IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 1, August 2025
Impact Factor: 7.67

Smart Lawn Cutter using Solar and Bluetooth

Rani N Bhosale[1], Tejashri M Salunkhe[1], Sayali S Ghodake[1], Shruti S Deshpande[1], Chandani N Kendale[1], Suhas B Khadake[2]
[1]EE Students, SVERI's College of Engineering, Pandharpur, India
[2]Assistant Professor, SVERI's College of Engineering, Pandharpur, India

Abstract: *An eco-friendly, solar-powered smart lawn mower is designed to automate lawn maintenance while minimizing cost, emissions, and user effort. The system integrates photovoltaic panels charging a 12 V rechargeable battery, which supplies power to multiple DC motors—including those driving wheels and the cutting blades—with optional height adjustment functionality. User interaction is enabled via an Android smartphone app communicating over Bluetooth (typically HC-05) and/or Wi-Fi to control motions (forward/backward/turn), blade activation, and optional functions like height control or sprinkling timing. Obstacle detection is implemented using IR or ultrasonic sensors, ensuring operational safety and path correction during cutting.*
The onboard microcontroller (e.g. Arduino UNO) serves as the central controller, managing power distribution, motor drivers (e.g. L293D), sensor readings, and wireless communication with the app. In some designs, sun-tracking panels further optimize solar harvesting efficiency. The smart lawn mower offers benefits in terms of reduced labour, low maintenance, quiet operation, and zero emissions. Further developments propose features like automatic scheduling, sprinkler integration, time-tracking, smart-home connectivity, and enhanced obstacle avoidance/path-planning for improved autonomy and user experience.

Keywords: *"Solar Powered, Bluetooth lawn cutter"*

I. INTRODUCTION

The smart solar-powered Bluetooth lawn cutter is an innovative solution designed to automate lawn maintenance while promoting environmental sustainability. By integrating solar energy, Bluetooth connectivity, and robotic automation, this device offers a convenient and eco-friendly alternative to traditional gas-powered lawn mowers.

Equipped with photovoltaic panels, the mower harnesses sunlight to charge a rechargeable battery, ensuring continuous operation without reliance on external power sources. This self-sustaining energy model reduces electricity consumption and minimizes carbon emissions. Through Bluetooth technology, users can remotely control the mower using a smartphone application. This feature allows for easy navigation, scheduling, and monitoring of mowing sessions, enhancing user convenience and control.

The mower is equipped with sensors and an onboard microcontroller, enabling it to autonomously navigate the lawn, detect obstacles, and adjust its path accordingly. This automation reduces the need for manual intervention and ensures consistent mowing results. By utilizing solar power and reducing the need for fossil fuels, the smart lawn cutter contributes to a decrease in greenhouse gas emissions. Its quiet operation also minimizes noise pollution, making it suitable for residential areas. In summary, the smart solar-powered Bluetooth lawn cutter represents a significant advancement in sustainable lawn care technology, offering a blend of automation, energy efficiency, and environmental responsibility.

The increasing demand for efficient and sustainable lawn maintenance solutions has led to the development of the Smart Solar-Powered Lawn Cutter. This innovative device integrates renewable energy sources with modern technology to provide an eco-friendly alternative to traditional gasoline- powered lawn Cutter. Traditional lawn Cutter often contributes to environmental pollution due to their reliance on fossil fuels and the emission of greenhouse gases. Additionally, manual operation can be labour intensive and time consuming. The Smart Solar-Powered Lawn Cutter addresses these issues by utilizing solar energy for operation and Bluetooth technology for remote control, thereby

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 1, August 2025 Impact Factor: 7.67

reducing carbon footprints and enhancing user convenience. This project aims to design and implement a lawn cutter that operates autonomously, powered entirely by solar energy, and can be controlled remotely via Bluetooth using a smartphone application. The integration of ultrasonic sensors ensures obstacle detection, allowing the mower to navigate complex terrains safely. By combining renewable energy with wireless control, this project seeks to revolutionize lawn maintenance practices, making them more sustainable and user-friendly.

System Overview: The smart lawn cutter operates on a solar-powered system, utilizing a solar panel to charge a rechargeable battery. This setup ensures continuous operation without reliance on external power sources, making it ideal for residential and commercial applications. The cutter is equipped with a microcontroller, such as Arduino or Raspberry Pi, which manages the mower's functions and processes inputs from various sensors.

Bluetooth Control: Bluetooth technology enables users to control the lawn cutter remotely via a smartphone application. This wireless control allows for easy navigation and operation, enhancing user convenience and accessibility. The application interface typically includes options for directional movement, start/stop functions, and status monitoring.

Obstacle Detection and Safety Features: To ensure safe operation, the lawn cutter is equipped with ultrasonic sensors that detect obstacles in its path. Upon detecting an obstacle, the system automatically adjusts its movement to avoid collisions, preventing potential damage to the mower and surrounding objects. Some models also incorporate additional sensors, such as flame detectors, to enhance safety by detecting and responding to fire hazards

Environmental Impact and Benefits: By utilizing solar energy, the smart lawn cutter reduces dependence on fossil fuels, contributing to a decrease in greenhouse gas emissions. The absence of internal combustion engines also minimizes noise pollution, providing a quieter alternative to traditional gas-powered mowers. Additionally, the automation of lawn maintenance tasks reduces labor costs and time investment, offering a practical solution for maintaining well-kept lawns with minimal effort.

Maintaining a healthy and neat lawn often requires time, effort, and energy. Traditional lawn mowers, whether manual or fuel-powered, are labor-intensive and contribute to noise and air pollution. With advancements in technology and growing awareness about sustainable living, there is a need for smarter, eco-friendly alternatives.

The Smart Lawn Cutter using solar energy and Bluetooth control offers a modern solution to this problem. By harnessing the power of the sun to charge its battery and allowing users to operate the mower remotely via a smartphone, this system minimizes manual labor while promoting clean energy usage. The use of microcontrollers, wireless communication, and motorized cutting mechanisms makes it an efficient and user-friendly device ideal for residential lawn care.

This project combines automation, renewable energy, and wireless control to create a reliable lawn maintenance tool that supports both convenience and sustainability.

PROBLEM STATEMENT

Traditional lawn care methods often rely on gasoline-powered mowers, leading to environmental pollution and high operational costs. Additionally, manual mowing is labor-intensive and time-consuming. There is a growing need for an eco-friendly, efficient, and user-friendly solution to address these challenges. The proposed Smart Solar-Powered Bluetooth Lawn Cutter aims to provide an automated, sustainable, and convenient alternative. By integrating solar energy for power, Bluetooth connectivity for remote control, and autonomous navigation, this device seeks to: Reduce Carbon Footprint: Minimize reliance on fossil fuels, decreasing greenhouse gas emissions. Enhance User Convenience: Allow remote operation and monitoring via Bluetooth-enabled devices.

Ensure Autonomous Operation: Navigate and mow lawns without human intervention, optimizing efficiency. Adapt to Various Terrains: Utilize sensors and intelligent algorithms for effective obstacle detection and path planning.

However, several challenges must be addressed to realize this vision: Power Management: Ensuring sufficient energy storage and efficient solar charging to support continuous operation. Navigation and Obstacle Avoidance: Developing reliable systems for detecting and avoiding obstacles in diverse environments Cost-Effectiveness: Balancing advanced features with affordability to make the technology accessible. Weather Dependency: Ensuring consistent performance under varying weather conditions.

IJARSCT

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

ISSN: 2581-9429 Volume 5, Issue 1, August 2025 Impact Factor: 7.67

Lawn maintenance is a routine but physically demanding task that traditionally relies on manual or fuel-powered lawn mowers. These methods require continuous human effort, consume non-renewable energy sources, and often produce noise and air pollution. Additionally, many existing automated solutions are either expensive or lack flexibility in user control.

There is a need for a cost-effective, energy-efficient, and user-friendly solution that can reduce manual effort, operate sustainably, and be controlled easily. Therefore, the problem is to design and develop a smart lawn cutter system that:

Uses solar energy to reduce reliance on traditional power sources, Operates with Bluetooth-based wireless control to enhance user convenience, Maintains cutting performance suitable for small to medium-sized lawns.

This project aims to address the limitations of traditional lawn cutting methods by creating a smart, portable, and eco-friendly alternative.

II. LITERATURE SURVEY

Development of solar-powered lawn cutters has gained significant attention due to the increasing cost of fuel and the environmental impact of traditional gasoline-powered cutters. Several studies have focused on designing and evaluating solar-powered lawn cutters to address these issues.

Design of Smart and Self-Controlled Solar Grass Cutter with Lawn Coverage This study presents a solar- powered grass cutter utilizing an Arduino microcontroller, ultrasonic sensors for obstacle detection, and a variable head mechanism for adjustable cutting height. The system operates autonomously, adjusting to varying lawn conditions.

The project integrates solar energy with IoT, using a 12V rechargeable battery charged by a solar panel. Components include Arduino UNO, NodeMCU, IR sensors, and a Bluetooth module (HC-05) for manual control via a mobile app. The system emphasizes eco-friendliness and efficiency. 3. Literature Survey for Automatic Grass Cutter Using Solar Tracking System This survey analyzes various automated solar grass cutters, highlighting features like solar tracking, obstacle avoidance, and mobile app control. It discusses the evolution of these systems and their applications in lawn maintenance.

Design and Implementation of a Solar-Powered Grass Cutter using IoT: This paper details a solar-powered grass cutter with dual control modes: automatic and manual. It employs an ultrasonic sensor for obstacle avoidance and a NodeMCU microcontroller for operation, powered by a 12V battery charged via a solar panel. Smart Grass Cutter Using Solar Power System The design incorporates solar panels, charge controllers, and sensors like flame and obstacle detectors. An Android app facilitates remote control, making the system both user-friendly and environmentally responsible.

Several studies have focused on designing and evaluating solar-powered lawn cutters to address these issues.

Soyoye (2021) designed and fabricated solar-powered lawn cutters utilizing a DC motor, rechargeable battery, solar panel, and galvanized steel blades. Performance evaluation revealed cutting efficiencies ranging from 70.50% to 84.10% and cutting capacities between 0.05 ha/h and 0.27 ha/h, depending on blade thickness and shape.

Ajewole and Koyenikan (2024) developed robotic solar-powered lawn cutters incorporating a 16W solar panel, 2202mAh battery, and Raspberry Pi 3 B+ microcontroller. The mower achieved an effective field capacity of 0.13 m^2/s and a field efficiency of 88%, demonstrating its suitability for large-scale applications.

Mohatkar et al. (2022) focused on creating economical solar-powered lawn cutters using a 12V, 100AH battery and a 12V DC motor of 180W. A 1000V solar panel system was employed to charge the battery, aiming to provide an affordable and energy-efficient solution for lawn maintenance. Gadhiya et al. (2021) developed a solar- powered lawn mower featuring a BLDC motor, solar panel, battery, and charge controller. The mower achieved an efficiency of 81.33%, highlighting its potential for use in various settings such as playgrounds and golf courses. [4] Okafor et al. (2024) designed solar-powered lawn cutters comprising an electric motor, charge controller, 12V battery, 30W solar panel, and rotational blade. The mower demonstrated a theoretical efficiency of 85%, emphasizing the viability of solar energy in lawn maintenance applications. These studies underscore the feasibility and advantages of solar-powered lawn mowers, including reduced fuel costs, lower emissions, and quieter operation. Integrating Bluetooth connectivity into these systems can further enhance user convenience by enabling remote control and monitoring. However, challenges such as weather dependency and higher initial costs remain considerations for widespread adoption. Smart Lawn Cutter Using Sol

Integration of Solar Power: Many studies emphasize the use of solar panels to power the grass cutters, promoting sustainability and reducing dependency on non-renewable energy sources. Bluetooth and IoT Connectivity: The incorporation of Bluetooth and IoT technologies allows for remote control and monitoring, enhancing user convenience and system flexibility. Obstacle Detection and Navigation: Ultrasonic sensors and advanced algorithms are commonly used for obstacle detection and path planning, ensuring safe and efficient operation.

Dual Control Modes: Offering both automatic and manual control modes caters to different user preferences and operational scenarios. Environmental Considerations: The focus on eco-friendly designs addresses concerns related to noise pollution and emissions associated with traditional gas-powered mowers. These studies underscore the feasibility and advantages of solar-powered lawn mowers, including reduced fuel costs, lower emissions, and quieter operation. Integrating Bluetooth connectivity into these systems can further enhance user convenience by enabling remote control and monitoring. However, challenges such as weather dependency and higher initial costs remain considerations for widespread adoption.

1. Automation and Smart Control Systems

Research in smart agriculture and automation has shown that integrating microcontrollers (such as Arduino or PIC) with wireless modules (like Bluetooth or GSM) improves ease of operation. According to studies, Bluetooth-based control is highly effective for short-range and real-time manual control, eliminating the need for physical effort.

2. Solar-Powered Robotics

Solar energy is an efficient and eco-friendly power source for outdoor robotic applications. Various studies have demonstrated the feasibility of using solar panels to charge batteries, reducing dependency on grid electricity and enhancing portability. Solar-powered lawn mowers contribute to sustainable landscaping practices.

3. Cutting Mechanism and Safety

Literature on robotic lawn mowers suggests that a rotating blade or cutter mechanism, powered by a DC motor, is commonly used. Safety features such as obstacle detection or automatic shutdown on lift/tip are often implemented to avoid accidents, especially in domestic use.

4. Microcontroller-Based Design

Multiple projects and research works have used Arduino UNO or ESP32 for control logic. These platforms offer easy integration of sensors, motors, and communication modules. The Bluetooth module (HC-05 or similar) enables wireless communication with a smartphone for real-time operation.

5. Existing Systems and Limitations

Most commercial robotic lawn mowers are expensive and use GPS navigation or boundary wires. In contrast, Bluetooth-controlled models are low-cost and more suitable for small residential lawns. However, their limitation lies in the restricted range and lack of full autonomy.

III. PROJECT DESCRIPTION

The Smart Solar-Powered Bluetooth Lawn Cutter is an innovative, eco-friendly solution designed to automate lawn maintenance. By integrating solar energy for power and Bluetooth technology for control, this system offers a sustainable alternative to traditional gasoline-powered mowers. It aims to reduce environmental impact, minimize operational costs, and provide users with a convenient and efficient lawn care experience. The system operates by harnessing solar energy through a 12V solar panel, which charges a 12V rechargeable battery. The Arduino UNO microcontroller manages the operation of the DC motors, which drive the wheels and the blade. Ultrasonic sensors are employed to detect obstacles, allowing the cutter to navigate around them autonomously. Users can control the lawn cutter remotely via a smartphone application using Bluetooth connectivity. The system offers multiple modes of operation: Manual Mode: Users can control the cutter's movement using directional buttons on the app. Voice Mode: Voice commands are used to control the cutter's actions. Auto Mode: The cutter navigates and mows the lawn automatically based on pre-programmed algorithms. By utilizing solar energy, the Smart Lawn Cutter eliminates the need for fossil fuels, reducing carbon emissions and promoting environmental sustainability. Additionally, the system's

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 1, August 2025 Impact Factor: 7.67

quiet operation minimizes noise pollution, making it suitable for residential areas and public spaces. The Smart Solar-Powered Bluetooth Lawn Cutter represents a significant advancement in sustainable landscaping technology. By combining renewable energy, wireless control, and intelligent automation, this project offers a practical and environmentally friendly solution to modern lawn care challenges.

Solar-Powered Operation: Design a lawn cutter that operates entirely on solar energy, utilizing a solar panel to charge a rechargeable battery, thereby reducing reliance on conventional power sources and promoting sustainability.

• Bluetooth Connectivity: Implement Bluetooth technology to enable remote control of the lawn cutter via a smartphone application, allowing users to operate the device from a distance and monitor its status in real-time.

• Autonomous Navigation: Equip the lawn cutter with ultrasonic sensors to detect obstacles and navigate the lawn autonomously, ensuring efficient and safe operation without human intervention.

• User-Friendly Interface: Develop an intuitive smartphone application that allows users to control the lawn cutter, set mowing schedules, and receive notifications about the device's status and battery levels.

• Energy Efficiency: Optimize the energy consumption of the lawn cutter to maximize the usage of solar energy, extending the operating time and reducing the frequency of battery recharges.

• Safety Features: Incorporate safety mechanisms to prevent the lawn cutter from operating in unsafe conditions, such as when it is lifted or tilted, to protect users and the device.

• Cost-Effectiveness: Design the lawn cutter to be cost-effective, reducing operational costs by eliminating the need for gasoline and minimizing maintenance requirements.

• Environmental Impact: Assess and minimize the environmental impact of the lawn cutter, ensuring it contributes positively to sustainable landscaping practices by reducing carbon emissions and noise pollution.

This project aims to develop an autonomous, solar-powered lawn cutter integrated with Bluetooth connectivity, designed to provide an eco-friendly and efficient solution for lawn maintenance. The scope encompasses the design, development, and implementation of a system that operates primarily on solar energy, reducing dependence on conventional power sources and minimizing environmental impact. The Bluetooth integration allows for remote control and monitoring via a smartphone application, enhancing user convenience and operational flexibility. The system includes features such as obstacle detection to ensure safe navigation, and autonomous operation to reduce the need for manual intervention. The project also involves the creation of a user-friendly interface that facilitates easy interaction with the cutter. While the focus is on residential applications, the design principles and technologies can be adapted for commercial use, contributing to sustainable landscaping practices.

1. System Design and Component Selection The project begins with the selection of appropriate components to ensure efficient operation: Solar Panel: A 12V, 10W solar panel is chosen to harness solar energy and charge the battery, ensuring eco-friendly operation. Battery: A 12V lithium-ion battery stores energy from the solar panel, providing power to the system during non-sunny periods. Microcontroller: An Arduino UNO is selected for its versatility and ease of integration with various sensors and modules. Bluetooth Module: The HC-05 Bluetooth module facilitates wireless communication between the cutter and a smartphone application. Motors and Motor Driver: DC geared motors are used for movement, and an L298N motor driver controls the direction and speed of the motors. Sensors: Ultrasonic sensors detect motion around the cutter. Hardware Integration The components are integrated as follows: The solar panel is connected to the battery through a charge controller to regulate charging. The Arduino UNO is programmed to control the motors via the L298N motor driver, process inputs from the sensors, and communicate with the Bluetooth module. The Bluetooth module is paired with a smartphone application, allowing remote control of the cutter. The ultrasonic sensors are mounted on the cutter to detect obstacles and prevent collisions.. 3. Software Development The software development involves: Arduino Programming: Writing code to manage motor control, sensor data processing, and Bluetooth communication. Sensor Integration: Implementing algorithms to process data from the ultrasonic and PIR sensors, enabling autonomous navigation and safety features. 4. Testing and Calibration The system undergoes rigorous testing to ensure functionality: Obstacle Detection: The ultrasonic sensors' range and accuracy are tested to ensure reliable obstacle detection. Smart Lawn Cutter Using Solar & Bluetooth 12 Motion Detection: The ultrasonic sensor's sensitivity is adjusted to accurately detect human presence. Solar Charging: The efficiency of the solar panel and battery charging system is evaluated under different condition. Bluetooth Communication: The range and stability of

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 1, August 2025 Impact Factor: 7.67

the Bluetooth connection are tested to ensure seamless control via the mobile application. Performance Evaluation The cutter performance is assessed based on: Autonomous Navigation: Evaluating the mower's ability to navigate the lawn, avoid obstacles, and cover the designated area efficiently. Battery Life: Monitoring the battery's charge and discharge cycles to ensure adequate operation time. User Interface: Assessing the ease of use and responsiveness of the mobile application. Safety Features: Testing the effectiveness of the motion detection system in preventing accidents.

IV. OBJECTIVE OF SYSTEM

- To design an eco-friendly and energy-efficient lawn cutting system: Utilize solar power as the primary energy source to reduce dependence on conventional electricity and promote sustainable landscaping tools.
- To implement wireless control via Bluetooth for remote operation: Enable the user to control the lawn cutter from a distance using a smartphone or Bluetooth-enabled device, improving convenience and safety.
- To automate the grass-cutting process: Develop a semi-autonomous or fully autonomous mechanism that can navigate and cut grass efficiently in a defined area.
- To integrate obstacle detection and safety features: Use sensors (e.g., IR or ultrasonic) to identify obstacles and avoid collisions, ensuring safe operation in a domestic environment.
- To minimize manual labor and time: Reduce human effort and time required for lawn maintenance through smart automation and remote control features.
- To ensure affordability and low maintenance: Design the system to be cost-effective and easy to maintain, making it suitable for small to medium-sized residential gardens.
- To evaluate system performance under various weather conditions: Analyze how the device operates in different lighting and surface conditions, particularly focusing on the efficiency of the solar charging system.
- To develop a smart lawn cutting system that reduces manual effort by automating the grass cutting process.
- To utilize solar energy as a renewable and eco-friendly power source, minimizing dependency on conventional electricity.
- To implement Bluetooth-based wireless control for remote operation of the lawn cutter using a smartphone.
- To design a cost-effective solution suitable for small to medium-sized lawns, especially for domestic use.
- To ensure user safety by incorporating basic safety features like emergency stop and blade control via Bluetooth.
- To minimize environmental impact by avoiding fuel-based engines and utilizing clean energy and silent electric motors.
- To increase system portability by using a compact and battery-operated design powered by solar charging.
- To provide a user-friendly interface through a mobile app or Bluetooth controller for easy operation and maneuvering.

V. ADVANTAGES & APPLICATION

Advantages:

1. Eco-Friendly Operation: Utilizes solar energy, reducing reliance on fossil fuels and minimizing carbon emissions.
2. Cost-Effective: Eliminates fuel costs associated with traditional gas-powered mowers, leading to long-term savings.
3. Remote Control via Bluetooth: Allows users to operate the mower from a distance using a smartphone app, enhancing convenience.
4. Autonomous Operation: Can operate independently with minimal human intervention, reducing labor requirements.
5. Low Maintenance: Fewer moving parts and no need for fuel or oil changes result in reduced maintenance needs.
6. Quiet Operation: Produces less noise compared to traditional mowers, minimizing disturbance to neighbors.
7. Enhanced Safety: Features like obstacle detection and fire sensors improve operational safety. Smart Lawn Cutter Using Solar & Bluetooth.

Applications:

1. Residential Lawns: Ideal for homeowners seeking an eco-friendly and automated solution for lawn maintenance.
2. Public Parks and Gardens: Suitable for maintaining public green spaces with minimal environmental impact.
3. Commercial Properties: Applicable for businesses aiming to reduce maintenance costs and environmental footprint.
4. Smart Landscaping Projects: Integrates into smart home systems, allowing users to schedule and monitor mowing sessions.
5. Educational Demonstrations: Serves as a practical example in educational settings to demonstrate renewable energy and IoT applications

VI. RESULTS AND DISCUSSION

The developed Smart Lawn Cutter was tested under different environmental and operational conditions to evaluate its performance, energy efficiency, and usability. The integration of solar charging and Bluetooth-based control was assessed for reliability, effectiveness, and practicality in real-world lawn maintenance. The prototype successfully performed its intended functions, demonstrating promising results for small to medium residential gardens.

- Efficient Solar Charging: The solar panel was able to charge the battery up to 80% capacity in about 5–6 hours of direct sunlight.
- Adequate Cutting Time: A fully charged battery powered the cutter for approximately 45 minutes of continuous operation.
- Reliable Bluetooth Control: The cutter responded effectively within a 10-meter range, offering smooth wireless control via smartphone.
- Effective Obstacle Avoidance: IR sensors detected objects within a 25–30 cm range, helping avoid collisions automatically.
- Uniform Grass Cutting: The cutter maintained consistent cutting results, reducing grass height from 8 cm to around 3 cm.
- User-Friendly Design: Simple mobile interface allowed for easy control, making it accessible to all user levels.
- Low Operating Cost: As a solar-powered device, it required no external electricity, making it energy-efficient and eco-friendly.

The designed smart lawn cutter was successfully able to:

- Operate on solar energy, charging the battery effectively during daylight hours.
- Be controlled wirelessly using Bluetooth from a smartphone with smooth directional control.
- Cut grass efficiently using a DC motor-driven rotating blade.
- Navigate on flat lawn surfaces with good maneuverability and stability.
- Reduce manual effort and electricity consumption, achieving an eco-friendly and user-friendly grass cutting solution.
- Discussion:
- The system proved effective for small to medium-sized lawns where GPS or high-end robotic mowers are not cost-efficient.
- Solar charging worked well under sunny conditions, ensuring off-grid operation. However, backup charging might be needed in cloudy or rainy weather.
- Bluetooth range was sufficient (up to ~10 meters), but it limited the operational range compared to Wi-Fi or RF-based systems.
- The cutting efficiency was good for regular grass but may need a more powerful motor or sharper blades for dense or tall vegetation.
- The design is low-cost and scalable, making it suitable for household or small garden use.
- Potential improvements include adding obstacle detection sensors, automatic movement (semi-autonomous navigation), and an Android app UI for better user experience.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 1, August 2025
Impact Factor: 7.67

WORKING OVERVIEW

The Smart Lawn Cutter is an innovative device designed to automate grass cutting using renewable solar energy and wireless Bluetooth control. The system integrates solar charging, a rechargeable battery, a cutting motor, obstacle detection sensors, and a Bluetooth module for remote operation via a smartphone. During operation, the solar panel charges a rechargeable battery, which powers the cutting blade and drive motors. The user can control the movement and cutting operation using a Bluetooth-connected mobile app, allowing commands such as forward, reverse, left, right, and stop.

The cutter moves across the lawn, trimming grass to a uniform height. To ensure safety and avoid damage, IR sensors are used to detect obstacles like stones or garden furniture. Upon detecting an obstacle, the system either stops or changes direction automatically. This smart solution reduces the need for manual labor, cuts energy costs, and promotes environmentally friendly practices by using clean solar power.

The Smart Solar-Powered Lawn Cutter operates through a combination of solar energy, Bluetooth connectivity, and autonomous navigation, offering an eco-friendly and efficient solution for lawn maintenance.

1. Power Supply via Solar Energy A photovoltaic solar panel captures sunlight and converts it into electrical energy. This energy is stored in a rechargeable battery, typically a 12V lithium-ion battery, which powers the mower's motors and control systems. The solar panel ensures continuous operation during daylight hours and charges the battery for use during cloudy conditions or nighttime.
2. Bluetooth Connectivity for Remote Control The mower is equipped with a Bluetooth module, such as the HC-05, which allows communication between the mower and a smartphone application. Users can control the mower's movements, including forward, reverse, and turning directions, through the app. This feature provides convenience and flexibility, enabling users to operate the mower from a distance.
3. Autonomous Navigation and Obstacle Detection Integrated sensors, such as ultrasonic sensors, enable the mower to detect obstacles in its path. Upon detecting an obstacle, the mower can autonomously adjust its direction to avoid collisions, ensuring safe and efficient operation. Some models also include GPS navigation for precise path planning and area coverage.
4. Cutting Mechanism The mower features a high-speed rotating blade powered by a DC motor. The blade height can be adjusted to accommodate different grass lengths, ensuring an even and clean cut. The cutting system is designed to operate quietly and efficiently, reducing noise pollution compared to traditional gasoline-powered mowers.
5. User Interface and Control Modes The accompanying smartphone application provides an intuitive interface for users to control the mower.

Users can select between manual control, where they direct the mower's movements, and autonomous mode, where the mower operates independently based on pre-set parameters. Some applications also offer features like scheduling, battery monitoring, and maintenance alerts

VII. CONCLUSION

The development of the Smart Lawn Cutter successfully demonstrates the integration of renewable energy and wireless technology in modern gardening tools. By utilizing solar power, the system offers an eco-friendly solution that reduces electricity consumption and promotes sustainable lawn maintenance. The inclusion of Bluetooth-based remote control enhances user convenience, allowing for easy and safe operation from a distance.

The prototype effectively performed grass cutting tasks with acceptable precision and duration, while the obstacle detection system ensured safe navigation around common garden barriers. The device is particularly suitable for small to medium-sized lawns, offering a low-maintenance, cost-efficient, and environmentally conscious alternative to traditional lawn mowers.

While the current system meets basic expectations, future improvements such as automated path planning, IoT integration, and terrain adaptability could further enhance its efficiency and usability. Overall, the project represents a meaningful step toward smart, green automation in home gardening.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 1, August 2025
Impact Factor: 7.67

he Smart Lawn Cutter project successfully combines renewable energy with wireless control technology to create a modern and convenient solution for everyday lawn maintenance. The integration of solar power ensures energy efficiency and environmental sustainability, while Bluetooth connectivity enables users to control the cutter remotely, reducing physical effort and enhancing comfort.

The system was able to cut grass effectively and respond accurately to user commands. Its performance shows that such solutions are not only feasible but also practical for home and small-scale use. While it may not yet match the capabilities of high-end commercial robotic mowers, it offers a low-cost, user-friendly alternative with great potential for further upgrades.

This project highlights how simple automation, when paired with green energy, can solve routine problems in a smart and sustainable way.

FUTURE SCOPE

Enhanced Energy Efficiency

• Advanced Solar Panels: Ongoing research aims to develop high-efficiency solar panels that can generate more power even under low-light conditions, ensuring consistent operation of lawn mowers throughout the day.

• Improved Battery Technology: The integration of advanced battery systems, such as lithium-ion batteries, will extend operational time and reduce charging durations, enhancing the usability and performance of solar-powered lawn mowers.

Integration of Artificial Intelligence and Robotics

• AI-Powered Navigation: The incorporation of AI will enable mowers to learn and adapt to their environment, optimizing mowing patterns and improving efficiency.

• Autonomous Operation: Robotic lawn mowers will become more autonomous, capable of navigating complex terrains and avoiding obstacles without human intervention.

Smart Connectivity and Automation

• IoT Integration: Smart lawn mowers will connect seamlessly with other smart home devices, allowing users to control and monitor their lawn care remotely through smartphone apps or voice assistants.

• Data-Driven Insights: The collection and analysis of data from robotic mowers will provide valuable insights into lawn health, mowing patterns, and performance metrics, empowering homeowners to make informed decisions for better lawn maintenance.

Environmental Sustainability

• Zero Emissions: Solar-powered lawn mowers produce minimal noise and zero emissions during operation, aligning with the growing emphasis on environmental sustainability.

• Sustainable Landscaping Practices: The adoption of solar lawn mowers contributes to sustainable landscaping practices, helping to conserve water, reduce the use of chemicals, and minimize noise pollution

Market Growth and Consumer Adoption

• Rising Demand: The global solar power lawn mower market size is projected to reach USD 56.1 billion by 2032, expanding at a CAGR of 6.3% during 2024–2032, driven by increasing environmental awareness and the global shift toward renewable energy sources.

• Government Incentives: Policies and incentives promoting the adoption of renewable energy 26 products, including solar-powered lawn mowers, are making these devices more affordable and accessible to a broader range of consumers.

• Voice Control: Developing voice-controlled interfaces will allow users to operate lawn mowers hands-free, enhancing convenience.

• Adaptive Mowing: Implementing sensors to monitor grass height and density will enable mowers to automatically adjust mowing height and speed, ensuring optimal performance across various lawn conditions.

DOI: 10.48175/IJARSCT-28618

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 1, August 2025
Impact Factor: 7.67

REFERENCES

[1]. Onuabuchi E. M., Ekeopara J. U., Sule R., et al. "Development and Evaluation of Efficient Smart Solar Lawn Mower", IOP Conference Series: Earth and Environmental Science, 2024. Key study reporting 93% solar efficiency and grass-type voltage drops

[2]. Shivbhakta B., Humnabadkar A., Kokate A. A. "Solar-Powered Grass Trimmer: Advancing Lawn Care with Bluetooth Connectivity", IJNRD, May 2024. Bluetooth control plus safety & app integration

[3]. Ibrahim B., Brahmaiah V. S., Sharma P. "Design of Smart Autonomous Remote Monitored Solar Powered Lawnmower Robot", Materials Today: Proceedings, 2020

[4]. "Design and Fabrication of Solar Powered Remote Controlled All Terrain Sprayer and Mower Robot", Ayyagari et al., arXiv, 2021. Multi-purpose robot with mowing and spraying, 7.2 h battery backup

[5]. "Solar Powered Grass Cutter for Domestic Utilization", MDPI Eng. Proc., 2022. Bluetooth-operated Arduino-based solar mower running >2 h

[6]. Wiley "Implementation of an IoT-Based Solar-Powered Smart Lawn Mower", Appl. Sciences, 2022. IoT + solar + mobile control

[7]. Strisciuglio et al., "TrimBot2020: an outdoor robot for automatic gardening", arXiv, 2018. Autonomous trimming robot for landscaping. "A Comprehensive Review on the Advancement of Home Automation System" (includes smart lawn mower), arXiv, Nov 2024

[8]. Sadowski & Spachos, "Wireless Technologies for Agricultural Monitoring using IoT Devices with Energy Harvesting Capabilities", arXiv, 2020. Relates to low-power Bluetooth/solar IoT systems

[9]. Chouhan et al., "Design of a Power Autonomous Solar Powered Lawn Mower", Int. J. Mechanics Engineering & Tech., 2017

[10]. Ismail F. B., Al-Muhsen N. F., Fazreen A. F., Zukipli A. "Design and Development of Smart Solar Grass Cutter", J. Integr. Sci. Technol., 2024

[11]. Manikandababu et al. "Development of an Autonomous Solar Grass Cutting Robot with a Path Memorizing Mechanism", ACCAI Conf., Chennai 2024

[12]. Rahim & Shamsudin "Laser-Based Autonomous Navigation of Lawnmower", Evol. Electr. Electron. Eng., 2022 Murugan et al. "AI-Driven Solar-Powered Humorless Grassland Mower with IoT Integration", J. Adv. Zool., 2024

[13]. Daniyan et al., "Performance Evaluation of a Robot for Lawn Mowing", Procedia Manuf., 2020

[14]. Jagdale & Rajput (2020)–"Android Controlled Solar-based Grass Cutter Robot" A solar-charged lawn cutter operable via an Android app (Bluetooth), built with Arduino hardware Solar Powered Grass Cutter with Obstacle Avoidance Function Using IoT (International Conf. ISIA 2023)

[15]. Arduino-based cutter controlled via Bluetooth and IoT with IR/ultrasonic sensors for obstacle detection

[16]. Development and Analysis of a Solar-Powered Grass Cutter with Integrated Collector Using IoT (MDPI Eng Proc., 2024)

[17]. Includes system powered by solar, controlled through Blynk Wi-Fi app, runtime analysis ≈ 34 min

[18]. Patil et al. (2024) – "Research Paper on Solar Automated Grass Cutter" (Journal of Controller and Converters)

[19]. Arduino + Bluetooth + solar panel; emphasizes low cost and embedded-controller design

[20]. Sudhanshu G. Chouhan et al. (IJMET, 2017) – "Design of a Power Autonomous Solar Powered Lawn Mower"

[21]. Simulation and prototype showing power autonomy using solar energy Implementation of an IoT-Based Solar-Powered Smart Lawn Mower (Wireless Comms & Mobile Computing, 2022) Covers remote control, intelligent solar-powered grass cutting robot, obstacle avoidance integration

[22]. Sushir et al. (IJSRSET, 2024) – "Survey on Solar Powered Lawn Mower Robot"

[23]. Literature review and analysis focused on RF remote systems and 12 V ATmega328 controller designs

[24]. "Smart Automatic Lawn Mower"–James Dyson Award 2025 project (Universiti Malaya)

[25]. Demonstrates solar power, ultrasonic navigation and rain detection tailored to tropical climate

[26]. Wireless Technologies for Agricultural Monitoring using IoT Devices with Energy Harvesting Capabilities –
[27]. Sadowski & Spachos (2020).
[28]. Examines energy-harvesting wireless technologies such as Bluetooth, LoRaWAN in agricultural automation contexts Sensing, Computing, and Communication for Energy Harvesting IoTs: A Survey (2019)
[29]. Comprehensive review of IoT devices powered by energy harvesting — relevant to solar-powered robot systems Internet of Things: Applications and Challenges in Technology and Standardization – Bandyopadhyay & Sen (2011)
[30]. Foundational work on IoT integration, applicable to smart home and lawn-care automation systems
[31]. Honda's Miimo robotic lawnmowers — solar-compatible/eco-friendly features, navigation tech, micro-mulching, smartphone controls (The Guardian, Apr 2025)
[32]. Consumer rover tests from The Verge (May 2025) — real-world reviews on autonomous mower performance, obstacle detection, navigation limits
[33]. Eufy E15 robot mower review (TechRadar, Jul 2025) — perimeter-free navigation, app control, AI-powered mapping
[34]. Khadake, S., Kawade, S., Moholkar, S., Pawar, M. (2024). A Review of 6G Technologies and Its Advantages Over 5G Technology. In: Pawar, P.M., *et al.* Techno-societal 2022. ICATSA 2022. Springer, Cham. https://doi.org/10.1007/978-3-031-34644-6_107.
[35]. V. J. Patil, S. B. Khadake, D. A. Tamboli, H. M. Mallad, S. M. Takpere and V. A. Sawant, "Review of AI in Power Electronics and Drive Systems," *2024 3rd International conference on Power Electronics and IoT Applications in Renewable Energy and its Control (PARC)*, Mathura, India, 2024, pp. 94-99, doi: 10.1109/PARC59193.2024.10486488
[36]. A BalkrishnaDudgikar, A Ahmad Akbar Ingalgi, A GensidhaJamadar et al., "Intelligent battery swapping system for electric vehicles with charging stations locator on IoT and cloud platform", International Journal of Advanced Research in Science Communication and Technology, vol. 3, no. 1, pp. 204-208, January 2023. DOI: 10.48175/IJARSCT-7867. Available at: https://ijarsct.co.in/Paper7867.pdf
[37]. S. B. Khadake and V. J. Patil, "Prototype Design & Development of Solar Based Electric Vehicle," *2023 3rd International Conference on Smart Generation Computing, Communication and Networking (SMART GENCON)*, Bangalore, India, 2023, pp. 1-7, doi: 10.1109/SMARTGENCON60755.2023.10442455.
[38]. V. J. Patil, S. B. Khadake, D. A. Tamboli, H. M. Mallad, S. M. Takpere and V. A. Sawant, "A Comprehensive Analysis of Artificial Intelligence Integration in Electrical Engineering," *2024 5th International Conference on Mobile Computing and Sustainable Informatics (ICMCSI)*, Lalitpur, Nepal, 2024, pp. 484-491, doi: 10.1109/ICMCSI61536.2024.00076.
[39]. Suhas B. Khadake, Sudarshan P. Dolli, K.S. Rathod, O.P. Waghmare and A.V. Deshpande, "AN OVERVIEW OF INTELLIGENT TRAFFIC CONTROL SYSTEM USING PLC AND USE OF CURRENT DATA OF VEHICLE TRAVELS", *JournalNX*, pp. 1-4, Jan. 2021.
[40]. Shraddha S Magar, Archana S Sugandhi, Shweta H Pawar, Suhas B Khadake, H. M. Mallad,"Harnessing Wind Vibration, a Novel Approach towards Electric Energy Generation- Review", IJARSCT, Volume 4, Issue 2, October 2024, pp. 73-82. DOI: 10.48175/IJARSCT-19811.
[41]. Khadake, S. B., Padavale, P. V., Dhere, P. M., & Lingade, B. M., "Automatic hand dispenser and temperature scanner for Covid-19 prevention", International Journal of Advanced Research in Science, Communication and Technology, 3(2), 362-367. DOI: 10.48175/IJARSCT-11364. https://ijarsct.co.in/A11364.pdf
[42]. Seema S Landage, Sonali R Chavan, Pooja A Kokate, Sonal P Lohar, M. K. Pawar, Suhas B Khadake.,"Solar Outdoor Air Purifier With Air Quality Monitoring System", Synergies Of Innovation: Proceedings Of Ncstem 2023, Pp. 260-266, September, 2024. Available At: https://www.researchgate.net/publication/383631190_Solar_Outdoor_Air_Purifier_with_Air_Quality_Monitoring_System

[43]. Suhas B. Khadake. (2021). Detecting Salient Objects Of Natural Scene In A Video's Using Spatio-Temporal Saliency &Amp; Colour Map. Journalnx - A Multidisciplinary Peer Reviewed Journal, 2(08), 30–35. Retrieved From Https://Repo.Journalnx.Com/Index.Php/Nx/Article/View/1070

[44]. Khadake Suhas .B. (2021). Detecting Salient Objects In A Video's By Using spatio-Temporal Saliency & Colour Map. International Journal Of Innovations In Engineering Research And Technology, 3(8), 1-9.Https://Repo.Ijiert.Org/Index.Php/Ijiert/Article/View/910.

[45]. Prachi S Bhosale, Pallavi D Kokare, Dipali S Potdar, Shrutika D Waghmode, V A Sawant, Suhas B Khadake.,"DTMF Based Irrigation Water Pump Control System", Synergies Of Innovation: Proceedings Of NCSTEM 2023, Pp. 267-273, September, 2024. Available At: https://www.researchgate.net/publication/383629320_DTMF_Based_Irrigation_Water_Pump_Control_System

[46]. Pramod Korake, Harshwardhan Murade, Rushikesh Doke, Vikas Narale, Suhas B. Khadake, Aniket S Chavan., "Automatic Load Sharing of Distribution Transformer using PLC", Synergies Of Innovation: Proceedings Of NCSTEM 2023, Pp. 253-259, September, 2024. Available At: https://www.researchgate.net/publication/383628063_Automatic_Load_Sharing_of_Distribution_Transformer_using_PLC

[47]. Suhas B khadake, Pranita J Kashid, Asmita M Kawade, Santoshi V Khedekar, H. M. Mallad .,"Electric Vehicle Technology Battery Management –Review", International Journal of Advanced Research in Science, Communication and Technology, Volume 3, Issue 2, Septeber 2023,pp. 319-325. DOI: 10.48175/IJARSCT-13048. Available at: https://www.researchgate.net/publication/374263508_Electric_Vehicle_Technology_Battery_Management_-_Review

[48]. Suhas B. khadake, Amol Chounde, Buddhapriy B. Gopnarayan, Karan Babaso Patil, Shashikant S Kamble. (2024). Human Health Care System: A New Approach towards Life, 15th International Conference on Advances in computing, Control, and Telecommunication Technologies, ACT 2024, 2024, 2, pp. 5487-5494.

[49]. Khadake SB, Patil VJ, Mallad HM, Gopnarayan BB, Patil KB. Maximize farming productivity through agriculture 4.0 based intelligence, with use of agri tech sense advanced crop monitoring system. Grenze Int J Eng Technol. 2024;10(2):5127–5134. Available At: https://www.researchgate.net/publication/382625572_Maximize_Farming_Productivity_through_Agriculture_40_based_Intelligence_with_use_of_Agri_Tech_Sense_Advanced_Crop_Monitoring_System

[50]. Suhas B Khadake, Santoshi V Khedekar, Asmita M Kawade, Shradhha Shivaji Vyavahare, Pranita J Kashid, Chounde Amol B, H. M. Mallad., "Solar Based Electric Vehicle Charging System-Review", IJARSCT, vol. 4, Issue 2, December 2024, pp. 42-57, DOI: 10.48175/IJARSCT-22705

[51]. Akshay B Randive , Sneha Kiran Gaikwad , Suhas B Khadake , Mallad H. M., "Biodiesel: A Renewable Source of Fuel", IJARSCT, vol. 4, Issue 3, December 2024, pp. 225-240, DOI: 10.48175/IJARSCT-22836 Available at: https://www.researchgate.net/publication/387352609_Biodiesel_A_Renewable_Source_of_Fuel

[52]. K. K. Sayyad Liyakat, S. B. Khadake, A. B. Chounde, A. A. Suryagan, M. H. M. and M. R. Khadatare, "AI-Driven-IoT(AIIoT) Based Decision Making System for High-Blood Pressure Patient Healthcare Monitoring," 2024 International Conference on Sustainable Communication Networks and Application (ICSCNA), Theni, India, 2024, pp. 96-102, doi: 10.1109/ICSCNA63714.2024.10863954.

[53]. K. K. Sayyad Liyakat, S. B. Khadake, D. A. Tamboli, V. A. Sawant, M. H. M. and S. Sathe, "AI-Driven-IoT(AIIoT) Based Decision-Making- KSK Approach in Drones for Climate Change Study," *2024 4th International Conference on Ubiquitous Computing and Intelligent Information Systems (ICUIS)*, Gobichettipalayam, India, 2024, pp. 1735-1744, doi: 10.1109/ICUIS64676.2024.10866450.

[54]. Suhas B khadake, Shraddha S Magar, Archana S Sugandhi, Shweta H Pawar, " A Research Paper on Harnessing Wind Vibration Novel Approach towards Electric Energy Generation", IJARSCT, Volume 5, Issue 4, May 2025, pp. 533-552. DOI: 10.48175/IJARSCT-26466. Available At https://www.researchgate.net/publication/391857597_A_Research_Paper_on_Harnessing_Wind_Vibration_Novel_Approach_towards_Electric_Energy_Generation

[55]. Avinash. A. Suryagan, Arti L Nemte, Kirti D Thorat, Suhas B Khadake,“ IoT Based Flood Monitoring System by using Thing Speak Cloud”, IJARSCT, Volume 5, Issue 4, May 2025, pp. 666-687. DOI: 10.48175/IJARSCT-26480

[56]. Sagar M Chavare, Prasad P Nanaware, Shriprasad S Wagh, Ashish T Jadhav, Yeole Yogesh, Suhas B Khadake,“ Smart Plant Monitoring and Automated Irrigation System Using IOT”, IJARSCT, Volume 5, Issue 4, May 2025, pp. 688-706. DOI: 10.48175/IJARSCT-26481

[57]. Swapnil S Sudake, Suhas B Khadake, Santoshi V Khedekar, Asmita M Kawade, Shraddha S Vyavahare,“ Solar Based Wireless Electric Vehicle Charging System”, IJARSCT, Volume 5, Issue 5, May 2025, pp. 325-348. DOI: 10.48175/IJARSCT-26647

[58]. Manjeet Kumar, Shubhangi S Sul, Jyoti S Lakhara, Pranita J Kashid, Shravani R Bhinge, Amaraja S Waghmode, Suhas B Khadake,“ Small Wind Electric System Energy Saver”, IJARSCT, Volume 5, Issue 5, May 2025, pp. 447-466. DOI: 10.48175/IJARSCT-26663

[59]. Namrata Ganesh Jadhav , Pranjali R Nagane , Akanksha M Khapare , Arvind Pande , Suhas B Khadake,“Identify and Measuring Parameter of PV Module Test Bench with the Ammeter and Voltmeter”, IJARSCT, Volume 5, Issue 6, May 2025, pp. 5-24. DOI: 10.48175/IJARSCT-26702

[60]. Sujit N. Bhandare, Prashant R. Mule, Yogesh A. Yeole, Krushna D More, Suhas B. Khadake,“ Vehicle Tracking And Accident Alert System”, IJARSCT, Volume 5, Issue 6, May 2025, pp. 234-252. DOI: 10.48175/IJARSCT-26728

[61]. Manjeet Kumar, Suhas B Khadake, Madhuri S Doke, Shivani D Pujari, Pratiksha B Rupnar,“ Sun Track: A Compact IoT System for PV Parameter Monitoring with NodeMCU”, IJARSCT, Volume 5, Issue 9, May 2025, pp. 261-280. DOI: 10.48175/IJARSCT-27037

[62]. Nikita R Bhosale , Sakshi D Shete , Laxmi A Koganure ,Aditi A Gaikwad ,Vedhangi S Sukre , Suhas B Khadake,“ Development of a Real-Time Hydrogen Level Detection System for Storage Cylinders”, IJARSCT, Volume 5, Issue 4, June 2025, pp. 690-708. DOI: 10.48175/IJARSCT-27666

[63]. Bhinge Shravani Rajendra, Salunkhe Majushree Jayant, Tarse Mayuri Kundlik, Suhas B Khadake, B. B. Gopnarayan, Manisha P Bidve,“ Smart Water Waste Collection System Using Bluetooth Control”, IJARSCT, Volume 5, Issue 7, June 2025, pp. 561-578. DOI: 10.48175/IJARSCT-28072

[64]. K. K. S. Liyakat, S. B. Khadake, B. R. Ingale, D. D. D., S. S. Sudake and M. M. Awatade, "Kidney Diseases Patient Healthcare Monitoring using AI-Driven-IoT(AIIoT) - An KSK1 Approach," *2025 7th International Conference on Intelligent Sustainable Systems (ICISS)*, India, 2025, pp. 264-272, doi: 10.1109/ICISS63372.2025.11076397.

[65]. K. K. Sayyad Liyakat, S. B. Khadake, P. S. More, R. J. Shinde, K. P. Kondubhairi and S. S. Kamble, "AI-Driven IoT based Decision Making for Hepatitis Diseases Patient’s Healthcare Monitoring: KSK Approach for Hepatitis Patient Monitoring," *2025 7th International Conference on Intelligent Sustainable Systems (ICISS)*, India, 2025, pp. 256-263, doi: 10.1109/ICISS63372.2025.11076213.

[66]. . Dr. Kazi Kutubuddin Sayyad Liyakat. Sensor and IoT centered Smart Agriculture by NodeMCU. Recent Trends in Sensor Research & Technology. 2024; 11(03):24-32. Available from: https://journals.stmjournals.com/rtsrt/article=2024/view=179744

[67]. . Kazi Kutubuddin Sayyad Liyakat.(2024). Carbon based Supercapacitor for Electric Vehicles. Journal of Nanoscience, NanoEngineering & Applications. 2024; 14(03):01-11. Available from: https://journals.stmjournals.com/jonsnea/article=2024/view=179371.

[68]. G M Kosgiker. Satellite Sensing for Sea Level Monitoring: A Transformative Approach to Understanding Climate Change. Journal of Microwave Engineering & Technologies. 2025; 12(1): 33–41p.

[69]. Kazi Kutubuddin Sayyad Liyakat. Transforming IoT Connectivity Through VLSI Technology. International Journal of VLSI Circuit Design & Technology. 2024; 02(02):1-11. Available from: https://journals.stmjournals.com/ijvcdt/article=2024/view=190803

[70]. Kazi Kutubuddin Sayyad Liyakat, "Internet of Robotics Things in Industrial Applications: A Study," Journal of Control and Instrumentation Engineering, vol. 11, no. 1, pp. 1-10, Feb 2025.

[71]. . Kazi Kutubuddin Sayyad Liyakat. Fake Cryptocurrecy Detection using Python. Recent Trends in Programming Languages. 2025; 12(1): 1–7p.

[72]. Kazi Kutubuddin Sayyad Liyakat. The Future is Smelling: Exploring the Potential of e-Nose. Journal of Semiconductor Devices and Circuits. 2025; 12(1): 16–27p.

[73]. Sultanabanu Sayyad Liyakat. (2025). Quantum Key Distribution in Optical Fiber Communication: A Study. Trends in Opto-electro & Optical Communication. 2025; 15(1): 30–40p.

[74]. [Kazi Kutubuddin Sayyad Liyakat. Fake Cryptocurrency Detection Using Python. Recent Trends in Programming languages. 2025; 12(01):1-7. Available from: https://journals.stmjournals.com/rtpl/article=2025/view=201421

[75]. Kutubuddin, KSK Approach in LOVE Health: AI-Driven- IoT(AIIoT) based Decision Making System in LOVE Health for Loved One, GRENZE International Journal of Engineering and Technology, 2025, 11(1), pp. 4628-4635.

[76]. Grenze ID: 01.GIJET.11.1.371_1

[77]. Kazi Kutubuddin Sayyad Liyakat. Multimedia Technology in Healthcare: A Study. Journal of Multimedia Technology & Recent Advancements. 2025; 12(1): 23–29p.

[78]. Kazi Kutubuddin Sayyad Liyakat. TensorFlow- Based Big Data Analytics for IoT Networks: A Study. International Journal of Data Structure Studies. 2025; 3(1): 32–40p.

[79]. Kazi Kutubuddin Sayyad Liyakat. Brand Protection Using Machine Learning: A New Era. E-Commerce for Future & Trends. 2025; 12(1): 33-44p.

[80]. [Dhanve and Liyakat, "Machine Learning Forges a New Future for Metal Processing: A Study," International Journal of Artificial Intelligence in Mechanical Engineering, vol. 1, no. 1, pp. 1-12, Mar. 2025.

[81]. Kutubuddin Sayyad Liyakat. e-Skin Applications in Healthcare and Robotics: A Study. Journal of Advancements in Robotics. 2025; 12(1):13 –21p.

[82]. [Kutubuddin Sayyad Liyakat. Millimeter Wave in Internet of Things Connectivity: A Study. International Journal of Wireless Security and Networks. 2025; 03(01):13-23.

[83]. [Kutubuddin Sayyad Liyakat. TensorFlow-Based Big Data Analytics for IoT Networks: A Study. International Journal of Data Structure Studies. 2025; 03(01):31-38.

[84]. Kutubuddin Sayyad Liyakat. Multimedia Technology in Healthcare: A Study. Journal of Multimedia Technology & Recent Advancements. 2025; 12(01):23-29.