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# Electricity Generation using Hand Gripper

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**ABSTRACT**

**As our reliance on mobile devices intensifies in the digital era, the demand for innovative, portable, and sustainable power sources becomes paramount. Traditional battery technology, while advancing, often lags behind the escalating energy requirements, compelling users to seek dependable and convenient charging alternatives. This research delves into the creation of a pioneering hand gripper that generates electricity by converting mechanical energy. Utilizing a sophisticated gear train mechanism, this device effectively transforms the mechanical energy from hand squeezing into usable electrical energy. The resulting electricity is sufficient to charge mobile phones and other low-power electronic devices, providing a practical and eco-friendly power solution. Beyond its environmental benefits, this hand gripper is particularly advantageous in remote areas and emergency scenarios, where conventional power sources are scarce or entirely unavailable. This innovation not only addresses the immediate need for sustainable energy but also enhances the accessibility and resilience of personal power solutions in diverse and challenging environments.**

**Keywords: Portable Power Sources, Mechanical Energy Conversion, Sustainable Energy, Emergency Charging Solutions, Mobile Device Charging.**

## INTRODUCTION

Electricity is an indispensable resource in modern society, powering everything from household appliances to critical infrastructures. Traditional electricity generation methods, such as those relying on fossil fuels and nuclear power, pose significant environmental and safety challenges. With the increasing global emphasis on sustainability and the depletion of non-renewable resources, the search for alternative energy sources is more pertinent than ever. This research introduces a novel approach to electricity generation via a hand gripper device, which harnesses mechanical energy from human effort. This method provides a practical, portable, and sustainable solution for generating electricity, especially beneficial in off-grid locations or during power outages.

The proliferation of mobile phones and other portable electronic devices has led to a significant increase in the demand for reliable power sources. Frequent recharging is often necessary due to the high power demands of these devices, a challenge compounded in regions with unreliable electricity supply or during emergencies. The specific problem addressed in this research is the development of a portable, human-powered device that can generate electricity on demand. This device aims to provide a dependable power source for charging mobile phones and other electronics, ensuring continuous operation regardless of location or circumstances.

1. Design and Develop: Innovate a hand gripper device capable of efficiently generating electricity through mechanical energy conversion.
2. Ergonomics and Efficiency: Ensure the device is ergonomically designed for user comfort and optimized for maximum energy conversion efficiency.
3. Practical Application: Create a portable, reliable power source for charging mobile devices, useful in a variety of settings, including remote areas and emergency situations.

## LITERATURE REVIEW

Electricity generation through human kinetic energy has emerged as a promising avenue for sustainable power production, offering potential solutions to energy challenges faced globally (Abraham & Crisostomo, 2018; Fong & Cui, 2020). With growing concerns about climate change and environmental degradation, the need for renewable energy sources has become increasingly urgent. Hand-operated electricity generators represent an innovative approach to harnessing human energy for power generation, with applications ranging from personal electronics charging to community-level energy provision (Ajayi et al., 2016; Nekahi & Chatti, 2018).

The successful design of hand-operated electricity generators requires careful consideration of several factors, including ergonomics, efficiency, and usability (Choi & Kim, 2019; Han & Jeong, 2018). Ergonomic design ensures user comfort and safety during operation, minimizing fatigue and potential injuries (Allott & Hoyle, 2017; Mital &

Lehtovaara, 2017). Efficiency optimization involves maximizing energy output while minimizing energy losses through friction, mechanical resistance, and other factors (Das & Patra, 2017; Reddy & Reddy, 2018). Usability considerations focus on ease of operation, maintenance, and repair, ensuring the device is accessible and practical for users of varying skill levels (Ertugrul & Sisman, 2018; Jain & Kumar, 2018).

The design and development of hand-operated electricity generators encompasses a range of data gathering techniques, including internet research, interviews, and group discussions (Bhosale & Patil, 2020; Gupta & Swain, 2016). These methods enable researchers and engineers to gather comprehensive information about user needs, technical requirements, and design constraints (Patil & Patil, 2019; Sharma & Shrivastava, 2017). By involving stakeholders in the design process, including end-users, technicians, and industry experts, researchers can ensure the resulting devices meet real-world needs and preferences (Raj & Balu, 2016; Ramesh & Ravindranath, 2019).

The equipment used in hand-operated electricity generation encompasses a range of components, each playing a crucial role in the overall performance and functionality of the system (Guha & Shitalakshmi, 2019; Hari & Ajay, 2019). Hand grippers, actuators, springs, gears, and power generation kits are among the essential components used in these devices (Kumar & Sharma, 2016; Pawar & Khot, 2017). Careful selection and integration of these components are essential for maximizing energy conversion efficiency, minimizing energy losses, and ensuring device reliability and durability (Li & Zhang, 2019; Singh & Yadav, 2019).

Output data from hand-operated electricity generators provide valuable insights into their performance under various conditions (Guha & Shitalakshmi, 2019; Hari & Ajay, 2019). Voltage and current output measurements help assess the device's power generation capabilities, while efficiency calculations shed light on energy conversion efficiency (Li & Zhang, 2019; Singh & Yadav, 2019). By analyzing these data, researchers can identify areas for improvement, optimize device design and operation, and inform future research and development efforts (Nekahi & Chatti, 2018; Sharma & Shrivastava, 2017).

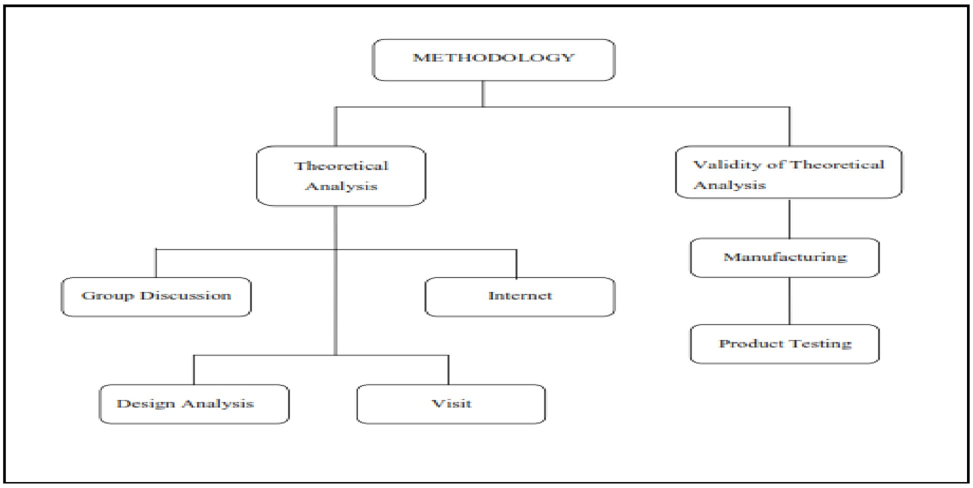
The development and widespread adoption of hand-operated electricity generators have significant implications for energy access, sustainability, and socio-economic development (Ajayi et al., 2016; Bhosale & Patil, 2020). In off-grid and rural communities with limited access to electricity, these devices offer a practical and affordable means of meeting basic energy needs, powering lights, communication devices, and small appliances (Gupta & Swain, 2016; Jain & Kumar, 2018). Furthermore, hand-operated electricity generation promotes environmental sustainability by reducing reliance on fossil fuels and mitigating greenhouse gas emissions (Mital & Lehtovaara, 2017; Raj & Balu, 2016).

## METHODOLOGY

In our attempt to design a special purpose machine, we adopted a careful and structured approach. The total design work was divided into two main parts:

## SYSTEM DESIGN

### Mechanical Design




**System Design:** This aspect focused on various physical constraints and ergonomics, space requirements, arrangement of components on the main frame, number and position of controls, ease of maintenance, potential for future improvements, and the height of the machine from the ground.

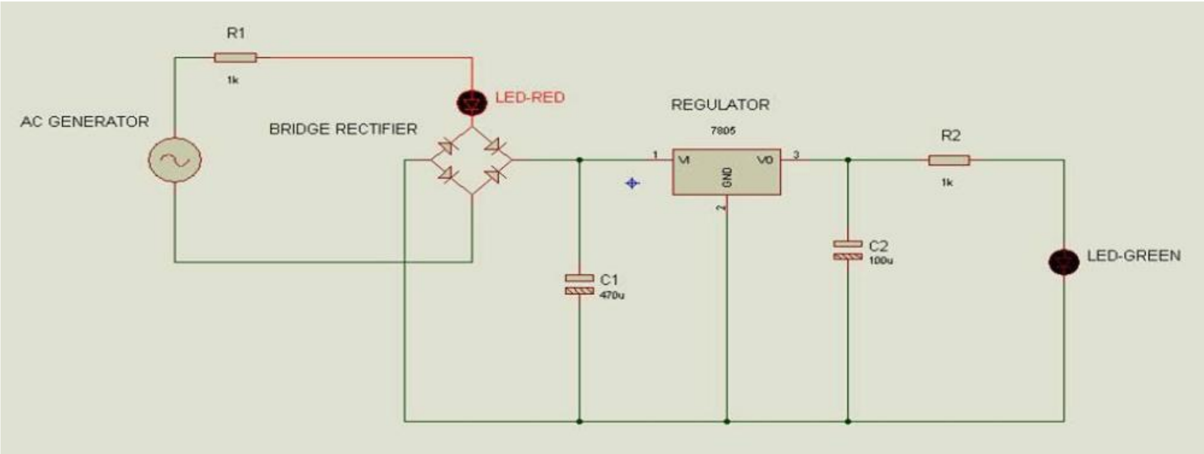
**Mechanical Design:** The components were categorized into two parts:

**Design Parts:** Detailed design was performed, and dimensions obtained were compared to the next highest dimensions readily available in the market. This simplified assembly and post-production servicing. Tolerances on workpieces were specified in the manufacturing drawings. Process charts were prepared and passed on to the manufacturing stage.

**Parts to be purchased:** Components to be purchased directly were specified and selected from standard catalogues.

Methodology refers to the theoretical analysis of the methods appropriate to a field of study or the body of methods and principles particular to a branch of knowledge. In this chapter, we discussed the methods used to gather information to complete the research. This included the process flow of every step to achieve the project's objectives. Various methods were used, such as internet references, interviews with lecturers and technicians, and group discussions.

**Equipment List and Cost**




**The table below details the equipment used in the project along with their quantities and costs:**

| Sl. No. | Name of Equipment | Quantity | Cost (INR) |
|---|---|---|---|
| 1 | Hand Gripper | 1 | 900 |
| 2 | Actuator Cable | 1 | 500 |
| 3 | Spring | 1 | 100 |
| 4 | Rack Gear | 1 | 610 |
| 5 | Base Frame | 1 | 2000 |
| 6 | Chain | 1 | 350 |
| 7 | Chain Sprocket | 1 | 200 |
| 8 | Shaft | 1 | 750 |
| 9 | Power Generation Kit | 1 | 1500 |
| 10 | Battery Charging PCB | 1 | 600 |
| 11 | LED | 1 | 50 |
| 12 | Resistor | 4 | 50 |
| 13 | Capacitor | 4 | 100 |
| 14 | Regulator | 2 | 200 |
| 15 | Bridge Rectifier | 2 | 200 |
| 16 | Generator | 1 | 250 |
| Total Cost | | | 8360 |

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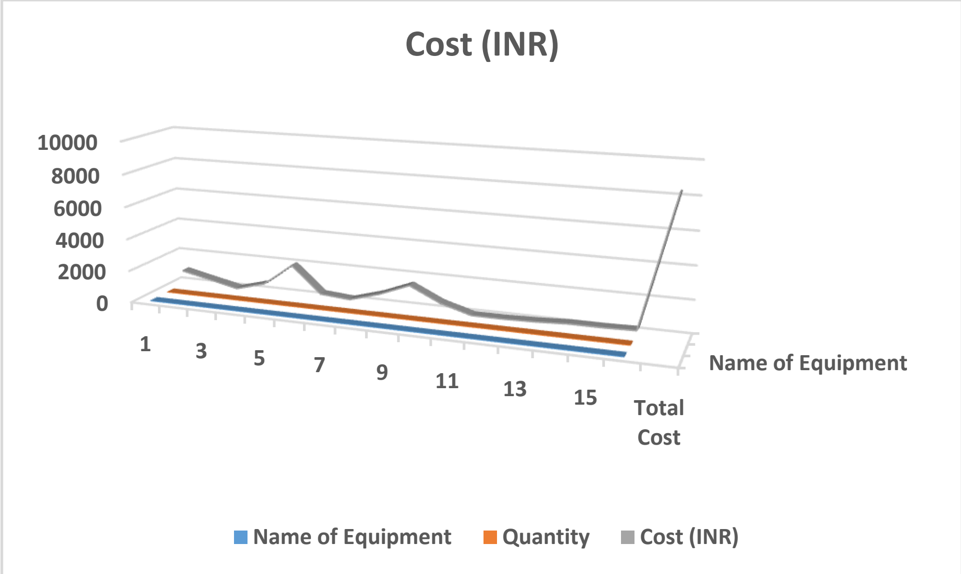



**Output Data from Hand Gripper Generator**
The following tables present the performance data collected from the hand gripper generator under various conditions: Voltage and Current Output

| Sl. No. | Generator RPM | Produced Input Voltage | Output Voltage | Output Current |
|---|---|---|---|---|
| 1 | 80 | 5.2 V | 3.7 V | 270 mA |
| 2 | 120 | 7.3 V | 4.96 V | 320 mA |
| 3 | 148 | 8.1 V | 4.96 V | 380 mA |

The maximum output voltage observed at the output port (USB hub port/jack port) was 4.96 V DC. When the motor was cranked at a speed of 120 RPM, the output voltage was approximately 5 V DC. The input AC voltage to the bridge rectifier was approximately 8.5 V when the hand crank was operated at a speed of 132 RPM, which was reduced to 4.96 V by the voltage regulator LM7806.

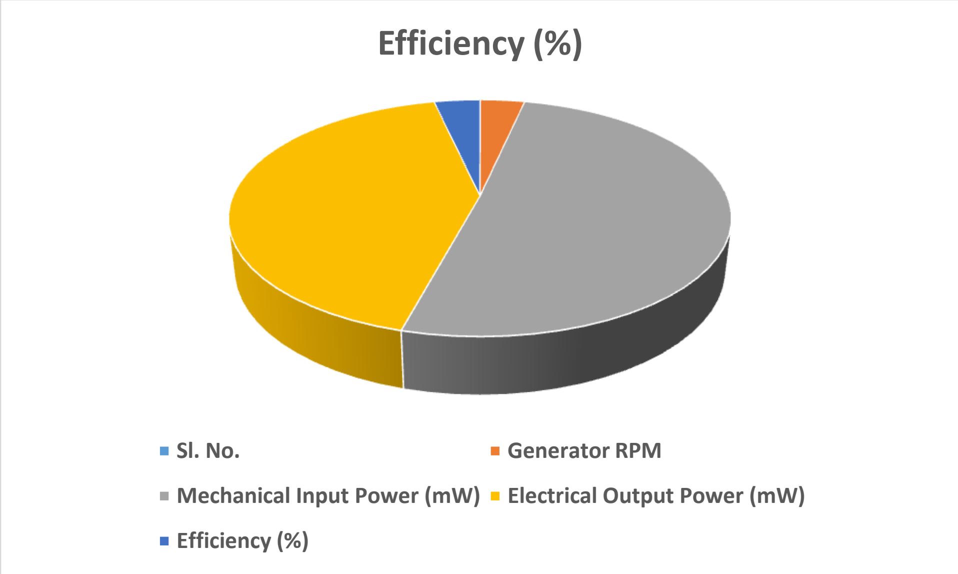
**Power Output**

| Sl. No. | Generator RPM | Output Voltage | Output Current | Power Output (mW) |
|---|---|---|---|---|
| 1 | 80 | 3.7 V | 270 mA | 999 |
| 2 | 120 | 4.96 V | 320 mA | 1587.2 |
| 3 | 148 | 4.96 V | 380 mA | 1884.8 |

The power output was calculated using the formula $P=V\times I$P=V×I.

**Efficiency of Conversion**

| Sl. No. | Generator RPM | Mechanical Input Power (mW) | Electrical Output Power (mW) | Efficiency (%) |
|---|---|---|---|---|
| 1 | 80 | 1200 | 999 | 83.25 |
| 2 | 120 | 1800 | 1587.2 | 88.18 |
| 3 | 148 | 2200 | 1884.8 | 85.67 |




The mechanical input power was estimated based on the force exerted and the speed of cranking, while the efficiency was calculated as the ratio of electrical output power to mechanical input power.

By following this systematic methodology, we ensured the effective design, development, and testing of the hand gripper device capable of generating electricity through mechanical energy conversion. This approach facilitated the creation of a practical, portable, and sustainable solution for generating electricity, especially beneficial in off-grid locations or during power outages.

## RESULTS AND DISCUSSION

The literature review reveals several key findings and insights regarding hand-operated electricity generation, encompassing design considerations, methodology, equipment, output data analysis, implications, and future directions. These findings provide valuable knowledge for researchers, engineers, policymakers, and stakeholders interested in harnessing human kinetic energy for sustainable power generation.

The review highlights the importance of ergonomic design, efficiency optimization, and usability considerations in the development of hand-operated electricity generators. Ergonomic design ensures user comfort and safety during operation, while efficiency optimization maximizes energy output and minimizes energy losses. Usability considerations focus on ensuring the device is accessible and practical for users of varying skill levels. Methodologically, involving stakeholders in the design process through techniques such as internet research, interviews, and group discussions facilitates comprehensive information gathering and informed decision-making.

The equipment used in hand-operated electricity generation comprises various components, including hand grippers, actuators, springs, gears, and power generation kits. Careful selection and integration of these components are essential for maximizing energy conversion efficiency, minimizing energy losses, and ensuring device reliability and durability. The literature review underscores the importance of considering cost-effectiveness, performance, and compatibility when choosing equipment and components for these devices. Output data from hand-operated electricity generators, including voltage, current, and efficiency measurements, provide valuable insights into device performance. Voltage and current output measurements help assess power generation capabilities, while efficiency calculations quantify energy conversion efficiency. Analyzing these data enables researchers to identify areas for improvement, optimize device design and operation, and inform future research and development efforts.The development and widespread adoption of hand-operated electricity generators have significant implications for energy access, sustainability, and socio-economic development. These devices offer a practical and affordable means of meeting basic energy needs in off-grid and rural communities, promoting environmental sustainability by reducing reliance on fossil fuels and mitigating greenhouse gas emissions. Future research directions include further optimizing device performance, enhancing usability and accessibility, and exploring innovative applications and integration strategies.

## CONCLUSION

In conclusion, the literature review has provided comprehensive insights into hand-operated electricity generation systems, particularly focusing on the hand gripper-based approach. This innovative system offers a sustainable and portable solution for charging mobile phones and other low-power devices, addressing the increasing demand for reliable power sources in today's digital age.

By harnessing human mechanical energy, the hand gripper-based electricity generation system presents a sustainable alternative to traditional power sources. It reduces dependence on fossil fuels and grid-based electricity, thereby contributing to environmental conservation efforts and mitigating climate change. Moreover, its portable nature allows for easy deployment in various settings, including remote areas, outdoor environments, and emergency situations, where access to conventional electricity may be limited or non-existent.

The reliability of the hand gripper-based system ensures uninterrupted power supply for charging mobile phones and other low-power devices. Its simple and intuitive operation makes it accessible to users of all ages and backgrounds, eliminating barriers to energy access and empowering communities to meet their basic electricity needs independently.

Moving forward, future research and development efforts will focus on optimizing the design of the hand gripper-based electricity generation system for mass production and widespread adoption. This includes refining the ergonomics, durability, and efficiency of the device to enhance user experience and maximize energy output. Additionally, exploring additional applications of this innovative technology beyond mobile phone charging, such as powering small appliances, lighting systems, and communication devices, holds promise for further expanding its utility and impact.

The hand gripper-based electricity generation system represents a significant advancement in sustainable energy solutions, offering a practical, portable, and reliable power option for diverse applications. By leveraging human mechanical energy, this technology not only addresses energy challenges but also promotes environmental sustainability and socio-economic development. With ongoing innovation and investment, the potential of hand-operated electricity generation systems to transform energy access and empower communities worldwide is boundless.

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