Department of Electrical

Student Journal Publications 2024-25

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3	EXPERIMENTAL ANALYSIS OF SINGLE-PHASE HALF CONTROLLED CONVERTER	Prof. Yogesh R. Naik	Electrical	International Research Journal of Engineering and Technology (IRJET)	25-Jun	2395-0056
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12	IOT Based Controlled Smart Distribution Box	Prof. A.M Bhandare	Electrical	International Journal for Research in Applied Science & Engineering Technology (IJRASET)	25-Jun	2321-9653

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DESIGN AND DEVELOPMENT OF A BLDC MOTOR BASED REGENERATIVE BRAKING SYSTEM FOR ENERGY-EFFICIENT ELECTRIC VEHICLES

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ABSTRACT
This paper presents the design, simulation, and experimental validation of a Brushless DC (BLDC) motor-based regenerative braking system aimed at enhancing energy efficiency in electric vehicles (EVs). With the growing demand for sustainable and low-maintenance EV technologies, regenerative braking has become a key enabler in minimizing energy loss during deceleration. The proposed system integrates a BLDC motor with a unidirectional DC-DC boost converter, enabling the recovery and reinjection of braking energy into a 12 V, 2 Ah lithium-ion battery. A detailed MATLAB/Simulink model was developed to simulate motor operation, regenerative torque generation, and battery charging dynamics. The system was then implemented in hardware using an ATmega328 microcontroller, real-time sensors, and PWM-based control logic. Test results show that the system effectively delivers up to 900 mA of regenerative current, charging the battery fully in approximately 2.22 hours. It ensures smooth torque transitions and prevents battery overvoltage through real-time voltage monitoring and adaptive control strategies. The system achieved significant reduction in mechanical brake wear, enhanced braking smoothness, and reliable energy recovery, particularly in urban stop-and-go traffic conditions. Challenges such as low-speed inefficiencies and thermal buildup were identified, and mitigation strategies were discussed. Overall, the proposed architecture offers a low-cost, scalable, and efficient solution suitable for lightweight and mid-range EVs, contributing to the development of greener and more sustainable transportation systems. This work lays the foundation for future enhancements using AI-based control, smart battery management, and real-time predictive braking algorithms.

Keywords:
BLDC motor, regenerative braking, electric vehicles, energy recovery, DC-DC boost converter, braking torque control, microcontroller-based control.

1. INTRODUCTION
The global shift towards sustainable transportation has accelerated the development and adoption of electric vehicles (EVs), driven by the urgent need to reduce carbon emissions, fossil fuel dependence, and urban air pollution [1,2]. However, one of the persistent challenges in EV technology is energy efficiency, particularly in extending the driving range without significantly increasing battery capacity or cost [3,4]. During regular operation, especially in urban stop-and-go traffic, a considerable amount of energy is lost as heat through traditional friction-based braking systems. This energy dissipation negatively impacts the overall efficiency and sustainability of electric mobility solutions [5,6]. To address this inefficiency, regenerative braking systems (RBS) have been introduced as a

"Design and Implementation of a Solar System Using DC Lighting for Energy Efficiency"

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Abstract- ALL product manufacturing units need to have a faulty product detection and separation system in order to maintain product quality and maintain to good reputation so here we demonstration such a system using a solar system by using DC lightning. We Proposed design and solar faulty product is different and thus has a different mechanism A DC lightning strike in a solar photovoltaic (PV) system can induce extremely high voltages and currents, potentially damaging the system's components like PV panels, inverters, and DC cables. These damages can result from over voltage, excessive currents, or arcing due to lightning strikes.

Keywords- SC Solar cell Solar System two or more system and connect together, DC (Direct Current), SRA solar panel ampere.

I. Introduction:

Photovoltaic (PV) solar systems generate direct current (DC) electricity from sunlight and serve as a sustainable energy source. However, their outdoor placement makes them vulnerable to lightning strikes, which can damage critical components like modules and inverters. To mitigate these risks, implementing a robust Lightning Protection System (LPS)—including lightning rods and grounding—is essential. The generated DC can be stored in batteries or converted to alternating current (AC) via inverters for powering standard appliances, making protection vital for safe and continuous operation.

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EXPERIMENTAL ANALYSIS OF SINGLE-PHASE HALF CONTROLLED CONVERTER

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Abstract - *This project focuses on the experimental analysis of a single-phase half-controlled converter, a critical component in power electronics, often used in applications such as DC motor control, battery charging, and power supply systems. The study examines the operation of the converter with various load types, including resistive (R), resistive-inductive (RL), and resistive-inductive capacitive (RLC) loads. The converter circuit utilizes a combination of thyristors and diodes to achieve controlled rectification and freewheeling actions. Key observations include the analysis of output voltage and current waveforms under different firing angles, demonstrating the impact of load and firing delay on performance. Through theoretical discussion, numerical problem-solving, and practical waveform observations, the project highlights the efficiency and operational characteristics of the single-phase half-controlled converter. Safety precautions and procedural guidelines ensure accurate data collection and a safe working environment. This study aims to deepen understanding of controlled rectification techniques and their implications in practical scenarios*

Key Words: Single-phase half-controlled converter, power electronics, DC motor control, battery charging, rectification, freewheeling, thyristors, diodes, RLC load, firing angle of time.

1.INTRODUCTION

A single-phase half-controlled converter is a vital component in power electronics that converts AC power into DC power. It uses a combination of thyristors and diodes to regulate the output voltage and current. The controlled nature of the converter allows it to adjust the DC output by varying the firing angle of the thyristors. This type of converter is extensively used in various industries due to its simplicity, reliability, and cost-effectiveness. Efficient AC-DC converters are essential in applications where variable voltage and current are required. With the increasing demand for energy-efficient systems, there is a need for converters that can adapt to varying load conditions while maintaining performance and precision. This project addresses these requirements by developing a microcontroller-based solution that ensures synchronized and precise firing of thyristors efficient AC-DC converters are essential for applications requiring variable voltage and current. This project focuses on a microcontroller-based solution to enhance performance under varying loads.

2.DESIGN AND IMPLEMENTATION

For college purposes, the Adhyayan Online Platform was built with more responsible activities. It is used in academic schedules most frequently in related ways. We followed these studies and developed a kit after studying research papers.

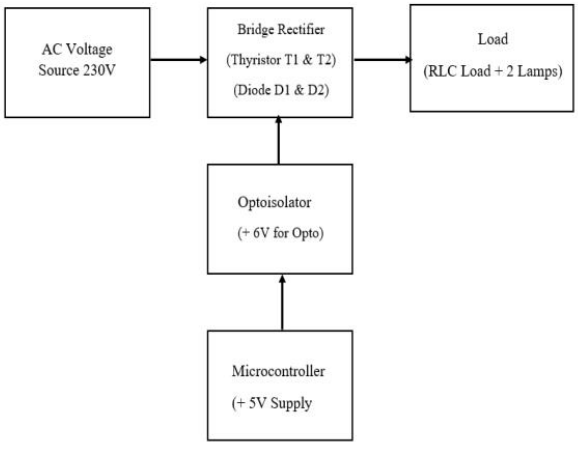

Fig -1: Flow Diagram

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GENERATING DC HIGH VOLTAGE USING MARX GENERATOR

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ABSTRACT

This project presents a method for generating high-voltage DC using the Marx Generator principle. Originally introduced by Erwin Otto Marx, the concept involves charging multiple capacitors in parallel and then discharging them in series to produce a high-voltage output. The proposed system incorporates MOSFETs, diodes, capacitors, and a 555 timer to control switching operations. During the ON period, capacitors are charged through diodes, and in the OFF period, they are connected in series using MOSFETs to deliver a multiplied output voltage. A compact version with four stages using a 12V DC input achieves an output of approximately 30–36V, while a larger setup with 60 stages can generate nearly 1000V from an 18V source. This technique is highly efficient for high-voltage DC generation and can be applied in insulation testing of electrical equipment. The system is low-cost, reliable, and suitable for laboratory testing environments or educational demonstration setups.

Keywords: Marx Generator, MOSFETs, DC generation, low-cost.

I. INTRODUCTION

Our project focuses on generating high-voltage DC using the Marx generator principle, which involves MOSFETs and capacitor stacks. The Marx generator concept was introduced by Erwin Otto Marx in 1923. It works by charging capacitors in parallel during the ON time and then connecting them in series during the OFF time to produce a high-voltage pulse.

This technique is useful for producing voltage in the kilovolt (kV) range, commonly used for testing the insulation strength of electrical devices and components used in power systems. The system in our project includes four stages, where each stage is made up of one capacitor, one MOSFET, and two diodes.

In each stage, the diodes help charge the capacitors in parallel, and MOSFETs act as switches to connect the capacitors in series during discharge, minimizing power loss. A 555 timer IC is used to control the timing of charging and discharging cycles.

By using this method, the output voltage becomes approximately 3.2 times the input supply voltage. For instance, with a 12V DC input, our setup can generate around 30 to 36 volts.

In an extended version of the project, with 60 stages, each consisting of a capacitor, IGBT/MOSFET, and diodes, the system can achieve an output of nearly 60 times the input voltage. With an 18V DC supply, the output can reach around 1000 volts. This setup is compact, cost-effective, and suitable for high-voltage testing applications.

1.1 Motivation of the Present Work

The main motivation for using a Marx generator to produce high DC voltage is to generate high-voltage pulses needed for different purposes such as insulation testing, lightning strike simulation, and use in pulsed power systems. The Marx generator works by charging capacitors in parallel and then discharging them in series, which results in a high-voltage output.

1.2 Need for the Work

High DC voltage generation is important in research areas of both pure and applied physics. It is also used in insulation testing of cables and capacitors. Devices like impulse generators need DC voltages as high as 100 to 200 kV.

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SOLAR BASED ELECTRIC VEHICLE CHARGING STATION

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ABSTRACT

A solar-based electric vehicle charging station harnesses solar energy through photovoltaic panels to generate electricity, offering an eco-friendly and sustainable solution for charging electric vehicles. This system integrates solar power generation, energy storage, and charging infrastructure, reducing dependency on traditional energy sources and lowering carbon emissions. Key components include solar panels, inverters, battery storage units, and EV chargers etc. Solar energy is stored during peak sunlight hours and used for vehicle charging, ensuring reliable energy availability. These stations support the transition to green transportation by minimizing environmental impact and operating costs. Utilizing solar photovoltaic (PV) panels, the station harnesses sunlight to generate electricity, reducing & minimizing carbon emissions. Energy storage systems, such as batteries, are employed to store excess solar energy, ensuring availability during low sunlight periods or peak demand. Solar EV charging stations cater to the growing EV market while addressing environmental challenges, offering a cost-effective, green alternative to traditional charging systems

Keywords: Solar energy, Electric vehicles, Photovoltaic panels, Energy storage, Sustainable transportation.

I. INTRODUCTION

A solar-based electric vehicle (EV) charging station is an innovative solution that combines renewable energy and sustainable transportation. These stations use solar photovoltaic (PV) panels to generate electricity from sunlight, which is then used to charge electric vehicles. The energy harnessed from the sun is clean, renewable, and free from greenhouse gas emissions, making it an eco-friendly alternative to conventional fossil-fuel-based charging. The setup typically includes solar panels mounted on rooftops, canopies, or open land. These panels convert sunlight into direct current (DC) electricity. An inverter is then used to convert the DC electricity into alternating current (AC), which is compatible with most EV chargers. In some cases, the system also includes a battery energy storage system that stores excess solar power, allowing charging to continue even during cloudy weather or at night.

There are generally three types of solar-based EV charging setups: on-grid, off-grid, and hybrid systems. On-grid stations are connected to the main electricity grid and can feed surplus energy back into it, often taking advantage of net metering policies. Off-grid systems are completely independent and rely entirely on solar generation and battery storage.

1.1. Need of Work:

In today's generation the number of petrol and diesel vehicles has increased this caused the stock of petrol and diesel is running out and whole world is turning towards electric technology. Also Ev's are better than

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ELECTRIC BICYCLE

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ABSTRACT

In today in world travelling is very essential for human beings in order to protract in this world. In addition, to dose his travelling should be done in minimum possible way and in jiffy. This paper details about the Electric Bike, which wins on the battery thereby providing voltage to the motor. This paper compromises with device and fabric of Electric Bicycle, which makes use of Electric energy as the primary source. There are many varieties of electric bicycles. Some of these bikes have a rechargeable This makes it easy to power the bike whenever you want. E-bikes use rechargeable batteries and the lighter varieties can travel up 50 to 60 km/h. depending on the laws of the country in which they are sold, while the more high-powered can often do in excess of 40 km/h.

Keywords: Electric Bicycle, Battery, Traffic Safety.

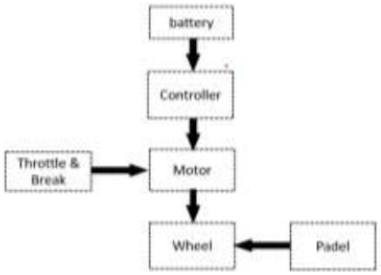
I. INTRODUTION

The term "electric vehicle" refers to a vehicle that is propelled by one or more electric motors or traction motors (EV). A self-contained electric vehicle can convert gasoline to energy using a battery, solar panels, fuel cells, or an electric generator, or it can be powered by electricity from off-vehicle sources using a collector system. E-Cycle is an electric and power-assisted bicycle that is one of the bicycle industry's fastest-growing technologies. This bicycle has an electric motor to assist you in moving forward. As a result, you can ride it like a regular bicycle while exerting less effort. An E-Cycle motor works by turning on automatically when you peddle or throttle 16 out of 30 top polluted cities in the world are in India. The air in these cities contains high levels of dangerous particulate matter, small enough to enter the human bloodstream through the lungs a problem that contributes to an estimated 7 million premature deaths each year. Irrespective of various efforts of alternative fuel and technology, emissions are not observed to be in control.

This Bicycle is designed and made in very less cost as compared to original cost, so any one can afford this Bicycle. As we know that due fuel powered vehicles, the emission of toxic gases is increasing day by day, due to this 4.3 million people.

The Regenerative method of adding a converter not only increases cost but also reduces conversion efficiency. This project proposes a DSP (digital signal processor) controlled bicycle with regenerative braking. When the system controller receives the braking signal, the motor can work as a generator, and the energy generated from braking can charge the battery. This project proposes a DSP controlled electric bicycles with regenerative braking control. The kinetic energy is converted into electric energy and stored in batteries when braking, thus improve the driving range and performance of electric bicycles.

II. BLOCK DIAGRAM



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PORTABLE AIR CONDITIONER AND HEATER

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ABSTRACT

This project focuses on developing a compact and energy-efficient portable air conditioner and heater using Peltier modules. These devices function on the thermoelectric principle, utilizing the Peltier effect to create a temperature difference when electricity flows through the module. The system combines several Peltier modules, heat sinks, fans, and a microcontroller-based control circuit for effective temperature management. Its dual-function design allows it to switch between heating and cooling modes by reversing the current through the Peltier modules. Its lightweight and compact structure, powered by a rechargeable battery, makes it suitable for personal comfort in small areas, outdoor activities, or locations without traditional HVAC systems. The prototype highlights the capabilities of thermoelectric technology for portable climate control, offering an eco-friendly alternative to conventional refrigerant systems.

Keywords: Peltier Module, Heat Sink, Exhaust Fan, Solar Panel, Charge Controller, Etc.

I. INTRODUCTION

This project aims to create a versatile, energy-efficient portable air conditioner and heater that effectively manages indoor climate for both homes and businesses. The system combines modern cooling and heating technologies for year-round use in a compact, user-friendly device. Key features include portability for easy movement, adjustable temperature settings, and environmentally friendly refrigerants to promote sustainability. The project seeks to maximize energy efficiency, reduce noise levels, and improve user experience with simple controls and smart connectivity options. Given the growing demand for flexible climate solutions, this initiative aims to provide a cost-effective, reliable, and green option for various environments. Portable air conditioners and heaters serve as adaptable appliances that offer both cooling and heating in one unit. They are perfect for spaces where permanent systems are impractical or unwanted. Portable air conditioners draw warm air from the room, cool it using a refrigeration cycle, and expel heat outside through an exhaust hose. The heater function converts electrical energy into heat, which a fan distributes evenly throughout the room.

II. METHODOLOGY

Peltier Effect:

Jean Peltier discovered that applying an electric current across the junction of two different metals causes heat to move from one metal to another. This principle is fundamental to thermoelectric refrigeration. Thermoelectric modules consist of tiny metal cubes made from dissimilar exotic metals, bonded physically and connected electrically. When an electric current runs through the junctions, heat transfers from one metal to the other. Solid-state thermoelectric modules can transfer large amounts of heat when paired with a heat-absorbing device on one side and a heat-dissipating device on the other. The internal aluminum cold plate fins absorb heat from the contents, such as food and beverages, while the thermoelectric modules transfer heat to dissipation fins under the control panel. A small fan helps disperse the heat into the air. Solid-state electrically-driven refrigerators, or thermoelectric coolers (TEC), operate on the Peltier effect: DC current flowing through a circuit made of two different conductors absorbs heat from one junction and releases it at the other.

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DESIGN AND DEVELOPMENT OF A MULTIPURPOSE AGRICULTURAL QUADCOPTER FOR PESTICIDE SPRAYING AND WILDLIFE MONITORING

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ABSTRACT

This project presents a multipurpose agricultural drone designed for efficient fertilizer spraying, equipped with an advanced animal detection system, night vision camera, and high-frequency noise emitter. The drone autonomously covers farmland, ensuring uniform spray distribution while minimizing labor and environmental impact. Integrated infrared night vision enables 24/7 operation and real-time monitoring, especially during low-light conditions. The animal detection system identifies intrusions, and the high-frequency sound module deters wildlife without causing harm. This smart solution enhances crop protection, prevents fertilizer wastage, and promotes sustainable farming practices through automation, surveillance, and intelligent deterrent mechanisms.

Keywords: Agricultural Drone, Quadcopter, Pesticide Spraying, Night Vision, Animal Detection, Precision Farming.

I. INTRODUCTION

Agriculture plays a pivotal role in the Indian economy, significantly contributing to the nation's GDP. Despite its importance, the sector is plagued by several challenges, such as pest attacks, crop diseases, and damage caused by wildlife. These issues lead to substantial crop losses each year. To mitigate these challenges, farmers often rely on the use of pesticides and fertilizers to enhance crop productivity. However, the manual application of these chemicals poses severe health risks for farmers, including skin irritations, genetic disorders, and long-term health complications.

The proposed project aims to address these concerns by developing an advanced quadcopter drone that can serve multiple agricultural purposes. This drone is designed to not only spray pesticides but also monitor crops, enhancing overall farm management.

The improved drone features a robust frame capable of supporting heavier payloads, such as a high-resolution night vision camera. This camera enables the drone to detect animal movements on fields at night, alerting farmers in real-time to prevent crop damage. With its ability to hover and navigate across large farming areas, the drone ensures thorough coverage, improving both operational efficiency and safety.

The growing concept of precision agriculture focuses on optimizing farming practices to improve yield while addressing labor-related issues and enhancing the efficiency of farming processes. Several developing countries have started to use unmanned aerial vehicles (UAVs) for precision agriculture, a practice that first gained momentum with Yamaha's introduction of UAVs for pest control and crop monitoring. However, Yamaha discontinued production in 2007. Various studies have explored UAV applications for tasks such as crop monitoring, plant height estimation, pesticide spraying, and land analysis. Despite the advances, the widespread adoption of UAVs in agriculture is limited due to factors like UAV weight, flight range, payload capacity, configuration, and cost.

Multifunctional UAVs are essential in reducing health risks associated with manual pesticide application and improving wildlife management. These drones can enhance agricultural productivity, protect crops, and promote sustainable farming practices. In the past decades, agricultural imaging technologies, such as those used by NASA for large-scale coffee plantations, have been utilized to increase crop yields. UAVs like VIPtero have proven effective for site-specific management in vineyards, capturing multispectral images within minutes. Advancements in laser technology have increased UAV flight times, and research into UAV aerodynamics has improved flight performance, enabling more precise applications.

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OPTIMAL PESTICIDE AND FERTILIZER SPRAYING SOLAR VEHICLE

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ABSTRACT

The growing demand for sustainable agricultural practices has led to the development of innovative technologies aimed at enhancing productivity while minimizing environmental impact. This paper presents the design and implementation of a solar-powered vehicle equipped for optimal pesticide and fertilizer application in agricultural fields. The vehicle integrates solar energy harvesting systems to power its operation, reducing reliance on conventional fuels and lowering carbon emissions. Equipped with sensors and smart technology, the vehicle optimizes the application of pesticides and fertilizers based on real-time data analysis of soil conditions, crop health, and environmental factors. This ensures precise resource utilization, reducing wastage and mitigating the harmful effects of over-application. The system employs GPS-based navigation and automated controls to enable efficient field coverage, enhancing productivity and reducing labor costs. The use of renewable solar energy ensures continuous and cost-effective operation, making the vehicle a sustainable solution for modern agriculture. This study highlights the potential of solar- powered automated systems to revolutionize farming practices by improving efficiency, reducing input costs, and promoting environmentally friendly operations.

Keywords: Fertilizer, Pesticide, Solar, Carbon Emission.

I. INTRODUCTION

In modern agriculture, the need for precision and efficiency in pesticide and fertilizer application is paramount. Overuse or improper application of these chemicals no only leads to environmental harm but also wastes valuable resources and can affect crop yields. Traditional methods of spraying often result in uneven distribution, runoff, and excessive chemical usage. This has led to a growing interest in automated, energy-efficient solutions that can optimize the spraying process while minimizing the ecological impact. This report introduces a cutting-edge solution: the Optimal Pesticide and Fertilizer Spraying Solar Vehicle. Powered by renewable solar energy, this autonomous vehicle is designed to apply pesticides and fertilizers in a highly efficient, precise, and environmentally friendly manner. The vehicle uses advanced technologies, including GPS-based navigation, sensor systems, and precision application techniques, to ensure that the right amount of chemicals is applied to the right areas at the right time. This results in significant reductions in chemical usage, increased crop health, and minimized environmental contamination. Furthermore, the solar-powered aspect of the vehicle ensures that it operates sustainably, reducing the carbon footprint associated with conventional fuel-powered agricultural machinery. By integrating renewable energy and smart spraying technology, this vehicle presents a promising solution for the future of sustainable farming. This report outlines the design, functionality, and benefits of the Optimal Pesticide and Fertilizer Spraying Solar Vehicle, with a focus on its contribution to sustainable agricultural practices, cost-effectiveness, and environmental preservation.

1.1. Need of Work

The optimal pesticide and fertilizer spraying solar vehicle project aims to develop an eco-friendly, efficient, and automated system for agricultural spraying. This project involves the integration of solar power technology with autonomous vehicle systems to reduce environmental impact, improve crop management, and lower operating costs. By using solar panels, the vehicle can recharge during the day, making it independent of conventional energy sources. The vehicle will be equipped with sensors and GPS technology to precisely apply pesticides and fertilizers, ensuring optimal use and reducing waste. Additionally, the system can be designed for minimal human intervention, improving safety and reducing labor costs. The project requires expertise in

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ANALYSIS OF VARIABLE FREQUENCY DRIVE (VFD)

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ABSTRACT

The design and execution of a Variable Frequency Drive (VFD) system especially suited for accurate speed control of a three-phase induction motor are described in this paper. Essentially, the system utilizes the Emn Unidrive M300 VFD model, a sophisticated device that has the capability to adjust dynamically the voltage and frequency supplied to the motor. This dual adjustment is necessary for maximizing the efficiency with which the motor operates, which will lead to significant energy savings and longer motor operating life. The selected induction motor for use in this case features a nominal speed of 1440 revolutions per minute (RPM), a rating of 3.0 horsepower (HP), and is operated using a 415V input supply. Through rigorous testing, the project convincingly demonstrates the beneficial benefits of incorporating such a system by highlighting the VFD's ability to provide responsive and efficient motor control, provide substantial energy savings, and ensure consistently smooth operation across a wide range of varying speeds.

Keywords: Variable Frequency Drive, Voltage, Frequency, Speed Control, 3-Phase Induction Motor.

I. INTRODUCTION

Variable frequency drives (VFDs), also known as frequency inverters or inverter drives, are a major innovation in modern motor control technology. By cleverly varying the frequency and voltage of the electrical power supplied to alternating current (AC) motors, these high-technology electronic devices finely control their speed This crucial capability allows AC motors to work satisfactorily at a broad spectrum of speeds, beyond the fixed-speed limitation of direct-on-line operation. Due to this, VFDs are increasingly becoming a necessity in applications with a need for accurate motor control, including industrial pumps, conveyor systems, HVAC fans, and numerous other industrial equipment. Their ability to optimize motor performance is responsible for more efficient and environmentally friendly industrial operation through enhanced process control and significant benefits in the way of energy savings and extended motor life.

VFDs are a key technology in applications that demand accurate motor control due to its dynamic control mode, which allows motors to operate well across a broad range of speeds. Due to this, VFDs are widely applied in a broad variety of industrial applications, including pumps, fans, conveyors, and numerous other pieces of machinery where accurate and adjustable motor speed is critical to achieve optimum performance and energy efficiency.

II. LITERATURE REVIEW

The concept of Variable Frequency Drives (VFDs) is not something new; in fact, it began developing decades ago in the early 1900s. Factories and industries then understood that they required a new means of controlling the speed of their devices. The existing motors back then were fixed-speed, meaning they could only operate at one constant speed, which was inefficient and not flexible enough for applications requiring varied speeds

In 1960s, and a revolution occurred with the advent of electronic drives. This was revolutionary. Engineers suddenly had at their fingertips the means to manipulate electricity with precision in a way that enabled them to control the frequency and voltage fed to a motor. Imagine it as being able to adjust a radio dial rather than just having an on/off switch. This new capability to "shape" the electrical power directly resulted in the creation and mass adoption of VFDs so that motors could now run at a variety of speeds to exactly match the task at hand.

In early 1900s. There were factories and machines that used electric motors, but they operated primarily at a single, constant speed. This was somewhat like having a car that only had one speed to drive – not very adjustable or effective, particularly when different speeds were needed for different jobs, such as a conveyor belt that would move slowly to handle sensitive objects but rapidly to handle heavy objects.

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PROJECT ANALYSIS PAPER OF BUCK BOOST CONVERTER

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ABSTRACT

A buck-boost converter is a type of DC-DC converter that can increase or decrease voltage. It combines the features of both buck (step-down) and boost (step-up) converters. This means it can give an output voltage that is either higher or lower than the input voltage, depending on how it's working. The main parts of a buck-boost converter are an inductor, a switch (like a MOSFET), a diode, and a capacitor. It works by storing energy in the inductor when the switch is on, and then releasing that energy when the switch is off. The output voltage is controlled by adjusting how long the switch stays on—this is called the duty cycle. **Buck-boost converters** are used in devices like **power amplifiers**, **power supply units**, and **renewable energy systems** (like **solar panels**) to control and adjust voltage. They are efficient and compact, but can be tricky to control and may produce voltage ripples (small fluctuations). Overall, they are a useful and flexible way to manage voltage when the input voltage changes.

Keywords: DC-DC Converter, Step-up/Step-down, Inductor, Diode, Switch, Capacitor.

I. INTRODUCTION

In electronics, DC-DC converters are used to control voltage levels for different devices. One special type of converter is the Buck-Boost converter, which can both increase and decrease voltage. This makes it very flexible and useful. It can keep the output voltage steady even if the input voltage goes higher or lower than what's needed—a common issue in many real-life situations. The Buck-Boost converter works by using parts like inductors and capacitors to store energy, along with switches and diodes to control how that energy flows. One of its biggest advantages is that it can give a stable output voltage whether the input voltage is too high or too low. Because of this, it's perfect for things like battery-powered devices, solar energy systems, and power supplies that need to handle a wide range of input voltages. In this report, we'll look at how the Buck-Boost converter works, how its parts are chosen and designed, and what we learn from simulations and real-world testing. This will help us fully understand how it works and where it can be used.

II. METHODOLOGY

The methodology for designing and implementing a Buck-Boost converter typically involves a series of steps that range from theoretical modeling to practical implementation, followed by testing and optimization. Below is an outline of the general methodology for designing a Buck-Boost converter:

Problem Definition & Specification

- Define Input and Output Specifications:

o Determine the input voltage range (e.g., from 5V to 15V) and desired output voltage (e.g., 12V). A **Buck-Boost converter** must keep the **output voltage steady**, whether the **input voltage is higher or lower** than the output.

o Define the output current or power requirements for the specific application (e.g., 5A, 10W).

- Identify Key Constraints:

o Consider the required efficiency, size, cost, and thermal limits based on the application (e.g., portable electronics, renewable energy systems).

Topology Selection & Circuit Design

- Choose the Converter Topology:

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IOT Based Controlled Smart Distribution Box

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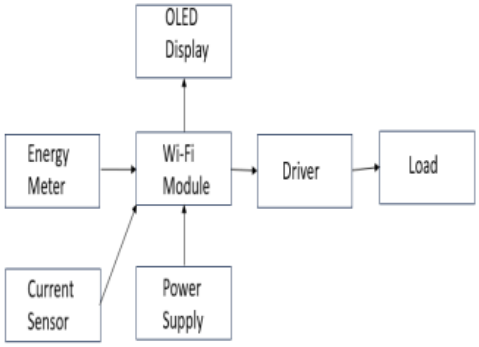
Abstract: ***This project introduces an IoT-controlled smart distribution box designed for enhanced energy management and convenience, boasting versatile features for both online and offline usage. Utilizing a NodeMCU microcontroller unit, the system integrates a 4-channel relay for load management via voice commands (Google Assistant, Amazon Alexa), manual switches, and programmable timers and schedules. An LCD 2004 display provides real-time feedback, while a PZEM004T sensor enables precise energy monitoring. Users can also set load limits, with notifications sent when thresholds are reached, further enhancing efficiency and safety. With these comprehensive capabilities, the system empowers users to optimize energy usage, promote sustainability, and simplify control of electrical appliances in residential and commercial settings.***
Keywords: IOT controller, Overload protection, Abnormal condition, Display monitoring in smart phone.

I. INTRODUCTION

In this project, we will implement a smart meter that will compute the power consumption and communicate with the control office over the internet. Also, it will have the capability to disable some of the loads based on the current electricity price and demand. The current electricity distribution and metering infrastructure faces significant challenges, including a lack of real-time data hindering efficient grid management and load forecasting for utility providers, costly and error-prone manual meter reading, limited remote monitoring and control capabilities, difficulties in implementing demand-side management programs, vulnerability to energy theft, inefficient outage management, and high operational costs. For consumers, this translates to a lack of transparency in energy consumption, potential for inaccurate billing, delayed outage information, limited control over energy usage, and difficulty in participating in demand response initiatives.

II. DESIGN AND IMPLEMENTATION

For college purposes, the IOT based controller and overload protection was built with more responsible activities. It is used in academic schedules most frequently in related ways. We followed these studies and developed a kit after studying research papers.



III. SETUP CONFIGURATION

1) Energy Meter

- Function: Measures the energy consumption (voltage, power, energy units).
- Configuration:
  - Interface with a microcontroller or Wi-Fi module via UART, SPI, or I2C.
  - Calibrate for accurate readings (e.g., set voltage/current scaling factors).
  - Ensure safety and isolation when interfacing with high-voltage systems.

