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Agriculture Adaptability:Multipurpose Machine Shaping the Future of Farming

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Abstract
The agriculture sector is going through a huge shift as it adopts cutting-edge technology to improve traditional farming methods. With this transition to contemporary agriculture, the use of multipurpose agricultural equipment is more important due to its cutting-edge qualities. The technological foundations of these adaptable machines and their significant effects on agricultural productivity, sustainability,A new era of multipurpose agricultural equipment has been created by the convergence of precision agriculture, automation, the Internet of Things (IoT), artificial intelligence, and robotics. These adaptable machines are designed to replace a variety of agricultural instruments that serve a particular purpose and are capable of carrying out a variety of duties like ploughing, sowing, fertilising, controlling pests, and harvesting. By providing exact location data and navigation support, the integration of GPS and GIS data further enhances their capabilities, enhancing field operations and reducing resource waste.

Keywords: Multipurpose Machine,Farming Technology,Automation in Agriculture,AI and Robotics.

1. Introduction

The long-established industry of agriculture is undergoing a fundamental transition in a time of lightning-fast technology advancement and a growing demand for sustainability. Multipurpose Agriculture Machines, amazing inventions that brilliantly combine the potentials of solar energy, Android-based applications, internal combustion engines, and robots, are at the forefront of this revolutionary development. These devices represent the coming together of cutting-edge technology with established agricultural methods, marking a major change in how we care for our land and feed the rising world population .Agriculture is a major component of the Indian economy, however there are problems with labor shortages, knowledge gaps, and resource waste. Agri-robots have been created to solve these problems. These robots operate on their own to do out duties like leveling, sowing, and plow. They collect data via sensors, and a central microprocessor directs their movements.[1] India's economy depends heavily on agriculture, which has a long history that dates back to the Indus Valley Civilization. India is the world's top producer of agricultural inputs. Despite the existence of specialized farming equipment, a versatile all-purpose agricultural vehicle is required. A prototype that includes an Arduino UNO, high-torque DC motors, an L293d motor driver IC, Bluetooth control, and safety relays is currently being developed. The goal of this four-wheeled vehicle is to increase farming accessibility and efficiency by combining soil preparation, seed sowing, and water supply.[13]India's economy is primarily dependent on agriculture, yet efficiency issues arise because of low mechanization, tiny farms, financial limitations, and labor-intensive operations. For tiny farms, a versatile agricultural vehicle that can do year-round activities including excavating, cultivating, and fertilizing efficiently is being designed. It uses a variety of gear mechanisms for activities and is solar-powered, minimizing its environmental impact.

2. Agriculture Robot Working Principle

This part includes the block diagram and circuit diagram as well as the agricultural robot's systematic development process. This agricultural robot was made possible by the seamless fusion of hardware and software technologies. A block diagram outlining the essential parts of the agricultural robot is shown in Fig 1[01].The Arduino Uno microcontroller serves as the robot's main control system. It acts as the central component,

coordinating every action of the robot through Bluetooth connectivity. This autonomous farming robot is intended for remote control operation, made possible by a Bluetooth wireless connection between a smartphone and the robot. The Bluetooth electronics app serves as the control interface for all robot operations. The robot has a Bluetooth HC-05 module that is safely fastened to it. This module effectively communicates instructions from the Bluetooth electronics app to the microcontroller for processing.[02]The microcontroller is powered by a 12V DC battery and has an integrated voltage regulator to provide steady input voltage. The microcontroller's 5V supply, nevertheless, is insufficient to power the DC motors. The driver circuit boosts the 5V current to 12V in order to successfully run these motors.We use the L293D motor driver circuit 1, which responds to signals from the microcontroller, to achieve bidirectional motion control. This circuit controls the DC motors in charge of the robot's mobility and other features. Signals sent by the microcontroller have the following formats: "00," "01," "10," or "11." The motors remain dormant when the signals are "00" or "11," thereby stopping the robot's mobility. The motors rotate in reverse if the signal is "01," whereas they rotate forward if the signal is any other number.In this system, two DC motors are controlled by the L293D motor driver circuit. One of these motors controls the robot's direction and the other distributes seeds along a specified path. The robot moves along a single line that serves as a guide for the motor that dispenses seeds. With the help of a smartphone, the depth at which the robot marks the line can be changed.A cone-shaped structure or hopper serves as the seed storage device, holding seeds for planting.The seed flow to the robot's planting area is streamlined by the hopper's lower extension tube. A seed dispenser assembly, which consists of a motor and a perforated tube installed on the motor shaft, controls the dispensing of seeds. Within the hopper tube, this tube is placed horizontally. The hole in the tube moves as the motor turns. When the hole is in alignment with the hopper tube's axis, seed is released; however, seed dispensing stops when the hole deviates from the axis. A leveler is used to seal and level the soil after planting.Three different sensors are built inside the robot: one to measure air humidity, another to measure seed temperature, and a third to determine whether the soil is wet or dry. For the user's convenience, the data produced by these sensors is displayed on an LCD screen.[05][07]

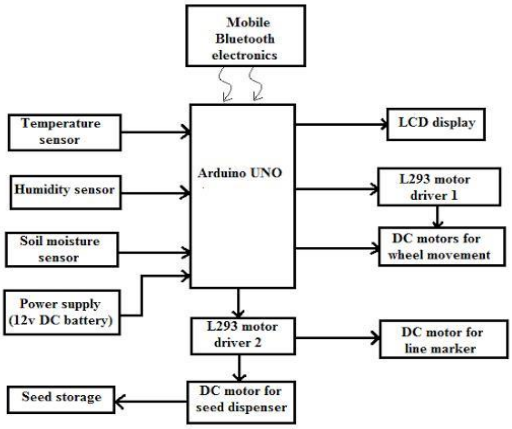

Fig1:Block Diagram of Model[13]

3. Advantages of agriculture robot

- Modern seed-sowing equipment makes it possible to place seeds in the soil continuously and seamlessly.
- Most of these seed-sowing equipments are user-friendly, which lowers labor costs.
- The use of these seed-sowing tools results in a general decrease in the costs associated with the seeding procedure.
- These machines are useful for small and medium-sized farmers because of their adaptability, which allows them to handle a variety of seed kinds.
- Solar technology used in agriculture machine. [9][11]

4. Multi-Purpose Agricultural Vehicle by using Solar Power

The main goal of this project is to design a versatile agricultural tool, as shown in figures 1 and 2, that can carry out a variety of farming chores, such as digging, sowing seeds, and spraying water.This cutting-edge car efficiently collects solar energy and stores it in a battery to produce electricity. The emissions generally linked to the usage of fossil fuels are significantly reduced by this switch to solar energy. Electrical switches are used to control different agricultural processes. Each switch has a distinct purpose, such as controlling a vehicle's

drive or turning on centrifugal pumps to distribute water.

5. Details of the components of vehicle

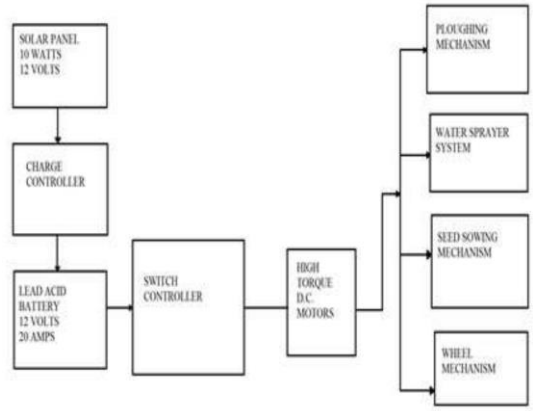

Fig 2: Block diagram of Multipurpose Agricultural Vehicle [13]

Fig 3:Prototype model of multipurpose agricultural vehicle [13]

5.1 The Chain Drive Mechanism

In some circumstances, lifting or dragging items is accomplished by rotating a chain, which transmits power. In some instances, a secondary gear is used instead, and power is harnessed by attaching shafts or hubs to this gear. The gear ratio can be altered by varying the distance between the input and output gears. The agricultural vehicle is driven by a DC motor in this instance. A chain drive system connects two sprockets together. A sprocket positioned on the back axle is connected to the DC motor. The sprockets revolve when the engine turns, which causes the back axle to also rotate. The car moves forward as a result of the rear axle's revolution driving the wheels.[16][17]

5.2 Seed sowing unit

Three separate components make up the seed sowing unit. The seed container, which contains all the seeds, is the first part. The second part is a shaft that supports two devices that resemble wheels but have scoop-shaped parts in place of teeth. These scoop-shaped structures make sure that every seed is precisely delivered to a specific deposition site, which is marked by a funnel matching to each wheel, and accurately gathered by the wheels. Each funnel has a pipe attached to the end that directs the seeds to the soil at the end of the plowing instrument.[18]

5.3 The Water supplying unit

A centrifugal pump is a machine that accelerates liquid using an impeller, converting input power into kinetic energy. The most popular kind is the volute pump, in which fluid is introduced through the impeller's central eye and quickly set into motion while the impeller rotates at a high rate of speed. As a result, the liquid inside the pump accelerates radially outward, producing a vacuum at the center of the impeller that continuously sucks in additional liquid.In this method, rubber tubes are attached to the nozzles at the centrifugal pump's outlet to make it easier to carry water from the reservoir of the supply unit to the precise spots in the fields where it is needed. Two centrifugal pumps are strategically positioned on either side of the supply unit to provide an even distribution of water on both sides of the vehicle as it travels across the landscape.Switches that are connected to both the battery unit and the centrifugal pumps control how much water is dispensed. The water supply unit uses centrifugal pumps with a total capacity of about 5 liters that run at a speed of 500 rpm and 12V.[16]

5.4 Ploughing mechanism

The seeds can be sown in the dirt route that has been plowed thanks to the vehicle's front-mounted plowing mechanism. A worm and spur gear mechanism is used to allow the plowing tool to move into the soil. The worm gear is turned by a D.C. motor, which then powers the spur gear or worm wheel. The little axle on which the plowing tool is mounted moves up and down as a result of this movement. A switch control system that is powered by a battery is also connected to the D.C. motor that is attached to the worm gear. The horizontal rotating motion of the shaft holding the plowing tool is successfully converted into vertical tool motion by this configuration, which enables

power transmission in two perpendicular directions.[13]

5.5 Power supply unit

This agricultural vehicle's power supply system consists of a battery and a 12V solar panel with a 10W power output. The solar panel directly charges the battery while it is in the sun. When there is no sunlight, the vehicle and its auxiliary components are run using the stored energy. Photovoltaic cells need to create an electric field in order to start producing electricity from the solar panel. Similar to how a magnetic field is formed by the division of poles, this electric field is produced by separating opposing electrical charges. Each layer of the cell carries either a positive or negative electrical charge as a result of the silicon being "doped" with other chemicals to produce this electric field.The lack of a charge controller in this vehicle as a result of its low power consumption lessens the load now placed on the battery. These divided electrons are effectively converted into useful electrical energy by other solar cell components. These electrons are gathered by metal conductive plates that line the cell's sides and enable their passage through wires. The electrons can now flow like any other regular electrical source at this point.[14][15]

5.6 DC Motor

A device that transforms electrical energy into mechanical energy is an electric DC motor. It works on the premise that an electrically charged conductor experiences a mechanical force when it is surrounded by a magnetic field. Fleming's Left-Hand Rule is used to establish this force's direction, and F = BIL in Newtons is used to determine its magnitude. A DC motor and generator have essentially the same structural elements. A single DC machine can actually function as both a motor and a generator. DC motors are still utilized in specialist applications like steel mills, mines, and electric trains where the conversion of alternating power to direct current is advantageous, despite the fact that the majority of electric supply providers provide alternating current.This preference results from the fact that DC motors outperform AC motors in terms of speed and torque. Therefore, it is not surprising that DC motors continue to be just as common as 3-phase induction motors for industrial applications.This preference results from the fact that D.C. motors' speed/torque properties are notably better than those of A.C. motors. This is why 3-phase induction motors and D.C. motors continue to be common choices for industrial drives.[14]

5.7 Chassis

The mild steel rods used to construct the vehicle's structural framework have a rectangular tube section. The chassis, a supporting framework that gives the car its interior structure and occasionally protects its internal parts, ensures the car's structural integrity. The bottom portion of a car serves as an illustration of a chassis; when it contains the running gear, which includes the wheels, transmission, and occasionally even the driver's seat, it is referred to as a rolling chassis.The mechanical frame has the following measurements: 3 feet long, 2 feet wide, and 15 feet tall. There are two wheels on each of the front and rear axles, for a total of four wheels on the chassis. A chain drive system, in which a DC motor turns the driving sprocket, propels these wheels into motion.The chassis has been modified to fit a unit for transporting seeds and another for delivering water. The seed-supplying device is positioned above the water-supplying unit, which is located in the lower part. The battery is located close to the car's rear axle, while the solar panel is installed on the roof of the vehicle to maximize exposure to sunshine.[20][21]

6. Technical specifications

- The goal of the project is to create a solar-powered, multipurpose agricultural vehicle.
- Solar Panel: 1 unit with a 12V, 10W output photovoltaic cell.
- Battery: One unit of a 7Ah 12V sealed lead-acid battery.
- A single, 12V, 1 amp, 10 rpm, high torque D.C. motor with an internal shaft diameter of 8mm is available. This high torque D.C. motor produces torque between 25 and 45 kgf.
- A worm and spur gear mechanism is used in the one unit, 12V, 60 rpm D.C. motor that powers the seeding mechanism.
- 12V, 60 rpm motor, 1 unit, plowing mechanism.
- Two 12V, 1500 rpm centrifugal pumps (for spraying).
- Mechanical Frame: a single item with dimensions of 15 inches in width by 30 inches in length.
- Square pipe, 1 inch by 1 inch, for the chassis.[13]

7. Proposed Work Methodology of a android based agricultural vehicle

This part includes a comprehensive analysis of the vehicle's operational components as well as a detailed discussion of how the vehicle's materials were chosen. Mechanical durability, chemical resistance, and thermal resistance are the main factors that influence material selection. You may see a 3D illustration of the frame design further down.[23]

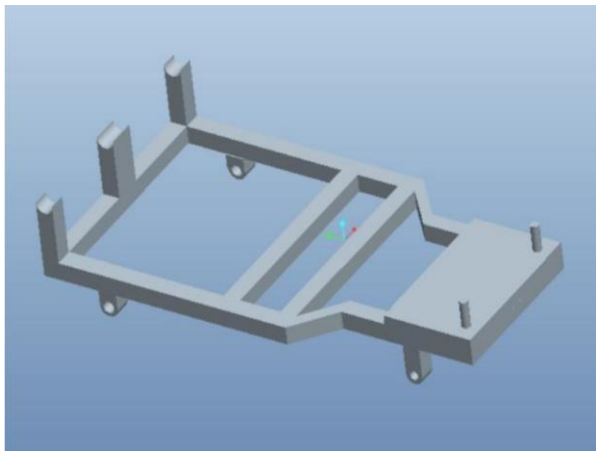

Fig 4: 3D-Design of Frame[22][25]

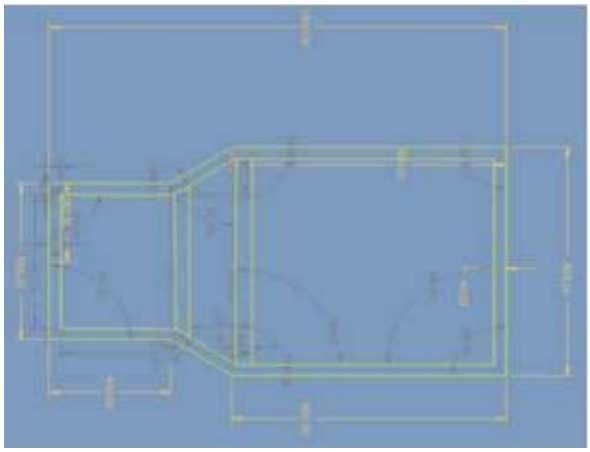

Fig 5 : 2D-Design of Frame[22][25]

Fig 6: Chassis of the Vehicle[22][25]

7.1 Chassis of the Vehicle

Iron is the first material choose for the base of the vehicle. The wheels can go over a variety of surfaces, including muddy roads and uneven pavement. Additionally, a cardboard mounting system is used for the seeds, and it is safely positioned in a predetermined space that is encircled by an iron structure.

7.2 Working Equipments/Tools

The wheel's measurements follow conventional lengths and diameters and were specifically created to manage uneven and challenging field conditions. The material used to make these wheels is iron.

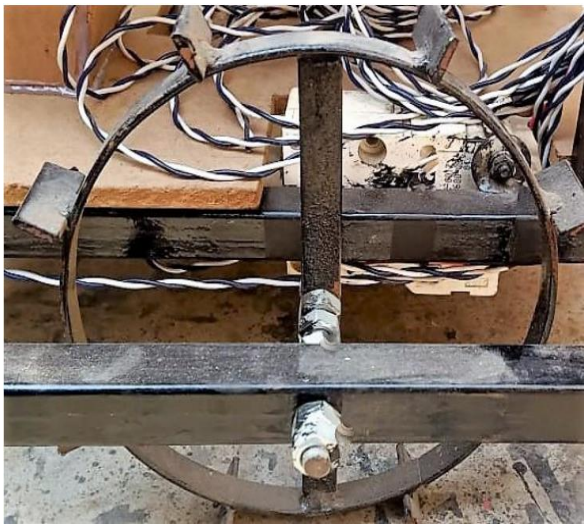

Fig 7: Wheel of the Vehicle[22]

Fig 8: Seed Sprinkle System[22]

The cardboard seed sowing box, which is mounted on top of the truck, is made to last. Sprinklers are included, and a microcontroller circuit controls

them. The system's tiny apertures enable the dispensing of the grains into the soil.[24][25]
The plow tool is made of iron and has pointed tips that make it easier for it to penetrate the soil and work efficiently. The plough tool also has a thin pipe attached to it that enables effective water distribution. For this, an overhead tank is safely fitted inside the vehicle's system.[28]

8. Internal circuit explanation

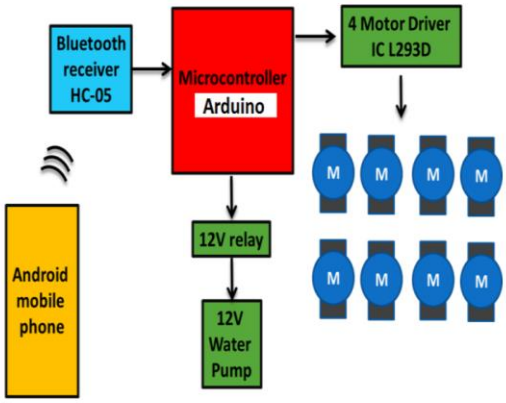

Fig 9: Block Diagram of the internal circuit [22]

A microcontroller from the Atmega family called the Arduino UNO was used to design the system's internal circuit. The system's central microcontroller, which it uses to manage several parts and operations. A high-torque motor is used to make moving the vehicle easier. Because the motor is coupled to a motor driver, its forward and backward motion may be precisely controlled.SPDT (single pole double throw) relays are used to protect the internal circuit from harm and act as a switching element to turn the system on and off. Within the system, these relays serve two purposes.The HC-05 Bluetooth module is also included to enable wireless communication between the machine and an Android phone. The Android mobile transmits data to the Arduino UNO, which receives it and uses it to operate a variety of operations, including moving the machine in four directions (forward, backward, left, and right).Additionally, the system has the ability to control extra parts like a seed-sowing mechanism, a water pump, and a plough tool. The Android app, which has buttons for managing the machine's various components, is used to control these features. Through the user-friendly software, this arrangement enables remote control and fine control of the machine's movements and operations.[22]

9. Conclusion

In conclusion, a major advancement in contemporary agriculture has been made with the creation and application of multipurpose agricultural vehicles based on robotics, android technology, and solar electricity. The major elements and technology that make these vehicles a viable answer to the problems facing the agriculture sector have been thoroughly covered in this review article.These cars' incorporation of solar power not only lessens their impact on the environment but also improves sustainability and energy efficiency. In order to provide remote monitoring and management and to provide farmers with more convenience and precision in managing their operations, Android technology is essential. These vehicles are also more versatile due to the robotics integration, which enables them to carry out a variety of activities like data collection and crop monitoring in addition to planting and harvesting.Numerous advantages are provided by these multipurpose agricultural vehicles, including enhanced resource management, less labor requirements, and higher output. They have the power to completely transform farming, making it more productive, economical, and ecologically benign. To guarantee broad adoption and success in the field, it is crucial to solve issues like cost, upkeep, and scalability.In conclusion, it is indisputable that the development and application of multifunctional agricultural vehicles based on solar, android, and robotics is critical to the future of agriculture. These cutting-edge innovations have the potential to completely change the agricultural environment and open the door to a more productive and sustainable farming future. We can anticipate many more ground-breaking ideas that will further assist farmers and the environment as research and development in this field continue to advance.

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