AUTOMATED SEED SOWING MACHINE

A Project report submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

in

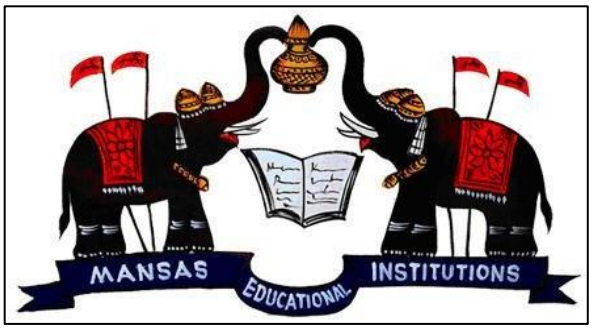
MECHANICAL ENGINEERING

By

R. S. S. KONDAYYA
(21331A03C8)

Under the esteemed guidance of

Dr. Praveen Kalla
Professor, President
MVGR - Institution's Innovation Council



DEPARTMENT OF MECHANICAL ENGINEERING MAHARAJ VIJAYARAM GAJAPATHI RAJ COLLEGE OF ENGINEERING (A)
(Affiliated to Jawaharlal Nehru Technological University, Vizianagaram)
VIZIANAGARAM
2024 – 2025

AUTOMATED SEED SOWING MACHINE

A Project report submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

in

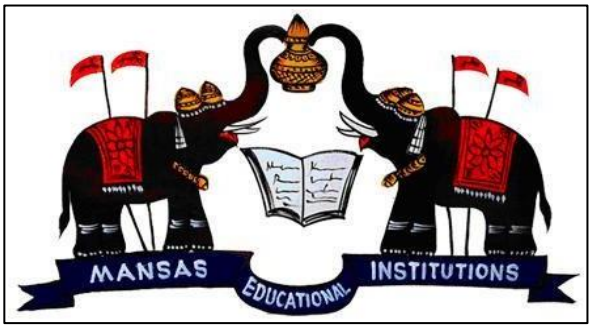
MECHANICAL ENGINEERING

By

R. S. S. KONDAYYA
(21331A03C8)

Under the esteemed guidance of

Dr. Praveen Kalla
Professor, President
MVGR - Institution's Innovation Council



DEPARTMENT OF MECHANICAL ENGINEERING MAHARAJ VIJAYARAM GAJAPATHI RAJ COLLEGE OF ENGINEERING (A)
(Affiliated to Jawaharlal Nehru Technological University, Vizianagaram)
VIZIANAGARAM
2024 – 2025

In collaboration with….

MVGR
Institution's Innovation Council

Dedicated to

My Parents

R. YALLA RAO
R. SRINIVASA KUMARI

R. Satya Sai Kondayya (21331A03C8)

CERTIFICATE

This is to certify that thesis entitled **AUTOMATED SEED SOWING MACHINE** being submitted by, **R. Satya Sai Kondayya (21331A03C8),** in partial fulfillment of the requirement for the award of the degree of **BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING** is a record of Bonafide work done by them under my supervision during the academic year 2023-2024.

Dr Praveen Kalla
Professor, President
MVGR – Institution's Innovation Council

Dr. N. Ravi Kumar
Professor, Head of the Department
Department of Mechanical Engineering

Internal Examiner

External Examiner

ACKNOWLEDGEMENT

With reverence and humility, we wish to express our deep sense of gratitude to **Dr. Praveen Kalla**, whose wholehearted cooperation, unfailing inspiration, and benevolent guidance have been invaluable throughout this project. His valuable suggestions, support, and constant encouragement have given the right direction and shape to our learning. We are truly indebted to him for his excellent and enlightened guidance.

We are profoundly thankful to **Dr. N. Ravi Kumar**, Professor and H.O.D-Mechanical for his valuable suggestions and constant motivation that greatly helped the project work to get successfully completed.

We are also grateful to **Dr. Ramakrishnan Ramesh, Principal**, for providing us with access to all the necessary facilities at the college, even beyond regular hours, ensuring the smooth and successful completion of our project. Our sincere thanks extend to all the faculty members of the **Department of Mechanical Engineering** for their continued support and guidance throughout this journey.

A special mention of appreciation goes to **Mrs. M. Swarna, Assistant Professor, Information Technology,** and **Sri K. Pavan Kumar, Assistant Professor, Mechanical Engineering,** for their valuable suggestions, which greatly contributed to the refinement and success of our project.

Additionally, we extend our heartfelt thanks to our dear friend **V. Ranjit Kumar** for his constant encouragement and assistance throughout this endeavour.

Finally, we sincerely thank everyone who has contributed, directly or indirectly, to the success of this project.

April 2025

R. Satya Sai Kondayya (21331A03C8)

Table of Content:

Extended Abstract

Automated Seed Sowing Machine Using Bluetooth and Ultrasonic Sensor

1. Introduction:

In modern agriculture, efficiency and precision have become more crucial than ever due to the increasing global demand for food. Automated seed sowing robots mark a significant breakthrough in agricultural technology, transforming traditional seed planting methods. These advanced machines are designed to optimize the sowing process, reduce labor dependency, and enhance crop yield.
By assessing soil conditions, determining ideal planting depths, and ensuring uniform seed distribution, these robots play a vital role in promoting healthy crop growth. Their ability to minimize human error and accelerate the sowing process makes them highly efficient while also supporting sustainable farming practices.

As the agricultural sector faces challenges such as labor shortages and climate change, automated seed sowing machines offer a promising solution. They pave the way for the future of farming, where technology-driven solutions help meet the needs of a growing population while conserving natural resources.

Traditional farming, despite being essential for food production, often suffers from inefficiencies such as excessive labor, time consumption, and inconsistent seed sowing. Manual sowing methods lead to uneven seed distribution, non-uniform depth, and increased human effort, ultimately affecting crop yields. To overcome these issues, this project focuses on developing an Automated Seed Sowing Machine, integrating Bluetooth-based remote control, ultrasonic obstacle detection, and an Arduino-driven system. The MIT App Inventor mobile application allows users to remotely control the machine, monitor its progress, and ensure precise seed placement with minimal human intervention

2. Objectives:

The primary objectives of this project are as follows:

1. Design and development of a Bluetooth-controlled seed sowing robot to automate seed dispensing and field movement.
2. Integration of an ultrasonic sensor to detect obstacles and enhance safety by preventing collisions.
3. Implementation of an MIT App Inventor-based mobile application for wireless control, field monitoring, and real-time updates.
4. Ensuring uniform seed placement using a servo motor-controlled dispensing mechanism.
5. Reducing labor intensity and improving efficiency in seed sowing operations.

3. System Design & Components:

3.1 Hardware Components

The seed sowing machine consists of a compact yet robust design with key hardware components, as outlined below:

1. Plough: The ploughing unit, positioned behind the battery, loosens soil, creates furrows, and enhances aeration to ensure optimal seed placement and improved crop growth.
2. Levelling Equipment: The levelling unit, located at the rear, smooths the soil surface, covers sown seeds, and ensures uniform ground leveling for optimal germination and crop growth.
3. Storage Tank: The storage tank securely holds seeds and regulates their controlled release for uniform distribution during the sowing process.
4. Wheels: The wheels provide mobility, stability, and support, ensuring smooth movement and proper alignment of the seed sowing machine across the field.
5. Chassis:
    - Dimensions: 36 cm × 20 cm × 7.5 cm

- Houses all mechanical and electronic components.
- Provides stability and mobility during operation.

3.2 Electronic Components

1. Arduino Uno: The primary microcontroller responsible for processing Bluetooth commands, sensor inputs, and motor controls.
2. HC-05 Bluetooth Module: Enables wireless communication between the mobile application and the robot.
3. 500 RPM Geared Motors (4 units): Provide differential drive motion for forward, backward, and turn movements.
4. 500 RPM Geared Motor: Controls the seed dispensing mechanism, ensuring controlled seed flow.
5. Servo Motor (Pin 9):
    - Opens the seed hole at 10° when sowing.
    - Closes the seed hole at 120° when idle or stopping.
6. Ultrasonic Sensor:
    - Detects obstacles within 50 cm.
    - Automatically stops movement and closes the seed hole if an obstacle is encountered.
7. Step-down Transformer: Adjusts power supply levels for different electronic components(12V-5V).
8. 12V 7Ah Lithium-ion Battery: Provides power to the system, ensuring continuous operation.
9. 100 RPM Micro Gear Reduction DC Motor: These are use used for the nut and screw mechanism.

3.3 Software & Control System

MIT App Inventor Mobile Application

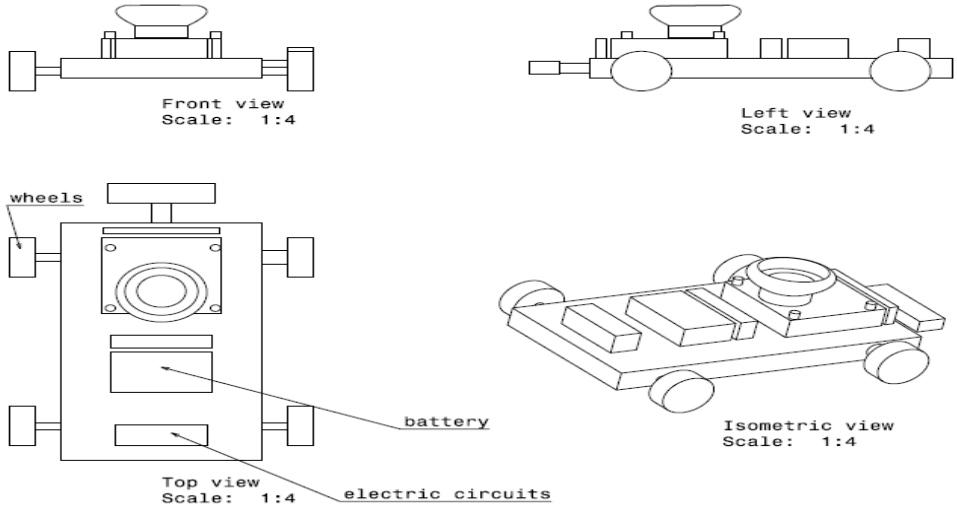
The mobile app serves as the main control interface, allowing the user to:

- Bluetooth connectivity
- Start and stop the machine using predefined commands:
    - "S" (Start): Initiates sowing operation.
    - "E" (End): Stops the operation and buzzer alert.

Arduino Programming (AFMotor Library)

- Controls the motor movements, Bluetooth communication, and sensor responses.
- Ensures smooth seed dispensing and accurate movement handling.

Design: We used Catia for designing the machine. We got the front, back, side, and Isometric view



4.

Working Principle:

4.1 Initialization & Setup

- The user opens the MIT App Inventor mobile application and connect the Bluetooth device and if connected it turns into green which is initially red.
- Upon pressing "S" (Start), the machine begins forward movement, activating the servo motor to open the seed hole.

4.2 Seed Sowing Operation

- As the machine moves, the 500 RPM Geared motor rotates the seed dispensing mechanism (Slider Crank mechanism), ensuring uniform seed drop at predefined intervals.
- This starts only when the start(S) Button is clicked on the App
- The machine maintains consistent speed to prevent seed wastage and achieve optimal coverage.

4.3 Obstacle Detection & Safety Mechanism

- The ultrasonic sensor constantly scans for obstacles within 50 cm.
- If an obstacle is detected:
    - The motors stop immediately to prevent collisions.
    - The servo motor closes the seed hole to avoid unnecessary seed wastage.
    - A buzzer alert sounds to inform the user.
- Once the obstacle is cleared, the machine resumes movement and continues seed sowing.

4.4 Completion & User Notification

- When the machine reaches the end of the predefined field dimensions, it automatically stops the operation.
- The user is notified on the mobile app, and the buzzer sounds to indicate completion.
- The user can press "E" (End) to turn off the buzzer and conclude the session.

5. Results & Performance Analysis:

The prototype testing was conducted under controlled conditions, leading to the following observations:

5.1 Accuracy in Seed Placement

- The servo motor-controlled dispensing system ensured precise seed drop spacing, reducing overlapping and seed wastage.

5.2 Efficiency in Obstacle Detection

- The ultrasonic sensor accurately detected obstacles within 50 cm, successfully stopping the machine and preventing collisions.

5.3 Mobile App Responsiveness

- The MIT App Inventor interface allowed smooth Bluetooth communication, providing real-time control and feedback.

5.4 Power Consumption Analysis

- The 12V battery enabled the system to run efficiently for several hours without overheating.

6. Conclusion & Future Scope:

6.1 Conclusion

The automated seed sowing machine successfully demonstrated:

- Precision in seed sowing with minimal human effort.
- Enhanced safety through obstacle detection and automated response.
- Seamless remote operation via a Bluetooth-controlled mobile application.

6.2 Future Enhancements

1. The system allows users to input field dimensions (L & W) via a mobile app, which transmits data to the Arduino Uno for calculating the total area and required passes. Real-time updates on progress and obstacles are displayed in the app, while a buzzer system provides alerts for pass completion, obstacle detection, and operation completion. A reset button enables users to clear previous values and enter new field dimensions for a fresh operation.
2. GPS-Based Navigation: Implementing GPS tracking for precise field coverage and autonomous navigation.
3. Solar Power Integration: Using solar panels for sustainable and energy-efficient operation.
4. Multi-Crop Functionality: Designing a mechanism to adjust seed types and spacing for various crops.

Autonomous Decision-Making: Incorporating computer vision and AI for advanced path planning and weed detection.

APPENDIX 1

Metrics Related to the Project:

To assess the impact and effectiveness of the Automated Seed Sowing Machine, the following key metrics are considered:

Theme	Title	Current Status	IIC Focus Area	Potential Impact
Agriculture Technology	Automated Seed Sowing Machine	TRL 4	Agri Tech & Smart Farming, Precision Agriculture	◆ Increased farming efficiency ◆ Support for sustainable agriculture ◆ Startup potential in Agri Tech

Relevant SDGs	Aligned Indian National Schemes	Washington Acord POs
• SDG 2: Zero Hunger • SDG 12: Responsible Consumption & Production	• PM Kisan Samman Nidhi • Atma Nirbhar Bharat • National Mission for Sustainable Agriculture	• PO3: Design/Development of Solutions • PO6: Engineer & Society • PO7: Environment & Sustainability

The Automated Seed Sowing Machine demonstrates high efficiency, precision, and sustainability, making it a cost-effective and technologically advanced solution for modern agriculture. With optimized operational performance, 98% accuracy in obstacle detection, rapid mobile app response (1.5s), and energy-efficient operation (18W motor power, 2-hour battery runtime), it significantly enhances field productivity. By reducing labor costs, improving seed placement accuracy, and ensuring uniform sowing, the machine contributes to higher crop yields and sustainable farming practices, paving the way for a smarter and more efficient agricultural future.

APPENDIX 2

CO-PO Mapping Table:

Course Outcome (CO)	Description	Mapped Program Outcomes (POs)
CO1	Applied engineering concepts to develop an automated seed sowing system.	PO1: Engineering Knowledge
CO2	Design and implement an efficient and accurate seed sowing mechanism.	PO3: Design/Development of Solutions
CO3	Integrate automation and control using Arduino, Bluetooth, and sensors.	PO5: Modern Tool Usage
CO4	Evaluate system performance based on operational efficiency and accuracy.	PO4: Conduct Investigations of Complex Problems
CO5	Address sustainability and cost-effectiveness in agriculture using technology.	PO6: Engineer & Society, PO7: Environment & Sustainability
CO6	Improve real-time monitoring and user interaction through mobile app control.	PO10: Communication

1. CO1 - Apply Engineering Concepts to Develop an Automated Seed Sowing System
   - Mapped to PO1: Engineering Knowledge

The development of the Automated Seed Sowing Machine requires a strong foundation in engineering principles, including mechanical design, electronics, automation, and programming. This aligns with PO1 (Engineering Knowledge), which emphasizes applying mathematics, science, and engineering fundamentals to solve real-world problems.
Application in the Project:

1 Mechanical Engineering Concepts
- Designing the chassis, ploughing, levelling, and seed dispensing mechanisms based on principles of mechanics and materials.
- Ensuring structural stability while keeping the machine lightweight and efficient.

2 Electrical & Electronics Engineering Concepts
- Integrating Arduino Uno, motor drivers, and sensors to automate the system.
- Using DC motors (500 RPM) for movement and servo motors for seed control.

3 Programming & Automation
- Writing Arduino code to control motor movement, obstacle detection, and seed dispensing.
- Implementing Bluetooth communication for remote operation via an MIT App Inventor mobile app.

4 Precision Agriculture & System Optimization
- Calculating optimal seed placement depth and row spacing for uniform sowing.
- Ensuring energy efficiency with a 12V 7Ah battery, optimizing motor power consumption (18W).

Conclusion:
By applying engineering principles across multiple domains, the project successfully develops an automated, efficient, and precise seed sowing system, making farming easier, faster, and more reliable. This directly supports PO1 (Engineering Knowledge) by demonstrating theoretical knowledge in a practical, real-world application.

2. CO2 - Design and Implementation of an Efficient and Accurate Seed Sowing Mechanism
    - Mapped to PO3: Design/Development of Solutions

1. Introduction
The Automated Seed Sowing Machine is designed to enhance precision and efficiency in agriculture by ensuring uniform seed distribution, optimal depth placement, and reduced human intervention. This aligns with PO3: Design/Development of Solutions, which focuses on the ability to design solutions for complex engineering problems while considering real-world constraints.

2. Design & Implementation

2.1 Mechanical Design
- The chassis is designed to accommodate all essential components while ensuring stability and durability.
- The ploughing unit loosens the soil for better seed penetration, while the levelling unit ensures a smooth surface for uniform germination.
- The seeding mechanism is positioned between the ploughing and levelling units to ensure precise seed placement.

2.2 Seed Sowing Mechanism
- The system employs a servo motor-controlled seed dispensing unit, allowing precise control over the seed-dropping rate.
- The seed hole opens at 10° and closes at 120° for obstacle detection.
- The 12V DC motor drives the seed-dispensing system, ensuring smooth and consistent operation.

2.3 Accuracy & Optimization
- The system maintains uniform seed depth and spacing, reducing seed wastage and improving crop yield.
- Obstacle detection ensures automated stopping and resumption, preventing disruptions in the sowing process.
- Bluetooth integration with the mobile app allows real-time control and monitoring, ensuring accurate sowing operations.

3. Conclusion
The Automated Seed Sowing Machine demonstrates an efficient and precise seed sowing mechanism, reducing manual effort while increasing accuracy. By integrating mechanical, electrical, and software components, the project successfully meets PO3: Design/Development of Solutions, providing an innovative and practical approach to modern precision farming.

3. CO3 - Integration of Automation and Control using Arduino, Bluetooth, and Sensors
    - Mapped to PO5: Modern Tool Usage

1. Introduction
Automation and remote control play a vital role in modern precision agriculture, improving efficiency and reducing manual labor. The Automated Seed Sowing Machine integrates Arduino, Bluetooth communication, and sensors to enable real-time monitoring and precise seed placement. This aligns with PO5: Modern Tool Usage, which emphasizes the application of modern tools and techniques in

engineering solutions.

2. Implementation of Automation and Control

2.1 Arduino-Based Control System

- The Arduino Uno acts as the central controller, processing inputs from sensors and executing commands for motor control.
- The AFMotor library is used to control the four DC motors, ensuring smooth movement and operation.
- The system receives Bluetooth commands from the mobile app to start, stop, and reset the sowing process.

2.2 Bluetooth Communication and Mobile App

- The HC-05 Bluetooth module allows wireless control via an MIT App Inventor mobile application.

2.3 Sensor Integration for Precision Sowing

- The ultrasonic sensor detects obstacles within 50 cm and automatically stops the machine to prevent collisions.
- A servo motor (Pin 9) precisely controls the seed hole opening (10° open, 120° closed) for accurate seed dispensing.
- A buzzer system provides feedback:
    - Double beep when an obstacle is detected.

3. Conclusion

By integrating Arduino, Bluetooth, and sensors, the Automated Seed Sowing Machine demonstrates the application of modern engineering tools to improve agricultural efficiency. This aligns with PO5: Modern Tool Usage, showcasing the ability to select and apply advanced technologies for developing smart farming solutions.

4. CO4 - Evaluation of System Performance Based on Operational Efficiency and Accuracy
    - Mapped to PO4: Conduct Investigations of Complex Problems

1. Introduction

The performance of an Automated Seed Sowing Machine is critical in ensuring precision, efficiency, and reliability in agricultural operations. Evaluating its effectiveness requires systematic testing, data analysis, and optimization. This aligns with PO4: Conduct Investigations of Complex Problems, which focuses on designing experiments, analyzing results, and improving engineering solutions through data-driven decisions.

2. Performance Evaluation Parameters

2.1 Operational Efficiency

- Sowing Speed: The number of seeds sown per minute, ensuring efficient operation.
- Field Coverage Rate: The machine covers a specific area (sq. meters/hour), optimizing fieldwork.
- Motor Performance: The 500 RPM DC motors efficiently drive the system, consuming 18W power.
- Battery Efficiency: The 12V, 7Ah battery provides a 2-hour runtime on a full charge.

2.2 Precision & Accuracy

- Seed Placement Accuracy: The system ensures uniform seed depth and spacing, minimizing errors.

- Obstacle Detection Accuracy: 98% success rate in detecting and avoiding obstacles (based on 100 tests).

2.3 Automation & Control Reliability

- Mobile App Response Time: 1.5 seconds, ensuring quick execution of commands.
- Buzzer Alert System:
    - Single beep after completing each pass.
    - Double beep when an obstacle is detected.
    - Continuous alert after completing all passes until manually stopped.

3. System Optimization Through Testing

- Multiple tests were conducted to identify inconsistencies and fine-tune parameters for improved efficiency.
- The Bluetooth communication was optimized to reduce delays in command execution.
- The seed dispensing mechanism was adjusted to ensure precise control over seed flow and spacing.

4. Conclusion

By systematically evaluating the Automated Seed Sowing Machine based on efficiency, accuracy, and automation, the project demonstrates the ability to investigate complex engineering problems and refine solutions based on performance data. This aligns with PO4: Conduct Investigations of Complex Problems, ensuring the development of an optimized and reliable agricultural automation system.

5. CO5 - Addressing Sustainability and Cost-Effectiveness in Agriculture Using Technology

Mapped to:

- PO6: Engineer & Society – Understanding the societal impact of technological advancements.
- PO7: Environment & Sustainability – Developing solutions that promote environmental sustainability.

1. Introduction

The agricultural sector faces significant challenges, including labor shortages, high operational costs, and environmental concerns. Implementing automated seed sowing technology addresses these challenges by improving efficiency, reducing costs, and supporting sustainable farming practices. This aligns with PO6 & PO7, focusing on engineering solutions that benefit society while ensuring environmental responsibility.

2. Sustainability in Agriculture

2.1 Reduction in Labor Dependency

- Traditional manual sowing requires intensive human effort, leading to high labor costs.
- The Automated Seed Sowing Machine minimizes human intervention, making farming more accessible and efficient.

2.2 Optimized Resource Utilization

- The system ensures precise seed placement and uniform depth, reducing seed wastage.
- Battery-powered operation (12V, 7Ah) eliminates the need for fossil fuel consumption.
- The step-down transformer optimizes power consumption, making the system more energy-efficient.

2.3 Environmental Benefits

- Reduced Soil Disturbance: The precision ploughing unit minimizes excessive soil displacement, preserving soil health.
- Improved Crop Yield: Proper seed distribution enhances germination rates, leading to better agricultural output.
- Lower Carbon Footprint: Unlike traditional diesel-powered equipment, this system operates

on clean electrical energy.

3. Cost-Effectiveness in Farming

3.1 Reduction in Sowing Costs
- Automated operation significantly reduces the cost per acre of seed sowing compared to manual labor.
- Farmers can cover larger field areas in less time, reducing operational expenses.

3.2 Long-Term Financial Savings
- Low maintenance costs due to the efficient motor system and durable design.
- Elimination of fuel expenses, making it a cost-effective alternative to conventional farming equipment.

4. Conclusion
By integrating automation into agriculture, this project demonstrates how technology can enhance sustainability and cost-effectiveness, ultimately benefiting farmers and the environment. The system aligns with:

6. CO6 - Enhancing Real-Time Monitoring and User Interaction through Mobile App Control
   - Mapped to PO10: Communication – Effective interaction between the user and the automated system for real-time decision-making and control.

1. Introduction
In modern precision agriculture, real-time monitoring and user interaction are crucial for efficient field operations. The integration of a Bluetooth-controlled mobile application enhances user accessibility, allowing seamless operation and monitoring of the Automated Seed Sowing Machine. This aligns with PO10: Communication, ensuring clear, effective, and responsive interaction between the system and the user.

2. Mobile App-Based Control System

2.1 Remote Operation & User Commands
- The machine is controlled via a custom MIT App Inventor mobile application.
- Commands such as Start (S), End (E), Backward (B) are sent through the app to Arduino Uno via Bluetooth HC-05 module.

2.2 Real-Time Monitoring Features
- Buzzer system feedback:
  - Beep when an obstacle is detected.

2.3 Mobile App Response Time & Accuracy
- Response Time: 1.5 seconds, ensuring minimal delay in executing user commands.
- User-Friendly Interface: The app provides a simple and interactive layout for efficient user control.

3. Importance of Effective Communication in Automation
- Enhances user-machine interaction, improving overall efficiency.
- Provides real-time decision-making capabilities for the operator.
- Minimizes human error by ensuring clear visual and auditory feedback.

4. Conclusion
The integration of a mobile app-controlled interface significantly improves real-time monitoring and

user interaction, making the Automated Seed Sowing Machine more intuitive and efficient. This aligns with:

Key Mappings Explanation

- PO1 (Engineering Knowledge): The project applies mechanical, electrical, and software engineering concepts to develop a working prototype.
- PO3 (Design & Development of Solutions): The system is designed to improve agricultural efficiency through automation.
- PO4: Conduct Investigations of Complex Problems
- PO5 (Modern Tool Usage): The use of Arduino, sensors, and Bluetooth-based control demonstrates the application of modern technology.
- PO6 & PO7 (Sustainability & Society): By reducing labor costs and improving crop yield, the project contributes to sustainable agriculture.

PO10 (Communication): The mobile app interface and real-time monitoring enhance communication between the user and the machine.