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IOT Based Smart Robotic Vehicle for Multiple Agriculture Operation

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Abstract- This review explores the field of Internet of Things (IoT)-enabled agricultural robots, looking at various applications and implementations in the agricultural industry. The study looks at how cutting-edge IoT technology and agricultural methods are combining, illuminating how agricutural robots are revolutionizing resource optimization, crop monitoring, and precision farming. Three different paradigms are examined: the use of edge computing for accurate data analysis, the coordination of agricultural robots with conventional sensor networks, and the application of machine learning techniques for intelligent decision making. The benefits and drawbacks of each strategy are carefully evaluated, taking into account variables like data quality, cost-effectiveness, scalability, and ability to adapt to various agricultural situations.

Keywords: Precision farming, Internet of Things (IoT), Agribot, and agricultural automation.

Introduction

Over time, the integration of modern technologies has led to transformative breakthroughs in agriculture, which serves as the foundation of our civilization. The convergence of the Internet of Things (IoT) and agriculture has proven to be a game-changer in this age of digital innovation, bringing in a new era of precision and smart farming. The agricultural robot a clever combination of robotics and IoT, is at the vanguard of this agricultural revolution. Its goal is to improve farming operations' productivity, sustainability, and efficiency.

There is an urgent need for creative solutions to satisfy the rising demand for food as the world's population grows and the amount of arable land decreases. With their wide range of sensors, motors, and connection modules, agricultural robots promise to completely change the way we think about agriculture. With the use of current information, automation, and networking, these intelligent machines function smoothly within the farmer's landscape, improving resource management, keeping an eye on crop health, and streamlining numerous farming tasks.

This research paper aims to investigate the complex web created by the combination of IoT and Agricultural robots, exploring the various dimensions that characterize this mutually beneficial connection. This study seeks to provide an in-depth study using the current state of Agricutural robots in precision agriculture by analyzing the technological nuances, evaluating the real-world uses, and closely examining the difficulties and opportunities that lie ahead.

Important factors including data precision, energy conservation, scaling, and adaptability to various agricultural contexts will be examined during this investigation. We will also explore the possible socioeconomic effects of agricutural robots, talking about how these smart devices could support resilient food production ecosystems, ease labor shortages, and promote sustainable agriculture.

The pages that come promise to reveal the life-changing promise of agricutural robots and their contribution in influencing farming's future as we set out on this trip across the nexus of the agricultural sector, robotics, and the Internet of Things.

In the field of autonomous agriculture vehicles, a concept is being researched to find out if using a number of small autonomous vehicles instead of typical large tractors and workers would increase efficiency.
These cars must to be able to operate in most weather conditions, around the clock, throughout the entire year.

Comparison between present agricultural techniques and with this smart agricultural vehicle

Sr. No.	Parameters	Manual	Tractor	Digging and sowing using Agribot
1.	Man Power	More	Moderate	Less
2.	Time Required	More	More	Less
3.	Digging and sowing technique	Manually	Manually	Automatically
4.	Adjustable seed distance	No	No	Yes
5.	Seed Wastage	Moderate	More	Less
6.	Energy needed	High	Very High	Less
7.	Pollution	No	More	No
8.	Alarm and display	No	No	Yes

Table 1: illustrates that using a tractor to sow requires less time and labor than using a human approach, but it still requires more labor than using an smart agricultural robot Additionally, we may alter the spacing among the two plants with robot, and there is less seed waste.

EXISTING SYSTEM

Robots can only be operated manually in the current system. Therefore, it is challenging to carry out in automated processes that don't need human intervention.
Negative
1. It is not amenable to automatic operation.
Robots are capable of performing fewer tasks.

2.It lacks user-friendliness.

PROPOSED SYSTEM

Different sensors is utilized in the system that is proposed to monitor the temperature, humidity, and water level. The data is sent to the Internet of Things (IOT) and the field environment is observed.
1. One of the suggested system's advantages is that it can run automatically.

2. Automation allows for the performance of additional operations.

Ease of use

A key factor in the uptake and effectiveness of agricutural robots connected with the Internet of Things (IoT) for farming is their ease of use. Having an easy-to-use and easy integration with current workflows becomes vital as these intelligent tools become an essential part of contemporary farming methods. The review paper's section on ease of use in agricutural robots will explore many aspects of the technology, highlighting the significance of adaptability, accessibility, and intuitive design in meeting the varied demands of agricultural stakeholders and farmers.

1. **Easy User Interfaces**: Since agricutural robots are instruments meant to be used by farmers, they ought to have user-friendly and intuitive interfaces. This entails creating user interfaces that are easy to use, visually appealing, and require little training to operate properly.

2. **Remote Monitor and Control**: agricutural robots' IoT connectivity makes it possible to do remote monitoring and control. Farmers may conveniently use their PCs or smartphones to connect to and manage agricultural activities.

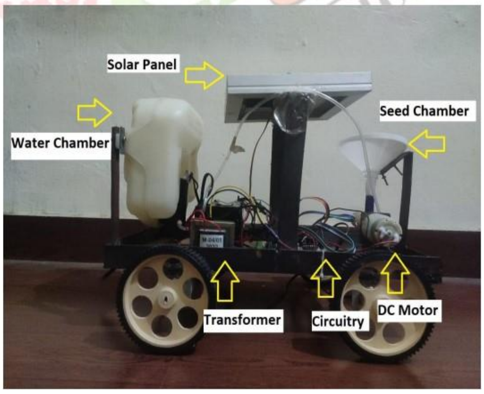
3. **Precision farming**: Real-time data on crop conditions, soil health, and moisture levels are provided by agricutural robots fitted with Internet of Things sensors. By using information to guide their actions, farmer may maximize the utilization of resources like pesticides, fertilizers, and water.

METHODOLOGY

The robot's frame is made up of four wheels attached to four arms, with a DC motor powering the front and rear wheels. Through a drilled hole fastened to the shaft, the seeds are sown. To apply the pesticide, a pump sprayer is utilized. The robot is operated by a smartphone using Wi-Fi technology to seed, plough, and spray pesticides. The microcontroller is the brains of the suggested system. DC motors, WiFi module**.**

The robot is turned on via the Internet of Things, and a web browser controls its direction. This initiates the robot's forward motion by turning its spiky wheels and beginning the plowing process at the same time. To hold the seeds, there is a vessel.

Figure 1 displays the concept of the model.



Because of the way this structure is made, it can easily navigate over uneven ground.

1. The function of sowing seeds Planting seeds in soil is known as seeding. In this device, a box is used to store seeds, and when the wheels move, a servo motor controls the box's opening. The seeds are thrown into the field by the shaft when the robot's wheels move.

2. Function of Pesticide Spraying The purpose of pesticides is to shield crops from fungi and insects. Some pesticides cause health problems for the workers when they are sprayed. Farmers who come into contact with chemicals on their skin are more vulnerable to skin problems. Thus, hazardous pesticides and fertilizers are sprayed using a pesticide sprayer, which is a relay-controlled solenoid valve.

3. Grazing Purpose The basic goal of plowing is to turn over the top layer of soil, putting weeds and the remnants of past harvests and enabling them to decompose while bringing bottom, new nutrients to the surface. The farm is ploughed in this model by using a DC motor and screw rod combination.

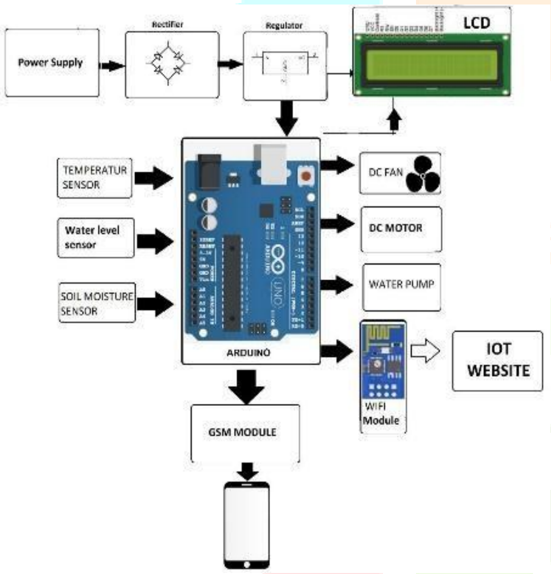
ALGORITHM

Step 1:First, turn on the robot.
Step 2: The robot moves forward and turns on all of its sensors.

Step 3: Infrared sensors detect any undesired plants or grass.

Step 4: The rotor begins revolving to chop grass or weed plants if the IR sensor detects the existence of weeds or grasses.
Step 5: To water the plants, a moisture sensor is utilized to measure the soil's moisture content.
Step 6: The moisture sensor either turns on the water pump if the moisture level is low or turns off the fluid pump if the moisture level is high.
Step 7: Periodically repeat Steps 3 through 6.
Step 8: The ploughshare is activated by flipping a switch, which is used to dig the field or farm.
Step 9: The robot and smart phone are linked via a WiFi interface.

ARCHITECTURE



In our suggested concept, which aims to simplify the agricultural system. In the AGRIBOT system, a rectifier is used to convert AC power to DC, after which 3.3V and 5V regulators are used. Here, Arduino serves as the brains behind our project. It regulates every aspect of it, including moisture humidity, Wi-Fi, ultrasonic sensors, digging control units, motors, mechanisms used for seeding operations, and more.

The following list contains the project's components:

Arduino: The open-source electronics platform Arduino is built on user-friendly hardware and software. Furthermore, a microcontroller is employed to manage many components.

DC Motor: Any type of rotating electrical equipment that transforms electrical energy from direct current into mechanical energy is known as a DC motor.

Servo Motor: A servomotor is a linear or rotary actuator that enables exact control over acceleration, velocity, and angular position.

Humidity sensor: A humidity sensor detects, gauges, and communicates the air's relative humidity. The ratio of the actual humidity in the air to the maximum amount of moisture that may be retained at that temperature is known as relative humidity.

Moisture sensor: The volumetric water content of soil is measured by soil moisture sensors.

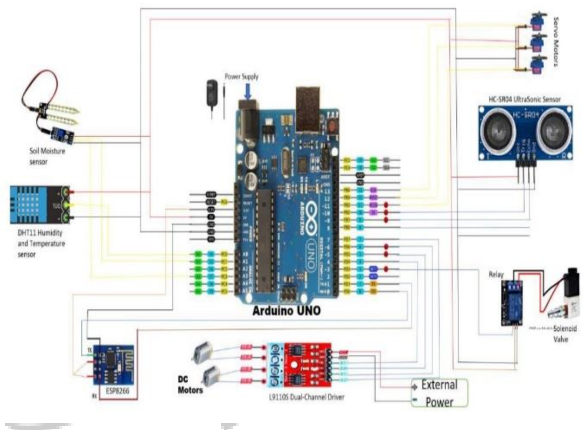
Bluetooth sensor: The Bluetooth Module is a user-friendly Bluetooth module that facilitates the construction of transparent wireless serial connections.

Wi-Fi module: Any microcontroller can gain access to your Wi-Fi network with the help of the ESP8266 Wi-Fi Module, a self-contained SOC with an integrated TCP/IP protocol stack.

Wheels: an axle bearing, around which a wheel rotates when force is applied by gravitation or torque to the wheel about its axis, is inserted into the center of a circular block made of a hard and durable material. Together, these wheels constitute one of the six simple machines.

Battery: A battery is a device made up of one or more cells that is used to transform chemical energy into electrical and provide power.

CIRCUIT DIAGRAM



APPLICATIONS

Traditional farming methods are revolutionized by the wide range of uses that agricultural robots offer. They may automate labor-intensive operations like planting, weeding, and harvesting, which lessens the demand for physical labor and helps the agriculture industry deal with the manpower problem. Furthermore, by gathering data on soil properties, moisture content, and plant development in real time, these robots can accurately monitor and control crop health, allowing farmers to maximize yields and optimize resource use. Additionally, precision fertilizer and pesticide spraying can be facilitated by agricultural robots outfitted with cutting-edge sensors and imaging technologies, limiting environmental effect and cutting down on chemical waste. All things considered, the uses of agricultural robots go beyond simple automation and include increased production, sustainability, and efficiency in contemporary farming methods.

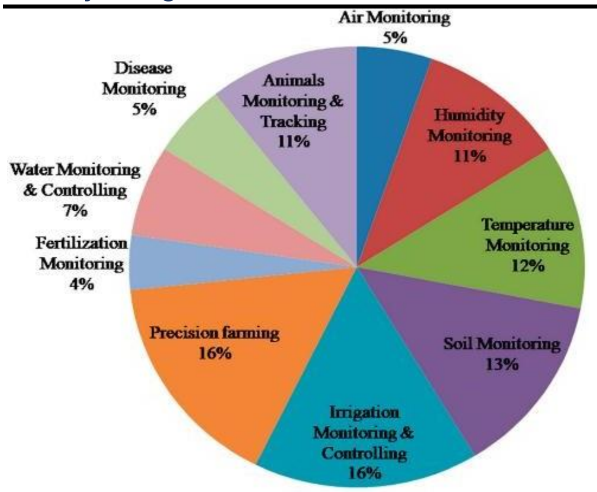


***Fig :* Applications of IoT smart farming.**

Among other things, farmers will be ready to use sensors to increase yields and prevent crop damage. Another place where IoT can be applied is in intelligent greenhouses. There are small-scale aquaponic and hydroponic systems available. Urban areas are seeing an increase in the use of intelligent greenhouses because they provide better monitoring.

RESULTS

This chapter discusses the suggested system's outcomes. The real-time operating components and necessary sensors make up the hardware implementation. The sensors are in charge of gathering data from the surroundings, which the components subsequently process to produce useful information. Numerous uses for this data exist, including decision-making, control, and monitoring.

a)Hardware Result:

The microcontroller has been effectively interfaced with the sensors and hardware.The test findings demonstrate that the Bluetooth module is used to perform and regulate a variety of field tasks, including irrigating, clearing obstacles, planting seeds, and plowing.
The given model shown in the figure below is working efficiently and showing the appropriate results as well

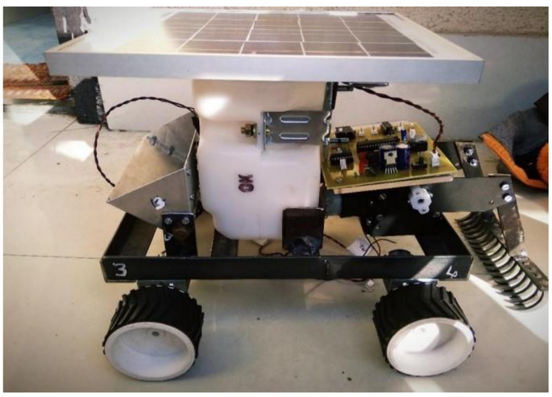


Fig: Hardware View.

b) Software Results:

The software part has been done with the help of C language because the code has implemented in C language .

The application is interfaced with microcontroller and microprocessor data. The ability to monitor and handle everything remotely has completely changed how farmers manage their livestock and crops, saving them time and improving productivity. Additionally, it enables prompt resolution of any problems that may emerge, guaranteeing ideal circumstances for development and output.

The successful software results achieved in agricultural robots using Arduino Uno microcontrollers typically revolve around enabling automation, data acquisition, and control of farming operations. Here are some key successful software results i.e

1)Autonomous Navigation

2) Sensor Data Acquisition and Processing

3) Communication and Connectivity.

4) Error Handling and Feedback

The figure below shows the app and the commands to run the robot as its run in horizontal and vertical direction.

CONCLUSION

In conclusion, a new age in agriculture is being heralded by the combination of agricultural robots with the Internet of Things (IoT), which promises revolutionary breakthroughs to meet the changing issues that the world's farmers are facing. Several important lessons emerged from our exploration of the complex world of agricultural robots in our review, highlighting the importance and potential influence of this creative combination of technology.

Precision agriculture has been made possible by the combination of robots, sensors, and communication in agricutural robots, which has redefined conventional farming paradigms. By means of automated farming operations, cognitive decision-making, and real-time data collecting, agricultural robots enable farmers to maximize resource efficiency, improve crop productivity, and reduce their ecological footprint.

Using IoT to explore the world of Agricutural robots as a final year project offers a distinctive and significant potential. The project has the potential to further the continuing revolution in agriculture, whether it is through the development of a prototype Agribot, the implementation of IoT connectivity, or the creation of an intuitive interface. It offers a setting for the application of academic knowledge, hands-on problem-solving, and actual, real-world technological improvement.

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