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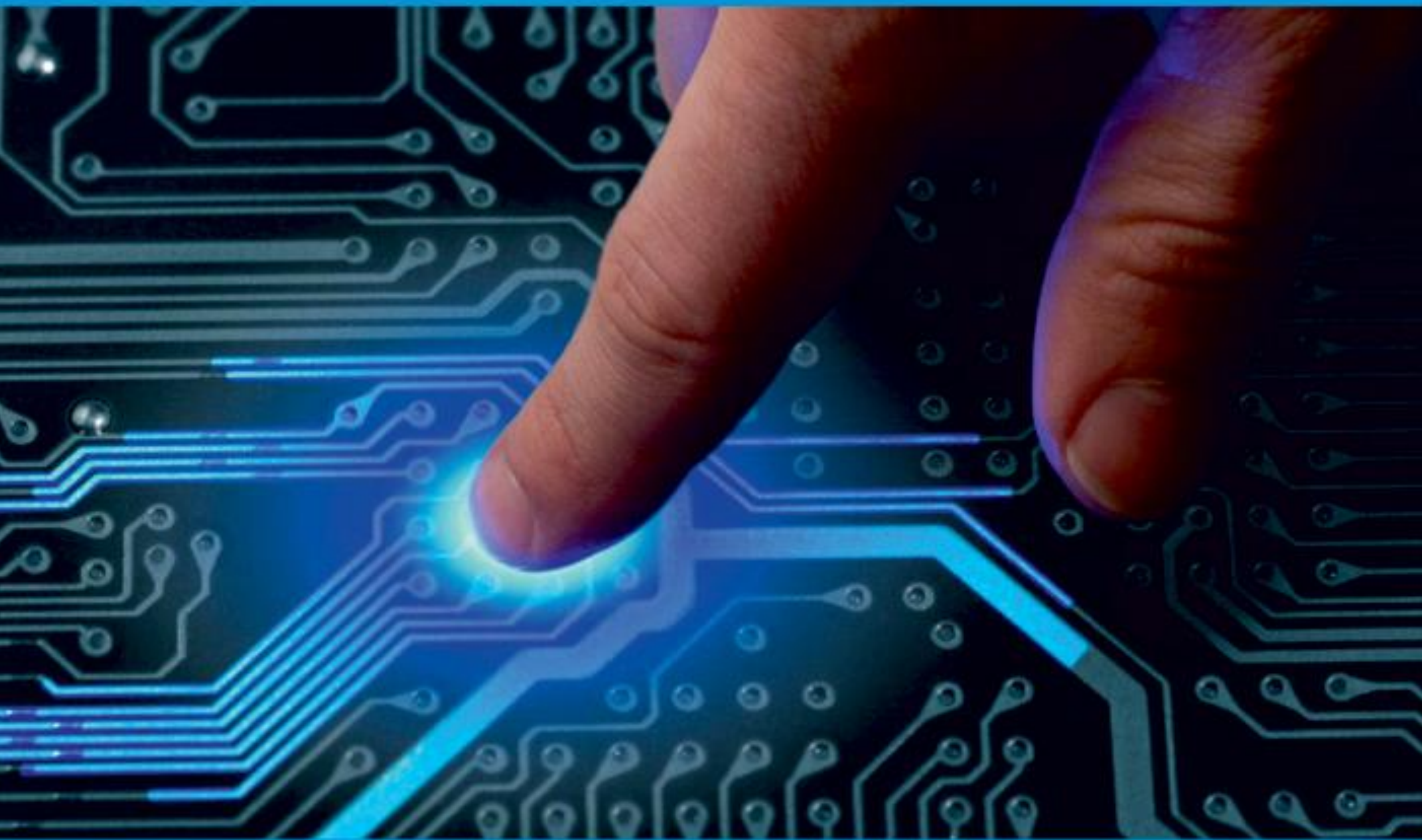

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# IOT Based Multi-Purpose Agricultural Robot

**Anu C.S[1], Rachana G Sunkad[2] , Chetan K[3], Deepak Patel K Y[4] , Vinay Patil M P[5], Yathish G S[6]**

Assistant Professor, Department of Computer Science and Engineering, Bapuji Institute of Engineering and Technology, Davangere, Karnataka, India[1 2]

B.E Student, Department of Computer Science and Engineering, Bapuji Institute of Engineering and Technology, Davangere, Karnataka, India[3 4 5 6]

**ABSTRACT:** The main aim of our project is to develop groundbreaking technology: a WiFi-enabled multipurpose robotic vehicle tailored for the agricultural sector. With over 50 percent of the global population engaged in agriculture, this innovation addresses the critical need for improved safety and efficiency. Seamlessly integrating WiFi, the robotic vehicle enables remote control for tasks such as ploughing, seeding, water and pesticides spraying,harvesting minimizing human exposure to potential hazards. Embedded C programming lies at the heart of the vehicle's functionality, allowing it to execute tasks with precision and reliability. Additionally, with the inclusion of a remote XY application, operators can precisely control the vehicle's movements and actions from a distance, further enhancing safety and efficiency. Prioritizing worker safety, this advancement marks a significant stride towards sustainable farming practices by optimizing resource utilization. This breakthrough heralds a new era in technologically-driven and eco-conscious agriculture, showcasing the potential of precision robotics to revolutionize traditional farming methods.

**KEYWORDS:** Multipurpose agricultural robot, Internet of Things, Remote XY application, WiFienabling, Embedded C programming

## I. INTRODUCTION

The development of Agricultural Automation Technology is primarily driven by the need to reduce labor force, a phenomenon particularly prevalent in the developed world. This shift is underscored by the quest for improved food quality. The convergence of robotics and artificial intelligence has emerged as a transformative force in precision agriculture, impacting processes such as seeding, harvesting, weed control, grove supervision, and chemical applications, thereby enhancing overall productivity and efficiency.

Instrumental robotics applications are expanding daily, offering effective solutions with a clearreturn on investment by replacing human operators in various agricultural activities. This includes the deployment of unmanned options for tasks like heavy chemicals or drugs dispensers, manure or fertilizer spreaders, reflecting a progressive shift towards more automated and efficient practices. Various agricultural robots have been researched and developed globally, with the Agribot designed to perform basic elementary functions such as harvesting, planting, and pesticide spraying. Precision agriculture has witnessed increased investment and research, driven by theintegration of robotics applications in machinery design and task executions Precision autonomous farming, encompassing the operation, guidance, and control of autonomous machines for agricultural tasks, serves as a catalyst for agricultural robotics. However, the objectives of agricultural robotics extend beyond mere technological application; they aim to revolutionize conventional agricultural practices.

Multipurpose agricultural robots are specifically engineered to autonomously perform essentialfarm functions, including ploughing, seed sowing, and water spraying . In thiscontext, the proposed system outlined in this project report addresses specific agricultural needs. This integration of technology into agriculture signifies a pivotal advancement towardsprecision and autonomous farming, contributing to the evolution of modern, efficient, and sustainable agricultural practices.

The main motive for developing Agricultural Automation Technology is decreasing labor force, a phenomenon common in the developed world. The reasons are the need for improved food quality. Robotics and artificial intelligence achievements offer solutions in precision agriculture to processes related to seeding, harvesting, weed control, grove supervision, chemical applications, etc. to improve productivity and efficiency. The applications of instrumental robotics are spreading every day to cover further domains, as the opportunity of replacing human

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operators provides effective solutions with return on investment. When more conservative issues are granted by robotics, heavy chemicals or drugs dispensers, manure or fertilizers spreaders, etc. are activities more and more concerned by the deployment of unmanned options.

All kinds of agricultural robots have been researched and developed to implement a number of agricultural products in many countries. This Agribot can performs basic elementary functions like harvesting, planting and spray the pesticides. The application of agricultural machinery in precision agriculture has experienced an increase in investment and research due to the use of robotics applications in the machinery design and task executions. Precision autonomous farming is the operation, guidance, and control of autonomous machines to carry out agricultural tasks. It motivates agricultural robotics. The goal of agricultural robotics is more than just the application of robotics technologies to agriculture.

## II. LITERATURE REVIEW

**Smith et al., 2023: "AI-Enhanced Robotic System for Diverse Agricultural Tasks"** Smith et al proposed "AI-Enhanced Robotic System for Diverse Agricultural Tasks" in the year 2023 Smith and colleagues introduced a novel approach to agriculture with the integration of artificial intelligence into robotic systems. The methodology of the research centers around a robot designed to perform a range of tasks, including planting, weeding, and data collection. The key advantage highlighted is the significant improvement in efficiency and the generation of accurate, data-driven insights for farming practices. However, the adoption of this technology comes with drawbacks, as the system incurs a high cost and necessitates a certain level of sophistication in understanding and managing AI technologies [1].

**Johnson and Zhao, 2023: "Solar-Powered Robotics in Sustainable Agriculture"** Johnson and Zhao proposed "Solar-Powered Robotics in Sustainable Agriculture" in the year 2023 revolves around the implementation of solar-powered robotics in sustainable agriculture. Their methodology focuses on the development of a robot powered by solar energy to undertake tasks such as seeding and harvesting. The advantages highlighted include its environmentally friendly nature and the potential for reducing operational costs. Nevertheless, the system faces limitations due to its dependence on weather conditions and the possibility of energy storage issues, presenting challenges for widespread and consistent implementation.The advantages of this approach include the utilization of real-time data and enhanced crop health monitoring [2].

**Huang and Kumar, 2022: "Agricultural Robots for Smart Farming**" Huang and Kumar proposed "Agricultural Robots for Smart Farming" in the year 2022 a study on agricultural robots with a focus on real-time monitoring and decision-making in crop management. The proposed methodology involves the deployment of robots for continuous monitoring of crops and making informed decisions based on the gathered data. The advantages of this approach include the utilization of real-time data and enhanced crop health monitoring. However, the study acknowledges that, despite these benefits, the robotic approach might currently be less efficient than traditional farming methods, potentially posing a challenge to its widespread adoption [3].

**García and Lee, 2022: "Autonomous Robots for High-Precision Organic Farming" García** and Lee proposed "Autonomous Robots for High-Precision Organic Farming" in the year 2022, García and Lee aim to develop autonomous robots tailored for high-precision organic farming. The methodology of their work revolves around the creation of robots designed to contribute to natural pest control and maintain soil health. This approach aligns with the promotion of organic farming practices by reducing reliance on chemical inputs. Despite the positive environmental impact, the study notes that autonomous robots might be less efficient than traditional methods, and their adoption may entail higher operational costs [4].

**Andersson and Singh, 2021: "Robotic Solutions for Automated Fruit Harvesting"** Andersson and Singh proposed "Robotic Solutions for Automated Fruit Harvesting" in the year 2021. Focuses on the development of robotic solutions dedicated to automated fruit harvesting. The methodology involves the utilization of sensory and visual feedback systems to enhance the efficiency of the robot in this specific agricultural task. The advantages highlighted include increased harvesting efficiency and a reduction in labor requirements. However, challenges are acknowledged, particularly the potential difficulty in handling delicate fruits and the expense associated with the advanced technology [5].

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**Dubois and Rodriguez, 2021: "Multi-Terrain Robotics for Effective Agricultural Management"** Dubois and Rodriguez's proposed "Multi-Terrain Robotics for Effective Agricultural Management" in the year 2021. Dubois and Rodriguez's delves into the exploration of multiterrain robotics for effective agricultural management. The methodology investigates robots capable of navigating diverse soil types and environmental conditions. The versatility and adaptability of these robots are considered advantageous, making them suitable for various landscapes. However, the study acknowledges the inherent complexities in developing such advanced systems, which may result in high initial costs and potential maintenance expenses, posing challenges to their widespread adoption [6].

**Nkosi and Tanaka, 2020 "Next-Generation Robotics for Seed Sowing and Crop Analysis"** the agricultural innovation centers around advanced robotic systems designed for precise seed sowing and crop growth analysis through the application of artificial intelligence (AI). By leveraging sophisticated AI algorithms, these robotic systems contribute to heightened planting precision and provide detailed analyses of crop growth. The pros of such a system include enhanced agricultural efficiency through precise seed placement and insightful growth assessments. However, it's important to acknowledge the associated cons, which encompass the necessity for advanced AI algorithms and the requirement for a substantial initial investment. Despite these challenges, the integration of AI-driven robotic systems presents a promising avenue for optimizing agricultural practices and achieving sustainable crop management [7].

**Kim and Müller, 2019 "Leveraging Drone Technology in Agricultural Robotics"** Kim and Müller, 2019 "Leveraging Drone Technology in Agricultural Robotics"The outlined in this study delves into the integration of drone technology with ground-based robots to achieve comprehensive farm management. This innovative approach promises enhanced monitoring capabilities and increased efficiency in tasks such as spraying. The pros of this integration include the ability to obtain real-time data and deploy precision spraying, contributing to improved crop health and resource optimization. However, potential challenges arise in the form of regulatory complexities associated with drone usage in agriculture and the need for intricate operational coordination between airborne drones and groundbased robots. Despite these challenges, the integration of drones and robots holds great potential for revolutionizing farm management practices and advancing precision agriculture [8].

**Patel and Nguyen, 2019 "Machine Learning Approaches in Pest Detection Robots"** Patel and Nguyen, 2019 "Machine Learning Approaches in Pest Detection Robots" The methodology employed in this research focuses on the application of machine learning in robots for early detection of pests and diseases in crops. Leveraging machine learning algorithms enables these robots to identify subtle signs of infestations or illnesses at their incipient stages. The pros of this approach are evident in the early detection capability, allowing for prompt intervention and significantly reducing potential crop damage. However, challenges include the necessity for extensive training data to enhance the model's accuracy and the potential for occasional inaccuracies in detection. Despite these concerns, the integration of machine learning into robotic systems offers a promising avenue for proactive and efficient crop protection in modern agriculture [9].

### 2.1 Literature Review Summary

In recent years, researchers have proposed various innovative approaches to revolutionize agriculture through robotics and artificial intelligence (AI). These proposals range from AIenhanced robotic systems for diverse agricultural tasks to solar-powered robotics in sustainable agriculture and autonomous robots for high-precision organic farming. Each approach offers unique advantages such as increased efficiency, reduced labor requirements, and enhanced crop health monitoring. However, challenges including high costs, technological complexity, and limitations in efficiency compared to traditional methods hinder widespread adoption. Nonetheless, these advancements hold promise for optimizing agricultural practices and achieving sustainable crop management in the future.

## III. GAPS IDENTIFIED

- High cost, requires sophisticated AI understanding.
- It only give the opportunity for short range communication between the device.
- During a rainy season there is no advantage of the solar panel.
- Less efficient than traditional methods, higher operational costs.
- Failed to successfully bring out the accuracy of specific tasks.

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## IV. EXISTING SYSTEM

- The main problem in the agricultural activities are lack of farm labor availability, increase in labor wages , wastage of seeds
- Existing Agricultural system depends on human for seeding, watering, pesticide spraying and grass cutting. Traditionally farming is done by human beings with the help of bullock carts tractors and other technalized machines.
- To over come these problems we are designing a multipurpose agricultural robot for ploughing, seeding, water and pesticides spraying and Harvesting operation.

## V. PROBLEM STATEMENT

In agriculture, challenges such as labor scarcity, escalating wages, and seed wastage persist. To tackle these issues, we propose a versatile agricultural robot designed for ploughing, seeding, water and pesticide spraying, and harvesting operations, aiming to optimize efficiency and resource utilization in farming practices

## VI. PROPOSED SYSTEM

- The proposed system focused on the design, development and the fabrication of the multipurpose agricultural robot with irrigation system in addition to ploughing and seeding.
- The multipurpose agricultural Robot is used to control the functions like ploughing thesoil, seed sowing, pesticides and water spraying, harvesting.

## VII. OBJECTIVES

- To design and implement a multipurpose agriculture robot for ploughing , seed sowing mechanism , harvesting and movement mechanism using DC motors.
- To design and implement a multipurpose agriculture robot for water and pesticide spraying mechanism using Pump motors.
- To design and implement a multipurpose agriculture robot for LED control, we use the liquidcrystal_i2c.h library.
- To control operations of our robot, we use the Remote XY application.

## VIII. METHODOLOGY

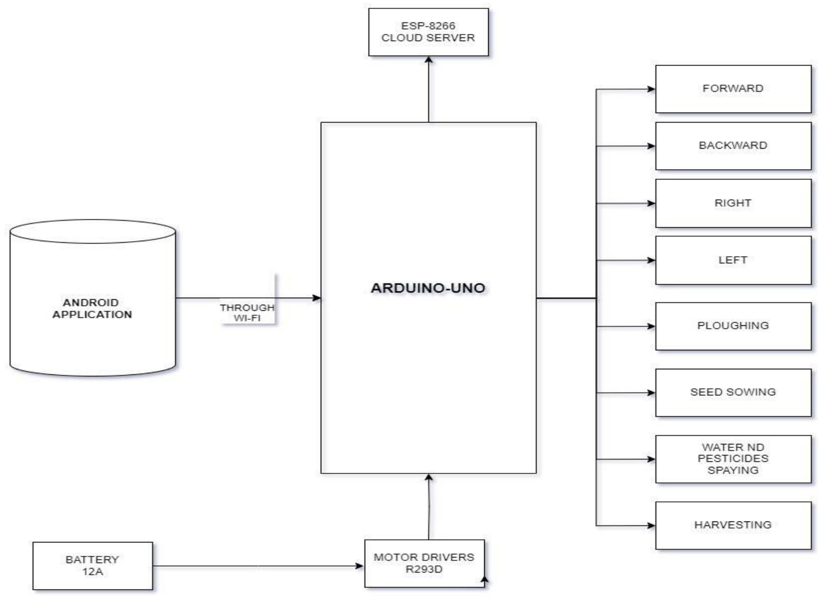


**Figure 8.1: System Methodology**

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**Arduino UNO**: Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack.

The mechanism that will be performed using Robot are :

**1. Ploughing Mechanism**: A plough is one of the agricultural tools used for the initial soil cultivation in preparation for seed sowing or planting to loosen or turn the soil. Ploughs were traditionally drawn by oxen and horses but in modern farms are drawn by tractors. A plough may have a wooden, iron or steel frame with a blade attached to cut and loosen the soil

**2. Seed Sowing Mechanism:** Seed sowing is the process of placing seeds in holes made in the seedbed and closing the seed with soil. Sowing is a process of planting seeds into the soil. During this agricultural process, proper precautions should be taken, including the appropriate depth, proper distance maintained, and soil should be clean, healthy and free from disease

**3. Water and Pesticides Spraying:** Spraying in agriculture is a crucial aspect of crop cultivation that involves Water the controlled application of water to crops for irrigation purposes. Water and pesticide spraying are common practices in agriculture aimed at ensuring crop health, promoting optimal growth, and controlling pests.

**4. Harvesting:** The harvesting process in agriculture involves the collection of mature crops from the field. Harvesting is a critical stage that determines the yield and quality of the produce. Harvesting is the operation of gathering the useful part or parts of the plant and is carried out at the time when all the nutrients have developed and the edible parts have reached the appropriate degree of maturity.

**8.1 FLOW CHART**

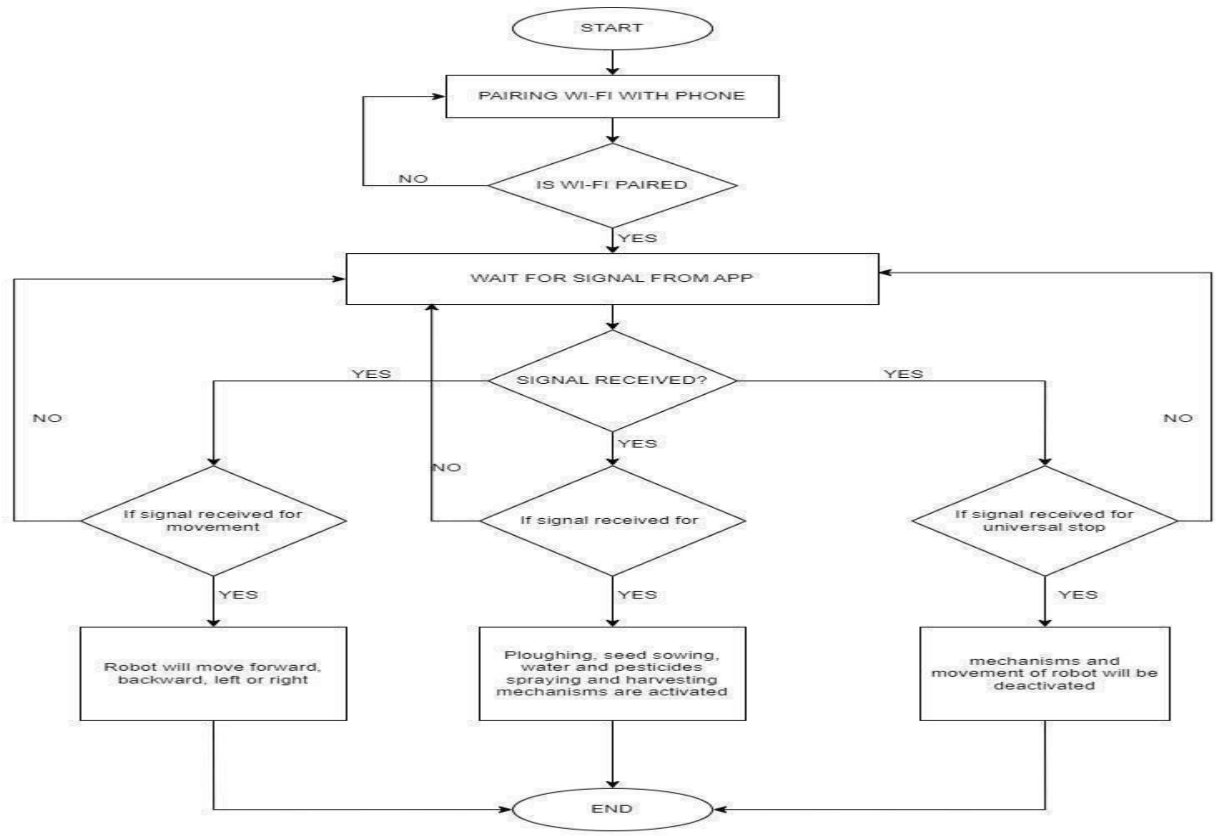


**Figure 8.2: Flow Chart**

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## IX. RESULTS

**FIG.8.1 Ploughing**

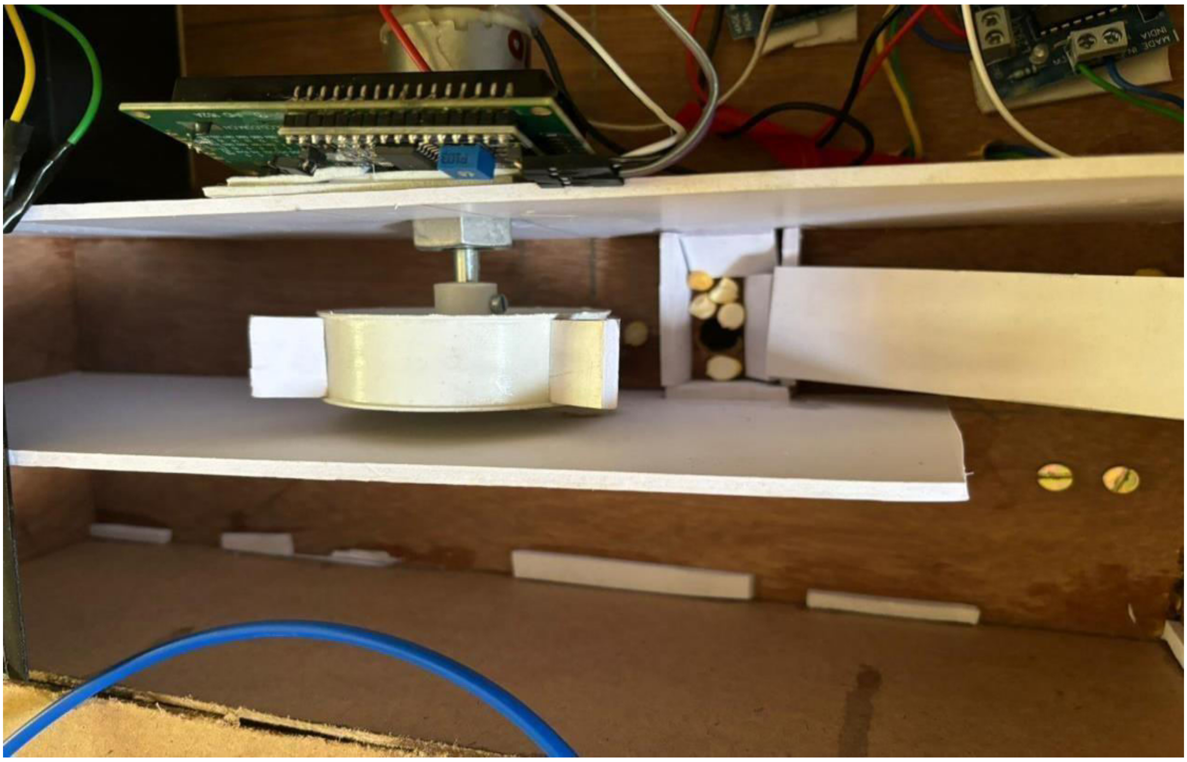

**FIG.8.2 Seeding**

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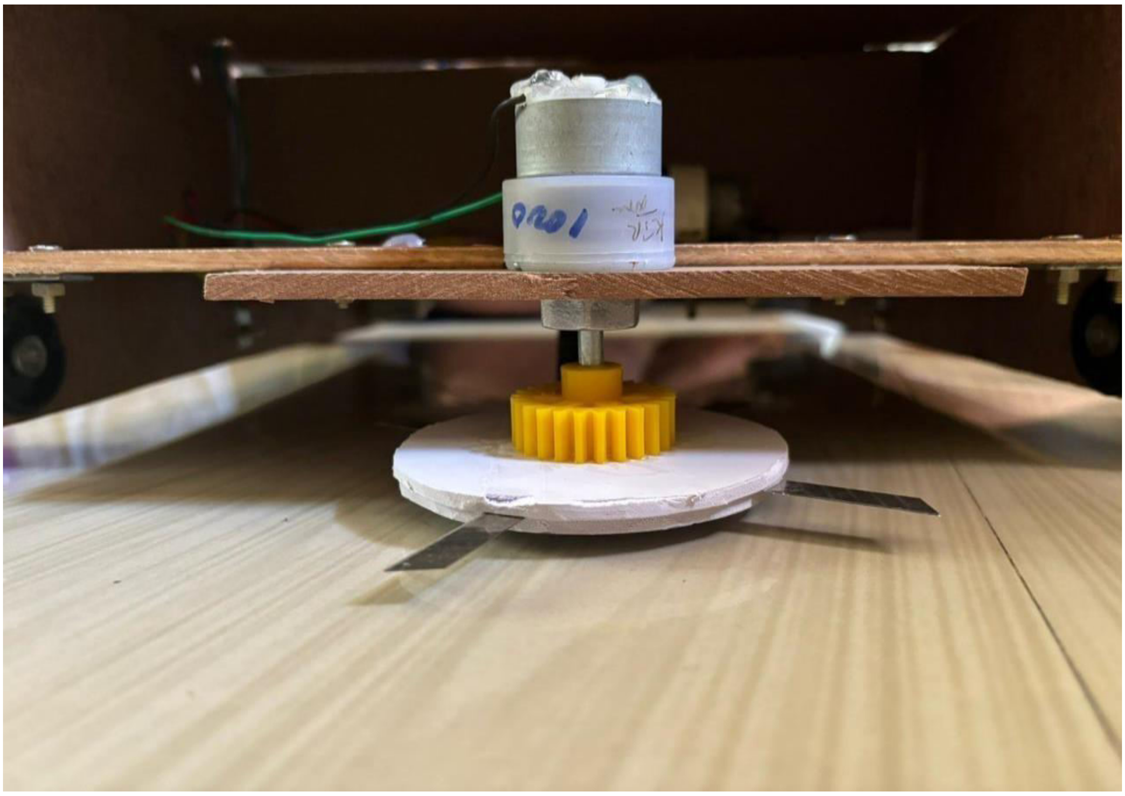


**FIG.8.3 Harvesting**

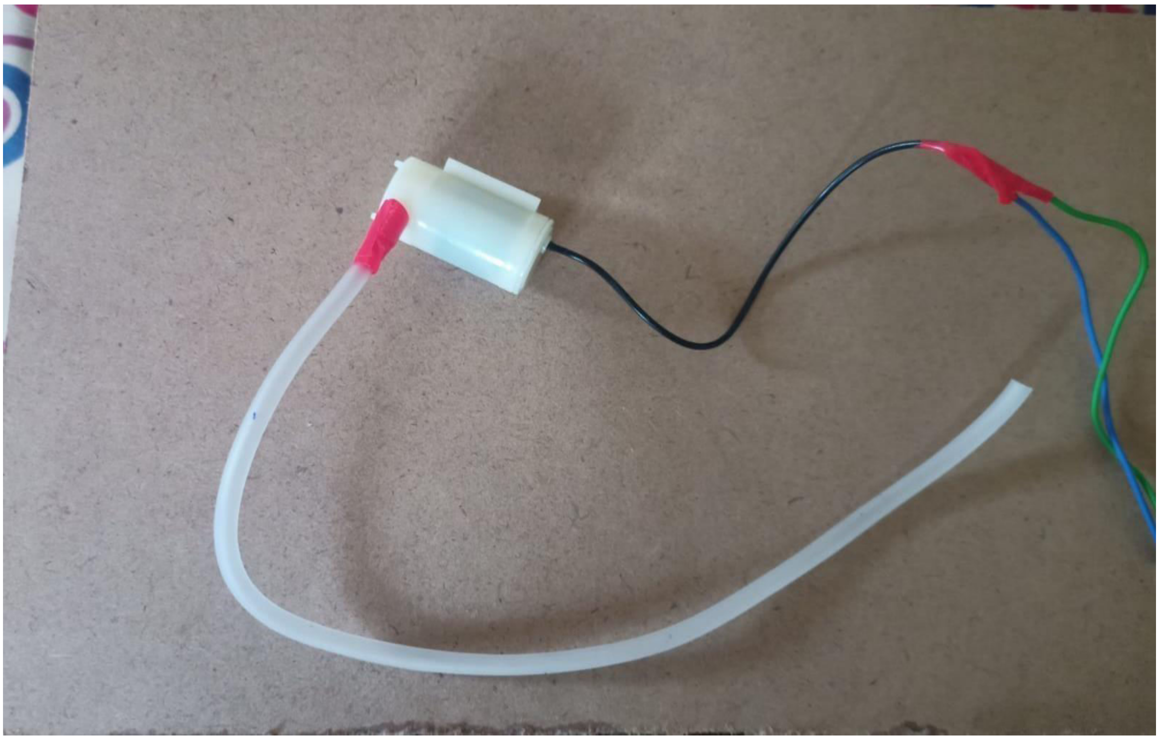

**FIG.8.4 Pump for Water and Pesticides Spraying**

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2. Johnson and Zhao, 2023 , Proposed a work on "Solar-Powered Robotics in Sustainable Agriculture" Focuses on a solar-powered robot for sustainable farming practices,performing tasks like seeding and harvesting.
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4. García and Lee, 2021, Proposed a work on "Autonomous Robots for High-Precision Organic Farming" Develops an autonomous robot for organic farming, focusing on naturalpestcontrol and Soil health .
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