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DESIGN AND DEVELOPMENT FOR FERTILIZER SPRAYING AGRICULTURE ROBOT

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ABSTRACT
The Modern agriculture is ensured by the development and dissemination of agricultural automation and intelligence. Since autonomous navigation may dramatically improve work efficiency while successfully minimizing the need for labor, it is currently the focus of agricultural robot progress. It is the most profitable robot in the agricultural sector. Its main tasks include mechanical design for spraying and fertilisation, navigation control, and chassis control. The main idea is that robots are used to reduce labor, work load, stress, and charge. The agriculture sector is extremely labor- and a resource-intensive. In order to solve that issue, farmers have become more dependent on automation and technology. Future recommendations call for entirely self-driving agricultural robots.

Keywords:
ESP12E microcontroller, spray nozzle, crop analysis

INTRODUCTION

Technology is being used by farmers in developing nations to address a number of grave problems facing the agriculture sector, such as the widening global food gap and the declining number of agricultural workers. Farmers may now focus on increasing agricultural yields while simultaneously improving farm efficiency and reducing labour expenses, thanks to the automation of labour-intensive, monotonous, and slow tasks performed by agricultural robots. Agricultural robots provide more efficient resource allocation through precision agriculture, which saves a significant number of resources. Currently, contemporary robotic systems are used for crop picking and harvesting, weed control, mowing, planting, sorting, and packing farm produce. Robots are ideal for usage in some fields, such as agriculture. For crops to maintain yields, constant applications of pesticides and fertilizers are necessary. Using knapsack sprayers, workers manually apply fertilizer and pesticides is an antiquated method that is not only labour-intensive and time-consuming, but also expensive and requires a lot of manpower to cover huge agricultural areas. Robots that spray pesticides and fertilizers can move large storage reservoirs, operate safely and even on their own, and do it for a tenth of the price of more conventional techniques. Agricultural robots are expected to be able to save up to five times as much labour when it comes to applying pesticides and fertilizers as human workers utilizing backpack sprayers. Some of these activities can currently be completed by a number of agricultural robots on the market, and many more will be available soon. Conversely, agricultural robots are far too costly, slow, and complex to be Because of this, although though Malaysia's agriculture sector makes a substantial economic contribution to the nation, it still uses outdated practices and lags behind in implementing contemporary technologies like agricultural robots because of the expensive cost of these systems. This research aims to develop an affordable agricultural robot capable of applying pesticides and fertilizers to agricultural areas. To keep costs down, repurposed materials were used to build the robot frame and liquid container for the prototype fertilizer and pesticide spraying robot. The agricultural robot developed for this study11 is primarily used for two tasks: general crop monitoring and the spraying of pesticides and fertilizers. One of the created system's features is a robot with four wheels that can move. He robot's movement with the use of a wireless controller and a camera that records live video to monitor crop health, growth, and pest detection in the agricultural field. The agricultural robot obeys a human operator's commands.

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The main objective of this projects are:
Automated Fertilizer Application Develop a robot that can traverse fields on its own and fertilize crops, eliminating the requirement for manual labor and boosting productivity.
Precision Agricultuer: Provide exact control systems to guarantee fertilizer application that is accurate, eliminating waste and maximizing nutrient dispersion for crop development e. Adaptability to diverse Crops: Create a robot that can be used in a variety of agricultural settings and is versatile enough to adjust to diverse crop varieties and field circumstances.
Sensing and Detection: To enable focused and effective spraying, include sensors and detection systems to pinpoint the parts of the field that need fertilizer delivery.
. Safety Measures: Put in place safety features like collision avoidance systems and spillage prevention mechanisms to stop accidents and lessen their negative effects on the environment. Remote Monitoring and Control: Turn on the features that enable farmers to supervise the robot's activities and make necessary adjustments from a distance.
Data Collection and Analysis: Include data collection instruments to obtain details on crop health, soil conditions, and fertilizer application, empowering farmers to make knowledgeable choices.Energy Efficiency: To ensure extended operating hours without the need for frequent refilling or charging, optimize the robot's power and energy utilization.
. Cost-Effectiveness: Provide a low-cost solution that offers farmers substantial labor savings, higher yields, and greater profitability all around.
Collaborative Development: To guarantee that the robot satisfies the real-world requirements and difficulties of contemporary agriculture, promote cooperation between agricultural specialists, engineers, and farmers.

COMPONENTS

ESP12E Base board:
• A well-known Wi-Fi module built on the ESP8266 micro controller chip is called the ESP12E. Owing to its affordability, integrated Wi-Fi functionality, and user-friendliness, it finds extensive application in Internet of Things projects.
• The ESP12E module is a surface-mount device that houses the ESP8266 chip and all its supporting components. Aantenna and flash memory, for example.24 Essentially a breakout board development board, an ESP12E base board is made to facilitate the use of the ESP12E module in projects.

ESP12E Micro controller:

- A prominent microcontroller module invented by Espressif Systems is the ESP12E. It belongs to the ESP8266 family of microcontrollers, which is renowned for its affordable price, Wi-Fi capability, and Arduino IDE compatibility.
- The ESP12E module has an ESP8266 chip and all the requisite parts, including antenna, power regulation, and flash memory.

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• The ESP8266 chip, which is built within the ESP12E module, offers Wi-Fi connectivity, enabling wireless connections between devices and the internet or local networks.
• Because of their reputation for cost, SP8266-based modules are a popular option for makers, hobbyists, and developers working on Internet of Things (IoT) projects.

DC Motors:

Electrical devices that transition electrical energy into mechanical energy are called direct current (DC) motors. They develop the basis of electromagnetic induction, a theory in which current-carrying conductors and a magnetic field combine in order to generate a force that causes rotational motion.The armature and field windings of these motors are connected in series.

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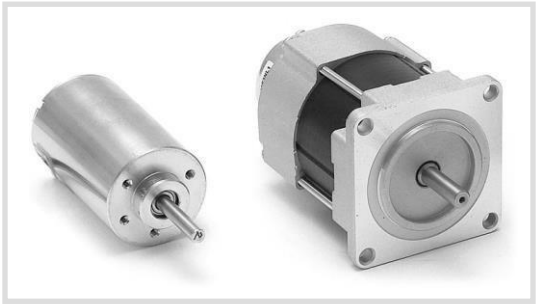

• Because of their intrinsic qualities, they have a high beginning torque yet are susceptible to rapid runaway if left unloaded. DC motors are used in many different industries and technologies, including as appliances, robots, electric vehicles, industrial machinery, and more. Their dependability, controllability, and versatility make them vital parts of many electromechanicalsystems.

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DC Pump

A DC pump is a kind of pump that runs on electrical power with direct current (DC). These pumps tend to be used in

numerous circumstances where a precise pressure or flow rate must be maintained. DC pumps are superior to AC pumps in an assortment of ways. (alternating current) counterparts, including:

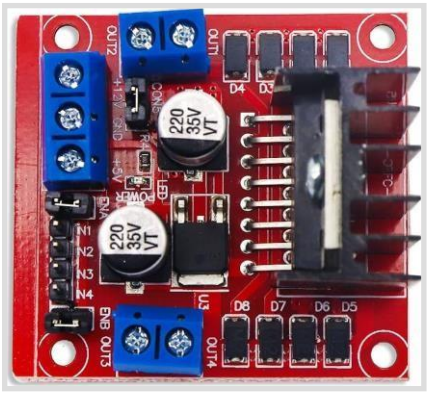
• Energy Efficiency: Because DC pumps can be made to run at numerous speeds, which gives designers better control over flow rates and cuts energy usage, they are sometimes more energy-efficient than AC pumps.

• Quiet Operation: DC pumps have an aptitude to run more peacefully than AC pumps, which makes them appropriate for situations like homes or aquariums where noise pollution is an issue.

• Compact Size: DC pumps are easier to install in restricted locations or in applications where space is limited whilst they are

Motor driver

An electronic device or circuit that modulates an electric motor's speed, torque, direction, and/or placement is called a motor drive, sometimes referred to as a motor controller. By controlling the flow of electrical energy to the motor in response to different control inputs, it essentially serves as a middleman between the motor and the power source.



Applications for motor drives are widespread in a variety of industries, including robotics, automation, automotive, aerospace, industrial machines, and more. They are essential for maximizing motor function, increasing effectiveness, and providing exact control over motor function.

Spray nozzle

A spray nozzle is a tool that is used to guide, shape, and control the force of a stream of fluid, usually for coating application, cleaning, or chilling. Numerous industries, including agriculture, automotive, industrial, and firefighting, heavily rely on these nozzles. In order for spray nozzles to function, a fluid (such as water, chemicals, or air) must be forced through a tiny opening, which causes the fluid to fragment into tiny droplets or a fine mist.

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The nozzle's design dictates elements including the spray pattern, spray angle, and droplet size. Spray nozzles come in a variety of forms tailored for particular uses, such as:
• Flat fan nozzles: Often used for applications like these, these create a flat, fan-shaped spray pattern.

.utilizing pesticides to clean surfaces or in agriculture.

Flat fan nozzles: These create a spray pattern that is flat and fan-shaped and are frequently used for cleaning surfaces or dispensing pesticides in agriculture

Arduino

Arduino is an electronics platform that offers both hardware and software that is open-source. Professionals, learners, and hobbyists who wish to create interactive, programmable electronic works are the target audience. The system provides a user-friendly way to design projects that use various electronic components, actuators, and sensors. Hardware and software that are easy to use form the foundation of Arduino, an open-source electronics platform. Arduino boards are capable of receiving inputs, such a sensor's light, a finger pushing a button, or a message from Twitter, and converting them into outputs, like an LED turning on, a motor starting, or an internet post. You may program your board's microcontroller to perform specific tasks by sending it a set of instructions. You make use of
the Arduino programming language, which is based on arduino software.

Future Scope:

There is a lot of room for creativity and future integration with emerging technology in the design and development of agricultural robots that spray fertilizer. Several crucial domains for progress encompass:
Enhanced Precision and Intelligence: In the future, robots will be able to use machine learning algorithms to analyze data on crop health in real time and modify the pace at which fertilizer is applied. This would make it possible to control nutrients even more precisely, according to the requirements of each crops, optimizing yields and resource use.
Multi-Functionality: Future agricultural robots may be capable of additional tasks like weed and pest removal, crop monitoring, and fertiliser application in addition to spraying fertilizer. Combining these features into a single robotic platform would provide all-encompassing farm management solutions, significantly simplifying processes and obviating the requirement for several specialized equipment.
Sustainability Features The importance of sustainable agricultural methods is rising. Future agricultural robots might include capabilities like biodegradable materials, sustainable energy sources (like sun or wind).

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LITERATURE SURVEY

Firas B. Ismail et.al [1]: The standard methods utilized in this research have been widely adopted recently by those employed in the gardening and agriculture industries. However, the energy consumption and air pollution produced by the manually operated lawn cutters might have a direct impact on the health of the operators. In addition to producing a great deal of noise and vibration, typical lawn cutters can also lead to major health problems like carpal tunnel syndrome, diminished hand sensitivity and dexterity, finger blanching or "white fingers," and poor grip strength.

T. Koppel et.al [2 The purpose of this research was to examine the vibration and noise characteristics produced by various lawn care equipment types in relation to the health risks to employees. The current study presents the methodology linking vibration hazard, health damages, and risk levels. Three categories of agricultural machinery were examined: ride-on mowers, basic lawn mowers, and all-terrain vehicles (ATVs).

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R. V. Sanjana Arunesh et.al [3]: Grass These days, cutting machines are highly common. For soft grass furnishing, the most popular machineries are utilized. The goal of this project is to improve the construction and operation of grass cutters. The primary components of the grass cutting machines are a 75 HP DC motor, a battery that is charged by a solar panel, and a relay switch for motor control. It is situated within an appropriate machine framework. The most frequently used items include GI sheet, paint, insulating material, square pipe, aluminum sheet, motor, switch, wheel, wire, and other commonplace items like nuts, bolts, and reverts.

Aybek. A. Kamer et.al [4]: Turkey produces crops with about a million agricultural tractors, and roughly one-third of the country's population lives in rural areas.18 The aim of this study was to ascertain the sound pressure levels, A-weighted sound pressure levels, and the allowable exposure time for agricultural tractor operators at the ear level for tractors without cabins, field-installed cabins, and original cabins for the following machines: rotary tillers, plows, cultivators, top soil cultivators, mechanical drills, pneumatic drills, chemical applicators, fertilizer applicators, drum mowers, balers, and forage harvesters.

B. P. Dilip et.al [5 Pollution is the universe's biggest problem right now. Gas-powered lawn mowers contribute to pollution because they release gases into the atmosphere. It is inefficient as fuel prices are rising as well. Lawn mowers are often large, cumbersome pieces of equipment that need a lot of strength and effort to operate. However, the innovative design of today's high-tech grass cutters makes the entire landscaping procedure much simpler and easier for the user.

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F. D. W. Praful et.al [6]: On May 20, 2021, this research paper was published. The sustainability of farm companies and food security are seriously threatened by COVID-19 and the demographics of age, migration, and urbanization, which are added environmental concerns facing agriculture. Specifically, agricultural enterprises worldwide are having difficulty filling job openings and offering workers secure working environments. Robots with autonomy could help with these
current difficulties. Although they are physically represented by hardware—a car with manipulators, for example—their independence stems from complex algorithms based on artificial intelligence. These algorithms combine sensor data to provide real-time decision assistance and control.

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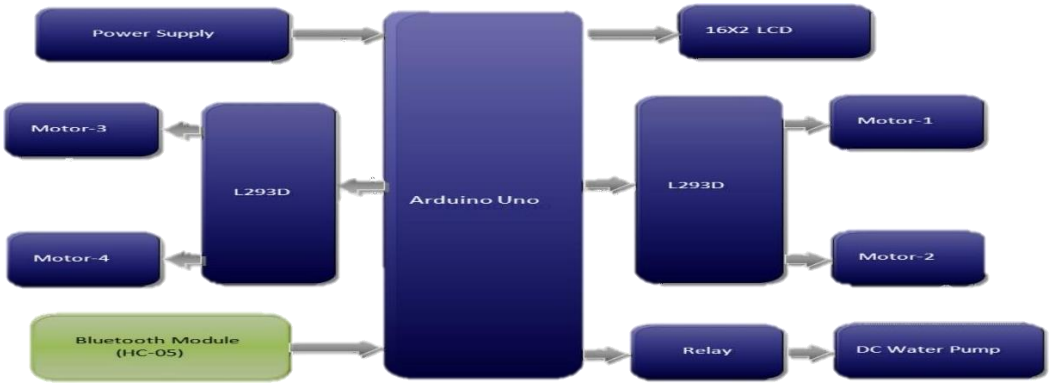
BLOCK DIAGRAM



Prototype

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METHODOLOGY

Research to understand farming necessitate is the initial step in the design and development of an agricultural robot that sprays fertilizer. Conception and prototype come next. Efficiency, accuracy, and safety are guaranteed by iterative testing and improvement. Under the principles of sustainability and intuitiveness, it is imperative to integrate sensors, actuators, and autonomous navigation. To ensure effectiveness, which is efficiency, and practicality, an integrated plan must be used throughout the design and development of an agricultural robot that sprays fertilizer. In order to understand the particular requirements of agricultural environments—which include crop kinds, geography, and current weather patterns—a comprehensive examination is the first step in the process. This research laid a foundation for the robot's design, which includes traits like mobility, payload capacity, and flawless spraying infrastructure.

Once the conceptual design is finalized, the development phase begins with prototyping and testing. Iterative prototyping allows for refinement based on feedback from agricultural specialists and potential end consumers. Attention is paid to ensuring that the robot can navigate a range of terrains on its own, detect crops and weeds with accuracy, and apply fertilizer accurately in order to enhance agricultural productivity while minimizing waste.

CONCLUSION

An extensive procedure combining engineering, robotics, and agricultural knowledge is needed to design and construct an agricultural robot that sprays fertilizer. The goal is to provide a practical and efficient answer to the issues faced by modern farmers. The project's conclusion considers the technology's potential and wider influence in addition to showcasing its technical accomplishments. In conclusion, the creation of an agricultural robot that sprays fertilizer is a noteworthy accomplishment in precision agriculture. This technique gives farmers a more effective and environmentally friendly way to apply fertilizer to crops by utilizing robotics and automation.

Precision fertilizer application targeting leads to increased agricultural output and less environmental impact, and this is made possible by the effective integration of sensors, actuators, and control systems. This initiative also emphasizes how important interdisciplinary collaboration is. To tackle the intricate problems of contemporary agriculture, engineers, agronomists, and robotics specialists must collaborate. Technical innovation is only one aspect of the development process; other factors include a thorough understanding of agricultural methods and environmental concerns.

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