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DESIGN AND IMPLEMENTATION OF AGRICULTURE MULTIPURPOSE VEHICLE

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Abstract:
The Agriculture Multi-Purpose Vehicle (AMPV) is an innovative solution designed to revolutionize farming practices by integrating multiple agricultural functionalities into a single platform. This prototype aims to streamline various tasks such as soil preparation, seed planting, irrigation, and crop maintenance, thereby enhancing efficiency, reducing labor requirements, and improving overall productivity in agriculture. The AMPV features modular attachments, motorized mechanisms, and a user-friendly control interface, allowing farmers to adapt to different cropping systems and field conditions with ease. This paper presents the design, development, and implementation of the AMPV prototype, highlighting its key features, operational capabilities, and potential applications in modern agriculture.
Keywords:
Agriculture, Multi-Purpose Vehicle, Farming, Automation, Soil Preparation, Seed Planting, Irrigation, Crop Maintenance, Modular Attachments, Motorized Mechanisms, Control Interface

1.Introduction

LITERATURE REVIEW

In recent years, the agricultural sector has witnessed a significant shift towards automation and mechanization to address the growing challenges of labor scarcity, rising production costs, and the need for increased productivity. The integration of technology into farming practices has led to the development of various agricultural machinery and equipment aimed at streamlining operations and improving efficiency. This literature review explores relevant studies and technological advancements in the field of agricultural automation, with a focus on multi-purpose vehicles and their applications in modern farming.

INTEGRATION OF TECHNOLOGY IN AGRICULTURE

The advent of precision agriculture and the Internet of Things (IoT) has revolutionized farming practices by enabling real-time monitoring, data-driven decision-making, and automated control of agricultural processes. Researchers have explored the integration of sensors, actuators, and communication systems into agricultural machinery to optimize resource usage, minimize environmental impact, and enhance crop yield.

MULTI-PURPOSE VEHICLES IN AGRICULTURE

Multi-purpose vehicles (MPVs) have emerged as versatile tools for performing various tasks in the agricultural field, ranging from soil preparation and planting to crop maintenance and harvesting. These vehicles are designed to accommodate interchangeable implements and equipment, allowing farmers to adapt to different cropping systems and field conditions efficiently. Previous studies have highlighted the benefits of MPVs in reducing labor requirements, increasing operational flexibility, and improving overall farm productivity.

ROTAVATOR TECHNOLOGY

Rotavators play a crucial role in soil preparation by breaking up soil clods, incorporating organic matter, and creating a favorable seedbed for planting. Traditional rotavators are typically attached to tractors and operated manually, limiting their effectiveness and efficiency. Recent advancements in rotavator technology have focused on enhancing performance, reducing fuel consumption, and improving ease of operation through automation and precision control systems.

SEED FEEDING MECHANISMS

Efficient seed delivery systems are essential for ensuring accurate planting and optimal seed spacing, which are critical factors influencing crop establishment and yield. Various seed feeding mechanisms, such as pneumatic seeders, mechanical seeders, and vacuum-based seeders, have been developed to address the challenges of seed placement and singulation in different cropping systems. These mechanisms aim to minimize seed wastage, improve planting accuracy, and enhance crop uniformity.

WATER SPRAYING SYSTEMS

Irrigation is a vital component of modern agriculture, facilitating the efficient delivery of water to crops for optimal growth and development. Conventional irrigation methods, such as flood irrigation and furrow irrigation, are labor-intensive and often result in water wastage and soil erosion. Automated water spraying systems, including drip irrigation, sprinkler irrigation, and micro-irrigation, offer more precise control over water application, thereby conserving water resources and maximizing irrigation efficiency.

EXISTING METHOD IN AGRICULTURE

Before the introduction of the Agriculture Multi-Purpose Vehicle (AMPV) prototype, traditional farming methods were predominantly manual or relied on single-purpose machinery. The existing method typically involved the use of separate implements or equipment for specific tasks, resulting in increased labor requirements, time inefficiency, and limited operational flexibility. Below is an overview of the existing method in agriculture:

Soil Preparation

Traditional soil preparation methods often involve the use of hand tools or tractor-mounted implements such as plows or cultivators. These implements are operated manually or attached to tractors, requiring multiple passes to achieve adequate soil tillage and preparation for planting.

Seed Planting

Seed planting is commonly performed using manual methods such as hand seeding or by using basic seeders attached to tractors. In manual seeding, farmers typically scatter seeds by hand onto prepared soil beds, resulting in uneven seed distribution and inconsistent planting depths.

Irrigation

Irrigation practices vary depending on the availability of water sources and infrastructure. In regions with limited access to irrigation systems, farmers rely on manual methods such as flood irrigation or furrow irrigation, which can be labor-intensive and inefficient in water usage.

Crop Maintenance

Weeding, fertilization, and pest control are essential aspects of crop maintenance in traditional farming methods. These tasks are often performed manually or with the use of basic tools and equipment, requiring significant labor inputs and time investment.

CHALLENGES WITH EXISTING METHOD

Labor Intensive: Traditional farming methods require a significant amount of manual labor, leading to high labor costs and dependence on seasonal workforce availability.

Time Inefficiency: Sequential execution of tasks using separate implements results in time inefficiency and delays in farm operations, especially during critical phases such as planting and harvesting.

Limited Flexibility: Single-purpose machinery limits the adaptability and versatility of farming operations, making it challenging to respond effectively to changing environmental conditions or crop management practices.

The introduction of the Agriculture Multi-Purpose Vehicle (AMPV) prototype aims to address these challenges by integrating multiple agricultural functionalities into a single, versatile platform. By consolidating tasks such as soil preparation, seed planting, irrigation, and crop maintenance into one

vehicle, the AMPV offers farmers increased efficiency, reduced labor requirements, and enhanced operational flexibility in agricultural operations.

2.Proposed systems

PROPOSED METHOD

The proposed method introduces an innovative solution in the form of an Agriculture Multi-Purpose Vehicle (AMPV), designed to streamline various farming tasks using integrated functionalities. The AMPV prototype offers a comprehensive approach to agricultural automation, combining multiple operations into a single, versatile platform. Below is an overview of the proposed method:

INTEGRATED DESIGN

The AMPV prototype features a compact and robust design, incorporating all necessary components and functionalities within a single vehicle platform. This integrated approach eliminates the need for separate implements or equipment, thereby reducing operational complexity and enhancing overall efficiency.

MODULAR ATTACHMENTS

The AMPV is equipped with modular attachments for performing a range of agricultural tasks, including soil preparation, seed planting, irrigation, and crop maintenance. These attachments can be easily interchanged or customized based on specific farming requirements, allowing for greater flexibility and adaptability in different cropping systems and field conditions.

MOVEMENT MECHANISM

The AMPV is equipped with four TT gear motors with wheels, controlled by motor drivers (L2983D), enabling smooth and precise movement in various directions. This movement mechanism allows the AMPV to navigate through farm fields with ease, accessing different areas for performing different tasks.

ROTAVATOR

A rotavator attachment is integrated into the AMPV, powered by a John Deere side shaft gear motor. The rotavator facilitates soil preparation by breaking up soil clods, incorporating organic matter, and creating an optimal seedbed for planting. The rotavator can be raised or lowered as needed using the motorized mechanism for precise control.

SEED FEEDER

The AMPV features a seed feeder mechanism consisting of a basket-like structure containing seeds and a servo motor-controlled slider. This mechanism regulates the distribution of seeds into the ground through a pipe, ensuring accurate seed placement and uniform spacing for optimal crop establishment.

WATER SPRAYERS

Two pump motors are installed on the AMPV to facilitate irrigation operations. The water sprayers are used to apply water onto crops, promoting growth and ensuring adequate moisture levels in the soil. The water spraying system can be activated or deactivated as needed using the control interface.

CONTROL INTERFACE

The AMPV is controlled via a user-friendly interface developed using the MIT App Inventor. The control interface features buttons for controlling the vehicle's movement (forward, backward, left, right), activating the rotavator, adjusting its height, activating the water sprayers, and controlling the seed feeder mechanism. Communication between the control interface and the AMPV is established using a Bluetooth module (HC-05), allowing for wireless operation and remote monitoring.

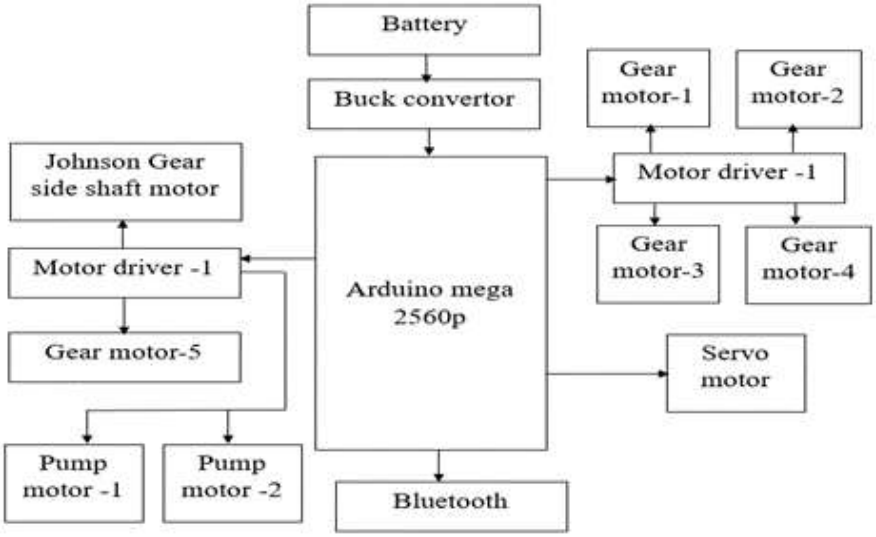


Figure.1.Block Diagram of AMPV

Arduino Mega 2560 Controller:

This block represents the central control unit of the AMPV, responsible for processing inputs, executing control algorithms, and generating outputs to drive the vehicle's operation.

Motor Drivers (L2983D):

These blocks represent the motor driver modules used to control the movement of the vehicle's wheels. They receive commands from the Arduino controller and regulate the power supplied to the motors to achieve forward, backward, left, and right movement.

Johnson gear Side Shaft Gear Motor:

This block represents the gear motor used to drive the rotavator attachment of the AMPV. It receives commands from the Arduino controller to raise or lower the rotavator, as well as to control its rotation speed.

Pump Motors:

These blocks represent the pump motors used to operate the water spraying system of the AMPV. They receive commands from the Arduino controller to activate or deactivate the water sprayers for irrigation purposes.

TT Gear Motor for Rotavator:

This block represents the gear motor used to rotate the blades of the rotavator attachment. It receives commands from the Arduino controller to control the rotation speed and direction of the rotavator.

Servo Motor for Seed Feeder:

This block represents the servo motor used to open and close the holes in the seed feeder mechanism. It receives commands from the Arduino controller to regulate the flow of seeds into the ground during planting.

Bluetooth Module (HC-05):

This block represents the Bluetooth module used for wireless communication between the AMPV and the control interface. It facilitates remote control and monitoring of the vehicle's operation using a smartphone or other mobile device.

SCHEMATIC OF AMPV

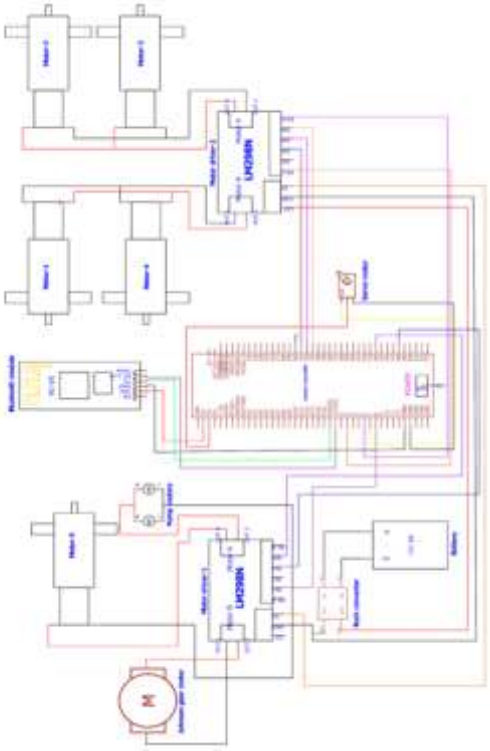


Figure.2.Schematic Diagram of AMPV

3.Results and Discussion

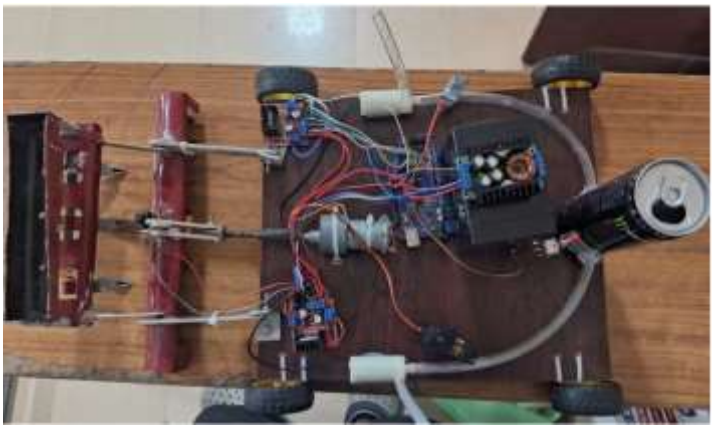


Figure.3. Agriculture Multipurpose Vehicle

1. To drive the vehicle in 4 directions which are Forward, Backward, Right & Left, we need to operate from the application.

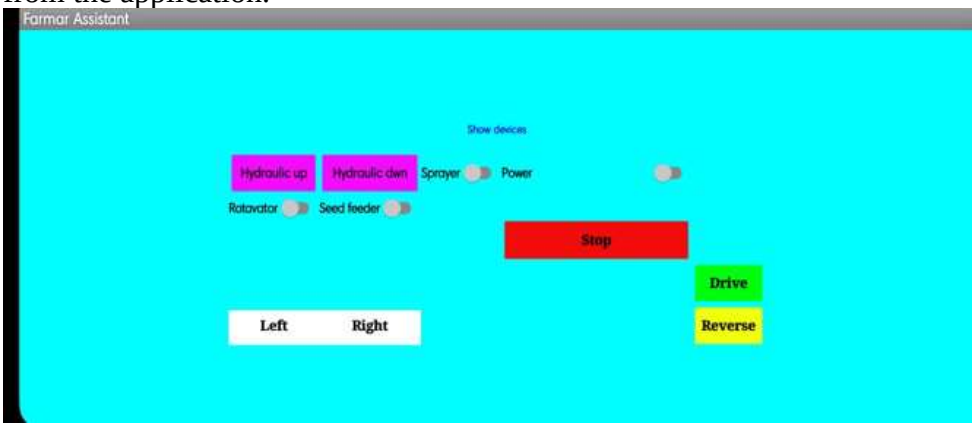


Figure.4.Mobile Application Interface

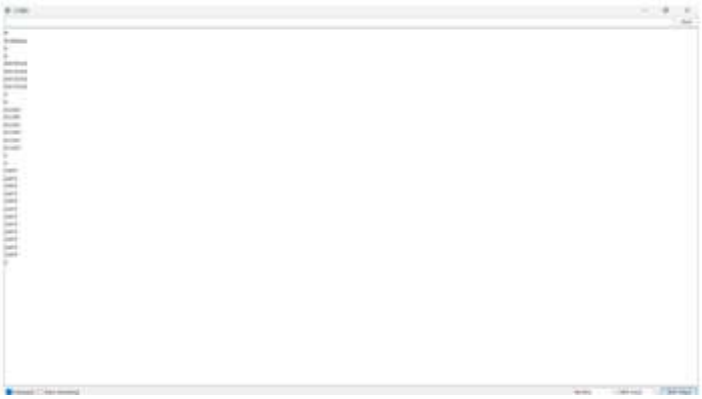


Figure.5.Serial Motor shows direction of vehicle

2. To operate the Johnson gear motor to move up & down from the application we need to press the hydraulic up and hydraulic. After that, we can observe the result in serial monitor as shown:

Fig NO: 5.7 Rotavator3. Turning ON the Rotavator. There is a toggle switch which enables the Rotavator by enabling as show

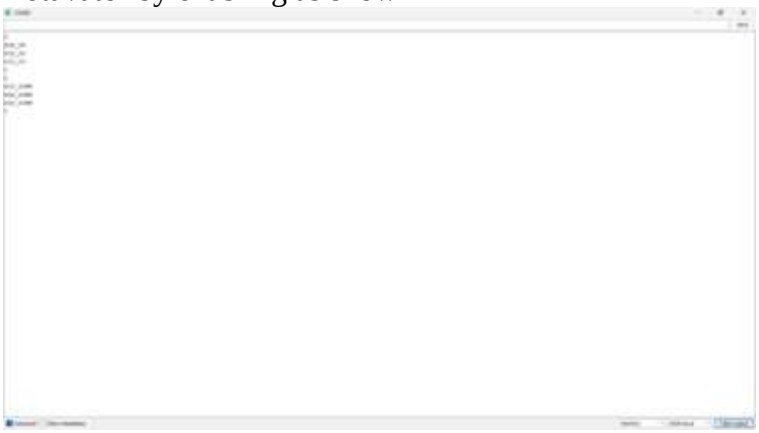


Figure.6. Serial Monitor show the Hydraulic Up & Hydraulic down

Figure.7. Mobile Application shows that Rotavator ON

Figure.8.Rotavator

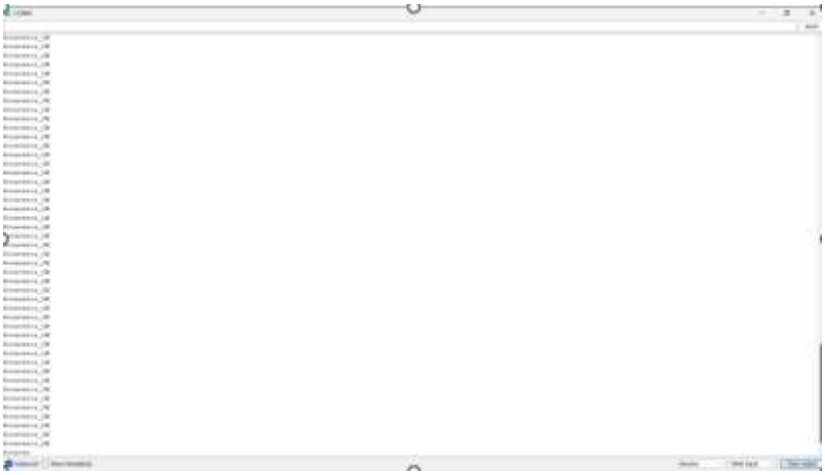


Figure.9. Serial Monitor show Rotavator ON

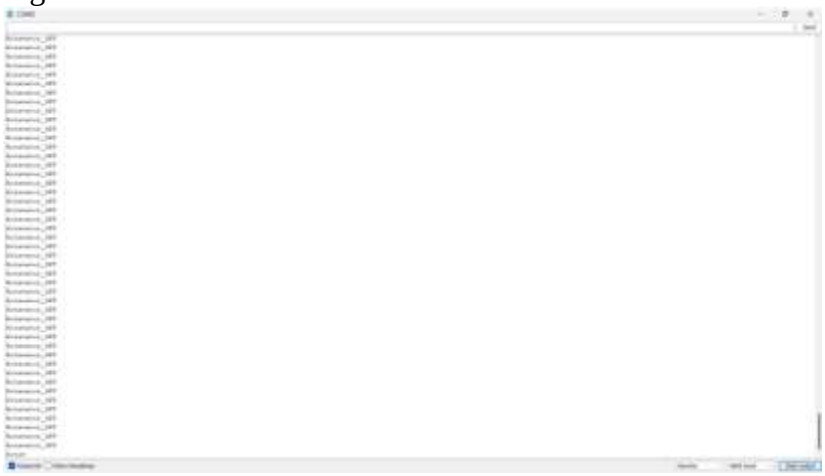


Figure.10.Serial Monitor show Rotavator OFF

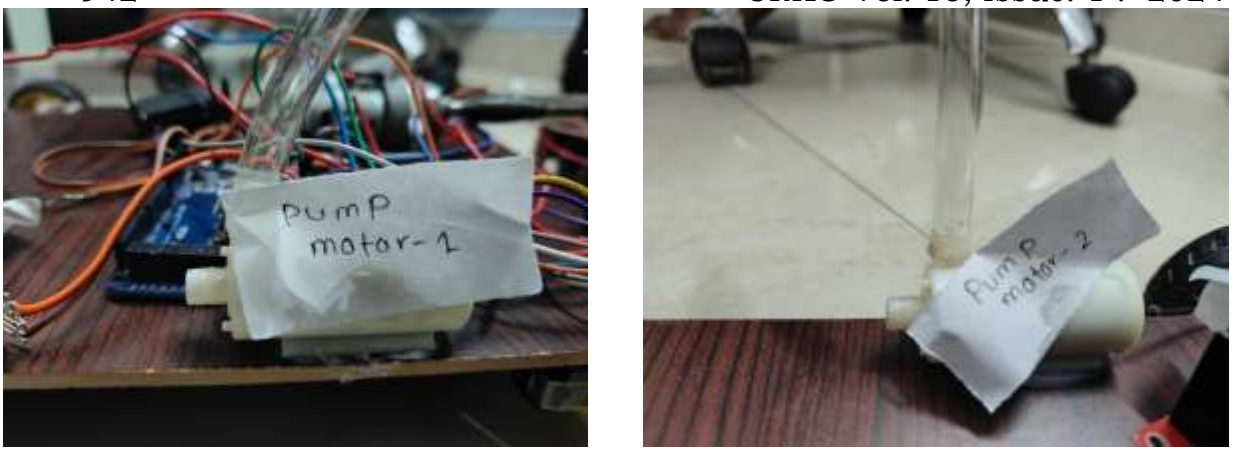


Figure.11. Pump motors for sprayers

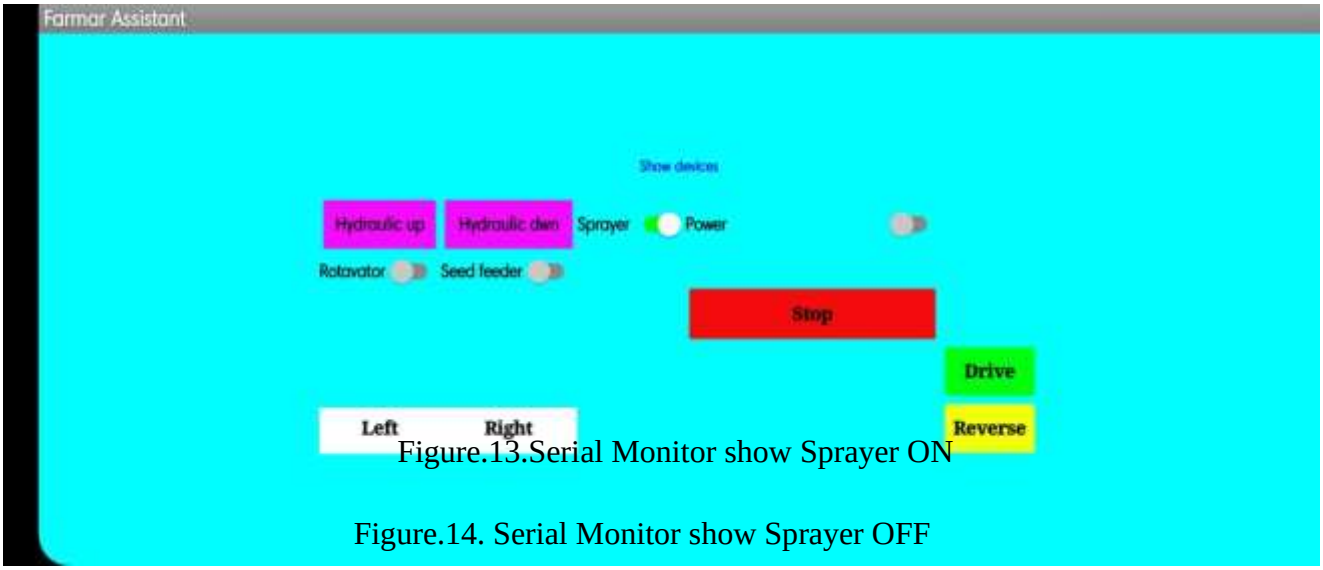
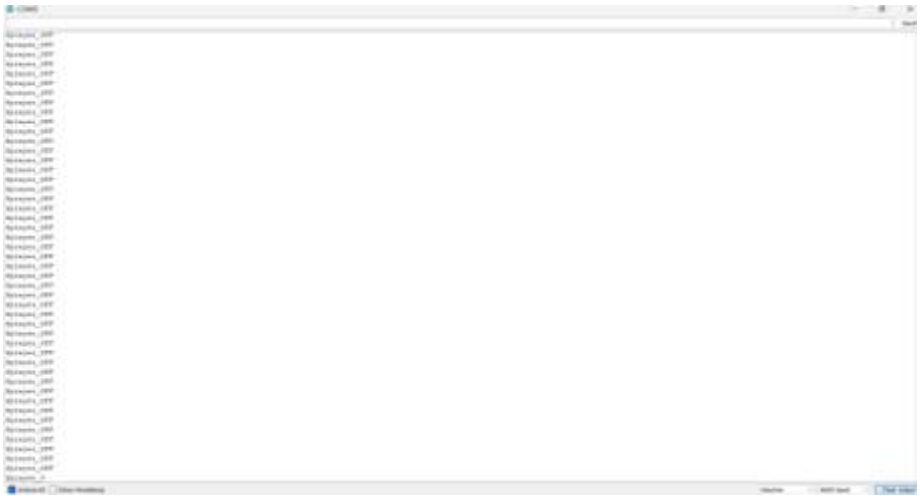
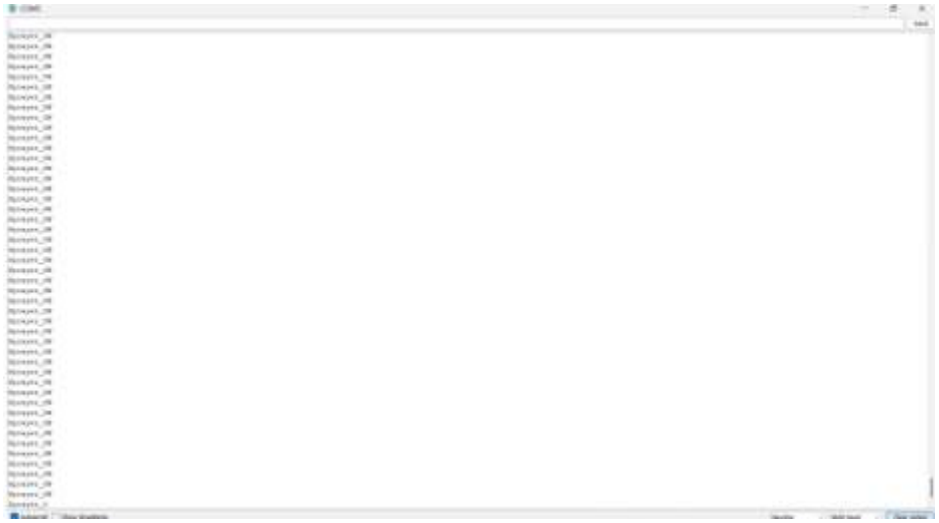


Figure.13.Serial Monitor show Sprayer ON

Figure.14. Serial Monitor show Sprayer OFF

Figure.12.Mobile Application shows Sprayer ON





Turing ON the seed feeder from the application

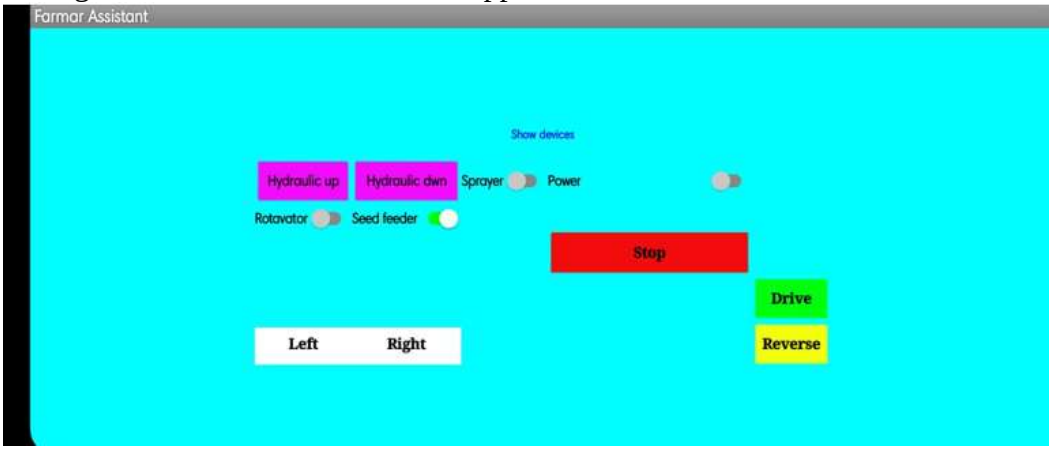


Figure.15.Mobile Application shows the Seed feeder ON

The seed feeder holes are open and closed for a particular time interval.

Figure.16. Seed Feeder with plougher

Figure.17. Seed Feeder holes are opened

Figure.18.Seed Feeder holes are closed

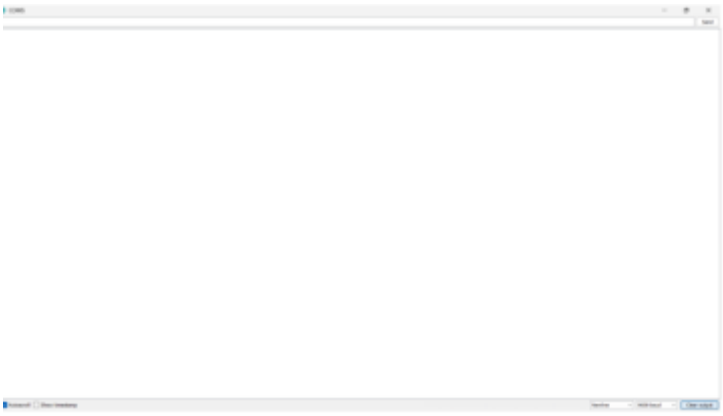


Figure.19.Serial Monitor show 7 (ON) & 6 (OFF)

4.Conclusion

The Agriculture Multi-Purpose Vehicle (AMPV) project presents a significant advancement in agricultural automation technology. Through the integration of various components such as motors, sensors, and a microcontroller, the AMPV offers a versatile solution for addressing multiple agricultural tasks efficiently.In conclusion, the AMPV project demonstrates the potential for enhancing agricultural processes through automation and innovation. By providing functionalities such as seed planting, soil cultivation, and water spraying in a single platform, the AMPV offers farmers the ability

to increase productivity, reduce labor costs, and optimize resource utilization. Furthermore, the integration of wireless communication capabilities enables remote control and monitoring, enhancing convenience and accessibility for users.Moving forward, further refinement and optimization of the AMPV design and functionalities can unlock even greater benefits for agricultural operations. Continued research and development in this area hold the promise of revolutionizing farming practices, leading to improved efficiency, sustainability, and food security for communities worldwide.

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