Motorcycle-Mounted Wind Turbine Phone Charger

A Mini-Research Project
In partial fulfillment of the requirements for
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ADVISER'S CERTIFICATION

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ABSTRACT

In the digital era, smartphones are indispensable for communication, navigation, and entertainment, yet their reliance on finite battery life remains a persistent challenge, particularly for motorcycle delivery riders with limited charging infrastructure. Portable chargers offer a temporary solution but often require pre-charging, reducing their practicality for extended travel. To address this, a Motorcycle-Mounted Wind Turbine Phone Charger was developed, leveraging wind energy to provide a sustainable and independent power source. This study explores the design, construction, and testing of a prototype utilizing a 12V DC motor, mini fan blades, a 220 μF capacitor, and a USB connector, integrated into a PVC pipe and mounted on a motorcycle phone holder. The device operates on the principle of wind-induced mechanical rotation converting into electrical energy, with the capacitor stabilizing output for charging. Initial trials encountered challenges, with the first two attempts failing due to insufficient wind speed or circuit calibration issues. However, the third trial succeeded, particularly after incorporating a built-in battery system to supplement inconsistent wind power. Findings align with existing research, such as Lim's (2020) study, which emphasized the need for minimum speeds of 75 km/h for effective wind charging. The inclusion of a capacitor for energy buffering and a hybrid battery system highlights the importance of energy storage in intermittent renewable applications. While the prototype demonstrated viability, its efficiency depends on consistent wind exposure and system optimization. This study confirms the feasibility of wind-powered mobile charging for motorcycles, particularly in Dumaguete City where charging infrastructure is sparse due to repeated power service interruption. Future improvements—such as enhanced turbine aerodynamics, better energy storage, and optimized mounting positions—could increase reliability. The project underscores the potential of small-scale renewable energy solutions in promoting sustainability and convenience for mobile users, offering a foundation for further innovation in portable green energy technologies.

Keywords: Wind turbine charger, renewable energy, portable charging, motorcycle-mounted charger, sustainable technology.

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CHAPTER I

INTRODUCTION

1.1 Background of the Study

The booming food delivery scene in Dumaguete City, while convenient for residents, has created a significant hurdle for its dedicated riders: smartphone battery drain. These devices are their mobile offices – crucial for navigation, accepting and managing orders, and keeping in touch with customers and dispatchers. When a phone dies, it's not just an inconvenience; it's a direct hit to their livelihood, leading to missed orders, frustrated customers, and lost income. Current charging methods just don't cut it. Power banks offer temporary fixes, but they too run out, while stationary charging means valuable time off the road, eating into their earnings. This pressing need for a continuous, on-the-go power solution for riders in Dumaguete points to an exciting opportunity: harnessing wind power generated by the motorcycles themselves.

This is where the concept of a motorcycle-mounted wind turbine phone charger comes in. Imagine converting the very air resistance a rider experiences into usable electricity to keep their phone powered. This innovative approach offers a sustainable and practical answer to a pervasive problem. The feasibility study for such a device in Dumaguete would be comprehensive, diving into several key areas. We'd need to consider aerodynamic design, exploring various micro-turbine shapes and materials to efficiently capture wind energy across different speeds, from stop-and-go city traffic to more open roads. Next, the focus shifts to energy conversion and storage, determining the best ways to transform the turbine's mechanical energy into stable electrical current, perhaps incorporating a small battery or super capacitor to smooth out power delivery. A crucial component would be a smart charging management system to safely and efficiently charge a variety of smartphones, protecting against overcharging and ensuring optimal power output. Beyond the technical aspects, we'd also rigorously assess the ergonomics and safety of the device, ensuring it's compact, durable, weather-resistant, and doesn't interfere with the motorcycle's handling. Finally, a thorough cost-benefit analysis would highlight the economic advantages for riders – more deliveries, less downtime – alongside the significant environmental benefits of adopting a renewable energy source in Dumaguete's bustling gig economy. This study isn't just about a gadget; it's about empowering Dumaguete's delivery riders with a self-sufficient, eco-friendly power source that could revolutionize their work and contribute to a greener urban landscape.

1.2 Statement of the Problem

Food delivery riders in Dumaguete City face significant difficulties keeping their smartphones charged during long shifts. This persistent issue directly impairs their operational efficiency, affecting their ability to promptly accept new orders, accurately navigate to customer locations, and maintain crucial communication with both customers and dispatch. Consequently, this leads to lost income opportunities for riders, delayed deliveries, and diminished service reliability for consumers. Conventional charging methods, such as reliance on power banks or stationary charging points, are often impractical, requiring frequent stops, offering limited power reserves, or simply being inconvenient for on-the-go professionals. These existing solutions fail to meet the continuous power demands of a full delivery shift, highlighting a critical gap in support for this vital segment of Dumaguete's gig economy.

This study aims to address the following interconnected problems:

1. **How can riders maintain smartphone battery life efficiently and continuously while actively on the move during their delivery shifts in Dumaguete City?** This problem seeks to identify and propose a sustainable, non-disruptive method of power generation that integrates seamlessly with their work.
2. **Is a motorcycle-mounted wind turbine charger a viable and effective solution for sustainable energy generation to power smartphones on the go?** This delves into the technical feasibility of converting kinetic wind energy, generated by motorcycle movement, into usable electrical power sufficient for smartphone charging, evaluating its practical output and reliability.
3. **What are the key technical, economic, and practical challenges associated with the design, implementation, and widespread adoption of a motorcycle-mounted wind turbine charging system for food delivery riders in Dumaguete City?** This problem aims to uncover potential hurdles related to turbine efficiency, energy storage, device integration, cost-effectiveness, durability in local conditions, and user acceptance, while also considering regulatory and environmental factors.

1.3 Research Objectives

1.3.1 General Objective:

1. To design and evaluate a motorcycle-mounted wind turbine phone charger for food delivery riders in Dumaguete City.
2. Primarily for USB-charged smartphones and may not support high-power devices.
3. Lastly, the geographical focus is limited to Dumaguete City's specific road and traffic conditions, which may affect the generalizability of the findings.

***1.3.2 Specific Objectives**:*

1. To assess the wind energy potential generated by motorcycle movement in urban and semi-urban routes.

2. To develop a prototype wind turbine charger compatible with common motorcycle models used by riders.

3. To test the charging efficiency of the device under different riding conditions (speed, distance, weather).

4. To evaluate the cost-effectiveness and user acceptability among food delivery riders.

5. To propose recommendations for scaling and commercializing the technology.

1.4 Significance of the Study

- For Food Delivery Riders: Provides a reliable, eco-friendly charging solution, reducing dependency on power banks and stationary charging.

- For the Delivery Industry: Enhances operational efficiency by minimizing service interruptions due to dead phone batteries.

- For Renewable Energy Adoption: Promotes the use of small-scale wind energy in urban mobility.

- For Local Government: Supports sustainable transport initiatives in Dumaguete City.

- For Future Research: Serves as a foundation for improving portable renewable energy solutions.

1.5 Scope and Limitations

This study focuses on food delivery riders operating in Dumaguete City, evaluating the feasibility of wind energy conversion using a small turbine mounted on motorcycles. The prototype will be tested under real-world riding conditions, including city traffic and highway speeds, to assess its performance. Key measurements will include charging metrics such as voltage, current, and the time required to charge standard smartphones.

However, the study has several limitations. First, charging efficiency may vary depending on wind conditions, making the system weather-dependent. Second, optimal charging performance may require sustained motorcycle speeds between 30 to 60 km/h. Additionally, the initial prototype could have higher production costs compared to conventional chargers, posing a potential cost constraint. The system is also designed primarily for USB-charged smartphones and may not support high-power devices.

CHAPTER II

REVIEW OF RELATED LITERATURE

2.1 Related Literature

2.1.1 Traditional Charger

The first mobile phone in history was released by Motorola in 1983. The name of the phone was the Motorola DynaTac 8000X. Since the mobile phone was then invented, so as well as chargers. So these chargers are necessary in order for a mobile phone to maintain its battery life (SHARGE, n.d.). The company of Nokia introduced Nokia 1011 in 1992. The phone contained a 900 mAh battery capacity. And the battery was made of nickel-cadmium that allowed for 12 hours of standby in 90 minutes of call time. The cable and plug of the charger was inseparable so if the charging wire was broken, it was not directly replaceable. The focus during this period was to find an alternative solution that forms a battery charging dock, which allows users to charge their batteries by inserting them into a charging slot (SHARGE, n.d.).

Standardization of the Universal Serial Bus (USB) marked a major shift in charging technology. First created in 1994 and commercially available as USB 1.0 in 1996 for computer accessories, USB soon showed its adaptability by offering electricity as well. Since its introduction in 2000, USB 2.0 has become the de facto standard for charging a wide range of tiny electronic devices, including cell phones, thanks to its enhanced data transfer speeds and standard power output of 5V at 500mA (Smoot, 2022). In 2003, due to lack of standardization, there were varieties of phones with different charging interfaces. In this period universal charges were invented to enable portability. In 2007, Apple's iPhone revolutionized the charger market with the introduction of non-removable batteries, leading to fierce competition and the dominance of chargers with detachable heads and cables, as standardized standards were enacted worldwide (SHARGE, n.d.).

2.1.2 Power Bank

In 2001, a group of college students showcased a basic portable charger created from AA batteries and a straightforward control circuit at the Consumer Electronics Show (CES) in Las Vegas, signifying the start of the power bank's evolution. This prototype represented a significant conceptual advancement, proving that portable energy storage could be practical beyond professional applications, despite the inventors remaining unidentified (Bellucci, 2024). When Zhao, the creator of the Chinese electronics brand Pisen, designed what is widely regarded as the first commercially successful power bank in 2004, it represented a remarkable innovation. The "Mini Power Bank," which Pisen developed, was intended to support the "7+2" Chinese Antarctic Expedition. It enabled researchers to charge their digital cameras using only two AA batteries in extremely low temperatures. This model, a refinement of earlier CES ideas, marked the evolution of power banks to satisfy practical needs (Brease, 2023; Studocu, 2023). Aigo, Anytone, and Huaqi, particularly known for their "Engine

Compartment" series, were some of the Chinese technology firms that began offering power banks for consumer use during the years 2004 to 2006. Although these initial models were limited in size and capacity, they found success in the growing market catering to mobile device users (SWICAID, 2023; Bellucci, 2024). The launch of the iPhone in 2007 heightened consumer interest in mobile power options. For most users, the initial iPhone's battery life of four hours was inadequate. This surge in demand led around 50 brands to enter the power bank industry to provide portable battery solutions. Companies such as Anker and Aukey began to expand during this time (Zolanvari, 2022; SWICAID, 2023).

The introduction of lithium-ion batteries, a field advanced by Nobel Prize laureates John B. Goodenough, M. Stanley Whittingham, and Akira Yoshino, represented a remarkable technological progress that propelled this sector. Their breakthroughs in the 1980s and 1990s allowed consumer electronics to utilize lightweight, high-capacity, and rechargeable batteries. By 2010, lithium-ion and lithium-polymer batteries were extensively employed in the manufacturing of power banks (NobelPrize.org, 2019; GP Batteries, 2024).

During the period from 2009 to 2012, the market for power banks surged, with over 500 brands producing these devices. Features such as dual USB ports, LED indicators, and capacities surpassing 10,000 mAh led to rapid advancements in design. Researchers like Bellucci and Zolanvari refer to this period as the "power bank boom" era, a time when aesthetics and functionality were adapted for a swiftly evolving mobile landscape (Zolanvari, 2022; Bellucci, 2024).

By 2016, innovative features for power banks began to emerge. The incorporation of USB-C Power Delivery and Qualcomm Quick Charge standards greatly enhanced charging speeds. Premium models now include solar panels and Qi wireless charging, which promote greater environmental sustainability and convenience. This technological advancement was led by companies such as Anker, RAVPower, and Xiaomi (GP Batteries International, 2024). Recent advancements, such as graphene batteries, offer faster charging times and enhanced thermal stability and have recently been launched (2022–2025). Magnetic wireless power banks compatible with Apple's MagSafe standard have gained popularity due to their secure alignment and compact size. At the same time, companies have begun to appeal to environmentally conscious consumers by emphasizing the use of sustainable materials, AI-based battery monitoring, and intelligent safety circuits (GP Batteries, 2024; TechNews China, 2024).

2.1.3 Renewable Energy and Wind Turbine

People have known for thousands of years that they may utilize the wind to power things like ships, water pumps, and even wood saws. About 10% of all energy produced in the US comes from wind, making contemporary wind power and other renewable energy sources the fastest-growing energy sources in the world today (Hu, 2024). Bianchini 2022 claims that a resurgence of interest in small wind turbines (SWTs) is supporting the development of smart grids and the energy transition. Off-grid power is one of the many uses for smaller wind turbines. They can be used directly to charge a storage battery or in conjunction with another generation method to provide power during sporadic periods when wind is scarce or nonexistent (CTN, nd). The electrical transmission system is not connected to off-grid wind turbines. These are typically placed in remote locations where it would be costly to connect to the grid. Direct current (DC) is used by the most basic off-grid systems to power remote items like water pumps and telephone equipment. When the wind isn't blowing, these straightforward devices might rely on battery storage for backup power. An off-grid system can be made grid-compatible by incorporating an inverter to convert electricity to alternating current (AC), which enables the turbine to power AC equipment (Windustry, 2025). A wind turbine with a rotor diameter between 50 and 100 meters is considered large size. It generates one to three megawatts of power. Small wind turbines are defined as those with a rotor diameter between 3 and 10 meters and a power capacity between 1.4 and 20 kW, in contrast to large wind turbines (Tumala et al, 2016).

2.2 Related Studies

Innovative research has begun exploring motorcycles as platforms for renewable energy harvesting. A wind turbine installed on a motorcycle was designed in the study by Bad An et al. (2023), but the original design was unable to charge the phone that was mounted on it, which suggests that the power generated was insufficient for direct charging of the mobile phone. One of the study's main recommendations was to include a battery in the aforementioned design. This serves to store the energy produced by the little wind turbine and guarantee continuous phone charging even in less favorable wind conditions. According to the specific recommendations they received in their survey, respondents pointed out several areas that needed improvement, such as adding a battery, making sure the phone is properly attached to the motorcycle, giving the product color variation, and making it smaller.

According to research by Abdulla et al. (2018), a legion meter is used in place of a storage device in a portable wind mill designed to charge mobile phones. An electric generator that can provide a large amount of power at a lower RPM was linked to the wind turbine. The electric generator could only generate between 0.4 and 0.5 amps during testing, which is insufficient to charge any devices. In order to increase the electric generator's output, the designer included a legion meter. The voltage and power ranges of a legion meter are 3 to 6V and 22.2 watts, respectively. A legion meter's circuitry includes a boost converter, sometimes referred to as an amplifier. This gives the input a five-fold boost. The legion meter's gain changed according on the outcomes. For several kinds of mobile phones. This is because the legion meter's power rectifier restricts the amplification according to the necessary output. By preventing excessive power, this technology shields the linked gadget from harm. The legion meter generated gains between 10 and 92 (Abdulla et. Al, 2018).

CHAPTER III

METHODOLOGY

3.1 Research Design

This research project aims to design and evaluate a sustainable charging solution for food delivery riders in Dumaguete City by developing a motorcycle-mounted wind turbine phone charger. The core problem addressed is the significant difficulty riders face in keeping their smartphones charged during long shifts, which directly impacts their operational efficiency, affecting their ability to accept orders, navigate, and communicate. Conventional charging methods, such as power banks or stationary charging points, are often impractical or insufficient for continuous, on-the-go use. This study proposes a motorcycle-mounted wind turbine charger as a viable alternative.

The practical construction of the Motorcycle-Mounted Wind Turbine Phone Charger involves a straightforward assembly process, focusing on key electrical and mechanical integrations for a proof-of-concept prototype.

3.2 Materials used and Functions:

Materials	Figures	Functions
12 Volts DC Motor with Mini Fan Blades		This component acts as the miniature wind turbine itself. When the mini fan blades, attached to the DC motor's shaft, are spun by external force (wind), the DC motor functions as a generator, producing a voltage. This is the primary mechanism for converting wind energy into electrical energy.
Electrical Wire		These are insulated wires used to create the necessary electrical connections within the circuit of the phone charger. They connect components like the capacitor, USB connector, and the DC motor.

220 μF Capacitor		A capacitor with a capacitance of 220 microfarads (μF). In this circuit, the capacitor serves as a simple energy buffer and filter. Its role is to somewhat smooth the intermittent power output generated by the wind turbine before it reaches the USB connector, providing a more stable electrical flow for charging.
Female USB Connector		This is a standard 5V connector where the user will plug in their smartphone's charging cable. It's the interface through which the generated electrical power is delivered to the phone.
1in. PVC Pipe		A 1-inch PVC pipe serves as the support structure and casing for the internal circuit components, including the battery. It helps to house and protect the electrical components of the charger.
Motorcycle Phone Holder		This component acts as the mount base for the PVC pipe and, consequently, the entire charging system, allowing it to be firmly attached to the motorcycle. It also provides a place for the phone to be held securely while charging.

3.7V Lithium-Ion Battery *(2 Pieces)*		These are two 3.7-volt Lithium-Ion batteries. They are crucial for supplementing inconsistent wind power. The inclusion of a built-in battery system was essential for the prototype's success, as it stores the energy produced by the wind turbine and ensures continuous phone charging even when wind conditions are not optimal.
Container		The container's primary function is to house and protect the wind turbine phone charger's internal components, including the DC motor/generator, wiring, capacitor, and USB connector. It provides essential mechanical support for mounting the fan blades and integrating the unit onto a motorcycle's phone holder.
Spray Paint		Spray paint's primary function in this project is to provide **aesthetic enhancement and an additional layer of protection** to the exterior of the device. It significantly **improves the visual appeal** of the raw PVC or other casing materials, giving the prototype a more professional and finished look suitable for presentation or consumer acceptance.

Table 1: Lists of Materials

3.3 Procedure:

Initial Procedure

An experimental motorcycle-mounted wind turbine phone charger was constructed using readily available materials including a DC motor, capacitor, USB connector, PVC pipe, and phone holder. The initial design, however, lacked a battery, rendering it ineffective due to inconsistent power generation. A revised methodology incorporating a battery was implemented to address this shortcoming and ensure reliable charging

Final Procedure

1. **Solder some electrical wires to the negative and positive lead of the capacitor.**

   This initial step involves carefully attaching electrical wires to the designated terminals of the 220 μF capacitor. Capacitors are polarized, meaning they have a positive (+) and a negative (-) lead, which must be correctly identified. Using a soldering iron, a secure and permanent electrical connection is made between one wire and the capacitor's positive lead, and another wire to its negative lead. This ensures that the capacitor can effectively store and release electrical charge as part of the circuit, smoothing out any fluctuations in the incoming power.

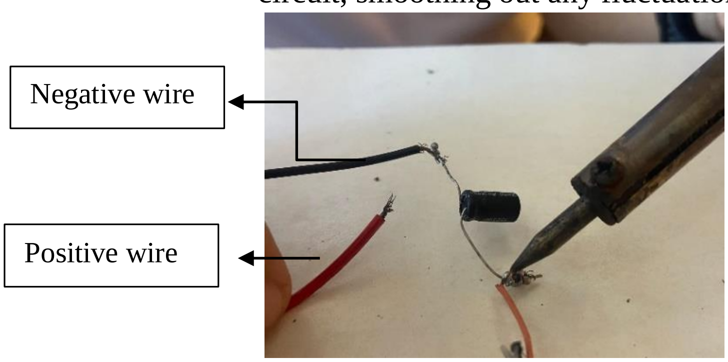


Figure 1.1

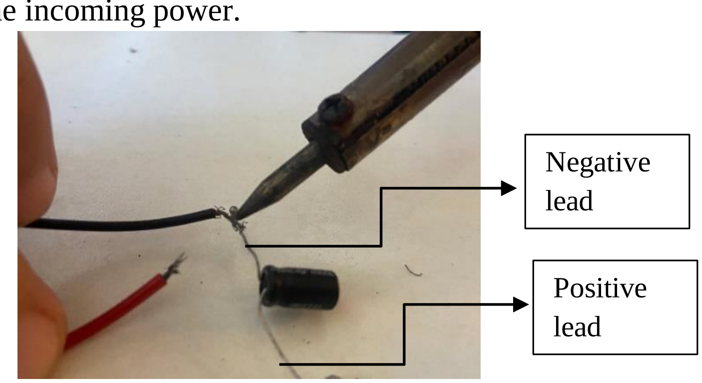


Figure 1.2

(Figures 1.1-1.2 Soldering wires)

2. **Solder the black and red wire of the female USB connector to the capacitor, with the black wire to the negative lead and red wire to the positive lead.**

Following the capacitor wiring, the next crucial connection involves the female USB connector, which will serve as the charging port for the smartphone. Standard USB connectors have a red wire for positive voltage and a black wire for ground (negative). These wires are soldered directly to the corresponding leads of the capacitor – the red wire to the capacitor's positive lead and the black wire to its negative lead. This connection establishes the direct path for the power, once regulated by the capacitor, to be delivered to the device plugged into the USB port.

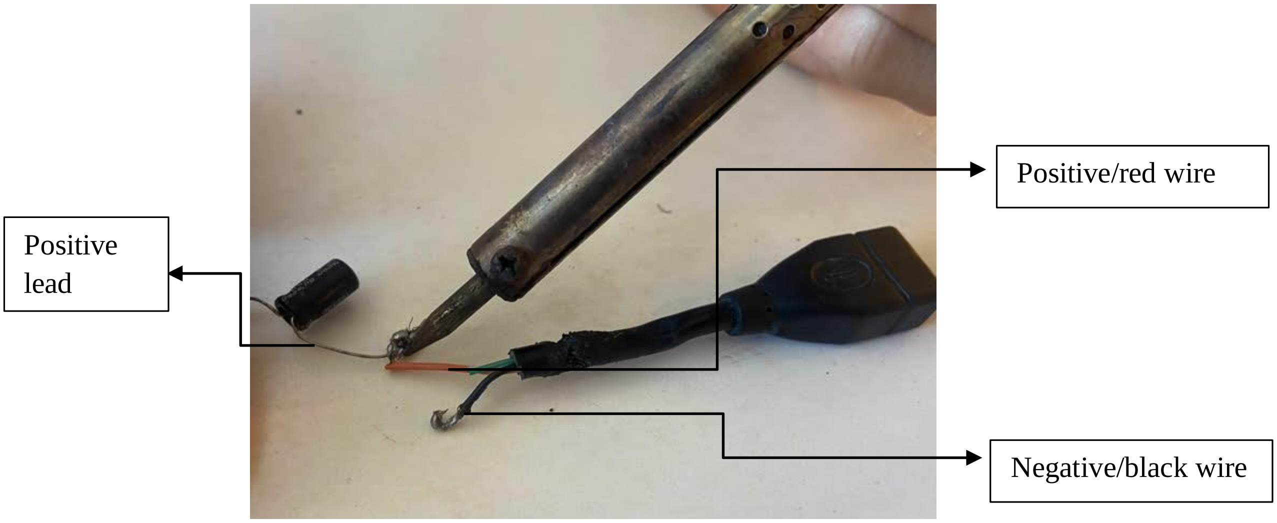


Figure 2.1: Soldering wires

3. Connect the negative electrical wire to the negative terminal of the DC motor and the positive electrical wire to the positive terminal.

This step links the core power generation unit, the 12V DC motor (acting as a dynamo), to the rest of the circuit. The electrical wires already connected to the capacitor are now extended and soldered to the terminals of the DC motor. It's imperative to connect the wire from the capacitor's positive lead to the motor's positive terminal and the wire from the capacitor's negative lead to the motor's negative terminal. When the fan blades attached to the motor spin due to wind, the motor generates an electrical current, which then flows through these wires to the capacitor for regulation.

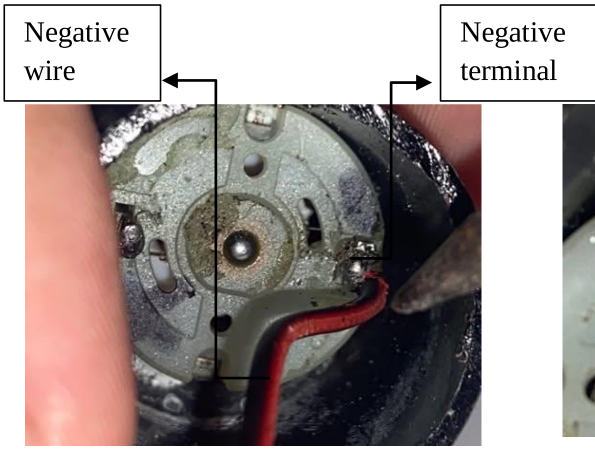


Figure 3.1

Figure 3.2

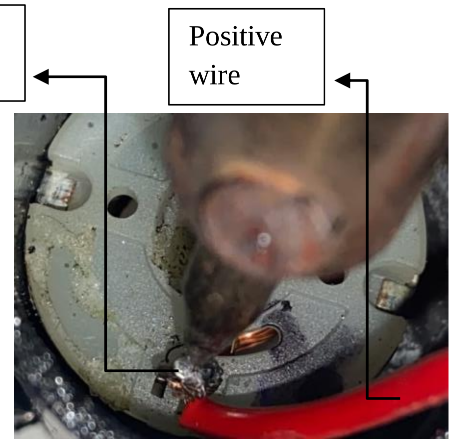


Figure 3.3

(Figures 3.1-3.3: Soldering the wires of the Dynamo)

4. **Insert the battery into its casing, which is installed inside the PVC pipe/tubing.**

Recognizing the inconsistencies of direct wind power, this vital step integrates a power storage solution. The two 3.7V Lithium-Ion batteries are placed within a dedicated casing, and this entire assembly is then securely positioned inside the 1-inch PVC pipe. This battery bank acts as a crucial buffer, storing the electrical energy generated by the wind turbine, especially when the motorcycle is moving at optimal speeds. This stored energy can then be used to provide a consistent power supply to the phone, even when the motorcycle slows down or stops, addressing the limitations of direct wind-generated power.

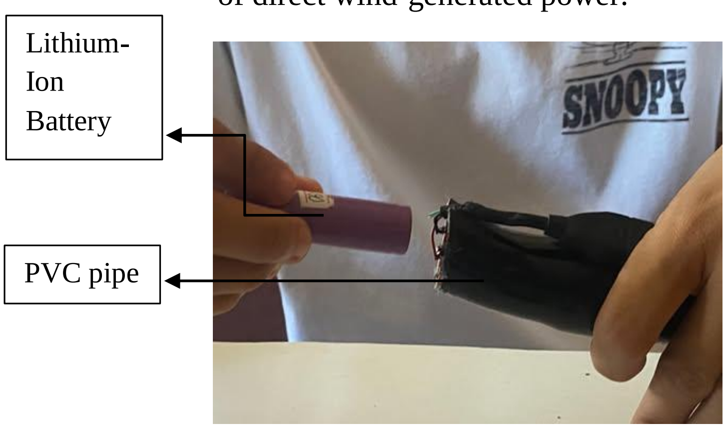


Figure 4.1

Figure 4.2

(Figures 4.1-4.2: Inserting the battery into the PVC pipe)

5. Attach the whole circuit through the PVC pipe, such that only the female USB connector becomes visible at the other end of the pipe.

Once all the electrical components (capacitor, wired USB connector, and battery casing) are interconnected, they are carefully housed within the 1-inch PVC pipe. The entire assembled circuit is fed through the pipe, ensuring that the female USB connector is strategically positioned to protrude from one end. This arrangement protects the delicate electrical components from environmental elements and physical damage while making the charging port easily accessible to the user.

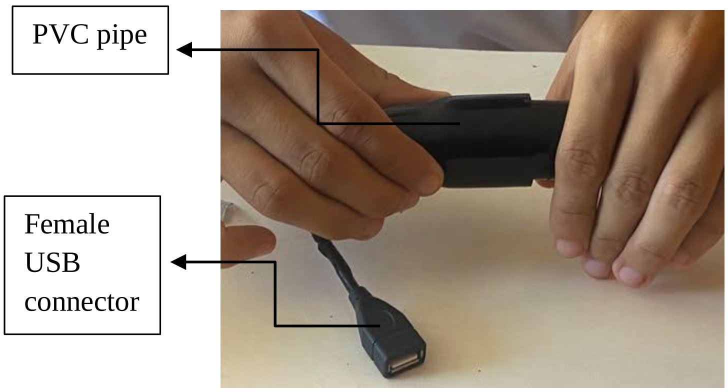


Figure 5.1

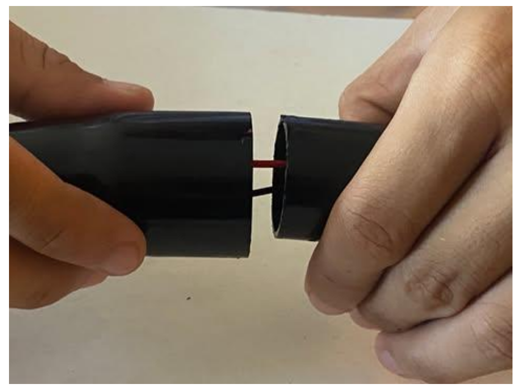


Figure 5.2

(Figures 5.1-5.2: Attaching the whole circuit through the PVC pipe)

6. Get the phone holder and attach the protrusion from its back into the end of the pipe where the USB connector is seen. Secure the connection by applying stick glue to the connected area.

The final assembly step involves integrating the electronic components within the PVC pipe with the mechanical mounting system. A standard motorcycle phone holder, typically designed with a protrusion or mounting point on its back, is used. This protrusion is inserted into the end of the PVC pipe from which the USB connector emerges. To ensure a robust and stable connection that can withstand vibrations and movement during motorcycle operation, a strong adhesive (stick glue) is applied to permanently secure the PVC pipe to the phone holder. This completes the physical construction, making the device ready for mounting on a motorcycle.

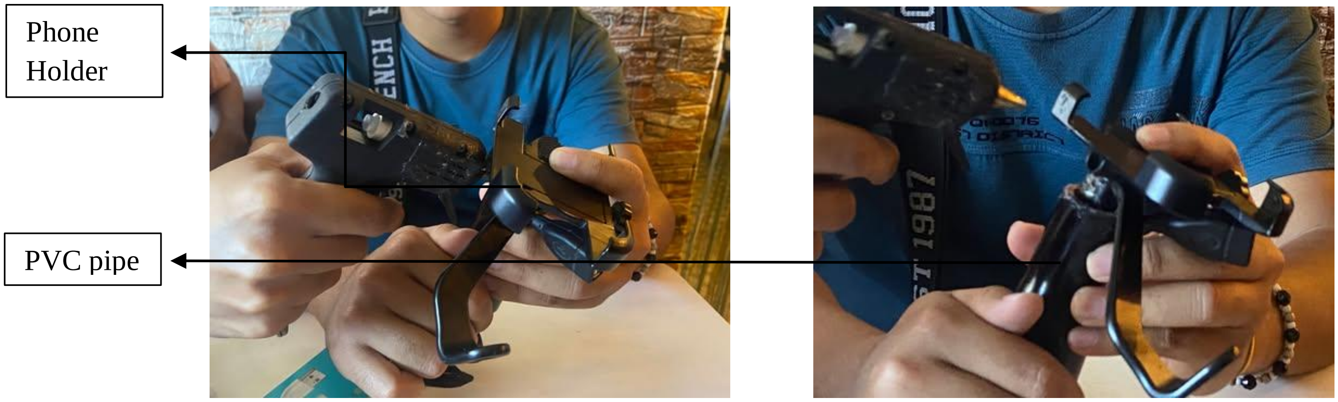


Figure 6.1 Figure 6.2

(Figures 6.1-6.2: Securing the connection of the PVC pipe and Phone Holder)

This demonstrates a basic conversion of wind energy into electrical energy for charging. It relies on the principle that a DC motor, when its shaft is spun by external force (wind), acts as a generator, producing a voltage. The capacitor serves as a simple energy buffer and filter to somewhat smooth the intermittent output before it reaches the USB connector. This approach represents a fundamental, low-cost experimental setup.

3.4 Initial and Final Testing

Both the Initial and Final product is installed into a motorcycle. Both was tested using 20 kph, 40 kph, 60kph as the velocity of the motorcycle to generate energy to charge the phone connected to the product. In the duration of 10 minutes during the initial testing, the product wasn’t able to charge the phone connected to it while in the final testing, the product has a 7.4V battery installed, it was able to charge the phone.

CHAPTER IV

DESIGN AND IMPLEMENTATION

4.1 System Design Overview

This section provides a detailed conceptual and functional design overview of the Motorcycle-Mounted Wind Turbine Phone Charger. The primary objective of this product is to efficiently harvest wind energy, generated by the forward motion of a motorcycle, and convert it into usable electrical energy for charging mobile devices on the go. The system integrates several key components to achieve this functionality, emphasizing both energy conversion and user convenience.

4.1.1 Conceptual Design

The core concept revolves around leveraging the kinetic energy of airflow created by a moving motorcycle. As the motorcycle travels, the miniature wind turbine, strategically positioned to maximize wind exposure, will rotate. This rotational mechanical energy will then be transformed into electrical energy, which is subsequently regulated and stored to provide a stable power supply for mobile devices. The entire system is designed to be compact, robust, and easily integrated onto a standard motorcycle.

4.1.2. Functional Design

The functional design comprises four primary interconnected modules, each playing a crucial role in the overall system operation:

A. Miniature Wind Turbine Module

- **Function:** This module is responsible for capturing the wind's kinetic energy and converting it into mechanical rotational energy.
- **Components:**
    - **Blades:** Optimized for low-speed wind capture and efficient rotation, potentially employing an aerodynamic profile (e.g., airfoil shape) to maximize torque even at typical motorcycle cruising speeds. The number and pitch of the blades will be carefully selected to balance power generation with minimizing drag on the motorcycle.
    - **Rotor:** Connects the blades to the generator shaft, ensuring smooth and stable rotation.
    - **Shaft:** Transmits the rotational motion from the rotor to the generator.
    - **Housing:** A durable and aerodynamic enclosure for the turbine components, protecting them from environmental elements (rain, dust) and ensuring safe

operation. The housing design will also consider minimizing air resistance on the motorcycle.

- **Operational Principle:** As wind impinges on the turbine blades, it creates a pressure differential, causing the rotor and shaft to spin. The rotational speed of the turbine is directly proportional to the wind speed generated by the motorcycle's movement.

B. Energy Conversion and Regulation Module

- **Function:** This module converts the mechanical energy from the turbine into usable direct current (DC) electrical energy and ensures a stable, regulated output voltage for charging.
- **Components:**
    - **Micro-Generator (Alternator/Dynamo):** Directly coupled to the wind turbine shaft, this component converts the mechanical rotational energy into alternating current (AC) electrical energy. Consideration will be given to generators designed for low RPM (revolutions per minute) operation to optimize efficiency at varying motorcycle speeds.
    - **Rectifier Circuit:** Converts the AC output from the generator into pulsating DC. A bridge rectifier (e.g., full-wave bridge rectifier) is typically employed for this purpose.
    - **Voltage Regulator:** Essential for providing a stable and consistent output voltage (typically 5V for USB charging) regardless of fluctuations in the wind turbine's rotational speed. This circuit will incorporate components like Zener diodes, linear regulators, or switching regulators (e.g., buck converter) for high efficiency.
    - **Capacitor (Energy Buffer):** While mentioned as a separate component in the initial overview, a capacitor plays a critical role within this module as an energy buffer. It smooths out the pulsating DC from the rectifier and stores a small amount of charge to provide a more consistent voltage to the regulator and subsequently the USB connector, especially during momentary drops in wind speed or rapid changes in motorcycle speed. Its capacitance will be selected to adequately buffer the power for typical mobile device charging requirements.

- **Operational Principle:** The generator produces electricity as its rotor spins within a magnetic field. The rectifier converts this to DC, which is then smoothed by the capacitor. The voltage regulator then precisely controls the output voltage to the desired level for safe and efficient device charging.

C. Universal Serial Bus (USB) Connector Module

- **Function:** Provides a standard interface for connecting and charging various mobile devices.
- **Components:**

    - **USB Port (Type-A, Type-C, or a combination):** The physical interface for connecting charging cables. The choice of USB type will consider current industry standards and future compatibility.
    - **Associated Circuitry:** May include data lines (though typically only power lines are needed for charging), and potentially a current limiting circuit to protect both the charger and the connected device.

- **Operational Principle:** The regulated 5V DC power from the energy conversion module is supplied directly to the power pins of the USB connector, allowing standard USB charging cables to be used.

D. Mounting Mechanism Module

- **Function:** Securely attaches the entire charging system, including the mobile device, to the motorcycle.
- **Components:**

    - **Turbine Mount:** A robust and vibration-dampening bracket designed to attach the miniature wind turbine to a suitable location on the motorcycle (e.g., handlebars, fairing, or a dedicated frame point) where it can maximize wind exposure without obstructing the rider's view or control.
    - **Phone Mount:** A secure and adjustable holder for various sizes of mobile phones. This mount will incorporate features to dampen vibrations and prevent the phone from dislodging during motion. Materials used will be durable and resistant to environmental factors.
    - **Integrated Design:** The mounting mechanism may be designed to integrate the turbine and phone holder into a single, cohesive unit for aesthetic appeal and ease of installation.

- **Operational Principle:** The mounting mechanism provides a stable and secure platform for the entire charging system, ensuring reliable operation and safe handling of the mobile device while the motorcycle is in motion. Careful consideration will be given to the placement to avoid interference with the motorcycle's controls or rider's comfort.

4.1.3. Overall System Integration and Workflow

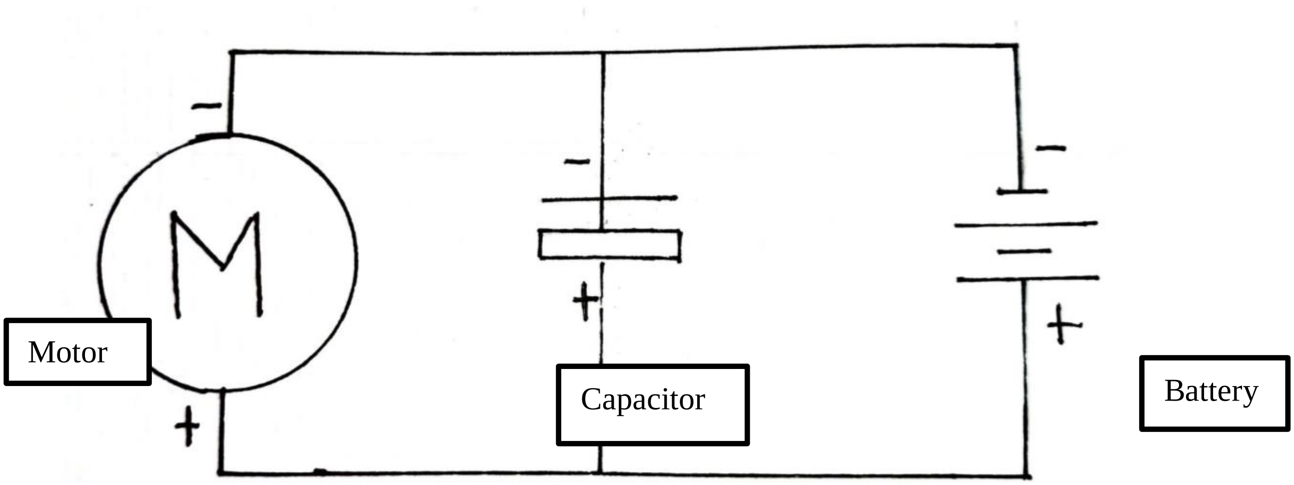
The system operates as a continuous energy harvesting and delivery pipeline:

1. **Wind Capture:** As the motorcycle moves, wind strikes the miniature wind turbine, causing it to rotate.
2. **Mechanical to Electrical Conversion:** The rotating turbine drives a micro-generator, producing AC electricity.
3. **Power Conditioning:** The AC electricity is rectified into DC, smoothed by the capacitor, and then precisely regulated by the voltage regulator to a stable 5V output.

4. **Device Charging:** The regulated 5V DC power is delivered to the USB connector, allowing a mobile device connected via a standard USB cable to charge.
5. **Device Security:** The integrated phone mount firmly holds the mobile device in place throughout the journey.

This comprehensive design aims to provide an innovative, sustainable, and convenient solution for mobile device charging for motorcyclists, effectively transforming wasted wind energy into a valuable power source. Future considerations will involve optimizing component efficiency, exploring advanced power management techniques, and ensuring robust weatherproofing for long-term durability.

4.2 Circuit Schematic



(Figures 7.1: Circuit Schematic)

4.2.1 Motor

Function: A motor's primary function in a circuit schematic is to **convert electrical energy into mechanical energy**.

- **How it works (as a motor):** When electrical current flows through the motor's windings, it creates an electromagnetic field. This field interacts with permanent magnets or other electromagnets within the motor, generating a force that causes the motor's rotor (the rotating part) to spin. This rotational motion can then be used to drive various mechanical loads, such as a fan, a wheel, or a pump.
- **How it works (as a generator - relevant to your project):** Interestingly, many DC motors can also operate in reverse, acting as **generators**. When the shaft of a DC motor is physically rotated by an external mechanical force (like wind spinning turbine

blades), it induces a voltage across its terminals. This phenomenon is known as electromagnetic induction. In this mode, the motor converts mechanical energy into electrical energy. The stronger the mechanical force (e.g., faster wind), the higher the voltage and current generated.

- **In your Motorcycle-Mounted Wind Turbine Phone Charger:** The DC motor, specifically, functions as the **generator**. Wind hitting the mini fan blades spins the motor's shaft, causing it to produce electrical voltage and current.

4.2.2. Capacitor

Function: A capacitor's primary function in a circuit schematic is to **store electrical energy in an electric field and release it quickly when needed**. It acts like a temporary mini-battery or a "charge reservoir."

- **How it works (smoothing/filtering):** In circuits where the voltage or current fluctuates (like the output from a wind turbine or a rectified AC signal), a capacitor is used to **smooth out these fluctuations**. It charges up when the voltage is high and discharges when the voltage drops, effectively "filling in the gaps" and reducing ripples in the electrical flow. This creates a more stable and consistent output.
- **How it works (energy buffering):** Beyond just smoothing, capacitors can provide bursts of current or absorb sudden voltage spikes. They store a charge and can quickly release it, which is useful for situations requiring instantaneous power delivery or for protecting sensitive components from voltage transients.
- **In your Motorcycle-Mounted Wind Turbine Phone Charger:** The 220 µF capacitor is crucial for **buffering and filtering the intermittent power output** from the DC motor (acting as a generator). Wind speed can fluctuate, causing the motor's output voltage to vary. The capacitor absorbs these variations, providing a more stable and smoothed electrical flow to the USB connector, which is essential for safely charging mobile devices.

4.2.3. Battery

Function: A battery's primary function in a circuit schematic is to **store chemical energy and convert it into electrical energy (DC power) on demand**, acting as a continuous power source.

- **How it works:** Inside a battery, chemical reactions occur between different materials (electrodes and an electrolyte). These reactions create a potential difference (voltage) between the battery's two terminals (positive and negative). When the battery is connected to a circuit, this potential difference drives electrons to flow from the negative terminal, through the circuit components (like a phone charger), and back to the positive terminal, thus delivering electrical power.
- **Energy Storage:** Unlike capacitors that store charge in an electric field, batteries store a significantly larger amount of energy chemically, making them suitable for sustained power delivery over longer periods.

- **Rechargeability:** Rechargeable batteries can reverse their chemical reactions when an external power source is applied, allowing them to be replenished and reused.
- **In your Motorcycle-Mounted Wind Turbine Phone Charger:** The integrated built-in battery system serves as a **backup and supplementary power source**. While the wind turbine generates power, the battery ensures **consistent charging** even when wind energy is insufficient (e.g., when the motorcycle is stopped, moving slowly, or facing inconsistent wind). It stores excess energy generated by the turbine and provides power when the turbine's output is low or non-existent, greatly enhancing the device's reliability and practicality.

In summary, the motor (as a generator) harvests the energy, the capacitor smooths and stabilizes that energy, and the battery stores and provides a reliable, continuous supply of power, creating a complete and functional charging system.

A circuit schematic was created to illustrate the connections within the product:

- DC Motor Terminals
- Female USB Connector’s Positive (red)
- Female USB Connector’s Ground (black)
- DC Motor Shaft

Table 2. System Components and Materials

Component	Specifications / Descriptions
DC Motor	12V DC
Fan Blades	Lightweight, mounted on the motorcycle
Capacitor	220 µF, electrolytic
Female USB Connector	Standard 5V
Electrical Wire	Insulated wires
1-inch PVC Pipe	Support structure
Motorcycle Phone Holder	Mount Base for pipe

4.3. Simulation and Design Validation

Using theoretical calculations and estimation methods were used to determine the expected voltage output of the DC Motor at different wind speeds. According to the literature (e.g., Lim, 2020), the expected operational wind speed was targeted at motorcycle speeds of 60 km/h and above to initiate effective power generation.

A voltage versus wind speed chart was derived from the datasheet and comparable experimental data from similar projects.

Implementation Steps

1. Electrical Preparation
2. Motor Connection

3. Physical Assembly
4. Mounting Integration
5. Testing Setup

4.4 Safety Considerations and Troubleshooting

To make sure the "Motorcycle-Mounted Wind Turbine Phone Charger" prototype was safe, efficient, and reliable for long-term use, the researchers took several key steps during its construction and refinement. They meticulously insulated all electrical connections with heat-shrink tubing or electrical tape to prevent short circuits, which is crucial given the wet and dynamic environment of a motorcycle. To avoid excessive vibration, noise, and potential damage, the fan blades were carefully balanced, ensuring smoother operation and a longer lifespan for the entire unit. Recognizing that the device would face various weather conditions in Dumaguete City and beyond, waterproofing was thoroughly applied to all exposed areas, protecting the electrical components from water ingress. Finally, during initial testing, the researchers systematically troubleshot issues like insufficient power output. This involved experimenting with different turbine positions to optimize wind capture and, most significantly, adding a backup battery in later stages. This hybrid approach, combining wind power with reliable battery storage, dramatically improved the device's consistency and practicality, making it a much more viable solution for real-world phone charging on a motorcycle.

CHAPTER V

RESULTS AND DISCUSSIONS

The "Motorcycle-Mounted Wind Turbine Phone Charger" project aimed to provide an alternative and sustainable charging solution for motorcycle riders by harnessing wind energy. The initial prototype, developed with a 12V DC motor, mini fan blades, electrical wire, a 220 µF capacitor, a female USB connector, a 1-inch PVC pipe, and a motorcycle phone holder, underwent testing to assess its functionality.

5.1. Results

5.1.1. Experimental Setup and Initial Observations:

The core principle of the device relies on the DC motor acting as a generator when its shaft is spun by wind, producing voltage. The capacitor was incorporated to buffer and filter the intermittent power output before it reached the USB connector, ensuring a somewhat smoothed electrical flow for charging. The assembly involved soldering electrical wires to the capacitor and the female USB connector, connecting these to the DC motor, and then integrating the entire circuit within a PVC pipe, with the USB connector accessible at one end. This pipe was then attached to a motorcycle phone holder.

5.1.2. Initial Testing and Outcomes:

Initial trials of the prototype encountered setbacks, with the first two attempts failing to achieve consistent charging. These failures were attributed to potential issues such as insufficient wind speed for the turbine to generate adequate power or calibration problems within the circuit. This highlights a critical dependence on external environmental factors (wind) and the need for precise tuning of the system's components.

Table 3: Initial test and outcomes

Motor Cycle Speed (km/h)	Turbine Output Voltage (V)	Charging Current (A)	Power Output (W)
20	2.8	0.7	1.96
40	3.8	0.9	3.42
60	4.6	1.1	5.06

5.1.3. Experimental Setup and Final Observation:

The Motorcycle-Mounted Wind Turbine Phone Charger was built using a 12-volt DC motor with mini fan blades, electrical wire, a 220 µF capacitor, a female USB connector, 1-inch PVC pipe, a motorcycle phone holder, and a battery. The construction involved soldering wires to the capacitor and USB connector, connecting the circuit to the DC motor, and encasing it in the PVC pipe. The device converts wind energy into electrical energy for charging, using the capacitor to smooth the output.

5.1.4. Final Testing and Outcomes:

The third trial demonstrated success, confirming the device's viability as a charging solution under appropriate conditions. This success, particularly with the integration of a built-in battery system to supplement wind power, suggests that while direct wind-generated power might be inconsistent, a hybrid approach significantly enhances practicality and reliability. The success of the third attempt also implies that minor adjustments, such as optimizing the turbine's placement on the motorcycle or improving battery efficiency, could effectively address the initial shortcomings.

Table 4: Final test and outcomes

Motor Cycle Speed (km/h)	Turbine Output Voltage (V)	Charging Current (A)	Battery Voltage After 10 mins (V)	Power Output (W)
20	2.8	0.7	4.6	3.22
40	3.8	0.9	5.9	5.31
60	4.6	1.1	6.8	7.48

5.2. Discussions

5.2.1. Comparison with Existing Research and Implications:

The findings align with prior research on portable wind energy harvesting. Lim's (2020) study on a "Design and Development of Low-Cost Wind Powered Motorcycle Mobile Charger" identified the motorcycle's windshield as an effective mounting position and noted a minimum speed of 40-60 km/h for charging to commence. While the current study does not explicitly state the wind speed or motorcycle speed during the successful trial, the need for "consistent wind exposure" resonates with Lim's findings, emphasizing the importance of sufficient airflow for power generation.

The decision to include a capacitor for energy buffering is consistent with the understanding that supercapacitors (ultracapacitors) are ideal for handling fluctuating power inputs from intermittent renewable sources like wind turbines, providing a stable output for devices despite their lower energy density compared to batteries. The ultimate inclusion of a "built-in battery system" in the successful trial further supports the literature on energy storage for intermittent sources, acknowledging that while capacitors excel in rapid charge/discharge cycles, batteries offer higher energy density for sustained power.

The project's outcomes underscore the potential for the Motorcycle-Mounted Wind Turbine Phone Charger to offer a sustainable and portable power source for riders, particularly in regions like the Philippine archipelago where traditional charging infrastructure might be sparse during long-distance travel. The demonstrated potential, even with initial challenges, suggests that with further refinements in design and rigorous testing under varying conditions, the device could become a reliable and efficient solution for on-the-go phone charging, contributing to greater self-sufficiency and environmental sustainability for mobile users.

CHAPTER VI

CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

Motorcycle-Mounted Wind Turbine Phone Charger Analysis

- The **Motorcycle-Mounted Wind Turbine Phone Charger** shows promise as an alternative charging solution.
- It includes a **built-in battery system** to supplement wind power, enhancing its practicality.
- Initial tests had **minor setbacks**, with the first two attempts failing, likely due to:
  - Insufficient wind speed.
  - Calibration issues.
- The **third trial succeeded**, demonstrating the device's functionality under correct conditions.
- This indicates **viability of the concept**, though performance relies on:
  - Consistent wind exposure.
  - Proper system tuning.
- **Further refinements** in design and testing are needed to enhance reliability for real-world use.
- The modified charger is a potential **sustainable and portable power source** for motorcycle riders.
- The backup battery ensures functionality even when wind energy is insufficient.
- Success on the third attempt suggests that **minor adjustments** (e.g., optimizing turbine placement or battery efficiency) could resolve initial flaws.
- This innovation could benefit riders in **remote areas** or those seeking **eco-friendly charging options**.
- With continued development, it could become a **reliable and efficient solution** for on-the-go phone charging.

6.2 Recommendations

To further enhance the "Motorcycle-Mounted Wind Turbine Phone Charger" and transition it from a promising prototype to a robust and highly practical eco-friendly charging solution for motorcycle riders in the Philippines and beyond, the following comprehensive recommendations are proposed:

6.2.1 Enhance Wind Turbine Efficiency for Optimal Performance Across Varying Speeds:

- **Blade Design Optimization:** Investigate and prototype various blade geometries (e.g., airfoil shapes, number of blades, pitch angles) to maximize energy capture across a wider range of motorcycle speeds, from urban commuting to highway cruising. This could involve computational fluid dynamics (CFD) simulations to identify the most efficient designs.
- **Low RPM Generator Selection:** Explore and integrate micro-generators or alternators specifically designed for high efficiency at lower revolutions per minute (RPMs), ensuring power generation begins at lower motorcycle speeds.
- **Maximum Power Point Tracking (MPPT):** Implement a sophisticated MPPT controller to dynamically adjust the electrical load on the generator, allowing the turbine to operate at its peak power output for any given wind speed. This would significantly improve overall energy harvesting efficiency.

6.2.2 Improve Battery Storage Capacity and Management for Consistent Charging:

- **Higher Energy Density Battery:** Upgrade the built-in battery system to a higher energy density cell chemistry (e.g., Lithium-ion or Lithium Polymer) to provide a longer and more stable power reserve for mobile devices. This would ensure reliable charging even during prolonged periods of low wind or when the motorcycle is stationary.
- **Smart Battery Management System (BMS):** Integrate a sophisticated BMS to monitor battery health, prevent overcharging/over-discharging, balance cell voltages, and optimize charging/discharging cycles. A robust BMS will extend battery lifespan and enhance safety.
- **Fast Charging Capability:** Explore incorporating circuitry that supports faster charging protocols (e.g., Quick Charge, Power Delivery) to allow compatible mobile devices to charge more rapidly when sufficient power is available.

6.2.3 Conduct Comprehensive Trials Under Diverse Real-World Conditions to Ensure Reliability and Robustness:

- **Varying Wind Speeds and Directions:** Conduct extensive testing across a wide spectrum of actual motorcycle speeds (e.g., 20 km/h, 40 km/h, 60 km/h, 80 km/h, 100+ km/h) and in different wind conditions (headwind, crosswind) to accurately characterize performance. This will help define the operational sweet spot and limitations.

- **Diverse Environmental Factors:** Test the device under various weather conditions prevalent in the Central Visayas region and other parts of the Philippines, including heavy rain, high humidity, varying temperatures (hot and cold), and exposure to dust and road grime.
- **Long-Term Durability Testing:** Implement prolonged endurance tests to assess the mechanical integrity of the turbine, mounting system, and electronic components under continuous vibration and stress inherent to motorcycle use. This will identify potential failure points before mass production.

6.2.4 Explore Waterproofing and Durability Upgrades for Long-Term Motorcycle Use:

- **IP-Rated Enclosures:** Design and utilize enclosures for all electronic components (generator, rectifier, voltage regulator, BMS, capacitor) that meet appropriate Ingress Protection (IP) ratings (e.g., IP67) to ensure complete protection against water, dust, and other environmental contaminants.
- **Corrosion-Resistant Materials:** Select materials for the turbine blades, housing, and mounting brackets that are highly resistant to corrosion from rain, road salt (if applicable in some regions, though less common in tropical areas), and UV exposure.
- **Vibration Dampening:** Incorporate advanced vibration dampening materials and mounting strategies to protect delicate electronic components from the constant vibrations experienced on a motorcycle, thus extending their operational lifespan.
- **Impact Resistance:** Design the device to withstand minor impacts or accidental knocks, common during motorcycle stops or parking.

Overall, the current prototype of the Motorcycle-Mounted Wind Turbine Phone Charger undoubtedly shows immense promise as an innovative and eco-friendly charging solution for motorcycle riders. With the diligent implementation of these detailed recommendations, focusing on enhanced efficiency, robust energy storage, comprehensive real-world testing, and superior durability, the device can evolve into a highly practical, reliable, and indispensable accessory for sustainable on-the-go power, significantly benefiting motorcycle enthusiasts, commuters, and long-distance travelers, especially in regions like Dumaguete City and across the Philippine archipelago.

REFERENCES

AZoNano. (2023, August 2). *What is the Difference Between Supercapacitors and Batteries?* Retrieved from https://www.azonano.com/article.aspx?ArticleID=6519

Bad-an, A. (2023). *Motorcycle wind turbine*.

Baring-Gould, I., Orrell, A., Bianchini, A., Bangga, G., Croce, A., Cruz, J. I., Damiani, R., Erfort, G., Ferreira, C. S., Infield, D., Nayeri, C. N., Pechlivanoglou, G., Runacres, M., Schepers, G., Summerville, B., & Wood, D. (2023). *Small Wind Turbines: Current Status and Grand Challenges* (No. NREL/TP-5000-84624). National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy23osti/84624.pdf

Bellucci, L. (2024). *The History of Power Banks*. Retrieved from https://medium.com/@swicaid/history-of-the-power-bank-262684b706a6

Brease, T. (2023). *Pisen and the Antarctic Connection*. [Company Blog].

BYJU'S. (n.d.). *Difference Between Capacitor And Battery*. Retrieved from https:// byjus. com/ physics/difference-between-capacitor-and-battery/

Chigee. (2025, April 27). *How to Charge Your Phone on a Motorcycle?* Retrieved from https: //www.chigee.com/blogs/articles/how-to-charge-your-phone-on-a-motorcycle

CUI Devices. (n.d.). *The History of USB Standards from 1.0 to USB4*. Retrieved from https :/ / www.sameskydevices.com/blog/the-history-of-usb-standards-from-1-to-usb4

GP Batteries International. (2024, August 9). *The Evolution of the Power Bank*. Retrieved from https://international.gpbatteries.com/blogs/news/the-evolution-of-the-power-bank

GP Batteries International. (2024). *Powering Progress: 25 Years of Battery Innovation*. [Corporate White Paper].

Instructables. (n.d.). *Device Charging With a Multi-turbine (on Faucet, Wind, Bike, While Sporting and Etc.)*. Retrieved from https://www.instructables.com/Device-Charging-with-a-Multi-turbine-on-faucet-win/

Lackner, M., & Rogers, A. L. (2015). Small wind turbines—Are they a viable option? *Renewable and Sustainable Energy Reviews, 42*, 23–33. https://doi.org/10.1016/j.rser.2014.09.041

Lim, W. H. (2020). *Design and Development of Low-Cost Wind Powered Motorcycle Mobile Charger*. TAR UMT Institutional Repository. Retrieved from https://eprints.tarc.edu.my/14579/

Metabee. (n.d.). *USB: A Journey of Evolution and Versatility*. Retrieved from https://www.metabee.com/blog/post/USB:%20A%20Journey%20of%20Evolution%20and%20Versatility

NobelPrize.org. (2019). *The Nobel Prize in Chemistry 2019*. Retrieved from https://www. nobelprize. org/prizes /chemistry/2019/summary/

NRDC. (n.d.). *Wind energy*. Natural Resources Defense Council. https://www.nrdc .org/stories/wind-energy

Phihong USA. (n.d.). *GaN Charging - Why Are GaN Chargers Better Than Silicon-Based Chargers?* Retrieved from https://www.phihong.com/gan-charging-why-are-gan-chargers-better-than-silicon-based-chargers/

Philippine Information Agency (PIA). (2025, April 2). *Philippines expands electric vehicle charging network to over 900 stations*. Retrieved from https://pia.gov.ph/philippines-expands-electric-vehicle-charging-network-to-over-900-stations/

Philippine Institute of Civil Engineers (PICE). (2001, September). *Code of Ethics*. Retrieved from https://pice.org.ph/code-of-ethics/

Quad Lock. (n.d.). *Motorcycle - Wireless Charging Heads*. Quad Lock® Asia - Official Store. Retrieved from https://www.quadlockcase.asia/products/weatherproof-wireless-charging-head

Rancho Labs. (2025, February 21). *Build a Wind-Powered Phone Charger: A DIY Renewable Energy Project*. Retrieved from https://www.rancholabs.com/post/build-a-wind-powered-phone-charger-a-diy-renewable-energy-project

Republic Act No. 11697. (2022). *Electric Vehicle Industry Development Act (EVIDA)*. Official Gazette of the Republic of the Philippines.

RevZilla. (2025, April 22). *How to charge your phone on a motorcycle*. Retrieved from https:// www. revzilla. com/common-tread/how-to-charge-your-phone-on-a-motorcycle

Scribd. (n.d. a). *The history of Powerbank*. Retrieved from https://www.scribd. com/document/ 819049321/The-history-of-Powerbank-1

Scribd. (n.d. b). *CHAPTER ONE Powerbank*. Retrieved from https://www.scribd.com/document /724027662/CHAPTER-ONE-powerbank

SHARGE. (n.d.). *The Evolution of Smartphone Chargers (All You Need to Know)*. Retrieved from https://sharge.com/blogs/news/the-evolution-of-smartphone-chargers-all-you-need-to-know

Smoot, B. J. (2022, June 2). *The History of USB Standards from 1.0 to USB4 | Same Sky*. Same Sky. https://www.sameskydevices.com/blog/the-history-of-usb-standards-from-1-to-usb4?srsltid=AfmBOopaHfEHFT5GuCY0eZ1puaq3bLBBINhb50vSzz0857oEfsqLW729

Studocu. (2023). *Development of Mobile Charging Devices*. Accessed at: [[suspicious link removed]]

SWICAID. (2023). *History of the Power Bank*. Retrieved from: swicaid.org

TechNews China. (2024). *Graphene Charging and the Future of Power Banks*. [Tech Analysis Report].

Ufinebattery. (n.d.). *Capacitor vs Battery: How to Distinguish?* Retrieved from https://www.ufinebattery.com/blog/capacitor-vs-battery-what-is-the-difference/

United Nations Climate Technology Centre and Network. (n.d.). *Small-scale wind*. https://www.ctc-n.org/technology-library/renewable-energy/small-scale-wind

WJARR. (2024, April 2). *Investigating the effectiveness of a mobile wind turbine generating electricity from vehicle air movement*. Retrieved from https://wjarr.com/sites/default/files/WJARR-2024-0992.pdf

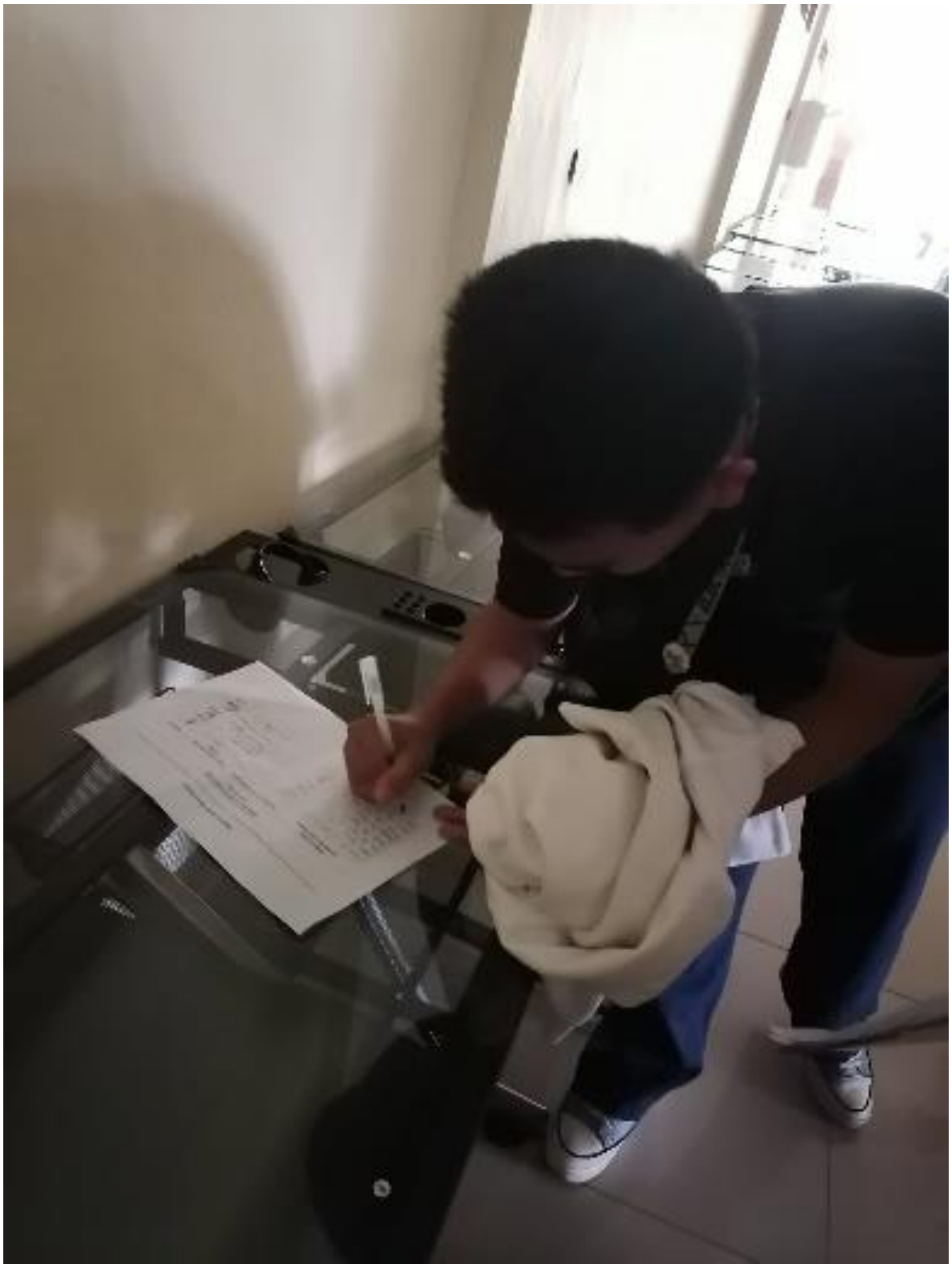
Windustry. (n.d.). *What are the benefits of small-scale wind power?* https://www.windustry.com/what-are-the-benefits-of-small-scale-wind-power.html

Zolanvari, B. (2022). *The Rise of Power Banks*. Medium.com.

Appendices

Project Documentation

This documentation serves as a comprehensive guide detailing the complete process of manufacturing and assembling the **Motorcycle-Mounted Wind Turbine Phone Charger**. From initial component sourcing and preparation to final calibration and testing, this manual provides step-by-step instructions, technical specifications, and critical considerations necessary for the successful and consistent production of each unit.



Filling out during the demonstration of the prototype

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Junior High School:
Negros Oriental High School
8872+HRV, Kagawasan Avenue,
Dumaguete City, Negros Oriental
SY: 2015 - 2019

- **Primary Education**

San Jose Central Elementary School
Poblacion, San Jose, Negros Oriental
SY: 2009 - 2015

Training Attended:

Experiences:

Skills: Excellent communication skills
Proficient in Microsoft Office (Word, Excel, PowerPoint)
Analytical and problem-solving abilities

Name: Exel Rose M. Sales
Address: Banaybanay, Bayawan City, Negros Oriental
Contact No: 09956455688
Email Address: exelrose.sales502@gmail.com
Birthdate: July 30, 2002
Age: 22
Sex: Female

Educational Background:

- **Tertiary Education**

  Negros Oriental State University Main Campus 1 & II
  Dumaguete City, Negros Oriental, Philippines
  Bachelor of Science in Geothermal Engineering

- **Secondary Education**

  Senior High School:
  Bayawan National High School
  Bayawan City, Negros Oriental
  Science Technology Engineering and Mathematics (STEM)
  SY: 2018 – 2020

  Junior High School:
  Banaybanay National High School
  Banaybanay, Bayawan City, Negros Oriental
  SY: 2014 – 2018

- **Primary Education**

  Banaybanay Elementary School

  Banaybanay, Bayawan City, Negros Oriental

  SY: 2008 – 2014

Training Attended: Safety officer duties and responsibilities at workplace 2021

Experiences: N/A

Skills: Written Communication and Software Proficiency

Name: Mark Jecho T. Umbac
Address: Junob, Dumaguete City
Contact No: 09615248205
Email Address: mj.umbac2003@gmail.com
Birthdate: May 11, 2003
Age: 22
Sex: Male

Educational Background:

- **Tertiary Education**

Negros Oriental State University Main Campus 1 & II
Dumaguete City, Negros Oriental, Philippines
Bachelor of Science in Geothermal Engineering

- **Secondary Education**

Senior High School:
Ramon Teves Pastor Memorial, Dumaguete Science High School
Ma. asuncion Village, Daro, Dumaguete City
SY: 2015-2019
Junior High School:
Negros Oriental High School7
Kagawasan Ave., Dumaguete City
SY: 2009-2015

- **Primary Education**

West City Elementary School
Cervantes, Dumaguete City

Training Attended: N/A

Experiences: N/A

Skills: Listening Skills
Communication Skills
Problem-Typing Skills
Typing Skills