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A Cost Effective Approach to Design A Portable Mobile Charging Device using Wind Energy

S. Harivardhagini
Professor, CVR College of Engineering/EIE Department, Hyderabad, India
Email: harivardhagini@cvr.ac.in

Abstract: **Renewable energy is energy from renewable resources that are naturally replenished on a human timescale. Renewable resources include sunlight, wind, the movement of water, and geothermal heat. This project is designed to create a portable mobile charging device that is chargable through wind energy. This portable device system utilizes a small, lightweight wind turbine that can be easily carried or attached to various objects, such as backpacks or bicycles, to harness the power of wind and convert it into electrical energy. The generated energy is stored in a portable battery pack, which can be used to charge mobile devices, such as smartphones, tablets, or other USB-powered devices, anytime and anywhere. This project also discusses the performance evaluation of our system, including the power output, charging time, and energy efficiency, under different wind conditions and usage scenarios. Our project helps in accessing affordable, reliable, sustainable energy which in turn assists in achieving the 'sustainable development goal 7[SDG], that is ensuring access to affordable and clean energy'. This technology has the potential to provide a reliable and eco-friendly energy source for mobile devices, reducing the dependence on traditional electricity sources and contributing to a greener and more sustainable future.**

Index Terms: **Renewable Energy, Wind Energy, Sustainable Development, Portable, Affordable & Reliable Energy**

I. Introduction

In today's world, mobile phones have become an essential part of our daily lives and keeping them charged all the time is crucial. However, in many remote areas or during outdoor activities, access to a stable power source for mobile charging can be limited. This project aims to develop a portable mobile charging system that utilizes wind energy to provide a sustainable and convenient solution for charging mobile devices on-the-go. In recent years, there has been a growing global concern regarding the environmental impact of conventional energy sources, such as fossil fuels. The increasing demand for energy, coupled with the urgent need to mitigate climate change, has spurred extensive research into harnessing renewable energy as a sustainable path to power the future. This literature review aims to provide an overview of key findings from five relevant papers published in reputable journals, highlighting the advancements and challenges in the field of renewable energy. Overview of the global energy crisis and climate change concerns. Need for renewable energy sources to mitigate environmental impact. Importance of sustainable energy solutions for a sustainable future. Types of Renewable Energy Sources are Solar energy: Photovoltaic and solar thermal systems. Wind energy: Onshore and offshore wind turbines. Hydropower: Conventional hydroelectric plants and small-scale hydropower. Biomass energy: Conversion of organic matter into biofuels. Geothermal energy: Utilizing heat from the Earth's interior. Tidal and wave energy: Harnessing the power of ocean currents and waves. As the global demand for energy continues to rise, the need for sustainable and clean sources of power has become increasingly urgent. Harnessing renewable energy has emerged as a promising solution to meet this demand while reducing the environmental impact of traditional fossil fuel-based energy systems. This literature review aims to explore the current state of research on harnessing renewable energy and its potential to power the future sustainably. By analyzing and synthesizing findings from five selected papers, this review provides valuable insights into the advancements, challenges, and future prospects of renewable energy technologies. Harnessing renewable energy has emerged as a critical solution to address the challenges posed by climate change and the limited availability of fossil fuels. This synopsis provides an overview of the current state of renewable energy technologies, their benefits, and the challenges associated with their implementation. It explores various sources of renewable energy, including solar, wind, hydroelectric, biomass, and geothermal, highlighting their potential as sustainable alternatives to conventional energy sources. The synopsis examines the significant environmental advantages offered by renewable energy, such as reduced greenhouse gas emissions, improved air quality, and minimized ecological impact. It emphasizes the potential for renewable energy to contribute to global efforts in mitigating climate change, achieving energy security, and promoting sustainable development. Furthermore, the synopsis delves into the technological advancements and innovations driving the growth of renewable energy systems. It discusses key components such as solar panels, wind turbines, hydroelectric generators, and biomass conversion technologies, shedding light on their efficiency, reliability, and scalability. The role of energy storage systems and smart grids in integrating intermittent renewable sources into the existing energy infrastructure is also explored. Despite the numerous advantages, several challenges hinder the widespread adoption of renewable energy. This synopsis highlights the economic barriers, including initial installation costs and intermittency issues, as well as the need for supportive policies and incentives to facilitate the transition towards renewable energy. The role of research and development in improving efficiency, cost-effectiveness, and energy storage technologies is also emphasized. The synopsis concludes by emphasizing the need for a comprehensive and integrated approach to harnessing renewable energy. It highlights the

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importance of collaboration between governments, industries, and research institutions to drive innovation, policy formulation, and investment in renewable energy projects. By leveraging the potential of renewable energy sources, societies can pave the way for a sustainable, clean, and resilient energy future, while mitigating the adverse impacts of climate change and promoting environmental stewardship.

II. Literature Survey

This paper presents a design and implementation of a small-scale low speed wind power based portable mobile phone charger. The implementation includes a savonius wind turbine and a controller.[1]

In this work, the researcher came up with a solution of maintaining sustainability of energy stored in the phone battery exploration that has been carried out with mobile phones. This concept utilizes wind generated electrical Energy to charge the mobile phone's battery. The model consists of four main components that are propeller, generator, chip integrated on PCB, and mobile set suitable charging pin. [2]

In this paperwork they develop a small compact and easy to carry mobile charger which utilizes wind energy to charge mobile phones with ease during travelling. It minimizes the dependability on conventional chargers. It utilizes a fan connected to a DC generator, a bridge rectifier which minimizes fluctuations. It works effectively between vehicle/wind speed of 40kmph and 80kmph. It can be easily installed in the window of the car/bus/train etc. and the mobile phone can be charged directly. [3]

In their paperwork, wind energy is used to get 6V with the help of generator and solar energy is used to 8 V with the help of solar panel. The proposed charger will solve the problem of mobile charging during traveling, power cut and non-availability of power in remote areas. [4]

A prototype of battery charger is developed for application with mobile phones as an example to address the design considerations, plus demonstrates the performance of the charger adapted to a practical application system. This mobile charger is better than normal mobile charging as it uses wind power as a renewable energy source. [5]

III. Design And Implementation

In today's fast-paced digital age, mobile devices have become an integral part of our lives, providing us with constant connectivity and access to a plethora of information and services. However, the ever-increasing reliance on these devices often leads to a common problem - limited battery life. This issue is particularly challenging in situations where a power source is not readily available, such as during outdoor activities, emergencies, or in remote areas. To address this problem, harnessing renewable energy sources has emerged as a viable solution. Among these sources, wind energy stands out as a promising option due to its abundance and accessibility in various environments.[6] [7].

Portable mobile charging systems that utilize wind energy present a compelling solution, [8] [9] [10] allowing users to recharge their mobile devices on the go while simultaneously leveraging a clean and sustainable energy source. The design and implementation of a portable mobile charging system powered by wind energy requires careful consideration of various factors. These include the efficiency of energy conversion, the portability and durability of the system, and the user experience. This synopsis aims to explore the design and implementation aspects of a wind-powered mobile charging system, discussing the key components, technologies, and considerations involved in its development. By utilizing wind energy, not only can we extend the battery life of our mobile devices, but we can also reduce our carbon footprint and promote the adoption of renewable energy solutions. [11] [12] This paper delves into the intricacies of designing an efficient and practical wind-powered mobile charging system, presenting a sustainable and portable solution for powering our devices in diverse settings.

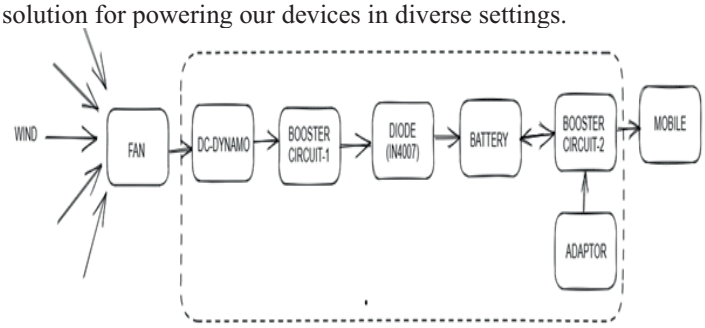

Figure 1. Block diagram of portable mobile charger using wind energy

Figure 1 represents the block diagram presents an efficient and self-sustaining portable mobile charging system that harnesses wind energy through a fan and DC-dynamo, regulates the output voltage using a booster converter, and incorporates a battery to store and supply power to charge mobile devices. With this innovative solution, users can stay connected and charge their devices anytime, anywhere, relying on clean and renewable wind energy. [13] [14] [15]

The portable mobile charging system using wind energy consists of the following key components:

1. Wind Fan
2. Dc-Dynamo
3. Booster Converters
4. Diode
5. Battery
6. Adapter
7. Load (Mobile)

Below is a detailed description of each block in the diagram:

1. Wind Fan:

The project begins with a wind fan, which serves as the primary source of wind energy. The fan is designed to capture the kinetic energy from the wind and direct it towards the DC dynamo. The size and shape of the fan are optimized for portability and efficient energy capture, making it suitable for on-the-go use.

2. DC-Dynamo:

The wind fan is connected to a DC-dynamo, also known as a small-scale wind turbine generator. The DC-dynamo's main function is to convert the mechanical energy from the rotating fan blades into electrical energy in the form of direct current

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(DC). As the wind spins the fan blades, the dynamo's internal coils and magnets generate an electric current.

3. Booster Converter:

The output of the DC-dynamo generates variable voltage levels depending on wind speed. To ensure a stable and optimal charging voltage for mobile devices, a booster converter is incorporated into the system. The booster converter regulates the incoming DC voltage, stepping it up or down as necessary, to provide a consistent output voltage suitable for charging mobile devices efficiently.

4. Diode:

In the charging circuit, a diode is placed to prevent any reverse current flow from the battery to the generator during low wind speed or no wind conditions. This ensures that the battery remains charged and ready to supply power to the mobile device when required, without wasting energy back to the generator.

5. Adapter:

The regulated output from the booster converter is connected to an adapter, which acts as an interface between the charging system and the mobile device. The adapter typically includes USB ports or other standard charging connectors to support various mobile devices, such as smartphones and tablets.

6. Battery:

To provide a continuous power supply even in the absence of wind or during periods of low wind, the system includes a battery. The battery stores the excess electrical energy generated by the DC-dynamo and the booster converter. During periods of low wind or when the mobile device is actively drawing power, the battery discharges its stored energy to ensure a consistent charging experience for the mobile device.

Figure 2 shows the schematic of portable mobile charger using wind energy. The connections of the setup is seen in the same. Figure 3 shows the flowchart of the process. The user unfolds the wind turbine and secures it in an open area with sufficient wind flow. As wind flows through the turbine blades, they rotate, generating mechanical energy. The rotating motion of the turbine's shaft drives the generator, converting mechanical energy into electrical energy. The generated electrical energy is stored in the battery pack, ensuring a constant power supply for charging mobile devices. Users connect their mobile devices to the USB charging ports provided by the system.

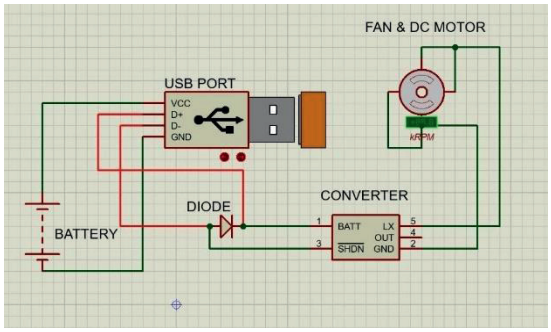

Figure 2. Schematic of the portable mobile charger using wind energy

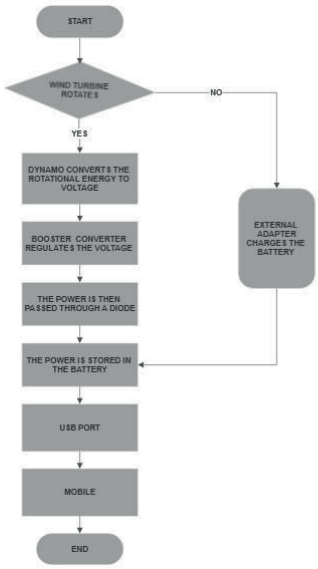

Figure 3. Flowchart of the process

The regulated electrical energy from the battery pack is used to charge the connected devices. The figure 4 depicts the prototype of the system. It was successfully operated to get the required output.

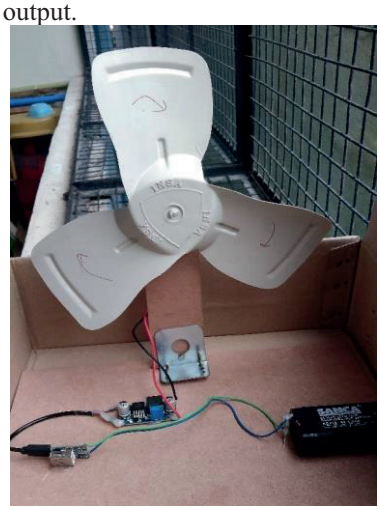

Figure 4. Prototype of the process

IV. Result

Figure 5 shows the mobile charging rate with the wind charger and the conventional charger are monitored and compared for every 5 min and recorded. The details are mentioned in the table below.

S. No	TIME (in Min)	CHARGE BY WIND CHARGER (in %)	CHARGE BY CONVENTIONAL CHARGER (in %)
1	5	1	3
2	10	2	8
3	15	4	13
4	20	8	17
5	25	12	23
6	30	15	28

Figure 5. Mobile Charging Percentage with Time (in min)

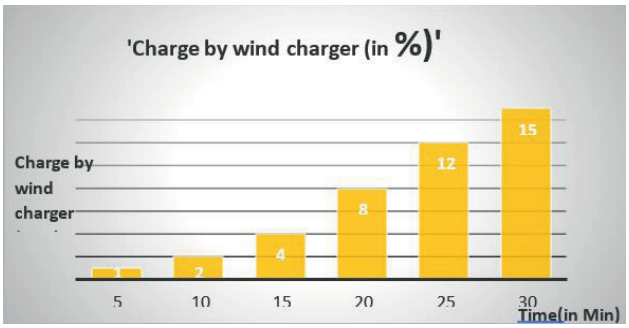

Figure 6. Mobile Charging using wind energy in percentag &time (in min)

The figure 6 shows the graph of rate of charging of wind based charger with respect to time. Figure 7 shows the comparison of Mobile Charging Rate for Wind charger & Conventional Charger Vs Time (in min)

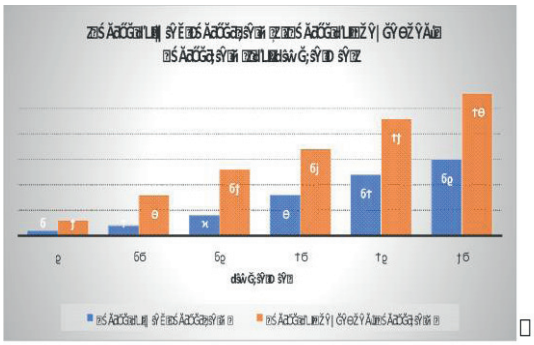

Figure 7. Mobile Charging Rate for Wind charger & Conventional Charger Vs Time(in min)

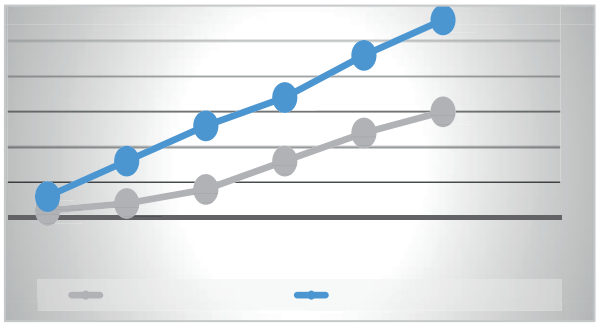

Figure 8. Trends Between Charging Rate of Wind Charger and Conventional Charge

The above graph in figure 8 clearly describes the difference between the charging rates of both the Wind Powered charger and the Conventional Charger. However, the conventional charger charges the mobile quickly. But it works with the help of electric power. Where the Wind -Powered charger harness the wind energy, which is a natural resource to charges the mobile. Thus, this portable wind-powered charger provides a sustainable and eco-friendly method to charge electronic devices.

V. Conclusions

The use of wind energy for portable mobile charging presents an innovative and sustainable solution to address the increasing demand for mobile power [16]. By utilizing wind power, we can reduce our reliance on traditional energy sources and contribute to a greener future. Portable wind turbines offer a flexible and convenient way to generate electricity, [17] [18] enabling users to charge their mobile devices even in remote locations or during outdoor activities. Wind power is an abundant and inexhaustible energy source that does not produce harmful emissions or contribute to climate change. Furthermore, the use of wind energy for portable mobile charging promotes energy independence [19] and empowers individuals to take control of their power needs. With the advancements in technology, portable wind turbines have become more efficient, compact, and affordable, making them accessible to a wider range of users.[20] However, it is important to acknowledge the challenges associated with portable wind charging, such as the variability of wind resources and the need for appropriate wind conditions for optimal charging efficiency. It combines the benefits of renewable energy with the convenience of portable technology, paving the way for a cleaner and more environmentally conscious future.

The utilization of wind energy for portable mobile charging has gained significant momentum in recent years [21] [22]. As we look towards the future, there are several exciting possibilities and potential advancements in this field. Here are some future scopes for portable mobile charging using wind energy:

1. Technological Improvements: With ongoing advancements in renewable energy technology, we can expect the development of more efficient and compact wind energy harvesting devices specifically designed for portable mobile charging. These devices may incorporate innovative materials, enhanced aerodynamic designs, and optimized power conversion systems to maximize energy generation.
2. Miniaturization and Integration: Future developments may lead to the miniaturization and integration of wind energy harvesting technologies into portable mobile charging solutions. This could involve the incorporation of small wind turbines directly into mobile devices or the development of compact wind energy harvesting accessories that seamlessly integrate with smartphones and other portable electronics.
3. Energy Storage Solutions: One of the key challenges in portable mobile charging using wind energy is the intermittent nature of wind resources. Future research may focus on improving energy storage technologies, such as advanced batteries or supercapacitors, to efficiently store excess energy generated by wind turbines. This would enable continuous and reliable charging of mobile devices, even when wind resources are limited.
4. Hybrid Energy Systems: The integration of multiple renewable energy sources into hybrid energy systems holds great potential. In the future, we may witness the combination of wind energy harvesting with other renewable sources like solar or kinetic energy to create more robust and efficient portable charging solutions. Such hybrid systems could offer greater charging capacity and increased reliability, ensuring uninterrupted power supply for mobile devices.

5. Application Diversification: As the technology matures, portable mobile charging using wind energy could find application beyond personal devices. Industries such as outdoor recreation, emergency response, and remote areas with limited access to electricity could benefit from ruggedized and efficient wind energy-based charging solutions. These could include portable charging stations for multiple devices or specialized chargers for specific purposes, catering to a wide range of user needs.

6. Environmental Impact: In the future, there may be a greater emphasis on sustainable and environmentally friendly solutions. Portable mobile charging using wind energy aligns well with this objective, as it harnesses a clean and renewable energy source. As awareness and demand for eco-friendly technologies increase, the future scope of wind energy-based mobile charging could expand significantly.

The future of portable mobile charging using wind energy holds immense potential for technological advancements, miniaturization, integration, energy storage solutions, hybrid energy systems, application diversification, and environmental impact. These developments will not only enhance the convenience and reliability of portable charging but also contribute to a more sustainable and greener future.

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