## Abstract:

*This paper explores the evolution of pacemakers from their early beginnings to their modern-day iterations, focusing on the technical advancements that have shaped their design and functionality. We delve into the challenges faced by early pacemakers, such as issues with battery encapsulation and lead materials, and how these challenges were addressed through innovations in materials science and semiconductor technology. Furthermore, we discuss the transition from epoxy resin encapsulation to titanium housings, highlighting the improvements in durability and biocompatibility. Finally, we compare the surgical procedures involved in implanting early pacemakers versus modern ones, emphasizing the strides made in reducing invasiveness and recovery times*

### Introduction:

Pacemakers have undergone significant technological advancements since their inception, driven by the need for more reliable and efficient cardiac rhythm management devices. This paper examines the engineering considerations that have shaped the development of pacemakers, from early challenges to modern solutions.


Fig.1. Implantable blood pressure sensor. (A) Surgically im- planted blood pressure sensor with a cuff-type design. The sensor is installed on the blood vessel directly. (B) Cardiomems im- plantable blood pressure sensor.

### Early Challenges:

Early pacemakers faced several challenges, including issues with battery encapsulation and lead materials. Epoxy resin encapsulation was initially used to protect electronic circuits and batteries; however, it proved susceptible to swelling and dissolution within the body. Additionally, stainless steel leads posed problems such as fracture rates and corrosion.

### Technological Innovations:

Advancements in materials science and semiconductor technology have revolutionized pacemaker design. The transition from epoxy resin to titanium housings has significantly improved durability and biocompatibility, addressing concerns about body fluid penetration and tissue invasion. Furthermore, the development of smaller, lighter electronic components has enabled the creation of more compact and efficient pacemakers.

## Modern Solutions:

Modern pacemakers boast streamlined surgical procedures and enhanced performance. Implantation procedures have become less invasive, with smaller electrodes and shorter operation times. Titanium housings offer superior mechanical hardness and corrosion resistance, ensuring long-term reliability. Additionally, advancements in battery technology have extended device longevity while reducing the risk of complications.

## Electrical System Integration and Performance:

Implantable medical devices rely heavily on their electrical systems for functionality. These systems must be carefully integrated into the device to ensure optimal performance and safety. One crucial consideration is the electrical connections between the device's components. These connections must be robust and reliable to withstand the rigors of the body's internal environment.

Furthermore, the electrical components themselves must be carefully selected and designed to meet the specific requirements of the device. This includes choosing components with low power consumption to prolong battery life and minimize the need for frequent replacements. Additionally, advancements in semiconductor technology have enabled the development of smaller and more efficient electronic components, allowing for the creation of more compact and lightweight devices.

## Battery Technology and Power Management:

The development of long-lasting and reliable battery technology is essential for implantable medical devices. Early devices utilized nickel-cadmium batteries, which, although effective, had limitations in terms of size and capacity. However, the introduction of lithium-iodine batteries by Greatbatch and Holmes in 1973 revolutionized the field by offering improved characteristics such as longer lifetime, lower current drain, and more stable voltage output.

Today, implantable medical devices utilize advanced battery technologies to power their electrical systems. These batteries must be carefully selected and integrated into the device to ensure optimal performance and longevity. Additionally, efficient power management systems are employed to maximize battery life and ensure continuous operation of the device.

## Materials Selection and Encapsulation:

The materials used in the construction of implantable medical devices play a critical role in their performance and longevity. Biocompatibility is of utmost importance, as the device must interact harmoniously with the body's internal environment to prevent adverse reactions or rejection. Materials such as titanium, noble metals, biograde stainless steels, and biocompatible polymers have been extensively utilized for their compatibility with biological tissues.

Moreover, the encapsulation of electronic components is essential to protect them from bodily fluids and tissue invasion. Early devices utilized epoxy resin for encapsulation, but concerns regarding swelling and dissolution led to the adoption of ceramics and titanium for enhanced durability and biocompatibility. Laser welding techniques are employed for sealing the encapsulation, ensuring a hermetic barrier between the electronic components and the body's internal environment.

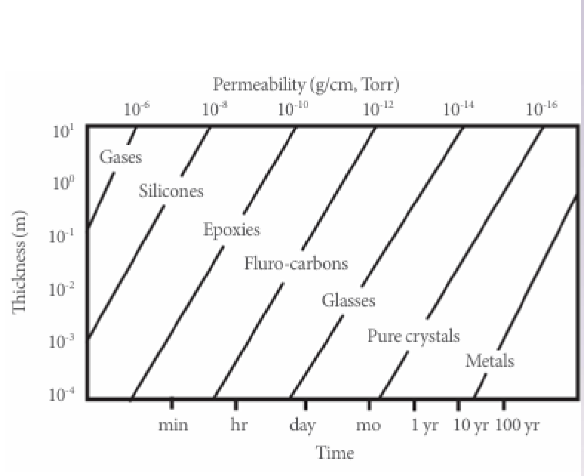


Fig.2.Material-dependent permeability. The graph shows also permeability as a function of thickness.

## Surgical Techniques and Patient Experience:

Advancements in surgical techniques have also played a significant role in the evolution of implantable medical devices. Early procedures involved invasive open-heart surgeries with lengthy recovery times. However, modern techniques allow for minimally invasive procedures with shorter recovery times and improved patient outcomes. For example, pacemaker implantation procedures now typically take only 1 to 2 hours, with patients able to resume their normal activities shortly after surgery.

Additionally, the design of implantable medical devices has evolved to prioritize patient comfort and convenience. Smaller, lighter devices reduce the need for invasive surgeries and allow for easier implantation and removal. Flexible platinum lead coils ensure secure placement and minimize the risk of complications such as dislodgement or fracture.

## Conclusion:

In conclusion, the development of implantable medical devices has been driven by a combination of engineering innovation, technological advancements, and a deep understanding of the complex interactions between the device and the human body. By addressing key considerations such as biocompatibility, electrical system integration, materials selection, and surgical techniques, researchers and engineers continue to push the boundaries of what is possible, ultimately improving the quality of life for patients worldwide.

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# ADVANCED LPG DETECTION SYSTEM


**S. Vishalini EEE**

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## ABSTRACT

*This project introduces an innovative system designed to detect LPG gas leaks and enhance safety through automated features. By combining advanced gas sensor technology with automated valve control, the system aims to mitigate hazards associated with gas leaks. It provides timely detection of leaks and triggers automated responses such as buzzer alerts, activation of gas exhaust mechanisms, and automatic control of cylinder valves. This proactive approach improves safety in environments where LPG is used for cooking, heating, or industrial purposes. The system ensures real-time monitoring, prevention of hazards, and enhanced safety through its integration of gas sensor technology and automated safety measures.*

## INTRODUCTION

Liquefied Petroleum Gas (LPG) is widely used for cooking, heating, and industrial purposes due to its efficiency and convenience. However, the inherent risks of gas leaks leading to explosions or fires highlight the critical need for effective safety measures. This project introduces an innovative approach to address these concerns through an integrated LPG gas detection system with automated safety features. By utilizing advanced sensor technology and automated valve control, the system ensures continuous monitoring, timely leak detection, and swift response to mitigate risks. Ultimately, it enhances safety across residential, commercial, and industrial settings where LPG is employed by activating buzzers, initiating exhaust fans for ventilation, and automatically stopping the regulator in case of a leak.

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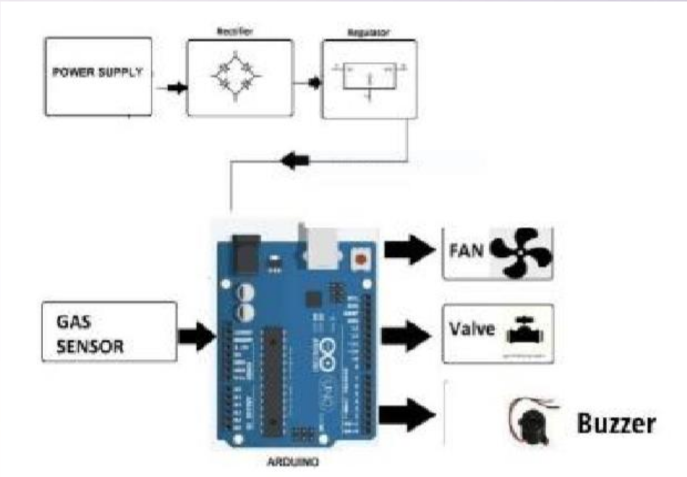
## BLOCK DIAGRAM




## HARDWARE COMPONENT

Gas sensors: Gas sensors capable of detecting LPG leaks, such as MQ series gas sensors (e.g., MQ-5 or MQ-6). These sensors detect changes in gas concentration and provide analog or digital output signals.

## MICROCONTROLLER UNIT (MCU)

A microcontroller unit to process sensor data, control system operation, and execute safety algorithms. Commonly used MCUs include Arduino boards (e.g., Arduino Uno or Arduino Mega) or microcontroller chips like PIC or STM32.

**BUZZER**

An audible buzzer or alarm to provide an alert when a gas leak is detected.

**EXHAUST FAN**

A fan or exhaust mechanism to ventilate the area and disperse leaked gas. SOLENOID VALVE: A solenoid valve connected to the LPG cylinder valve for automated shut-off in case of a gas leak.

**SERVO MOTOR**

Used to automate gas valve closure upon detecting leaks, enhancing safety

By integrating these hardware components effectively, the LPG gas detection system can accurately detect gas leaks, provide timely alerts, and implement automated safety measures to mitigate potential hazards.

**BENEFITS**

- The main benefit is the reduction of risks when humans are not present.
- Automated detection and response to LPG gas leaks help prevent accidents, minimizing potential harm without the need for human intervention.

**APPLICATION**

- Residential Setting
- Commercial Establishment
- Industrial Facilities
- Educational Institutions

**REFERENCE**

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2.“A Review on Gas Leakage Detection and Monitoring *Systems” by M. Vijayarani and R. Suresh*

## DISCOVERY ZONE

- **Francis Ronalds is the first electrical engineer.**

- The biggest power plant in the world is the Three Gorges Dam, China. In 2021, it generated 103.649 billion kWh. It also has the largest installed


- Windmills dates back to ancient Persia around 700-900 AD.


- The largest wind turbine in the world is in Denmark. It is 720 feet tall, has 260-foot blades, and can generate8 megawatts of power (enough to supply electricity for 3,000 American homes)

- One Google search produces about 0.2 g of CO2. But since you hardly get an answer from one search, atypical search session produces about the same amount of CO2 as does boiling a tea kettle. Google Handles about 1 billion search queries per day, releasing some200tons

SPOTLIGHT


1. **Arun kumar. from final year won gold medal in 55kg best physique competition and overall championship**
2. **Aakash.S and Vijay.T from, third year attended 15 days internship at IPRC, Mahendragiri**

- **5 students from second year attended 5-day workshop on Artificial Intelligence and Machine Learning Techniques for Engineering Application at NITPY**
- **Jasmine. R from third year attended 15 days internship at GAIL -Karaikal.**
- **Industrial visit to uttamacholapuram TNEB substation**

# EDITORIAL BOARD