International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 22, No. 2, 2026
© 2026 IJERST. All Rights Reserved
Peer Reviewed, Referred & Indexed Journal

FABRICATION OF SOLAR POWERED SMART WHEEL CHAIR WITH BLUETOOTH CONTROL FOR PHYSICALLY CHALLENGED PEOPLES

K. MAHESH, G. DINESH KUMAR[2]. R. PRASANNA KUMAR[3]. Mr. P. RAMU[4].

1,2, 3. Student, Dept. of Mechanical Engineering, P.V.K.K Institute of Technology, Road, Alamuru Anantapur, Andhra Pradesh
4.Assistant Professor, Dept. of Mechanical Engineering, P.V.K.K Institute of Technology, Road, Alamuru Anantapur, Andhra Pradesh

ABSTRACT

The *Solar Powered Smart Wheelchair with Bluetooth Control for Physically Challenged People* is designed to provide an efficient, eco-friendly, and user-friendly mobility solution for individuals with physical disabilities. Traditional wheelchairs often require manual effort or frequent battery charging, which can be difficult for users. This project proposes a smart wheelchair system powered by solar energy and controlled through Bluetooth technology using a mobile device. The system integrates solar panels, a rechargeable battery, a motorized wheel mechanism, and a Bluetooth communication module connected to a microcontroller. Solar panels convert sunlight into electrical energy and store it in the battery, reducing dependence on external power sources. The Bluetooth module allows users or caregivers to control the wheelchair wirelessly through a smartphone application, enabling movements such as forward, backward, left, and right with ease. The proposed design improves mobility, independence, and convenience for physically challenged individuals. It also promotes the use of renewable energy, making the system cost-effective and environmentally sustainable. The fabrication of this wheelchair demonstrates how modern technologies like solar power, embedded systems, and wireless communication can be integrated to enhance assistive mobility devices.

1.INTRODUCTION

1.1 BACKGROUND STUDY

Assistive mobility devices have evolved significantly over the past few decades, improving the quality of life for physically challenged individuals. Traditional wheelchairs, though widely used, rely heavily on manual effort or caregiver assistance, which can be physically exhausting and limiting for users.

The introduction of powered wheelchairs marked a major advancement, enabling users to move independently using electric motors and battery systems. However, these systems depend entirely on grid electricity for charging, which can be inconvenient and costly in the long run. With the increasing demand for sustainable and eco-friendly technologies, renewable energy sources such as solar power have gained importance in assistive devices. Solar energy offers a clean, renewable, and cost-effective alternative to conventional power sources. Integrating solar panels into mobility devices allows continuous charging of batteries, thereby extending operational time and reducing dependency on external charging infrastructure. In addition to energy efficiency, modern smart technologies have enabled wireless control systems such as Bluetooth, which enhance user convenience and accessibility.

Bluetooth-controlled systems allow users to operate wheelchairs using smartphones or dedicated controllers, making navigation easier, especially for individuals with limited physical movement.

This project focuses on the design and fabrication of a solar-powered smart wheelchair equipped with Bluetooth control. The system combines renewable energy, electric propulsion, and wireless communication to provide a reliable, efficient, and user-friendly mobility solution. The integration of these technologies aims to improve independence, safety, and comfort for physically challenged individuals while promoting sustainable engineering practices.



Figure 1.1: Fabrication of Solar powered smart wheelchair with Bluetooth control For Physically Challenged People

1.2 Limited Availability of Components:

The advanced components required for the development of the smart control system are not easily available



Figure 1.2: Working principle of solar powered Smart Wheel Chair with Bluetooth Control for Physically Challenged People

2.LITERATURE SURVEY

The field of assistive mobility systems has evolved significantly over the years with the integration of advanced technologies such as renewable energy systems, wireless communication, and intelligent control mechanisms. Wheelchairs, being one of the most important mobility aids, have undergone continuous development to improve efficiency, safety, and user comfort. This chapter presents a detailed review of existing research works related to smart and solar-powered wheelchairs.

R. Simpson et al. [1] presented a comprehensive review of smart wheelchair technologies and their evolution over time. The study discussed various control interfaces such as joystick control, voice control, head movement control, and brain-computer interfaces. The author highlighted that traditional control methods are not suitable for all users, especially those with severe disabilities. The research emphasized the importance of intelligent navigation systems that can assist users in obstacle avoidance and path planning. Additionally, the paper discussed the integration of sensors and artificial intelligence to improve decision-making capabilities. The study

concluded that smart wheelchairs can significantly enhance independence and reduce reliance on caregivers.

S. A. Fehr et al. [2] conducted an extensive study on the effectiveness of power wheelchair control interfaces for individuals with severe disabilities. The research focused on evaluating different control systems and their usability for patients with limited motor skills. The authors found that conventional joystick-based control systems are difficult to operate for certain users. The study suggested alternative input methods such as sip-and-puff systems, voice recognition, and touch-based interfaces. It also highlighted the need for customizable control systems that can adapt to individual user requirements. The findings of this research are crucial in designing user-friendly smart wheelchair systems.

3.METHODOLOGY

3.1 OVERVIEW

The designing of a solar powered smart wheelchair using Bluetooth control can be initiated by studying different designing alternatives and selecting the best efficient and user-friendly system. The structure and components of the smart wheelchair were conceptualized using modeling techniques and basic engineering calculations. The system will be based on solar power harvesting, battery power storage, motor control, and wireless control for providing assistance to physically challenged people.

The designing of the smart wheelchair will be done using an iterative approach for designing each system in the smart wheelchair. Emphasis will be given to the safety and reliability of the system. The system will be designed in a way that it is energy efficient and easy to use. It will be a cost-effective and environmentally friendly system.A systematic approach was followed for designing the smart wheelchair from idea generation to final prototype testing..

3.2 DESIGN CONSTRAINTS

Weight Requirements

The total weight of the wheelchair should be minimized to improve efficiency and ease of movement. Excess weight reduces battery life and motor performance; hence lightweight materials are preferred without compromising strength.

Minimalistic Design

The wheelchair must be compact, simple, and user-friendly. The design avoids unnecessary complexity while ensuring all essential functionalities are integrated effectively.

Ergonomic Design

User comfort is a primary consideration. The seating arrangement, back support, and control accessibility are designed to provide ease of use for physically challenged individuals. Proper posture and safety are maintained.

Safety

The system must ensure the safety of the user at all times. This includes stable structure, reliable braking system, controlled speed, and electrical safety of components.

Structural Integrity

The frame must withstand load conditions during operation, including user weight, motion, and uneven surfaces. Strong yet lightweight materials like mild steel or aluminum are used.

Solar Energy Utilization

The system must efficiently utilize solar energy. Proper positioning of solar panels and efficient charge controllers are necessary to maximize energy conversion and storage.

Performance and Efficiency

The wheelchair should provide smooth motion, adequate speed, and sufficient battery backup.

Efficient motor selection and power management are essential.

Manufacturing and Cost
The design should be economically feasible and easy to fabricate using available materials and tools.

3.3 COMPONENTS

1. DC MOTOR
2. SOLAR PANEL
3. BATTERY (12V/24V RECHARGEABLE)
4. MOTOR DRIVER / CONTROLLER
5. BLUETOOTH MODULE (HC-05/HC-06)
6. MICROCONTROLLER (ARDUINO/EMBEDDED SYSTEM)
7. WHEELCHAIR FRAME
8. WHEELS AND BEARINGS
9. JOYSTICK / MOBILE APP CONTROL
10. CHARGE CONTROLLER
11. SWITCHES AND WIRING SYSTEM

DC MOTOR

DC motors are widely used in solar-powered wheelchairs with Bluetooth control because they provide the high torque and precise speed regulation needed for safe mobility. In this application, geared DC motors drive the wheels, allowing the wheelchair to move forward, backward, and turn smoothly under electronic control. They are ideal for carrying heavy loads, such as a person, while operating efficiently on battery power charged from solar panels. With Bluetooth integration, DC motors enable wireless control through a smartphone or joystick system, making operation easier for users with limited mobility. Their reliability, simple construction, and compatibility with motor drivers and microcontrollers make them essential components in modern smart.

Key Specifications

Typical specs for wheelchair DC motor: Voltage: 24V DC (standard)

Power: 200W – 350W (ideal: 250W) Speed: 75–150 RPM (low speed for safety) Torque: ~20 Nm or more (very important) Current: ~10–15A rated

Gear Ratio: ~20:1 to 30:1 (for torque increase) Brake: Electromagnetic brake (optional but useful)

Efficiency: ~75–80%



Figure 3.1: DC Motor

SOLAR PANEL

Solar panels in a solar-powered smart wheelchair with Bluetooth control are used to convert sunlight into electrical energy and charge the battery that powers the entire system, including DC motors, control circuits, and wireless modules. They enable the wheelchair to operate independently of grid electricity, making it suitable for outdoor and remote use. In this application, solar panels typically have a power rating of around 100W to 200W, with an output voltage of 12V or 24V to match the battery system. They generate direct current (DC) electricity, which is stored in batteries and later used for driving the motors and supporting Bluetooth-based control through a microcontroller. Solar panels are preferred because they are eco-friendly, low maintenance, and provide a continuous renewable energy source, improving the efficiency and usability of smart wheelchair systems.



Fig 3.2 solar panel

BATTERY

The battery in a solar-powered smart wheelchair stores energy from solar panels. It supplies power to motors, control circuits, and Bluetooth modules. It ensures continuous operation without sunlight. Rechargeable types like lithium-ion or lead-acid are commonly used. Typical voltage is 12V or 24V. Capacity ranges from 20Ah to 40Ah. It provides high current for motor operation. The battery supports stable and reliable performance. It has good charge-discharge efficiency. Long cycle life is important for durability. Protection features prevent overcharging and deep discharge. It enables smooth and safe wheelchair movement.



Figure 3.3: Battery

MOTOR DRIVER

A motor driver in a solar-powered smart wheelchair with Bluetooth control is used to control the speed and direction of DC motors. It connects the microcontroller and motors, handling high voltage and current. Typical specifications include 24V operation, 20A–40A current capacity, dual-channel output, and PWM control for smooth.

BLUETOOTH MODULE

A Bluetooth module is used in a solar-powered smart wheelchair to enable wireless communication between the wheelchair and a smartphone or control device,

allowing the user to control movement without physical switches. It helps in sending commands such as forward, backward, left, right, and speed control through a mobile app. Commonly used modules like HC-05 or HC-06 operate on a voltage of 3.3V to 5V and support serial communication (UART) with microcontrollers such as Arduino or ESP32. These modules have a typical range of about 10 meters, which is sufficient for personal mobility control. The data transfer rate is usually up to 2.1 Mbps, ensuring smooth and quick response. Bluetooth modules consume low power, making them suitable for battery-operated systems like solar wheelchairs. They are compact, cost- effective, and easy to interface with motor drivers and control circuits. Security features like pairing and password protection ensure safe operation. Overall, the Bluetooth module enhances user convenience and accessibility by enabling remote and flexible control of the wheel chair

Fig 3.4: Bluetooth module



MICROCONTROLLER

A microcontroller is used in a solar-powered

smart wheelchair with Bluetooth control to manage and control all system operations. It receives commands from the Bluetooth module and controls the direction and speed of the DC motors through a motor driver.

It also helps monitor battery usage and ensures efficient power management. Common microcontrollers like Arduino or ESP32 operate at 3.3V–5V, support serial communication, have multiple input/output pins, and consume low power, making them suitable for such smart systems.



Fig 3.5:Microcontroller

WHEELCHAIR FRAME

The wheelchair frame in a solar-powered smart wheelchair with Bluetooth control provides strong structural support for the user, motors, battery, and solar panel. It is usually made of materials like aluminum or steel for durability and lightweight performance. The frame supports a load capacity of around 100–150 kg and includes mounting points for electronic components and motors. It is designed for stability, comfort, and easy movement, with compact and ergonomic features suitable for integrating Bluetooth control systems**.**



Fig 3.6: Wheel chair frame

4.ESTIMATION OF COST ANALYSYS

BILLS OF MATERIALS

The following section presents the estimated cost required for the fabrication of a solar powered smart wheelchair with Bluetooth control. The total cost includes the price of electrical components, mechanical parts, fabrication, and assembly.

TABLE 4.1: ESTIMATION OF COST ANALYSYS

SL.NO	MATERIALS	QUANTITY	COS
1	24V Gear motor	2	9800
2	Motor Driver Controller	2	5000
3	12V Battery-28Ah	2	9000
4	Bluetooth Controller Module	1	1500
5	Wiring kit	1	1000
6	10*3 Wheel	2	5000
7	Wheel Safety	1	2500
8	Motor Fixing Brackets	1	1500
9	Wheel chair frame	1	8000
10	Wheel chair Cushion	1	2500
11	24V Battery charger	1	2500
12	Fuse	1	500/
13	Switches, connectors,	1 Set	1000
14	Solar panel	1	2500
15	Workshop allowances	-	4000
16	Charge Controller	1	1000
17	Iron rods	-	1000
	TOTAL		**5830**

5.RESULT

The main objective of this project is to design and fabricate a solar powered smart wheelchair with Bluetooth control for physically challenged individuals. The system was successfully developed by integrating solar energy generation, battery storage, motor drive, and wireless control.

The fabricated model operates efficiently using solar power as the primary energy source, reducing dependency on conventional electricity. The Bluetooth-based control system enables the user to operate the wheelchair easily through a smartphone, providing convenience and independence The wheelchair demonstrated smooth movement in forward, reverse, left, and right directions. The system was tested under different conditions, and the performance was found to be satisfactory in terms of speed, control, and stability

S. No	OUTPUT	TORQUE IN NM	SPEED IN RPM	SPEED IN KMPH
1	Wheel chair motion	10	2500	Forward : 6-10 Reverse : 5-6



Figure 5.1 Frame Work

5.1 OBSERVATIONS

1. The solar panel efficiently charges the battery during sunlight conditions.
2. The Bluetooth module responds quickly to user commands.
3. Smooth acceleration and deceleration were observed.
4. The system is stable and safe for operation.
5. The wheelchair performs well on flat surfaces.



Figure 5.2 Alignment of Batters and Wiring System

5.2 FINAL OUTPUT

The final fabricated solar powered smart wheelchair successfully achieves:

1. Renewable energy utilization
2. Smart control using Bluetooth
3. Improved mobility for physically challenged users
4. Cost-effective and eco-friendly operation



Figure 5.3 Final Image of Solar powered smart wheel chair with Bluetooth control For physically challenged people

CONCLUSION

The project titled *"Fabrication of Solar Powered Smart Wheelchair with Bluetooth Control for Physically Challenged People"* has been successfully designed and developed. The main objective of this project was to provide an efficient, eco-friendly, and user-friendly mobility solution for physically challenged individuals. The integration of solar energy with an electric wheelchair system helps in reducing dependency on conventional charging methods and promotes the use of renewable energy. The use of a Bluetooth control system enables easy operation through a smartphone, making it convenient for users with limited physical mobility. The system consists of major components such as a DC motor, rechargeable battery, solar panel, motor controller, and Bluetooth module. All components were assembled and tested to ensure smooth operation. The wheelchair demonstrated satisfactory performance in terms of speed, control, and stability. This project proves that assistive mobility devices can be enhanced with modern technologies to improve independence and quality of life for physically challenged individuals. It is cost-effective, energy-efficient, and easy to operate.

FUTURE SCOPE

The project can be further improved with advanced features and technologies to enhance its performance and usability. Some possible future enhancements are:

- Integration of IoT (Internet of Things) for remote monitoring
- Addition of GPS tracking system for safety and navigation
- Implementation of voice control system for better accessibility
- Use of AI-based obstacle detection and avoidance system
- Improved battery technology for longer backup
- Automatic solar tracking system for efficient charging
- Mobile application with advanced control features

REFERENCES

1. R. Simpson, "Smart wheelchairs: A literature review," *Journal of Rehabilitation Research and Development*, vol. 42, no. 4, pp. 423–436, 2005.
2. S. A. Fehr, W. E. Langbein, and S. B. Skaar, "Adequacy of power wheelchair control interfaces for persons with severe disabilities: A clinical survey," *Journal of Rehabilitation Research and Development*, vol. 37, no. 3, pp. 353–360, 2000.
3. P. Jayaprakash, K. Saravanan, and R. Suresh,

"Design and implementation of solar powered wheelchair," *International Journal of Engineering Research & Technology (IJERT)*, vol. 3, no. 2, pp. 1–5, 2014.

4. S. Sharma and R. Gupta, "Bluetooth based smart wheelchair control system," *International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)*, vol. 5, no. 6, pp. 10234–10239, 2016.
5. M. F. Khan, S. R. Ahmed, and A. Ali, "Voice controlled wheelchair for physically disabled persons," *International Journal of Computer Applications*, vol. 120, no. 3, pp. 10–14, 2015.