Technical Magazine

Sparkling Innovation

Where Electrical Engineering meets imagination

Pragya

state of wisdom

Department of Electrical & Electronics Engineering

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY AND SCIENCE

Vol. 2 Issue: I, January' 2022

Contents

PRINCIPAL'S MESSAGE

Dr. K . Ramesh Reddy

It is with great pleasure that I extend a warm welcome to you all to the latest edition of our esteemed electrical engineering technical magazine. As we peruse through its pages, we embark on a journey of discovery, innovation, and collaboration that defines the essence of our department.

At the heart of our electrical engineering department lies a steadfast commitment to academic excellence, research prowess, and the relentless pursuit of innovation. This magazine stands as a testament to the remarkable achievements and groundbreaking contributions made by our faculty, students, and researchers.

I wish that this Trigger establishes to be a flint to fire the enthusiasm and excite their minds for many intrusive innovations among the students and inspire passion among the members of the faculty of Electrical and Electronics committee.

As you delve into the pages of this magazine, I encourage you to celebrate the accomplishments of our department, to be inspired by the groundbreaking research being conducted, and to envision the boundless possibilities that lie ahead. Together, let us continue to uphold the highest standards of excellence and to push the boundaries of what is possible in the field of electrical engineering.

I extend my heartfelt gratitude to all those who have contributed to the success of this magazine and commend the editorial team for their dedication and hard work in bringing this publication to fruition.

MESSAGE FROM HEAD OF THE DEPARTMENT

Dr. N. Malla Reddy

Dear Esteemed Readers,

It brings me great pleasure to welcome you to the latest edition of our electrical engineering technical magazine. As we delve into the pages of this publication, we embark on a journey of discovery, innovation, and excellence within our department.

It's with great pleasure that I introduce you to the latest issue of Pragya! As Head of the Electrical and Electronics Engineering department, I'm constantly impressed by the dedication and expertise of our team. But knowledge thrives on exchange, and that's precisely what Pragya facilitates.

This magazine serves as a bridge, connecting the cutting-edge advancements in our field with the passionate minds that drive those advancements forward. Whether you're a seasoned professional or just starting your journey, Pragya offers something for everyone.

In this issue, you'll find insightful technical articles. We've assembled a fantastic roster of contributors, including leading figures from within our own department. Their diverse perspectives ensure the content is both informative and thought-provoking.

This technical magazine isn't just about staying informed; it's about fostering a community of innovation. We encourage you to actively engage with the magazine. So, turn the page, explore the articles, and let your passion for Electrical Engineering ignite!

Warm Regards.

Highlights

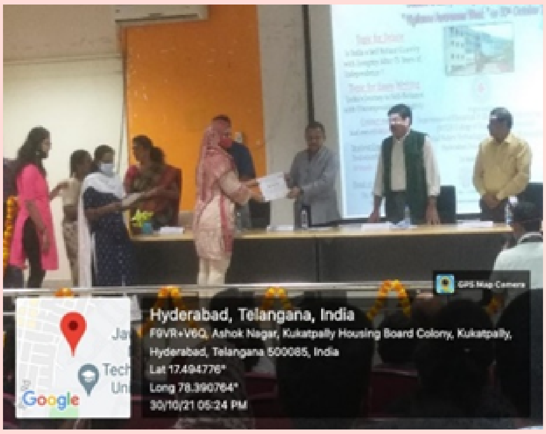
Three patents are granted for three faculty members in EEE department

- Mrs.G.Ujwala Asst. Prof., and Mrs.E.Gouthami Asst. Prof., have been granted a patent for the invention of fertilizer Usage Monitoring and Price Estimation System for Crops with patent no.202141038799 A on 10/9/21.

- Mrs.G.Ujwala Asst. Prof., and Mrs.E.Gouthami Asst. Prof., have been granted a patent for the invention of IOT based smart energy theft detection and Power Monitoring system for smart homes with patent no.202141035598A on 13/8/21.

- Mrs. K. Swarna Latha, Asst. Prof., has been granted a patent for the invention of An AI based EV battery charging controller with enhanced battery management with patent no.202141050407 on 19/11/21.
- Career guidance seminar was conducted on 15/12/21.

- Ms. Amtul Husna, of IV B.Tech won first prize in debate competition on 'Is India a self Reliant Country with Integrity After 75 Years of Independence ?' as a part of Vigilance Awareness Week 2021 conducted by the Department of Electrical & Electronics Engineering JNTUHCEH in association with Power Grid Corporation of India limited.



- Dr.T.Surya Prakash, Asst. Prof., has published a paper on 'Machine Learning-Based Predictive Techno-Economic Analysis of Power System' in IEEE.

- Mrs. S. Bhulakshmi, Asst. Prof., has published a paper on 'Implementation of the modular multilevel converter and cascaded H- bridge multilevel inverter using SPWM' in TOJQI.

- Mrs. K. Swarnalatha, Asst. Prof., has published a paper on 'Optimum placing and sizing of renewable energy sources using QPSO for distributed generation system' in The international journal of Analytical and Experimental Modal analysis and published a paper on 'A 6-switched three –level Inverter based smart grid hybrid power system for power management using zigbee in Journal of Interdisciplinary cycle research.

- Mrs. P. Tejaswi, Asst. Prof., has published a paper on 'Reconfigurable Solar Converter with PQ and ES Controllers for DC and AC loads' in High Technology Letters.

- Mr.V.Badri Ramakrishnan has published a paper on 'An Intelligent Controller For Solar Pv And Battery Fed Electrical Vehicle Charging Station' in Journal of Engineering Sciences.

- Mrs. G.Sujatha, Asst.Prof., has published a paper on ‘Modelling and Design of an Electric Vehicle Fed with Dual Drive Motors using Hybrid Energy Storage System’ in International Journal of Innovative Technology and Exploring Engineering (IJITEE).

- Mrs. K. V. Sowmya, Asst. Prof., has published a paper on ‘Optimum placing and sizing of renewable energy sources using QPSO for distributed generation system’, in The international journal of Analytical and Experimental Modal analysis and published a paper on ‘A 6- switched three –level Inverter based smart grid hybrid power system for power management using zigbee’ in Journal of Interdisciplinary cycle research.

- Mr. P. Siva Prasad, Asst. prof., has been awarded with Best Young Researcher by Novel Research Academy, Puducherry on 5/9/21.

- Dr. T.Surya Prakash, Dr.B.Ravichandra Rao, Mrs. B. Narmada Reddi have undergone Industrial Training program on‘Design, Installation and Maintenance of Solar PV Systems and Grid Integration’ at PV Power Plant, AB REL, SPV1Ltd., Rayachoti, A.P during 4/8/21-16/8/21.

- Mrs. E. Gouthami, Asst. Prof., has attended a webinar on ‘Emerging Technologies in Electric Vehicles’ conducted during 2/8/21-14/8/21, MATLAB Onramp course’ during 1/8/21-22/8/21, ‘Sutainable Technologies for Electric Transportation System’ during 14/6/21-26/6/21, ‘Current Trends in Research & Innovation Research Paper Publications- IPR and Patents- Research Projects & Fundraising’ during 27/8/21-31/8/21.

- Mr. P. Buchibabu, Asst. Prof., has attended a workshop on ‘Synergizing Higher Education in the context of NEP:2020: Strategies for Implementation’ during 22/12/21-23/12/21.

- Mrs.P. Tejaswi, Asst. Prof., has attended a workshop on ‘Synergizing higher education in the context of NEP-2020: Strategies for Implementation’ during 22/12/21-23/12/21,v, webinar on Artificial Intelligence and Machine learning: Real time applications’ during 20/9/21-30/9/21 and also completed module 1,2&4 of NITTT’.

- Mrs. K. V. Dhanalakshmi, Asst. Prof., has attended an online FDP on Current Trends in Research and Innovation- Research paper publications- IPR and Patents Research projects and fundraising’ during 27/8/21-31/8/21.

- Mrs.P. V. S. S. A. Parimala, Asst.Prof., has attended a workshop on ‘Synergizing Higher Education in the context of NEP:2020: Strategies for Implementation’ during 22/12/21-23/12/21

Technical Association of Electrical & Electronics Department (TEJASS)

Faculty Coordinator:
V. Badri Rama Krishnan, Asst. Prof. & P. Mamta, Asst. Prof.
President: N. Sai Samhitha IV B
Vice President: V. Sneha Reddy IV B & K. R. Sindhuja IV A

Technical & Non-Technical Events

A Technical paper presentation for B.Tech students was conducted on 7/1/21 and 8/1/21

1.**Paper Presentation was conducted on 1/05/2021and 3/05/21**

I Prize : Ms.Sai Nikitha, IV EEE

II Prize : Ms. Amtul Husna, IV EEE

III Prize : Ms. Sai Samhitha , IV EEE

I Prize : Ms. K. Rinny, IV EEE

II Prize : Ms. Godha , IV EEE

III Prize : Ms. D.Kavya Reddy, IV EEE

2. JAM was conducted on 20/11/21

I Prize :Ms. Keerthana, III EEE

II Prize : Ms. Priya, III EEE

III Prize :,Ms. Priyanka, III EEE

3. **Technical paper presentation was conducted on 7/1/21 and 8/1/21**

I Prize : Ms. A Lasya Priya & Ms. N Vaishnavi, III EEE

II Prize : Ms. B. Raja Rajeshwari, III EEE

III Prize : Ms. N. Sreeja Reddy & Ms. A Chinmayee III EEE

4. **Logo Design for TEJASS**

I prize: Ms. D. Architha, III EEE

- Ms. Md. Anjum Tabassum, Ms. J. Meghana, Ms. Ch. Anjani, Ms. K. Sravya, Ms. M. Sri Harshini Reddy, Ms. N. Adhithi Sai have undergone an internship in Wipro.
- Ms. Godha Naravara, Ms. V. Kavya, Ms. J. Sri Vidya, Ms. Y. Vasanthi, Ms. G. Sakshika Reddy, Ms. B. Sai Sandhiptha, Ms. B. Harika, Ms. J. Greeshma, Ms. T. Bhoomika, Ms. D. Kavya Sri, Ms. I. Lakshmidevi, Ms. J. Navya, Ms. N. Ramya, Ms. S. Umamaheshwari, Ms. Shaik Reshma have undergone an internship in Cognizant.
- Ms. Ch. Kankalatha has undergone internship in JPMORGAN.
- Ms. C. Archana has undergone internship in Persistent.
- Ms. Y. Sri Koumudhi has undergone internship in Telstra.
- Ms. P. Kavya, Ms. S. Jyostna have undergone internship in DXC.
- Ms. P. Gayatri has undergone internship in Nuclear Fuel Complex.
- Ms. D. Sindhusritha has undergone internship in IBM.
- Ms. B. Kavya Madhuri has undergone internship in ACS Solutions.
- Ms. P. Laksmi Chandana, Ms. Samrin Sulthana have undergone an internship in Mind tree.
- Ms. S. Lasyasri has undergone internship in Colruyt.
- Ms. M. Sneha, Ms. L. Vineetha, Ms M. Likitha have undergone an internship in State street.
- Ms. E. Sai Nikitha, Ms. Y. Yashasvini have undergone an internship in Harman Connected Service.
- Ms. T. Naga Jyothi has undergone internship in Kaptius.
- Ms. A. Manisha, Ms. K. Malleshwari have undergone an internship in Medtronic.
- Ms. D. Sindhu, Ms. K. Navya Sree, Ms. N. Sai Samhitha have undergone an internship in AT&T.
- Ms. B. Shailaja, Ms. D. Samyuktha have undergone an internship in Dupont.
- Ms. K. Akshatha, Ms. Sheema Firdous, Ms. C. Keerthana, Ms. Harshitha have undergone an internship in Deloitte.

Student Articles

Fault Detection in Underground Cables using Microcontroller

---MOCHARLA KUNDAN SHIVANI
19251A0236

Underground cables are a vital part of modern power distribution infrastructure. However, their location makes fault detection and identification a challenging task. Traditional methods involve physically excavating cable sections, which is time-consuming and expensive. This article explores employing a microcontroller-based system for efficient fault detection in underground cables. The paper discusses common fault types, the design principles of the system, and its implementation using a microcontroller.

Introduction

Underground cables offer numerous advantages over overhead lines, including improved reliability, reduced visual impact, and protection from adverse weather conditions. However, their buried nature presents a significant challenge when faults occur. Unlike overhead lines, visual inspection is not possible, and traditional fault identification methods rely on techniques like cable tracing and section-by-section excavation. These methods are labor-intensive, disrupt power supply, and damage surrounding infrastructure.

A microcontroller-based fault detection system offers a promising alternative. This system utilizes readily available components and can be designed to detect various fault types, including:

- Open circuit: This occurs when a conductor breaks, causing a complete interruption of current flow.
- Short circuit: This happens when two conductors come into contact, resulting in an abnormally high current flow.
- Ground fault: This occurs when a live conductor makes unintended contact with the ground, causing current leakage.

System Design

The core of the fault detection system is a microcontroller unit (MCU). The MCU is a programmable device that can acquire data from sensors, analyze it, and control various functionalities. The system typically comprises the following components:

- Current and Voltage Sensors: These sensors continuously monitor the current and voltage levels in the cable. Changes in these parameters can indicate potential faults.
- Potential Divider Network: This circuit configuration allows for safe and accurate voltage measurement across high-voltage cables.
- Analog-to-Digital Converter (ADC): This component converts the analog signals from the sensors into digital values that the microcontroller can understand.
- Microcontroller Unit (MCU): The MCU receives the digitized data from the ADC, analyzes it using pre-programmed algorithms, and identifies potential fault conditions.
- Communication Interface: This allows the system to transmit fault information to a user interface (UI) or a remote monitoring system. Options include LCD displays, cellular communication modules, or wired connections.

Microcontroller Programming

The microcontroller plays a critical role in the system. It is programmed with algorithms to:

- Continuously monitor the voltage and current readings from the sensors.
- Compare the readings with pre-defined thresholds for normal operation.
- Identify deviations outside the normal range, potentially indicating a fault.
- Analyze the specific deviation patterns to differentiate between different fault types (open circuit, short circuit, ground fault).
- Trigger alarms or notifications based on the detected fault type.

The programming language used depends on the specific microcontroller chosen. Popular options include C, C++, and assembly language. The code implementation should emphasize:

Data acquisition: Efficiently reading data from the ADC.
Thresholding: Setting appropriate voltage and current thresholds for fault detection.
Fault identification: Implementing algorithms to differentiate between fault types based on characteristic patterns in the readings.
Communication: Sending fault information through the chosen communication interface.
System Implementation
The actual implementation of the system involves:

1. Hardware Selection: Choosing appropriate sensors, potential divider network components, ADC, and a suitable microcontroller based on project requirements and budget.
2. Circuit Design: Creating a schematic diagram that connects all the components and ensures proper power supply and signal flow.
3. Microcontroller Programming: Developing the code to perform data acquisition, thresholding, fault identification, and communication tasks.
4. System Integration: Building the circuit on a Printed Circuit Board (PCB) or using a breadboard for prototyping.
5. Testing and Calibration: Thoroughly testing the system under various simulated fault conditions to ensure accurate detection and classification.

Benefits and Future Scope
A microcontroller-based fault detection system offers several advantages:

- Early Fault Detection: It can detect faults quickly, minimizing damage and downtime.
- Reduced Costs: It eliminates the need for extensive excavation and expedites repair processes.
- Improved Safety: Early detection minimizes safety risks associated with undetected faults.
- Remote Monitoring: Fault information can be transmitted for remote monitoring and analysis.

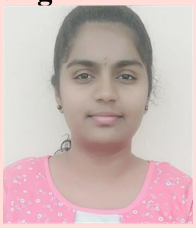
Future advancements in this field include:

- Fault Localization: Integrating techniques to determine the specific location of the fault along the cable length.
- Advanced Fault Analysis: Implementing more sophisticated algorithms to differentiate between complex fault scenarios.
- Wireless Communication: Utilizing wireless technologies for data transmission, enabling remote monitoring and control.

Conclusion
Microcontroller-based fault detection systems offer a cost-effective and efficient solution for identifying faults in underground cables. By employing readily available components and leveraging the power of microcontrollers.

Fault Diagnosis and Monitoring of Small Wind Turbines using IoT

---CHIRRA ANKITHA
20255A0204



The growing interest in renewable energy sources has led to a surge in the deployment of small wind turbines (SWTs). However, ensuring their optimal performance and timely fault detection requires efficient monitoring systems. This article explores the application of Internet of Things (IoT) technology for fault diagnosis and monitoring of SWTs. We discuss the challenges associated with traditional monitoring methods, the benefits of IoT-based systems, and the design considerations for such a system.
Introduction
SWTs are increasingly being used for residential and community-based power generation. These turbines offer numerous benefits, including lower environmental impact and reduced dependence on conventional energy sources. However, maintaining their optimal performance is crucial for maximizing energy production and ensuring long-term operation. Traditional monitoring methods for SWTs often rely on manual data collection or SCADA (Supervisory Control and Data Acquisition) systems. These methods have limitations:
Limited Data Acquisition: Manual data collection is infrequent and labor-intensive, potentially missing critical fault indicators. SCADA systems, while automated, can be expensive and complex to implement for individual SWTs

Delayed Fault Detection: Traditional methods might not detect faults promptly, leading to increased downtime and potential damage to the turbine components.
Limited Accessibility: Remotely located SWTs pose challenges for frequent physical inspections.
IoT for Smart Wind Turbine Monitoring

IoT technology offers a promising solution for overcoming the limitations of traditional monitoring methods. IoT systems leverage a network of interconnected devices equipped with sensors and actuators to collect, transmit, and analyze data. By integrating IoT with SWTs, we can create a smart monitoring system with several advantages:

Real-time Data Acquisition: Sensors continuously monitor critical parameters like wind speed, rotor speed, vibration, temperature, and power output. This data provides a comprehensive picture of the turbine's health.
Remote Monitoring and Diagnostics: The collected data can be transmitted wirelessly to a central server or cloud platform. This allows for remote monitoring of the turbine's performance and facilitates timely fault detection and diagnosis.
Predictive Maintenance: By analyzing historical data and identifying trends, the system can predict potential faults before they occur, enabling preventative maintenance strategies.
Improved Efficiency and Reliability: Real-time monitoring allows for optimizing turbine operation based on wind conditions, maximizing energy production and overall system efficiency.
Designing an IoT-based Monitoring System for SWTs

Developing an IoT-based monitoring system for SWTs involves several key considerations:

Sensor Selection: Choosing appropriate sensors to monitor vital parameters like wind speed, rotor speed, vibration, temperature, and current/voltage in the generator.
Data Acquisition Unit (DAU): Utilizing a microcontroller-based unit to collect data from the sensors and perform initial processing before transmission.
Communication Module: Selecting a reliable communication technology like cellular networks, LoRaWAN (Long Range Wide Area Network), or satellite communication to transmit data to the cloud platform.
Cloud Platform: Choosing a secure cloud platform for data storage, analysis, and visualization. The platform should offer functionalities for data dashboards, alarm generation, and historical data management.
Data Security: Implementing robust security measures to protect sensitive data from unauthorized access or cyberattacks.
Implementation and Future Scope

The implementation of an IoT-based monitoring system involves:

Hardware Selection: Choosing appropriate sensors, DAU, communication module, and cloud platform based on specific needs and budget considerations.
System Design and Integration: Designing the system architecture, integrating hardware components, and configuring the cloud platform.
Sensor Calibration and Deployment: Properly calibrating the sensors and installing them at designated locations on the SWT.
Software Development: Programming the DAU to collect data, perform basic processing, and transmit data to the cloud platform using the chosen communication protocol.
Data Analysis and Visualization: Developing tools on the cloud platform for data visualization, anomaly detection algorithms for fault diagnosis, and generation of alerts for critical conditions.
Future advancements in this field include:

Machine Learning and AI: Utilizing machine learning algorithms to identify complex fault patterns, predict potential failures, and optimize maintenance schedules.
Edge Computing: Performing data pre-processing and basic analytics on the DAU before sending data to the cloud, reducing bandwidth usage and enabling faster response times.
Integration with Smart Grids: Integrating the monitoring system with smart grids to optimize power generation and distribution based on real-time energy demands.
Conclusion

By leveraging IoT technology, we can create intelligent monitoring systems for SWTs. These systems enable real-time data acquisition, remote diagnostics, and predictive maintenance, leading to improved efficiency, reduced downtime, and extended turbine life. As technology advances, IoT-based monitoring systems will play a crucial role in ensuring the optimal performance and reliability of small wind turbines, contributing to a more sustainable and efficient future.

Implementation of G2V and V2G Technology in Microgrid

---AKKALA KEERTHANA
19251A0205

Microgrids, self-contained power systems, are gaining traction due to their ability to provide distributed and sustainable energy. Integrating Electric Vehicles (EVs) with microgrids using Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) technology unlocks significant advantages. This article explores the implementation of G2V and V2G functionalities in a microgrid, focusing on system components, control strategies, and the role of communication protocols.

Introduction

Microgrids operate independently or in grid-connected mode, integrating distributed energy resources like renewables (solar, wind), combined heat and power (CHP) units, and energy storage systems. EVs equipped with bi-directional chargers present a compelling opportunity to enhance microgrid functionality through G2V and V2G:

- Peak Shaving: During peak demand periods, EVs can inject power back into the grid (V2G), reducing reliance on external sources and minimizing grid stress.
- Improved Power Quality: Bi-directional power flow from EVs can contribute to voltage and frequency regulation, ensuring stable operation within the microgrid.
- Renewable Energy Integration: EVs act as mobile energy storage, facilitating the integration of intermittent renewable energy sources by absorbing excess power and discharging it during periods of low generation.
- Increased Grid Resilience: V2G capabilities improve overall grid resilience by providing backup power during outages, maintaining critical operations in the microgrid.

System Components for G2V/V2G Implementation

Implementing G2V and V2G in a microgrid requires careful consideration of several key components:

- Bi-directional DC-DC Converters: These interface EVs with the microgrid's DC bus, enabling bi-directional power flow for charging and discharging. Selection criteria include converter efficiency, power rating, and ability to handle varying DC voltages.
- Energy Storage Systems (ESS): The EV battery serves as the primary energy storage element. Battery models capturing charging/discharging efficiency, State of Charge (SOC), and power limitations are crucial for accurate system simulation.
- Microgrid Components: Models for renewable energy sources (solar panels, wind turbines), traditional generation units, and loads are incorporated to represent the complete microgrid ecosystem.
- Communication Infrastructure: A robust communication network is essential for real-time data exchange between the microgrid controller, EVs, and potentially the main grid. This facilitates control signal transmission, optimizing G2V and V2G operations. Common options include cellular networks, Power Line Communication (PLC), and dedicated wireless protocols.

Control Strategies for G2V/V2G

Effective control strategies are crucial for managing power flow between the grid, EVs, and other microgrid components:

- G2V Control: This strategy determines when to provide grid power for EV charging. Factors like grid availability, real-time energy prices, and EV owner preferences (charging time flexibility) are considered.

- V2G Control: This strategy decides when to discharge the EV battery and feed power back to the grid. It considers peak shaving needs, maximizing renewable energy utilization, while maintaining a minimum battery reserve to ensure EV mobility.

- Microgrid Controller: This central unit oversees the entire microgrid operation, including G2V/V2G control strategies. It optimizes power flow based on real-time data from various sources, ensuring grid stability and efficient energy utilization.

Communication Protocols for G2V/V2G

Standardized communication protocols are essential for seamless information exchange between components:

OpenADR (Open Automated Demand Response): This protocol enables communication between the microgrid controller and EVs, facilitating the exchange of control signals and energy pricing information for optimized charging/discharging decisions.
IEEE 2030.5 (Standard for Smart Grid Interoperability of Energy Resources): This standard promotes compatibility between various smart grid devices, including EVs, ensuring seamless data exchange within the microgrid.
ISO/IEC 15118 (V2G Communication Interface): This international standard defines the communication protocol specifically for V2G applications, focusing on safety, security, and interoperability between EVs and the grid.
Implementation Challenges and Considerations

While G2V/V2G offers significant benefits, some challenges need to be addressed:

Standardization: Ensuring consistent communication protocols across different EV models and charging infrastructure is crucial.
Grid Integration: Integrating large numbers of EVs into the grid requires careful planning and management to avoid overloading or instability.
Cybersecurity: Robust security measures are essential to protect the communication network and prevent unauthorized access to control systems.
Battery Degradation: Frequent charging/discharging cycles can impact battery health. V2G control strategies need to consider battery longevity.
Conclusion:
G2V and V2G technology, when implemented effectively in microgrids, presents a compelling solution for a more sustainable and resilient energy future. By integrating electric vehicles with bi-directional charging capabilities, microgrids can achieve several key benefits:

- Reduced reliance on external power sources: V2G allows EVs to inject power back into the grid during peak demand periods, alleviating stress on the main grid.
- Enhanced power quality: Bi-directional power flow from EVs contributes to voltage and frequency regulation, ensuring stable operation within the microgrid.
- Smoother integration of renewable energy: EVs act as mobile energy storage, facilitating the use of intermittent renewable sources by absorbing excess power and discharging it when needed.
- Improved grid resilience: V2G capabilities enhance overall grid resilience by providing backup power during outages, maintaining critical operations within the microgrid.

However, successful implementation requires careful consideration of various factors:

- Selection of appropriate bi-directional converters and communication protocols.
- Development of robust control strategies for G2V and V2G operations.
- Establishment of standardized communication infrastructure for seamless data exchange.
- Addressing challenges related to grid integration, cybersecurity, and battery degradation.

Despite these challenges, advancements in technology and ongoing research efforts hold significant promise for overcoming them. As G2V and V2G technology matures, its role in microgrids is poised to become increasingly crucial, paving the way for a more distributed, sustainable, and reliable energy landscape.

Design of Voltage Control for PV-Fed DC-DC Converter

---KYAMA MANASWINI
19251A0232

Photovoltaic (PV) systems are a rapidly growing renewable energy source. However, the output voltage of a PV panel varies depending on sunlight intensity and temperature. This necessitates the use of a DC-DC converter to regulate the voltage and provide a stable power output for various applications.

This report details the design and experimentation of a voltage control system for a PV-fed DC-DC converter. The report discusses different control techniques, the chosen design approach, and the experimental setup and results.

1. Introduction

PV systems are becoming increasingly popular due to their clean and sustainable energy generation. However, the output voltage of a PV panel is inherently variable, fluctuating with changes in sunlight intensity and temperature. This variability poses a challenge for integrating PV power into applications requiring a constant DC voltage.

DC-DC converters address this challenge by stepping up or down the voltage from a DC source. In a PV system, a DC-DC converter typically boosts the low voltage output of a PV panel to a higher voltage level suitable for battery charging, powering appliances, or grid connection. To ensure optimal system performance and compatibility with connected devices, the DC-DC converter requires a control system to regulate its output voltage.

2. Control Techniques for DC-DC Converters

Several control techniques can be employed to regulate the output voltage of a DC-DC converter. Here's an overview of commonly used methods:

- Open-Loop Control: This simple approach sets the duty cycle of the converter's switching element (e.g., MOSFET) to a fixed value. While easy to implement, it offers limited voltage regulation and is susceptible to variations in input voltage and load current.
- Pulse Width Modulation (PWM) Control: This widely used technique modulates the on-time (duty cycle) of the switching element based on the error between the desired output voltage and the actual measured value. This allows for dynamic adjustment and improved voltage regulation.
- Peak Current Mode Control (Peak CMC): This method regulates the peak current flowing through the inductor in the converter circuit. By controlling the peak current, the output voltage can be indirectly regulated. Peak CMC offers fast transient response and good line regulation.
- Average Current Mode Control (Avg CMC): This technique controls the average current flowing through the inductor. It provides good stability and simplifies control loop design compared to Peak CMC.

3. Chosen Design Approach

This project focuses on implementing a Pulse Width Modulation (PWM) control technique for the DC-DC converter. PWM control offers a good balance between complexity and performance, making it suitable for various applications.

The design involves the following key components:

- PV Panel: The DC voltage source representing the output of a real PV panel can be emulated using a programmable DC power supply.
- Boost Converter: A boost converter circuit will be designed to step up the emulated PV voltage to a desired higher level.
- Power Semiconductor Switch: A MOSFET will be used as the switching element within the boost converter circuit.
- Controller Circuit: A microcontroller unit (MCU) will be used to implement the PWM control algorithm. The MCU will measure the output voltage of the converter using an Analog-to-Digital Converter (ADC) and adjust the duty cycle of the MOSFET signal based on the difference between the measured voltage and the reference voltage (desired output voltage).
- Output Load: A variable resistor will be used to simulate different load conditions on the converter's output.

4. Experimental Setup

The experimentation will involve assembling the following:

- Building the boost converter circuit using the chosen components (MOSFET, inductor, diode, capacitor).
- Programming the MCU with the PWM control algorithm. The code will continuously read the output voltage via the ADC, compare it to the reference voltage, and adjust the duty cycle of the PWM signal driving the MOSFET.
- Connecting the emulated PV source (programmable DC power supply), boost converter circuit, and variable load resistor.
- Setting the desired output voltage and varying the input voltage (emulated PV voltage) and load current to observe the converter's voltage regulation performance.

5. Expected Results
The experimentation aims to achieve the following outcomes:
The DC-DC converter should maintain a stable output voltage despite variations in the input voltage (emulated PV voltage) within a specific operating range.
The output voltage should remain regulated even when the load current is adjusted using the variable resistor.
The measured output voltage should closely match the pre-defined reference voltage programmed into the MCU.
6. Conclusion
This report presented the design and planned experimentation for a voltage control system for a PV-fed DC-DC converter. By implementing PWM control using a microcontroller, the project aims to achieve stable and regulated output voltage despite variations in input voltage and load conditions.

- The inherent variability of PV panel output voltage necessitates the use of DC-DC converters for applications requiring a constant DC voltage.
- Pulse Width Modulation (PWM) control offers a practical approach for regulating the output voltage of a DC-DC converter.
- The designed system utilizes a microcontroller to implement the PWM control algorithm, dynamically adjusting the duty cycle of the switching element based on the measured output voltage.

IoT-based Energy Meter with Billing System and Load Privitization

---D TEJASWINI
19251A0220

Introduction
The conventional energy grid infrastructure faces challenges like inefficiency, rising energy demands, and tampering. IoT (Internet of Things) technology offers a revolutionary approach to address these issues by enabling smart meters with advanced functionalities. This article explores an IoT-based energy meter equipped with a billing system and load privatization capabilities.
Technical Architecture
The proposed system comprises the following key components:

- Smart Meter: Equipped with metering ICs (Integrated Circuits) for high-precision energy measurement. It communicates with the cloud platform through a communication module (e.g., cellular, Wi-Fi).
- Cloud Platform: A secure and scalable platform for data acquisition, processing, storage, and visualization. It facilitates communication between smart meters and user interfaces.
- Billing System: Manages customer accounts, tracks energy consumption, and generates automated bills based on pre-defined tariffs or real-time pricing models.
- Mobile App/Web Interface: Provides a user-friendly platform for customers to monitor their energy consumption, track bills, and manage payments.
- Load Privatization Module: Enables peer-to-peer energy trading within a localized community. Users can sell surplus solar power or buy from neighbors at negotiated rates.

Communication Protocol
The communication between smart meters and the cloud platform adheres to standardized protocols like DLMS (IEC 62056) or Open Metering Interface (OMI). These protocols ensure secure and interoperable data exchange between devices from various vendors.
Data Acquisition and Processing
Smart meters collect energy consumption data at regular intervals (e.g., every 15 minutes). This data is transmitted securely to the cloud platform using encryption techniques. The cloud platform pre-processes the data for anomalies, validates it, and stores it in a secure database.
Billing System
The billing system retrieves consumption data from the cloud platform and applies the chosen tariff structure (e.g., flat rate, time-of-use pricing) to calculate energy charges. It generates detailed bills with consumption breakdowns and cost visualizations. The system integrates with payment gateways to facilitate secure online transactions.

Load Privatization

The system facilitates a peer-to-peer energy trading marketplace within a localized community (e.g., apartment complex). Prosumers (consumers who also produce energy, like those with rooftop solar panels) can sell their surplus power to their neighbors at negotiated rates. The system ensures secure transactions through smart contracts and facilitates settlements through integrated payment channels.

Benefits

Improved Efficiency: Real-time monitoring of energy consumption enables better resource management and reduces energy wastage.

Reduced Costs: Automated billing eliminates manual intervention errors and facilitates timely payments.

Transparency: Customers gain real-time insights into their consumption patterns, empowering them to make informed energy-saving decisions.

Demand Management: Time-based pricing models or dynamic pricing based on real-time grid conditions can incentivize off-peak energy usage and reduce peak demand.

Sustainability: Load privatization promotes renewable energy integration and empowers prosumers to benefit from their green energy generation.

Security Considerations

- Secure communication protocols (e.g., TLS/SSL) are essential to safeguard data transmission between smart meters and the cloud platform.
- Robust authentication and authorization mechanisms are required to prevent unauthorized access to user data and system functionalities.
- The cloud platform should adhere to stringent data security standards and regulations.

Conclusion

IoT-based energy meters with billing and load privatization functionalities offer a promising solution for a more efficient, sustainable, and consumer-centric energy ecosystem. By leveraging secure communication, advanced data analytics, and innovative billing mechanisms, this technology empowers utilities and consumers to optimize energy management and contribute to a greener future.

The convergence of IoT technology and smart grid infrastructure creates a transformative opportunity for the energy sector. IoT-based energy meters with integrated billing systems and load privatization capabilities offer a compelling vision for a future that is:

- More Efficient: Real-time data empowers consumers and utilities to optimize energy use, reducing wastage and grid strain.
- Cost-Effective: Automated billing minimizes errors, facilitates timely payments, and enables dynamic pricing models that incentivize off-peak consumption.
- Transparent and Empowering: Customers gain valuable insights into their consumption patterns, enabling informed energy saving decisions.
- Sustainable: The rise of prosumers and peer-to-peer energy trading fosters the integration of renewable energy sources and empowers local communities.

While security considerations remain paramount, the potential benefits of this technology are significant. By embracing innovation and collaboration, stakeholders across the energy sector can unlock a future with a more efficient, sustainable, and consumer-centric energy ecosystem.

Further Exploration

This article provides a high-level overview of the technical aspects. For a deeper understanding, you can explore the following:

- Detailed technical specifications of smart meter communication protocols like DLMS and Open Metering Interface (OMI).
- Implementation of blockchain technology for secure and transparent peer-to-peer energy trading in load privatization schemes.
- Cybersecurity best practices for securing the communication infrastructure and data management systems within the IoT-based energy ecosystem.

The marriage of IoT technology and smart grids opens a treasure trove of possibilities for the future of energy management. Here are some exciting avenues for further exploration of IoT-based energy meters with billing and load privatization:

1. Advanced Data Analytics and Machine Learning

- Consumption Forecasting: Leverage machine learning to predict energy consumption patterns with high accuracy. This empowers utilities to optimize grid operations, improve demand forecasting, and implement preventive maintenance strategies.
- Personalized Customer Engagement: Analyze consumption data to create personalized recommendations for energy-saving measures and behavioral nudges to encourage efficient energy use.
- Dynamic Pricing with AI: Implement AI-powered dynamic pricing models that adjust electricity costs based on real-time grid conditions, consumer behavior, and weather patterns. This can incentivize off-peak consumption and flatten peak demand curves.

2. Blockchain for Secure and Transparent Transactions

Secure Peer-to-Peer Trading: Explore blockchain technology to create a secure and transparent platform for peer-to-peer energy trading within communities. Blockchain can immutably record transactions, automate settlements, and eliminate the need for intermediaries.
Enhanced Cybersecurity: Blockchain's inherent security features can be leveraged to strengthen cybersecurity across the entire IoT ecosystem, protecting against cyberattacks and unauthorized access to user data or system functionalities.

3. Integration with Smart Home Systems

Automated Energy Management: Integrate smart meters with smart home systems to automate appliance operations based on real-time energy prices and consumption patterns. This can optimize energy use within homes and contribute to overall grid stability.
Demand Response Management: Enable smart meters to participate in demand response programs where consumers are incentivized to reduce energy consumption during peak hours. This can be achieved by automatically adjusting appliance usage patterns or pre-cooling/heating homes during off-peak hours.

4. Artificial Intelligence for Grid Optimization

Predictive Maintenance: Implement AI algorithms to analyze sensor data from smart meters and predict potential equipment failures within the grid infrastructure. This enables proactive maintenance, minimizes downtime, and ensures efficient grid operations.
Self-Healing Grids: Explore the potential for AI-powered self-healing grids that can autonomously identify and respond to outages, rerouting power and minimizing disruption to consumers.

5. Regulatory Frameworks and Market Design

Standardization and Interoperability: Develop standardized protocols and regulations to ensure seamless interoperability between smart meters from various vendors. This is crucial for facilitating widespread adoption and maximizing the benefits of IoT-based energy management systems.
Market Design for Peer-to-Peer Trading: Establish regulatory frameworks and market designs that govern peer-to-peer energy trading within communities. This includes setting clear guidelines for pricing mechanisms, grid access rules, and dispute resolution procedures.
By exploring these exciting avenues, IoT-based energy meters with billing and load privatization have the potential to revolutionize the energy sector, paving the way for a more efficient, sustainable, and consumer-centric future.

Speed Control of Single-Phase Induction Motor using Android Bluetooth Module

---S. POOJA
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Single-phase induction motors are widely used in various applications due to their simplicity and robustness. However, precise control over their speed is often desirable for efficiency and functionality. This article explores a method for controlling the speed of a single-phase induction motor using an Android application and a Bluetooth module.
System Components
The system comprises the following key components:

1. Single-Phase Induction Motor: The motor whose speed needs to be controlled. Its characteristics (power rating, voltage, etc.) influence the design of the power control circuit.
2. Android Smartphone/Tablet: Acts as the user interface for controlling the motor speed. The Android device should be Bluetooth enabled.
3. Android Application: A custom-developed application installed on the Android device. It provides a user interface for setting the desired motor speed and transmits commands wirelessly via Bluetooth.

Bluetooth Module (HC-05/HC-06): A readily available and inexpensive Bluetooth module that bridges the communication gap between the Android device and the control circuit. It receives commands from the phone and transmits them to the microcontroller.
Microcontroller Unit (MCU): The brains of the system, responsible for interpreting commands from the Bluetooth module and generating control signals for the motor driver circuit. Popular choices include Arduino Uno, ESP32, etc.
Power Control Circuit: This circuit interfaces between the MCU and the motor. Depending on the chosen control method, it may involve TRIACS, relays, or motor drivers (e.g., IGBT drivers) to regulate the voltage supplied to the motor.

Control Method

There are two primary methods for controlling the speed of a single-phase induction motor using this system:

- Voltage Control: By varying the voltage supplied to the motor, its speed can be proportionally controlled. This is typically achieved using pulse width modulation (PWM) techniques on the AC waveform. The MCU generates a PWM signal based on the user input from the Android app. The PWM signal is then used to control a TRIAC or IGBT driver circuit, effectively regulating the average voltage delivered to the motor.
- Frequency Control: Induction motor speed is directly proportional to the frequency of the AC supply. This method requires an inverter circuit that converts the DC power from the supply into a variable-frequency AC output that drives the motor. The MCU generates a control signal that determines the output frequency of the inverter, thereby controlling the motor speed based on user input.

Android Application Development

The Android application provides a user-friendly interface for controlling the motor speed. It typically includes elements like:

- Speed slider: Allows the user to set the desired motor speed within a pre-defined range.
- Start/Stop button: Enables initiating and stopping the motor operation.
- Connection status indicator: Provides feedback on the Bluetooth connection between the phone and the control module.

Development tools like Android Studio can be used to create the application. The application utilizes Bluetooth functionalities to communicate with the paired Bluetooth module. The received user commands (e.g., speed value) are then transmitted via Bluetooth to the control circuit.

Microcontroller Programming

The MCU program receives commands from the Bluetooth module and generates control signals for the power control circuit. The program typically involves:

- Bluetooth communication library: Enables communication with the Bluetooth module via serial communication protocols.
- User input processing: Decodes the received data (speed value) from the Android application.
- PWM generation: Generates a PWM signal with a duty cycle proportional to the desired speed (for voltage control method).
- Inverter control (if applicable): Generates control signals for the inverter circuit to regulate the output frequency (for frequency control method).
- Safety features: May include overcurrent or overvoltage protection routines to safeguard the motor and the control circuit.

Advantages

- Wireless control: The Android app provides convenient and remote control over the motor speed.
- User-friendly interface: The Android application offers a simple and intuitive way to set the desired speed.
- Cost-effective: The system utilizes readily available components, making it a cost-effective solution for speed control applications.
- Scalability: The basic design can be adapted to control motors with different power ratings by adjusting the power control circuit accordingly.

Limitations

- Limited control range: Depending on the chosen control method, the achievable speed range may be limited.
- Safety considerations: Precautions are necessary when dealing with AC power and motor operation. Proper circuit design and safety measures are crucial.

Power limitations: The system's power handling capabilities depend on the selected components like the TRIAC or motor driver.

Conclusion

This article presented a method for controlling the speed of a single-phase induction motor using an Android Bluetooth module. By leveraging readily available components and software development. This approach, utilizing an Android application and a Bluetooth module, empowers users with:

- Wireless Convenience: Gone are the days of tethered controllers. The Android application provides remote and convenient control over motor speed, offering flexibility and ease of use.
- Intuitive Interface: The user interface on the smartphone allows for straightforward setting of desired speeds through a simple slider or buttons. This eliminates the complexity of traditional control methods.
- Cost-Effectiveness: The system utilizes readily available components like Bluetooth modules and microcontrollers, making it a budget-friendly solution for speed control applications.
- Scalability with Customization: The core design can be adapted to control motors of varying power ratings by adjusting the power control circuit based on motor specifications. This allows for customization to specific needs.

However, it's important to acknowledge the limitations:

- Control Range: Depending on the chosen control method (voltage or frequency control), the achievable speed range for the motor might be limited.
- Safety Considerations: Working with AC power and motors requires caution. Proper circuit design, safety measures like overcurrent protection, and user awareness are crucial for safe operation.
- Power Handling Capacity: The system's power handling capabilities are limited by the chosen components, particularly the TRIAC or motor driver. It's essential to ensure compatibility with the motor's power rating.

Despite these limitations, the potential benefits of this system are significant. It offers a user-friendly, cost-effective, and scalable solution for controlling single-phase induction motors. As technology continues to evolve, further advancements in motor control algorithms and integration with smart home systems can unlock even greater possibilities for efficient and intelligent motor operation.

Solar Wireless Electric Vehicle Charging System: Powering the Future of Transportation

---YADALA RANI
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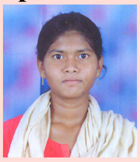

The transportation sector is undergoing a significant shift towards electric vehicles (EVs) due to environmental concerns and advancements in battery technology. However, charging infrastructure remains a crucial hurdle for widespread EV adoption. Solar wireless electric vehicle charging systems offer a promising solution, eliminating the need for physical cables and leveraging clean, renewable energy.

System Components

A solar wireless EV charging system consists of the following key elements:

- Solar Panels: Convert sunlight into DC electricity using the photovoltaic effect. The system size depends on factors like desired charging power, sunlight availability, and vehicle usage patterns.
- Maximum Power Point Tracker (MPPT): Optimizes the power output from the solar panels by matching their operating point to maximize power generation under varying sunlight conditions.
- Battery Bank (Optional): Stores excess solar energy during peak sunlight hours to enable charging even in low-light conditions.
- Inverter: Converts DC electricity from the solar panels (and battery bank, if present) into AC electricity suitable for wireless power transfer.
- Wireless Power Transmitter: Houses a primary coil that generates a strong magnetic field when AC current passes through it. This coil is typically embedded in the ground beneath a designated parking spot.

Wireless Power Receiver: Mounted on the underside of the electric vehicle, it houses a secondary coil that interacts with the magnetic field from the transmitter coil. This induces a current in the receiver coil, which is then rectified and regulated to charge the vehicle's battery.

Vehicle Positioning System (Optional): Improves charging efficiency by ensuring proper alignment between the transmitter and receiver coils. This can be achieved using cameras, sensors, or automated positioning mechanisms.
Wireless Power Transfer Technology

The core of the system lies in wireless power transfer (WPT) technology. Two primary methods are employed:

Inductive Charging: This widely used method leverages a magnetic field for contactless power transfer. The AC current in the transmitter coil generates a magnetic field that couples with the receiver coil on the vehicle, inducing a current in the receiver coil. The efficiency of inductive charging depends on factors like the distance between the coils and the alignment accuracy.
Resonant Charging: A more advanced approach that utilizes the principle of resonance to achieve higher efficiency and power transfer over larger distances. By tuning the transmitter and receiver coils to resonate at the same frequency, significant power transfer can occur even with slight misalignments between the coils.
System Operation

Solar Energy Capture: Solar panels convert sunlight into DC electricity.
Power Optimization: The MPPT ensures maximum power output from the solar panels under varying sunlight conditions.
Energy Storage (Optional): If a battery bank is present, excess solar energy is stored during peak sunlight hours.
AC Conversion: The inverter converts DC electricity from the solar panels (and battery bank, if applicable) into AC electricity suitable for wireless power transfer.
Wireless Power Transmission: The AC current from the inverter flows through the transmitter coil, generating a strong magnetic field.
Wireless Power Reception: The magnetic field from the transmitter coil interacts with the receiver coil mounted on the underside of the EV, inducing a current in the receiver coil.
Vehicle Battery Charging: The induced current in the receiver coil is rectified and regulated to match the voltage requirements of the EV battery, enabling charging.
Benefits

Convenience: Eliminates the need for physical cables, offering a more user-friendly charging experience.
Weatherproof Operation: Wireless charging is less susceptible to weather elements like rain or snow compared to plug-in charging.
Reduced Maintenance: Absence of physical connectors minimizes wear and tear, potentially reducing maintenance costs for both the charging system and the vehicle.
Scalability: The system can be scaled to accommodate a single charging pad or a network of charging spots in parking lots, driveways, or public spaces.
Integration with Renewable Energy: Leverages clean solar energy for EV charging, promoting environmental sustainability.
Challenges and Considerations

Efficiency: Wireless power transfer inherently experiences some energy loss. Optimizing coil design, alignment, and WPT technology can improve efficiency.
Power Transfer Distance: The effective charging distance depends on the chosen WPT method and system design. Resonant charging offers advantages over inductive charging in terms of longer distances.
Foreign Object Detection: The system may require mechanisms to detect foreign objects between the transmitter and receiver coils that could impact charging efficiency or safety.
Cost: The initial investment cost for a solar wireless EV charging system might be higher compared to traditional plug-in chargers. However, long-term operational savings due to reduced maintenance and reliance on renewable energy can offset these costs.

Advancements in Wireless Power Transfer Technology:

- Efficiency Improvements: Research into advanced materials and coil design will lead to significant improvements in WPT efficiency, minimizing energy losses during wireless power transfer.
- Long-Distance Charging: Advancements in resonant charging technology will enable efficient power transfer over larger distances, offering greater flexibility in parking arrangements.
- Dynamic Charging: Emerging concepts like dynamic in-road charging could allow for continuous charging of EVs while driving on specially equipped roads, eliminating the need for designated charging stops.

2.

2. Grid Integration and Smart Charging:

Smart Charging Systems: Integration with smart grids will enable dynamic charging strategies that consider factors like grid load and electricity prices.

This can optimize charging schedules and leverage off-peak renewable energy sources for efficient EV charging.

Vehicle-to-Grid (V2G) Technology: Bi-directional charging capabilities will allow EVs to act as distributed energy storage units, feeding excess power back into the grid during peak demand periods, contributing to grid stability.

3. Cost Reduction and Standardization:

Economies of Scale: As production volumes increase, the cost of solar panels, wireless charging components, and system installation is expected to decrease, making solar wireless charging systems more accessible.

Standardization and Interoperability: Establishing industry-wide standards for WPT technology and communication protocols will ensure compatibility between different charging systems and EV models, fostering wider adoption.

4. Regulatory Frameworks and Infrastructure Development:

- Government Incentives: Government policies and incentives can play a crucial role in promoting the development and deployment of solar wireless EV charging infrastructure.
- Public-Private Partnerships: Collaboration between governments, utilities, and private companies can accelerate the rollout of solar wireless charging systems in public spaces and parking lots.

5. Integration with Smart Cities and Sustainable Communities:

- Urban Planning: Solar wireless EV charging can be seamlessly integrated into smart city infrastructure, promoting sustainable transportation and reducing reliance on fossil fuels.
- Community Microgrids: Local communities can utilize solar wireless charging systems in conjunction with on-site renewable energy generation, creating self-sufficient microgrids for clean and sustainable EV charging.

Challenges and Considerations

While the future looks bright for solar wireless EV charging, some challenges remain:

- Safety Regulations: Establishing robust safety standards for high-power wireless charging systems and addressing potential health concerns related to electromagnetic fields is crucial.
- Cybersecurity: Ensuring the security of communication protocols and system components is essential to prevent cyberattacks and safeguard user data.

Conclusion

Solar wireless EV charging systems offer a compelling vision for a future powered by clean energy and convenient EV charging. By overcoming existing challenges and embracing technological advancements, this technology has the potential to revolutionize transportation, promote sustainability, and pave the way for a cleaner and more efficient future.

As research and development continue, solar wireless EV charging is poised to become a mainstream solution, propelling us towards a truly electrified transportation landscape.

Build the circuit: Following a schematic diagram, connect the voltage sensor, current sensor, and output device to the Arduino board using jumper wires and resistors as needed.
Write the Arduino code: The code should:
Initialize communication with the output device (LCD or serial monitor).
Read the analog values from the voltage sensor and current sensor.
Convert the analog readings to voltage and current values using appropriate calculations (refer to sensor datasheets).
Display the calculated voltage and current values on the chosen output device.

1. Upload the code and power on your project. You should now see the voltage and current readings being displayed!

Beyond the Basics: Expanding Your Project
This project provides a foundation for further exploration:

- Data Logging: Enhance your project by incorporating an SD card module. The Arduino can write voltage and current data to the SD card at regular intervals, allowing you to track and analyze these values over time.
- Alarms and Notifications: Set up voltage and current thresholds in your code. If readings fall outside these thresholds, the system can trigger alarms (visual or audible) or send notifications (via SMS or email - requiring additional modules).
- Multiple Channels: For projects requiring measurement of multiple voltage or current levels, explore using multiplexers to connect multiple sensors to the Arduino.

Safety Considerations
When working with electronics, safety is paramount:

- Understanding Circuit Voltages: Ensure all components are rated for the voltages you plan to measure.
- Proper Wiring and Connections: Double-check your circuit connections before powering it on to avoid damaging components.
- Working with Mains Power: This project is not intended for measuring mains electricity (household wall outlet voltage). Leave mains power work to qualified electricians.

Conclusion
Building a voltage and current display with Arduino offers a practical and engaging introduction to working with electronics and electrical concepts. By visualizing these often-invisible parameters, this project empowers you to gain a deeper understanding of electricity and its applications in our daily lives. Remember to prioritize safety and explore the many possibilities for expanding your project based on your interests and goals.

Wind-Solar Hybrid Power Generation System: A Synergy for Sustainable Energy

---MADASTU BINDHU
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The growing demand for clean and reliable energy has spurred the development of renewable energy sources. Wind and solar energy, with their complementary nature, offer a powerful combination when harnessed together in a hybrid power generation system. This article explores the technical aspects and benefits of wind-solar hybrid systems.

System Components
A wind-solar hybrid power generation system typically comprises the following key elements:

- **Wind Turbine:** Converts wind energy into mechanical energy through the rotation of blades driven by wind. The choice of wind turbine type (horizontal axis, vertical axis) depends on wind speed characteristics and site conditions.
- **Solar Photovoltaic (PV) Panels:** Convert sunlight into DC electricity using the photovoltaic effect. The size and type of solar panels depend on factors like solar irradiation and desired power output.
- **Maximum Power Point Tracker (MPPT):** Optimizes the power output from the solar panels by constantly adjusting the operating voltage to ensure maximum power generation under varying sunlight conditions.
- **Charge Controller:** Regulates the charging process for the battery bank, preventing overcharging and extending battery life.
- **Battery Bank (Optional):** Stores excess energy generated by the wind turbine and solar panels, enabling power supply during periods of low wind or weak sunlight. Battery selection considers factors like capacity, discharge depth, and lifespan.
- **Inverter:** Converts DC electricity from the wind turbine (through a rectifier) and solar panels (via the MPPT) into AC electricity suitable for powering appliances or feeding into the grid.
- **Power Conditioning Unit (PCU) (Optional):** Improves the quality of power output by filtering out voltage fluctuations and harmonics, ensuring clean and stable power supply.
- **Monitoring and Control System:** Continuously monitors system performance parameters like wind speed, solar irradiation, power generation, and battery status. This data is used for system optimization and control.

Operational Principle

Wind Energy Conversion: Wind energy rotates the blades of the wind turbine, generating mechanical energy.
Electrical Conversion: A generator within the wind turbine converts the mechanical energy into AC electricity.
Solar Energy Conversion: Sunlight falls on the solar panels, generating DC electricity.
Power Management: The MPPT optimizes the power output from the solar panels.
Battery Charging (Optional): Excess generated power charges the battery bank for storage.
DC-AC Conversion: The inverter converts DC electricity from the wind turbine (through a rectifier) and solar panels (via the MPPT) into AC electricity.
Power Conditioning (Optional): The PCU improves the quality of the AC output.
Power Utilization: The AC electricity is used to power appliances or fed into the grid.
System Monitoring: The monitoring and control system continuously tracks system performance and optimizes operations.
Benefits of Wind-Solar Hybrid Systems

Enhanced Reliability: Combining wind and solar energy mitigates the intermittency of each source. Wind can generate power during low sunlight periods, and vice versa, leading to a more reliable and consistent power supply.
Increased Energy Output: Utilizing two renewable resources maximizes energy production compared to relying on a single source.
Reduced Reliance on Fossil Fuels: Wind-solar hybrid systems reduce dependence on fossil fuels, lowering greenhouse gas emissions and contributing to environmental sustainability.
Fuel Cost Savings: By generating clean energy on-site, the system reduces dependence on the grid and potentially lowers electricity bills.
Scalability: The system can be scaled to meet varying power demands by adding more wind turbines or solar panels.
Islanding Capability (Optional): With proper controls and battery storage, the system can operate independently from the grid, providing a reliable power source in remote areas.
Challenges and Considerations

Initial Investment: The initial cost of installing a wind-solar hybrid system can be higher compared to traditional fossil fuel-based generators.
Site Selection: Both wind speed and solar irradiation need to be assessed to ensure sufficient energy production from both sources.
System Complexity: Integrating different renewable energy sources and managing power flow requires a well-designed and controlled system.
Battery Requirements (Optional): Battery storage adds complexity and cost to the system, and battery degradation over time needs to be considered.
Future Outlook

Advancements in technology are continuously improving the efficiency and affordability of wind-solar hybrid systems. Here are some promising trends for the future:

Smart Control Systems: Enhanced artificial intelligence and machine learning algorithms can optimize power generation and storage based on real-time weather forecasts and energy consumption patterns.
Cost Reductions: As manufacturing scales up and component prices decrease, wind-solar hybrid systems are expected to become more cost-competitive with traditional energy sources.
Hybrid Storage Solutions: Integration of advanced.

Rotor and Grid-Side Control of DFIG-Based Wind Energy Systems

---GOVALA SAI PRAVALLIKA
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Doubly Fed Induction Generator (DFIG) wind turbines have become a popular choice for large-scale wind energy integration due to their ability to control active and reactive power output. This article delves into the technical details of rotor-side converter (RSC) and grid-side converter (GSC) control strategies employed in DFIG-based wind energy systems.

DFIG System Overview

A DFIG wind turbine consists of a wound rotor induction generator directly coupled to the wind turbine shaft. The stator windings are connected directly to the grid, while the rotor windings are connected to a back-to-back converter consisting of the RSC and GSC. This configuration allows for independent control of the rotor's electrical characteristics, enabling active power regulation and reactive power management.

Rotor-Side Converter (RSC) Control

The primary function of the RSC is to control the electrical torque and rotational speed of the wind turbine generator. This is achieved by manipulating the magnitude and phase angle of the currents injected into the rotor windings. Popular RSC control strategies include:

Vector Control: This method utilizes decoupled control of active and reactive power by transforming stator and rotor currents into a rotating reference frame (d-q frame). This allows for independent control of torque (proportional to rotor current magnitude) and reactive power (proportional to the d-axis component of rotor current) through appropriate control of the converter output voltages.

Direct Torque Control (DTC): This method directly controls the electromagnetic torque and stator flux of the DFIG by manipulating the switching states of the RSC based on the measured values of these parameters. DTC offers fast dynamic response but may have higher switching losses compared to vector control.

Grid-Side Converter (GSC) Control

The primary function of the GSC is to regulate the DC link voltage between the RSC and GSC and to control the reactive power flow between the DFIG and the grid. Common GSC control strategies include:

DC Link Voltage Control: This method maintains a constant voltage level across the DC link capacitor by adjusting the real power flow through the GSC. The GSC injects or absorbs real power from the grid as needed to compensate for fluctuations in wind power generation or variations in rotor power due to RSC control actions.

Proportional-Integral (PI) Control: This method utilizes PI controllers to regulate the DC link voltage and reactive power output of the DFIG. The controller outputs determine the reference values for the GSC's active and reactive power components, enabling real-time adjustments based on system requirements.

Advanced Control Techniques

Modern DFIG control systems often incorporate advanced techniques to address challenges like grid fault ride-through capability and power quality improvement. These techniques include:

Maximum Power Point Tracking (MPPT): Optimizes wind energy capture by adjusting the rotor speed through RSC control to maintain operation at the wind turbine's maximum power point under varying wind speeds.

Low Voltage Ride-Through (LVRT): Enables the DFIG to remain connected to the grid during voltage sags by injecting reactive power into the grid, supporting grid voltage stability.

Flicker Mitigation: Mitigates rapid fluctuations in power output by incorporating control strategies within the RSC to smoothen the power delivered to the grid.

Communication and System Monitoring

Effective communication between the RSC, GSC, and supervisory control system is crucial for coordinated operation. Communication protocols like IEC 61850 enable real-time data exchange for control actions, system monitoring, and fault detection.

Benefits of DFIG Control

Active Power Regulation: Enables control of the wind turbine's active power output to match grid demand or participate in ancillary services.

Reactive Power Management: Provides the capability to inject or absorb reactive power, contributing to grid voltage regulation and power factor correction.

Improved Power Quality: Advanced control strategies can help mitigate power fluctuations and flicker, improving the overall quality of power delivered to the grid.

Enhanced Wind Energy Capture: MPPT techniques maximize wind energy extraction, leading to increased energy production.

Challenges and Considerations

Control System Complexity: Designing and implementing robust control algorithms requires expertise in power electronics, control theory, and wind turbine dynamics.
Computational Requirements: Real-time control algorithms may require significant processing power, necessitating powerful control hardware.
System Cost: The added complexity of the DFIG control system contributes to a higher initial cost compared to fixed-speed wind turbine generators.
Conclusion

DFIG-based wind energy systems with advanced rotor-side and grid-side converter control strategies offer significant benefits for large-scale wind power integration. By enabling active power regulation, reactive power management, and improved power quality, DFIG systems contribute to a more reliable and sustainable power grid.

Exploring Battery Storage Management Systems

---GUDI SRIJA
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Batteries are the workhorses of our modern world, powering everything from portable electronics to electric vehicles and large-scale grid storage. However, to ensure optimal performance, safety, and longevity, batteries require a sophisticated control system known as a Battery Storage Management System (BMS). This article delves into the technical details of BMS functionalities and their crucial role in battery operation.
The Need for a BMS
Batteries are complex electrochemical systems with inherent limitations and safety concerns. A BMS acts as the brain of the battery, continuously monitoring and managing various critical parameters to:

- Optimize Performance: Ensure efficient energy delivery by maximizing battery capacity and discharge rates.
- Extend Battery Life: Prevent premature degradation by regulating charging and discharging cycles and protecting against harmful operating conditions.
- Enhance Safety: Mitigate potential safety hazards like overcharging, over-discharging, overheating, and cell imbalances.
- Accurate State Estimation: Provide real-time information on the battery's state of charge (SOC), state of health (SOH), and remaining capacity.

Components of a BMS
A typical BMS comprises the following key components:

- Battery Management Unit (BMU): The core of the system, housing the microprocessor and associated circuitry. The BMU collects data from various sensors, processes it, and generates control signals for other components based on programmed algorithms.
- Sensors: Monitor various battery parameters like voltage, current, temperature, and cell voltages (individual cell voltages in multi-cell batteries).
- Cell Balancing Circuit (Optional): Actively balances voltages across individual cells in a multi-cell battery to prevent overcharging or over-discharging of any single cell, thereby extending battery life.
- Communication Interface: Enables communication with external systems like battery chargers, inverters, or a supervisory control system. Protocols like CAN (Controller Area Network) or I2C (Inter-Integrated Circuit) are commonly used.

BMS Functions and Control Strategies
The BMS performs a variety of critical functions to ensure safe and efficient battery operation. Here are some key functionalities:

- Data Acquisition: Continuously collects data from voltage, current, and temperature sensors to monitor the battery's health and performance.
- State Estimation: Utilizes advanced algorithms to estimate the battery's SOC, SOH, and remaining capacity based on the collected data.
- Cell Balancing: In multi-cell batteries, the BMS may actively balance cell voltages by shunting excess charge from high-voltage cells to low-voltage ones, ensuring uniform cell aging and preventing premature degradation.

Charging and Discharging Control: Regulates the charging and discharging processes by controlling the current and voltage limits based on battery parameters and safety considerations. This includes protection against overcharging, over-discharging, and excessive current flow.
Temperature Management: Monitors battery temperature and implements cooling or heating strategies (if applicable) to maintain optimal operating temperature range, as extreme temperatures can significantly impact battery performance and lifespan.
Safety Features: Implements safety features like overcurrent protection, overvoltage protection, and undervoltage protection to prevent damage to the battery and surrounding components in case of abnormal operating conditions.

Communication and System Integration
Modern BMS systems often integrate with external systems for data exchange and control purposes. Communication interfaces enable the BMS to:

- Communicate with Battery Chargers: Share information on battery state and health for optimized charging profiles.
- Communicate with Inverters: Provide data on available battery capacity to ensure safe and efficient power delivery.
- Integrate with Supervisory Control Systems: Transmit real-time battery data for system monitoring, fault diagnosis, and performance optimization.

Future Trends in BMS Technology
The field of BMS technology is constantly evolving. Here are some exciting trends to watch for:

- Advanced Cell Monitoring: Integration of advanced sensors and data analytics for more precise cell-level monitoring and improved state estimation.
- Machine Learning and AI: Utilization of machine learning algorithms to predict battery behavior, optimize charging strategies, and proactively address potential issues.
- Cloud-Based Monitoring: Real-time data from BMS systems feeding into cloud platforms for remote monitoring, diagnostics, and predictive maintenance.
- Wireless Communication: Adoption of wireless communication protocols for simplified data exchange and system integration.

Conclusion
Battery Storage Management Systems play a pivotal role in ensuring the safe, reliable, and efficient operation of batteries across various applications. By continuously monitoring critical parameters, implementing control strategies, and communicating with external systems, BMS technology safeguards battery integrity, extends lifespan, and optimizes performance. As battery storage becomes increasingly crucial for renewable energy integration and electric vehicle adoption, advancements in BMS technology will be at the forefront of unlocking the full potential of battery-powered solutions.

A Bluetooth-Controlled Robotic Car with Wireless Camera and Metal Detection

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The world of robotics offers a captivating blend of electronics, programming, and creativity. This article explores the design and development of a feature-rich robotic car controlled via Bluetooth using a smartphone and equipped with a wireless camera for remote viewing and a metal detector for added functionality.
Required Components:

- Microcontroller Unit (MCU): The brain of the robot, responsible for processing user commands, sensor data, and controlling actuators. Popular choices include Arduino Uno, ESP32, or Raspberry Pi (depending on desired processing power and camera functionalities).
- L298N Motor Driver: A dual H-bridge motor driver module that allows for independent control of the robot's two DC motors, enabling forward, backward, and turning maneuvers.
- Bluetooth Module (HC-05/HC-06): Facilitates wireless communication between the smartphone and the robot. This module receives control commands from the Bluetooth app and transmits them to the MCU.

DC Motors: Two geared DC motors provide the driving force for the robot. The motor selection depends on factors like desired speed, weight of the robot, and terrain.

Wireless Camera: A small, lightweight Wi-Fi or Bluetooth camera module transmits live video feed to the smartphone app, allowing for real-time remote monitoring of the robot's surroundings.
Metal Detector Module: A readily available metal detector circuit detects the presence of metallic objects in the vicinity of the robot. When metal is detected, the module typically generates an output signal (e.g., LED or buzzer) which can be integrated with the MCU for further actions.
Chassis: A sturdy base structure to house all the electronic components and motors. It can be built using metal, wood, or 3D-printed parts.
Wheels: Two wheels with appropriate traction for the intended operating environment.
Battery Pack: Provides power to the entire system. The voltage and capacity should be sufficient to meet the combined power requirements of all components.
Jumper Wires: For electrical connections between components.
Breadboard (Optional): Can be used for prototyping and testing the circuit before final assembly.

System Design and Operation

The robot can be broadly divided into three main subsystems:

1. Control Unit: The MCU forms the core, interfacing with the Bluetooth module, motor driver, and camera module (if using a Wi-Fi camera, an additional Wi-Fi module might be required).
2. Drive System: The L298N motor driver receives control signals from the MCU and drives the DC motors, enabling forward, backward, and turning movements based on user commands.
3. Sensing and Feedback: The metal detector module detects nearby metallic objects and transmits a signal to the MCU. The wireless camera provides a live video feed for remote viewing.

Software Development

The software development involves two key aspects:

1. Android Application: A user-friendly Android application is developed to send control commands (forward, backward, left turn, right turn) to the robot via Bluetooth. The app might also integrate a live video feed from the camera (if using a Wi-Fi camera, a dedicated app for the camera might be required). This can be achieved using tools like Android Studio.
   - MCU Programming: The MCU is programmed to:Receive control commands from the Bluetooth module.
   - Decode the received commands and translate them into control signals for the motor driver.
   - Process the signal from the metal detector and potentially trigger pre-defined actions (e.g., stop the robot, sound a buzzer).
   - If using a Wi-Fi camera, establish communication with the camera module and potentially integrate the video feed into the app (depending on chosen camera functionalities).

Assembly and Testing

1. Circuit Assembly: The electronic components are connected on a breadboard (for prototyping) or soldered onto a permanent PCB (Printed Circuit Board) based on the chosen design.
2. Software Upload: The developed Android application is installed on the smartphone, and the MCU program is uploaded to the microcontroller.
3. Integration and Testing: The complete system with the chassis, motors, camera, and metal detector is assembled. The Bluetooth connection is established between the phone and the robot. Individual components and functionalities (motor movement, camera feed, metal detection) are tested thoroughly.

Benefits and Applications

This project offers a feature-rich robotic car with the following benefits:

- Wireless Control: Bluetooth connectivity allows for convenient remote control of the robot using a smartphone app.
- Real-Time Monitoring: The wireless camera provides a live video feed, enabling remote observation of the robot's surroundings.
- The Bluetooth-controlled robotic car with a wireless camera and metal detection is not just a captivating project; it's a versatile platform for exploration, learning, and potential real-world applications. Key takeaways include:
- Educational Value: Building this robot provides hands-on experience with electronics, programming, and robotics principles, fostering creativity, problem-solving skills, and an understanding of various technological concepts.
- Customization Potential: The core design can be adapted to incorporate additional sensors (e.g., ultrasonic sensors for obstacle avoidance), actuators (e.g., robotic arms), or different functionalities based on user interests.
- Real-World Applications: The metal detection functionality could be used for treasure hunting enthusiasts, search and rescue operations in disaster zones, or even basic security applications. The live camera feed opens doors for remote monitoring and exploration in potentially hazardous or difficult-to-reach environments.

Future Advancements:

The future holds exciting possibilities for further development:

Integration with AI: Incorporating artificial intelligence algorithms could enable autonomous navigation, object recognition, and real-time decision-making for the robot.

Internet of Things (IoT) Connectivity: Connecting the robot to the internet could allow for remote control and monitoring from anywhere in the world, opening doors for collaborative robotics projects.

Advanced Sensor Fusion: Combining various sensors like LiDAR or infrared cameras with the existing functionalities could create a more sophisticated robot capable of navigating complex environments and performing intricate tasks.

This Bluetooth-controlled robotic car serves as a springboard for exploration and innovation. By combining the fun of building with the power of technology, this project paves the way for future advancements in robotics and its diverse applications in our ever-evolving world.

Department of Electrical and Electronics Engineering

Vision

To impart quality education in Electrical and Electronics Engineering for women empowerment

Mission

The vision can be accomplished by

1. Imparting fundamental knowledge in Electrical and Electronics Engineering through well-qualified faculty

2. Providing exposure to current technologies

3. Providing hands-on experience to meet the expectations of the industry

4. Facilitating individual and team activities to enhance personality and soft skills

Program Educational Objectives (PEOs)

PEO1: To Excel in chosen career

PEO2: To work effectively as an individual and as a team member, keeping in mind the high importance currently being given to sustainability and emerging Green Energy Technologies in the current scenario

PEO3: To contribute to the community/society development through acquired knowledge and skills

PEO4: Continuous up gradation of knowledge and skills