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 4, June 2025
Impact Factor: 7.67

Multitasking Agribot for Smart Farming Applications

Dr. Rahul Agrawal[1], Sushant Sananse[2], Tanvi Pawar[3], Akanksha Chavan[4], Naina Shelar[5], Ashwini Aher[6]
Head of Department, Department of Electrical Engineering [1]
Assistant Professor Department of Electrical Engineering[2]
UG Students, Department of Electrical Engineering, [3,4,5,6].
Guru Gobind Singh College of Engineering & Research Centre Nashik, Maharashtra, India

Abstract: *This paper presents the design and development of a multifunctional agricultural robot operated via remote control to enhance farm productivity and minimize manual effort. The robot is capable of performing four key agricultural tasks: fruit cutting, grass cutting, seed sowing, and water spraying. At its core lies the PIC16F877A microcontroller, which manages the coordination of various actuators and modules. A 12V, 8A DC battery powers the system, with a DC-DC converter ensuring voltage compatibility across different components. Wireless control is achieved using a Bluetooth module, while a 16x2 LCD display provides real-time operational feedback. Dedicated motors and actuators are used for executing individual tasks, such as tool movement, irrigation, locomotion, and seed dispensing, all controlled via a relay interface. The integration of these features enables the robot to operate effectively in diverse agricultural settings, particularly where manual labor is limited or challenging. By combining automation with wireless communication, the system supports precision farming practices and contributes to the advancement of smart agriculture.*

Keywords: Agribot (Agriculture Robot), PIC Microcontroller , DC Gear Motor , 12 V DC Battery , DC – DC Converter , Wheels, Blade , Robo ARM Kit , Jumper Wires , Bluetooth Module , Relay , LCD Display Nozzle

I. INTRODUCTION

Agriculture is very important for India as it provides food and jobs to a large number of people. However, traditional farming methods like manual harvesting, pesticide spraying, and grass cutting take a lot of time and effort and are often not efficient, especially on large farms. Farmers also face problems like labor shortages, high costs, and the need for better, modern farming techniques. To solve these issues, a Remote-Controlled Multifunctional Agricultural Robot has been developed. This robot can perform many tasks such as seed sowing, pesticide spraying, fruit harvesting, and grass cutting. It uses advanced technologies like robotics, machine learning (ML), and the Internet of Things (IoT), allowing it to work automatically and be controlled from a distance. The robot helps farmers save time, reduce labor costs, and carry out farming activities more safely and accurately. It can also be adjusted for different crops and needs, making it useful for various types of farming. By using fewer resources and reducing waste, it supports eco-friendly and smart farming. In short, this robot is a big step toward modern, efficient, and sustainable agriculture in India.

Agri-Bot: IoT Based Unmanned Smart Vehicle for Multiple Agriculture Operations. In 2021 International Conference on Simulation, Automation & Smart Manufacturing [1] Farming practices in India have evolved over the years, adapting to changes in weather, climate conditions, technological advancements, and socio-cultural practices. D A Mada In 2013, made a research paper and mentioned the importance of smart agricultural systems by giving examples [2]. The conclusion from the paper was the need for a multipurpose machine that will be used before harvesting the crops. We considered this for our research and further production of our multipurpose agricultural machine. Jin et al., present the design and experimental results of a multipurpose agricultural robot in 2021 [3]. The robot is equipped with various modules for tasks such as plowing, seeding, spraying, and harvesting. It utilizes advanced control algorithms

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 4, June 2025
Impact Factor: 7.67

and sensor systems to navigate and perform tasks autonomously in different agricultural environments. Wang [4] and colleagues developed a versatile agricultural robot system capable of performing multiple tasks in 2020. The robot system aims to improve efficiency and reduce labour costs in agricultural operations. Liu et al. present the development of a multipurpose agricultural robot tailored for small-scale farms in 2021.Their research addresses the specific challenges faced by small-scale farmers, offering a practical solution to improve productivity and sustainability [5]. In 2021, Chen and co-authors explore the integration of IoT technology into a multipurpose agricultural robot. By leveraging IoT, the robot can optimize resource usage, monitor crop health, and adapt to changing environmental conditions for improved agricultural performance [6]. Kim et al. propose an autonomous navigation system tailored for a multipurpose agricultural robot in 2022. Their research emphasizes the development of robust localization and mapping algorithms to enable accurate and efficient navigation in complex farm environments. The system aims to enhance the robot's autonomy and reliability during task execution [7]. Gupta and collaborators introduce a vision-based control system designed for a multipurpose agricultural robot in 2022 [8]. Their work focuses on integrating computer vision techniques to enable object detection, localization, and manipulation tasks. By harnessing visual information, the robot can perform precise and adaptive actions, enhancing its effectiveness in various agricultural tasks. In 2022 Patel et al. [9]. Explore a swarm robotics approach for multipurpose agricultural tasks. Their work focuses on optimizing the robot's power management system to maximize energy harvesting and utilization. By harnessing solar energy, the robot can operate autonomously for extended periods, reducing reliance on conventional power sources and minimizing environmental impact [10]. A Comprehensive Review of Parameters Optimization, and Applications. Communications on Applied Nonlinear Analysis [11]. Applications and Challenges of Machine Learning Techniques for Smart Manufacturing in Industry 4.0. In 2023 7th International Conference on Computing, Communication, Control and Automation [12]. Design and Analysis of Automatic Tripod Style Horizontal Multi Bobbin Wire Winder [13]. Recognition and localization methods for vision- based fruit picking robots [14]. Development status and trend of agricultural robot technology [15]. A robot-based intelligent management design for agricultural cyber-physical systems [16]

II. METHODOLOGY

Multitasking Agricultural Robot for Smart Farming Applications

Multifunctional agriculture robots employ various methodologies to optimize their functionality and efficiency in performing multiple agricultural tasks. The best methodologies integrate advanced technologies and innovative approaches to ensure precision, adaptability, and sustainability.

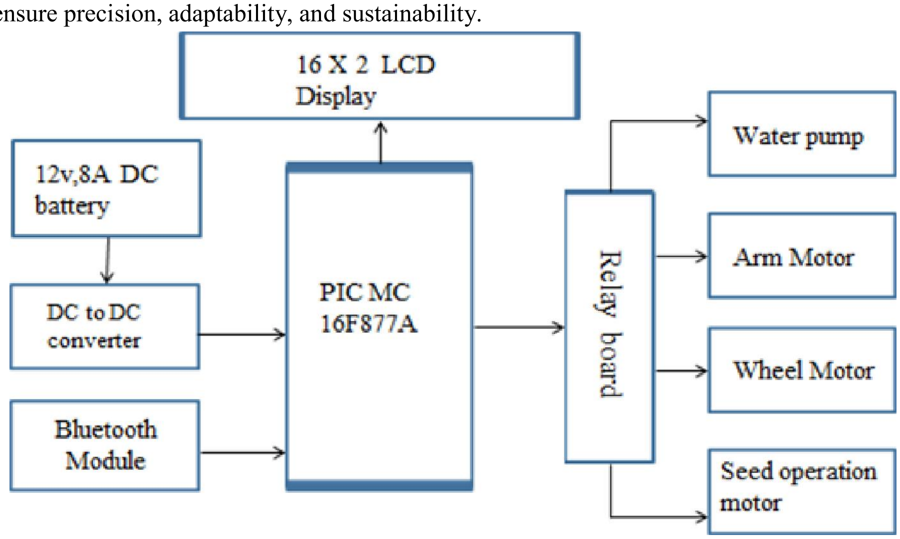

Figure No. 1. Block Diagram of Multitasking Agricultural Robot for Smart Farming Applications

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 4, June 2025 Impact Factor: 7.67

A. Hardware Model

As shown in Figure 1, Agribot is a robot designed for agricultural purposes. It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy of the work. It performs the elementary functions involved in farming i.e. ploughing the field, sowing of seeds and covering the seeds with soil. Multifunctional agricultural robot can perform a variety of tasks, including plowing, seeding, watering, and weed removal. These robots can be powered by solar panels and can be controlled using a smartphone. How they work Navigation: The robot uses image processing to navigate and identify crop diseases. Communication: The robot can be controlled using a smartphone via Bluetooth. Power: The robot can be powered by solar panels or a rechargeable battery. Sensors: The robot uses sensors to detect soil moisture, temperature, and humidity. Control: The robot is controlled by a microcontroller that controls the DC motors that move the wheels.

As shown in Figure 2, driver required 12V DC supply, when supply provided then drivers help to control dc motor as forward and reverse application. ENA, IN1, IN2, IN3, IN4, ENB these 6 pins are connected to 9, 8, 7,5,4,3 digital pins of the Arduino. 4 dc motor connected parallel to each other and (+ve) & (-ve) connected to the OUTPUT 1,2,3,4, pins of the drivers. Bluetooth Module is used for remote control application for the remote-control application create the program and dumped to the Arduino program file and compile it. 12V DC pump will help to spray the water during the running condition. Pump will help to pumped the water with the help of sprinkler it will spray surrounding the plants. For the grass cutting application we have used a separate DC motor connection by another motor driver. When program will dumped into the arduino then servo as well as DC motor runs simultaneously and by the remote control it will operate as per controlling command.

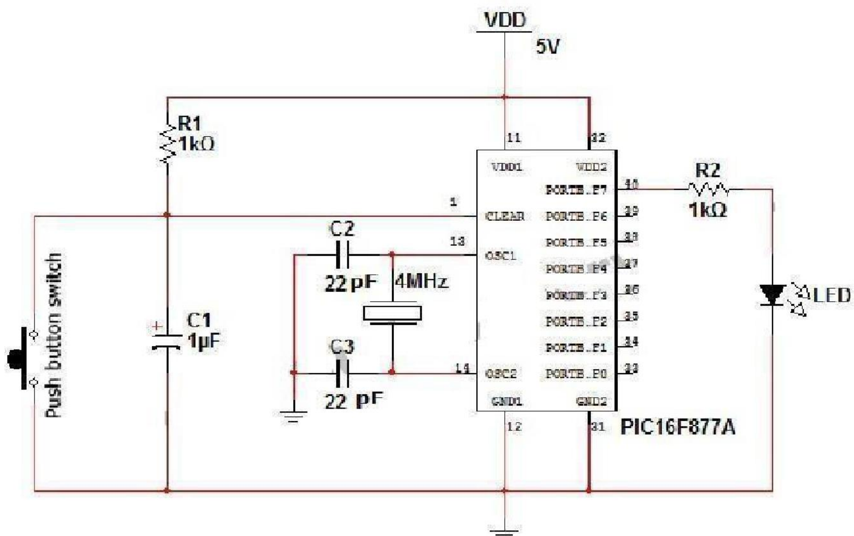

Figure No. 2. Circuit Diagram

B. Software

PIC Simulator IDE

PIC Simulator IDE is a software tool used for simulating and programming PIC microcontrollers. It allows developers to write, test, and debug their code for PIC devices without needing physical hardware. The software typically includes a compiler, debugger, and simulator to emulate how the microcontroller will behave with the code.

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 4, June 2025
Impact Factor: 7.67

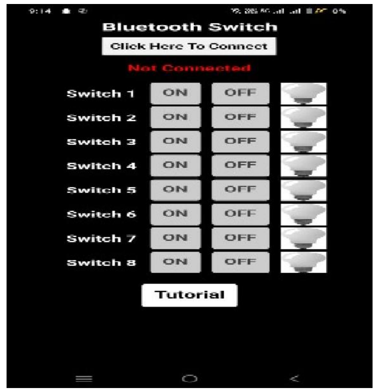

Figure No. 3. Blink Android App

Android App for Robot Operation:

As shown in Figure 3, Android application interface used to control various operations of a robot via Bluetooth. Here's a breakdown of how it works the app allows users to control different robotic functions using Bluetooth switches. The interface provides "ON" and "OFF" buttons for each switch, which correspond to specific robot actions.

Table 1: - Switch and Robot Operation

Switch no	Switch operation
Switch 1	Robot Arm in upward direction
Switch 2	Robot Arm in Downward direction
Switch 3	Seed Motor Operation
Switch 4	Water Pump Operation
Switch 5	Grass Cutting Operation
Switch 6	Robot Wheel Forward Operation
Switch 7	Robot Wheel Reverse Operation
Switch 8	Fruit Cutting Operation

Functionality of Each Switch:

Switch 1 – Moves the robot arm in the downward direction. Switch 2 – Moves the robot arm in the upward direction.

Switch 3 – Go (Means robot wheel move forward).

Switch 4 – Fruit Cutting Operation.

Switch 5 – Water Pump Operation

As shown in table no. 1.

App Interface Description:

Bluetooth Switch: A button at the top allows users to connect the app to the robot via Bluetooth.

The status indicator shows whether the connection is active or not ("Not Connected" in the image).

Working Principle:

The user connects the app to the robot via Bluetooth.

Each switch corresponds to a specific action, which can be toggled ON or OFF.

The app sends signals to the robot, allowing remote control of its mechanical functions.

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 4, June 2025
Impact Factor: 7.67

III. RESULTS AND DISCUSSION

Calculation for how much load can carry our robot:

Torque and Load Calculation for DC Gear Motor:

1. Torque Conversion:

- Given torque: 1.5 kg-cm
- Conversion factor: 1 kg-cm = 0.0981 N-m
- Torque in N-m: $1.5 \times 0.0981 = 0.14715$ N-m

2. Radius Calculation:

- Given shaft diameter: 4 mm
- Radius = Diameter / 2 = 4 mm / 2 = 2 mm = 0.002 meters

3. Force Calculation at the Shaft:

- Torque (T) = Force (F) × Radius (r)
- $F = T / r = 0.14715 / 0.002 = 73.575$ N

4. Load in Kilograms:

- Using gravity ($g = 9.81\ m/s^2$),
- Load (mass) = Force / g = 73.575 / 9.81 ~ 7.5 kg

-For all wheels of robot = 7.5 kg * 4 = 30 kg

With a 30 RPM DC gear motor providing 1.5 kg-cm (0.14715 N·m) torque and a 4 mm shaft diameter (2 mm radius), the maximum theoretical force the motor can apply at the shaft is about 73.6 N, equivalent to 7.5 kg of weight for only onr motor for all four motor weight is 30 kg.

Load Carrying Capacity:

-The robot uses a 30 RPM DC gear motor with a torque of 1.5 kg-cm and a 4 mm shaft diameter.

-Torque was converted to 0.14715 N-m.

-Calculated force at the shaft: 73.575 N.

-Equivalent load: 7.5 kg**.**

-This suggests the robot can transport lightweight agricultural inputs like seed trays or water containers effectively.

3.3 Fruit Cutting Capacity of 300 RPM DC Gear Motor (Angle of arm is 67 Degree)

1. Given Motor Torque:

- 9 kg-cm

-Converted to N·m:

$9 \times 0.0981 = 0.8829$ N·m (1 kg-cm = 0.0981 N·m)

2. Blade Radius:

- 0.025 meters (2.5 cm)

3. Force Applied at Blade Edge:

- Formula: $F = T / r$
- $F = 0.8829 / 0.025 = 35.316$ N

4. Equivalent Fruit Mass the Motor Can Cut:

-Formula: Mass = F / g

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 4, June 2025
Impact Factor: 7.67

3.3 Fruit Cutting Capability:
- A 300 RPM DC gear motor with 9 kg-cm torque (0.8829 N-m) and a blade radius of 2.5 cm was used.
- Force at blade edge: 35.316 N.
- Capable of cutting fruits with a mass up to 3.6 kg under ideal conditions.
- Indicates suitability for small fruits like apples, guavas, or citrus.

Grass Cutting Robot - Torque and Cutting Capacity Calculation

1. Motor Torque:
- Torque: 7 kg·cm
- Speed: 1000 RPM

2. **Torque Conversion:**
Torque (N·m) = 7 / 10.1972 approximately 0.6867 N·m

3. **Power Calculation:**
Power (W) = (2 * pi * Torque * RPM) / 60
= (2 * pi * 0.6867 * 1000) / 60 approximately 71.9 W

4. **Grass Cutting Requirement:**
Approximate cutting power requirement: 150-300 W per meter of cutting width

5. **Estimated Cutting Width:**
Cutting width = 72 / 200 approximately 0.36 meters (36 cm) Recommended practical width: ~25 cm (to account for inefficiencies)

6. **Cutting Area per Second:**
Area = 0.25 m * 0.5 m/s = 0.125 m²/s
Area per minute = 0.125 * 60 = 7.5 m²/min

3.4 Seed Sowing Result:

Figure 4. Seed Sowing operation

DOI: 10.48175/IJARSCT-27625

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 4, June 2025
Impact Factor: 7.67

The Seed Operation Mechanism of robot uses a dedicated "seed operation motor" controlled by a relay board connected to a PIC16F877A microcontroller is shown in Figure No. 4. This motor handles the precise dispensing of seeds into the soil.

Control System: Seed sowing is managed remotely through an Android application via a Bluetooth module, allowing the user to activate the seeding operation (specifically through Switch 3 in the app).

Water Spraying Result:

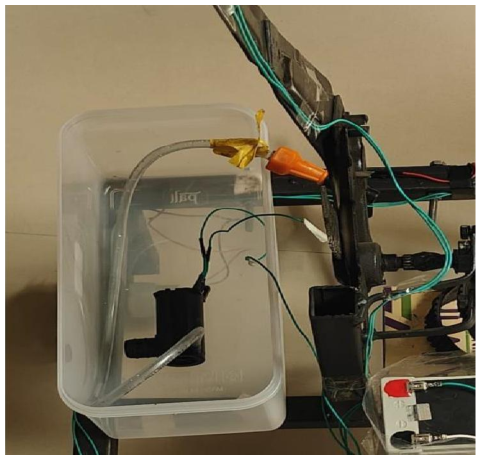

Figure 5. Water spraying

Water Spraying Feature

- The robot includes a water pump controlled via a relay board interfaced with a PIC16F877A microcontroller.
- The spraying function is remotely activated using a Bluetooth-controlled Android app.
- The nozzle used for spraying is a full-cone type, which is ideal for distributing large droplets across a wide area, typically used for soil-incorporated herbicide application.
- The water spray output is adjustable, and the nozzle supports up to 5 bar pressure, as shown in Figure no. 5.

Components Used for Spraying

- **Water Pump** – Electromechanical device to move water from tank to nozzle.
- **Relay** – Electrically operated switch to handle high-current operation of pump.
- **Nozzle** – Spraying tip to ensure proper coverage.
- **Bluetooth Module** – For remote control via app.

As shown in Figure 6. The Actual model is created and Tested in the farm

Figure 6. Actual Model of Agribot

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 4, June 2025 Impact Factor: 7.67

IV CONCLUSION

The development of the Remote Control Multifunctional Agribot for precision Agriculture marks a significant innovation in the modernization of farming practices. This project successfully demonstrates how automation and embedded systems can be effectively employed to address some of the most persistent challenges in agriculture, such as labor shortages, inefficient manual practices, and resource wastage. By integrating functionalities like seed sowing, pesticide spraying, grass cutting, and fruit harvesting into a single, remotely operated platform, this robot serves as a comprehensive tool to optimize farming operations with minimal human intervention. The robot's design, centered around the PIC16F877A microcontroller and Bluetooth-based wireless control, enables real-time responsiveness and efficient task execution. Additionally, the use of a DC gear motor system and various actuators contributes to the precision and mechanical reliability of each function. The modularity of the robot ensures adaptability for different crops and terrain conditions, making it a versatile asset for small to medium-scale farms.From a practical standpoint, the implementation of this robot not only reduces labor and operational costs but also enhances productivity by enabling consistent performance of repetitive tasks. It supports safer pesticide application by minimizing human exposure to chemicals and ensures accurate seed and water distribution, contributing to better yield outcomes. The system's user-friendly control via an Android application further adds to its accessibility and usability, especially for farmers in remote or challenging environments.

REFERENCES

[1]. Rai, H.M., Gupta, D., Mishra, S. and Sharma, H., 2021, August. Agri-Bot: IoT Based Unmanned Smart Vehicle for Multiple Agriculture Operations. In 2021 International Conference on Simulation, Automation & Smart Manufacturing (SASM) (pp. 1-6). IEEE . [2]. Mada, D. A., and Sunday Mahai. "The role of agricultural mechanization in the economic development for small scale farms in Adamawa State." Journal of Engineering and Science 2 (2013): 91-96.
[3]. Jin, Yucheng, Jizhan Liu, Zhujie Xu, Shouqi Yuan, Pingping Li, and Jizhang Wang. "Development status and trend of agricultural robot technology." International Journal of Agricultural and Biological Engineering 14, no. 4 (2021): 1-19. [4]. Wang, C., Tang, Y., Chen, M., Luo, L., Li, J., Lian, G. and Zou, X., 2020. Recognition and localization methods for visionbased fruit picking robots: A review. Frontiers in Plant Science, 11, p.510.
[5]. Liu, J., Xu, Z., Yuan, S., Li, P. and Wang, J., 2021. Development status and trend of agricultural robot technology. International Journal of Agricultural and Biological Engineering, 14(4), pp.1-19.
[6]. Chen, Huang, C.H., P.J., Lin, Y.J., Chen, B.W. and Zheng, J.X., 2021. A robot-based intelligent management design for agricultural cyber-physical systems. Computers and Electronics in Agriculture, 181, p.105967.
[7]. Kim, J., Ju, C., Seol, J. and Son, H.I., 2022. A review on multirobot systems in agriculture. Computers and Electronics in Agriculture, 202, p.107336.
[8]. Gupta P, Matholiya, Chirag S., Vishal V. Agravat, Ulpa V. Patel, and Piyush R. Balas. "Automatic guidance systems in agricultural autonomous robotic machine: a review." Pharm Innov J sp-11 (3) (2022): 307-312. Department of Electrical Engineering, GCOERC, Guru Gobind Singh Foundation, Nashik 31
[9]. Patel, Dhruv, Meet Gandhi, H. Shankaranarayanan, and Anand D. Darji. "Design of an Autonomous Agriculture Robot for Real-Time Weed Detection Using CNN." In Advances in VLSI and Embedded Systems: Select Proceedings of AVES 2021, pp. 141-161. Singapore: Springer Nature Singapore, 2022.
[10]. Yang, Jiachen, Jingfei Ni, Yang Li, Jiabao Wen, and Desheng Chen. "The intelligent path planning system of agricultural robot via reinforcement learning." Sensors 22, no. 12 (2022): 4316
[11] Somatkar, A. A. (2024). Enhancing Surface Integrity and Quality through Roller Burnishing: A Comprehensive Review of Parameters Optimization, and Applications. Communications on Applied Nonlinear Analysis, 31(1s), 151-169.
[12] Kolhe, K., Somatkar, A. A., Bhandarkar, M. S., Kotangale, K. B., Ayane, S. S., & Shirke, S. I. (2023, August). Applications and Challenges of Machine Learning Techniques for Smart Manufacturing in Industry 4.0. In 2023 7th International Conference on Computing, Communication, Control and Automation (ICCUBEA) (pp. 1-6). IEEE.

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 4, June 2025
Impact Factor: 7.67

[13] Karambelkar, S., Khaire, R., Ghule, R., Hiray, P., Kulkarni, S., & Somatkar, A. (2022, August). Design and Analysis of Automatic Tripod Style Horizontal Multi Bobbin Wire Winder. In 2022 6th International Conference on Computing, Communication, Control and Automation (ICCUBEA (pp. 1-4). IEEE.

[14]. Wang, C., Tang, Y., Chen, M., Luo, L., Li, J., Lian, G. and Zou, X., 2020. Recognition and localization methods for visionbased fruit picking robots: A review. Frontiers in Plant Science, 11, p.510.

[15]. Liu, J., Xu, Z., Yuan, S., Li, P. and Wang, J., 2021. Development status and trend of agricultural robot technology. International Journal of Agricultural and Biological Engineering, 14(4), pp.1-19.

[16]. Chen, Huang, C.H., P.J., Lin, Y.J., Chen, B.W. and Zheng, J.X., 2021

DOI: 10.48175/IJARSCT-27625