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Multipurpose Farming Robot Control

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Abstract

Conventional agricultural practices frequently involve a significant amount of manual labor and are prone to inefficiencies and resource waste.The relevance of incorporating robotics and mobile technology into agriculture lies in addressing several critical challenges faced by the industry. The implementation of IoT technology in smart farming systems. It covers various IoT applications in agriculture, such as environmental monitoring, automated irrigation, and precision farming, highlighting the benefits and challenges of IoT adoption in agriculture, Environmental Monitoring like IoT sensors can continuously monitor environmental conditions such as soil moisture, temperature, humidity, and light intensity. Strong agricultural equipment with outstanding soil-clearing qualities that provides a flexible method for planting, plowing, and watering crops with the least amount of labor. Developing a multipurpose farming robot that automates tasks like planting, watering, weeding, and monitoring soil conditions, all controlled via a smartphone using the Blynk app. The robot increases farming efficiency by performing repetitive tasks, reduces manual labor, and provides real-time data for better decision-making This innovative tool leverages Raspberry Pi to automate every phase of farming, including ploughing, water pumping, seed sowing, and harvesting. The vehicle can be operated using the Blynk application, ensuring ease of use and remote control. Motors are incorporated into the entire processing, monitoring, and computing system to improve operating efficiency. This robotic solution empowers farmers to implement more effective farming techniques. By harnessing the power of automation and remote connectivity, farmers can optimize resource utilization, minimize manual intervention, and improve overall crop yield and quality.

Keywords: Sensors, Raspberry Pi, Blynk application, Multipurpose, Plough, Robotic, IoT.

INTRODUCTION

Considerable technological progress has been made in the agriculture sector in recent years with the goal of enhancing farming methods, boosting output, and tackling sustainability issues. One notable innovation in this domain is the integration of robotics and mobile technology to create efficient and adaptable solutions for modern farming needs. Traditional farming methods often rely heavily on manual labour and are susceptible to inefficiencies and resource wastage. However, with the advent of Multipurpose Farming Robots controlled by smartphones, there emerges a promising avenue for revolutionizing agricultural operations.

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The relevance of incorporating robotics and mobile technology into agriculture lies in addressing several critical challenges faced by the industry. These challenges include labour shortages, rising operational costs, environmental concerns, and the need for increased productivity to meet the demands of a growing global population. By leveraging Multipurpose Farming Robots controlled by smartphones, farmers can optimize their farming processes, reduce dependency on manual labor, minimize resource usage, and enhance overall efficiency. Moreover, the integration of mobile technology enables real-time monitoring and management of farming operations, empowering farmers with greater control and decision-making capabilities. The development and implementation of a Multipurpose Farming Robot controlled by a smartphoneThe purpose of this study is to show that using robotics and mobile technologies in agricultural settings is both feasible and effective.

The Multipurpose Farming Robot is designed to perform a variety of tasks crucial to farming operations, including planting, irrigation, fertilization, and pest control. The smartphone application serves as the primary interface for controlling the robot, allowing farmers to remotely monitor its status, plan tasks, and adjust parameters as needed. Through this project, we seek to showcase the potential of Multipurpose Farming Robots controlled by smartphones in enhancing farming efficiency, sustainability, and productivity

Developing a multipurpose farming robot that automates tasks like planting, watering, weeding, and monitoring soil conditions, all controlled via a smartphone using the Blynk app. The robot increases farming efficiency by performing repetitive tasks, reduces manual labor, and provides real-time data for better decision-making. This user-friendly system aims to optimize resource use, lower costs, and improve productivity in agricultural practices.

LITERATURE SURVEY

The implementation of IoT technology in smart farming systems. It covers various IoT applications in agriculture, such as environmental monitoring, automated irrigation, and precision farming, highlighting the benefits and challenges of IoT adoption in agriculture, Environmental Monitoring: IoT sensors can continuously monitor environmental conditions such as soil moisture, temperature, humidity, and light intensity. Farmers can use this real-time data to inform their planting, fertilization, and watering decisions. Automated Irrigation Systems: Water usage can be minimized by combining IoT sensors with irrigation systems, guaranteeing that crops receive the proper amount of water. of water based on real-time soil moisture levels and weather forecasts. This reduces water wastage and promotes sustainable water management. Precision Farming: IoT devices can collect data on crop health and growth patterns, allowing for precise application of fertilizers and pesticides. This targeted approach minimizes the use of chemicals, reducing costs and environmental impact. Livestock Monitoring: IoT technology can also be used to monitor livestock health and behavior, ensuring timely intervention in case of health issues and improving overall herd management [1].

Examines the trends, benefits, and future directions of IoT-based smart farming. It discusses various IoT applications in agriculture, including precision farming, smart irrigation, and crop health monitoring, and highlights the impact of IoT on agricultural sustainability. They discuss how these trends are reshaping various aspects of agriculture, from crop monitoring and management to livestock tracking and environmental sustainability. The paper also examines the benefits of IoT-based smart farming, such as improved resource efficiency, increased productivity, reduced costs, and enhanced decision-making for farmers. Additionally, it explores the potential challenges and limitations of implementing IoT in agriculture, such as data privacy and security concerns, interoperability issues, and the digital divide in rural areas. The authors propose several future directions for research and development in IoT-based smart farming, including the development of advanced sensor technologies, AI-driven decision support systems, and scalable IoT platforms tailored for agricultural applications [2].

Development and implementation of an automated farming system that integrates Internet of Things (IoT) technology and robotics to enhance agricultural productivity and efficiency. The system is designed to perform various farming tasks such as irrigation, soil monitoring, pest control, and crop health assessment, using a network of interconnected sensors and robotic devices. System Architecture: To gather data on soil moisture, temperature, humidity, and other environmental parameters in real time, the automated farming system is made up of Internet of Things (IoT) sensors that are dispersed across the farm.

Future research directions suggested by the authors include enhancing the system's AI capabilities for better predictive analytics, developing more versatile robotic tools, and creating scalable solutions for different types of farms [3].

This paper focuses on the design, development, and implementation of a multipurpose agriculture robot that can be operated via a smartphoneThe main objective is to increase farming operations' productivity and efficiency by using automation and remote control capabilities. Functionality and Operations: The robot is capable of navigating through the fields autonomously, using GPS and obstacle detection sensors to avoid collisions. By carefully arranging seeds at the proper depth and spacing, it is capable of precision planting. Computer vision is used in the weeding feature to locate and eliminate weeds without damaging crops. In order to optimize water usage and guarantee that crops receive the proper amount of water, the irrigation system is automated based on soil moisture levels [4].

Testing for the spraying robot controlled by application smartphone: 1) the testing a Bluetooth signal connection for spraying robot can connected to a constant Bluetooth signal at a distance of up to 50 meters 2) the testing a WiFi signal connection can connected to a constant WiFi signal at a distance of up to 120 meters and 3) the testing power supply 24VDC from battery for spraying robot working continuously at time period 0-90 minutes per full charging in working area about 1,600 square meters, which was speed moving at 5 kilometers per hour. The 30 pepper farmers who have tested the spraying robot for pepper farm were satisfied on this spraying robot at 4.31 was at a high level. To develop and testing controlled signals of application smartphone for controlled spraying robot [5]. The proposed robotic vehicle is a powerful agricultural machine designed for efficient soil-clearing and versatile farming operations, including planting, ploughing, and watering crops, thereby minimizing labor requirements. The system uses microcontrollers to automate important farming operations like seeding, harvesting, water pumping, plowing, and detecting soil moisture.. Control of the robot is facilitated through the Blynk application, enabling remote operation. The entire process, from computing and processing to monitoring, is driven by motor integration, enhancing the effectiveness of farming techniques and providing a valuable tool for farmers [6].

Presents an autonomous farming robot built on the Internet of Things and Wireless Sensor Networks (WSN) that is intended to maximize crop yield and reduce human intervention. The robot is capable of monitoring and controlling multiple environmental conditions thanks to its array of sensors, which includes soil moisture, temperature, ultrasonic, LDR, and GAS sensors. Together with a motor driver, four motors, a servo motor, a 12V motor pump, and an ESP32 camera module, it is powered by Nodemcu and ArduinoUNO microcontrollers. Data gathering and transmission to a central server for analysis is made easier by WSN technology. The robot's ultrasonic sensor aids in obstacle avoidance, and it features an automatic plant watering system. This multifunctional robot can perform tasks like harvesting, pesticide spraying, and weed control, offering a cost-effective and efficient solution for crop management. The outcomes show how the approach can improve crop yield while lessening the negative effects of farming operations on the environment [7]

Discusses the use of a 433 MHz transmitter and receiver to enhance walkie-talkie communication, addressing the limitations faced by traditional FM and AM two-way radios in areas with no network coverage. By utilizing the 433 MHz RF module, which is cost-effective and easy to integrate, the system transmits signals that are received and output through a speaker. The new approach aims to improve on-site communication for businesses, providing a reliable and efficient solution where conventional networks fail [8].

Proposes the development of a solar-powered robot to perform these tasks, aiming to reduce manpower and time. The robot, powered by solar panels and controlled via Wi-Fi or an Android app, enhances the efficiency of agricultural operations such as seed sowing, spraying, ploughing, and grass cutting. This system offers a more convenient, cost-effective, and efficient solution compared to traditional methods, addressing the difficulties faced by farmers in manual planting and related activities [9].

The research papers collectively focus on smart farming solutions that utilize IoT, robotics, and wireless communication technologies to enhance agricultural efficiency and reduce manual labor. They explore versatile robotic systems for tasks like seed sowing, ploughing, grass cutting, and pesticide spraying, controlled via smartphone applications and powered by technologies such as solar panels and 433 MHz RF modules. These systems employ various sensors and microcontrollers to automate environmental monitoring and farming operations, aiming to improve crop production and resource management. The proposed innovations address the challenges of traditional farming methods by offering cost-effective, efficient, and sustainable solutions that minimize labor costs and optimize agricultural processes.

IMPLEMENTATION OF MULTIPURPOSE FARMING ROBOT

Hardware Requirements

Dc Gear Motor With Metal Gear. This is a Grade A, 3.5 RPM, 12 V, Low Noise DC Motor with Metal Gears. These motors are straightforward DC motors with metal shaft gears to get the best possible performance characteristics. Because the shaft of its gearbox assembly passes through its center, they are referred to as center shaft DC geared motors. Utilizing these DC motors in standard size is quite simple. Additionally, using an Arduino or other comparable board to control motors doesn't have to cost a lot of money. This motor, which has a voltage of between 5 and 35V DC, can be utilized with the L298N H-bridge module with an integrated voltage regulator motor driver.

DC Motor–60RPMDC Motor – 60RPM–12Volts geared motors are generally a simple DC motor with a gearbox attached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly.60 RPM 12V DC geared motors widely use for robotics applications. Very easy to use and available in standard size. Also, you don’t have to spend a lot of money to control motors with an Arduino or compatible board. The most popular L298N H-bridge module with onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 as well as 35V DC Alternately, you can select the most accurate motor diver module from the extensive selection in our motor divers category based on your unique needs. An internally threaded shaft with a nut and threads makes it simple to attach the shaft to the wheel. DC geared motors featuring sturdy and 35V DC alternatively, based on your unique needs, you can select the most accurate motor diver module from the large selection offered in our Motor divers category. Shafts with internal threading and nuts and threads make it simple to attach the shaft to the wheel. DC motors with gears and sturdy

Water Pump for Mini Aquarium R385. For any project that calls for moving water from one location to another, this R385 DC 6-12V MINI Aquarium Water Pump is the ideal option. The pump operates extremely silently when pumping a liquid. Air can also be pumped by this pump. For the R385 to function at its peak, it needs between 6 and 12 VDC and 0.5 and 0.7A.

Values at the top end of these ranges of power. When properly operated, the pump can suction water through the tube from a height of up to 2 meters and pump water vertically for up to 3 meters. It can also handle pumping heated liquids up to 80 degrees Celsius.

Motor Driver Module L298N. DC and stepper motors can be driven by this high power motor driver module, the L298N. An L298 motor driver integrated circuit and a 78M05 5V regulator make up this module. Up to four DC motors or two DC motors with directional and speed control can be operated by the L298N Module. Module for RF Wireless Transmitter and Receiver. This is a 433 MHz hybrid radio frequency transmitter and receiver module. A crystal-stabilized oscillator is used in the transmitter module to provide precise frequency management for optimal range performance. Other than an antenna, no external radio components are needed.

Mini Servo Motor SG90. The well-liked SG90 Mini Servo Motor with 180-degree Rotation is frequently utilized in do-it-yourself and hobbyist applications. This little, inexpensive servo motor has a maximum torque of 1.8 kg-cm and can spin 180 degrees. It weighs about 9 grams and runs at 4.8–6V, which makes it perfect for model control and small-scale robotics applications.

Raspberry Pi W form factor, 21 mm × 51 mm Raspberry Pi created the RP2040 microcontroller chip in the United Kingdom. 16 Arm Cortex-M0+ dual-core CPU with a programmable clock that can reach 133 MHz and 264 kB on-chip On-board QSPI flash SRAM 2MB 802.11n wireless LAN operating at 2.4 GHz (Raspberry Pi Pico W and WH only) Bluetooth 5.2, only to Raspberry Pi Pico W and WH Three analog inputs are among the 26 multipurpose GPIO pins. Specifications of the Arduino Nano:- ATmega328 Microcontroller Architecture AVR Voltage 5 VFlash Memory 32 KB, with the bootloader SRAM using 2 KB of that total 2 KB Analog IN Pins with 16 MHz Clock Speed 8 EEPROM with 1 KB

Software-Necessity

You can use Blynk to create smartphone applications that make it simple to communicate with microcontrollers and even complete computers, like the Raspberry Pi. The Blynk platform's primary goal is to make mobile application development incredibly simple. It's as simple as dragging a widget and setting up a pin to create a mobile app that communicates with your Arduino, as you will discover during this course. With Blynk, you can use your smartphone to operate a motor or an LED with essentially no programming knowledge. In fact, this is the first experiment I will present during the course. However, this simplicity should not lead you to believe that Blynk is limited to simple applications. Blynk has a strong and scalable instrument utilized by both industry professionals and enthusiasts. You may use it to use your phone to open your garage door, turn on the water, and keep an eye on the soil humidity in your vegetable garden. It can also be used to embed IoT or control smart furniture that learns from your routines.

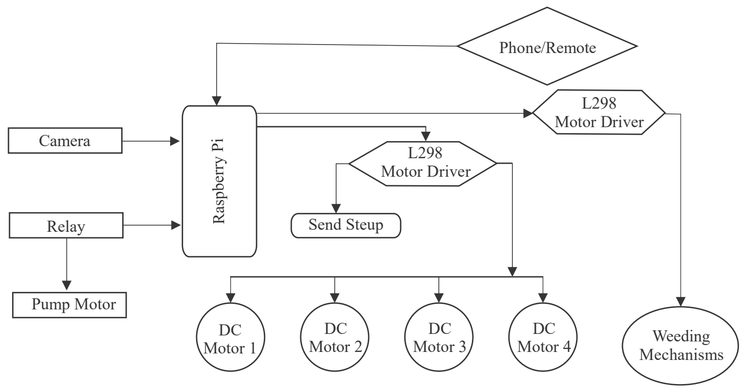

Figure 1. Block Diagram of multipurpose farming robot.

The block diagram showcases the design of a multipurpose farming robot controlled via a smartphone using the Blynk application. The Raspberry Pi serves as the central processing unit, interfacing with a camera for visual feedback, a relay controlling a pump motor for irrigation or spraying, and two L298 motor drivers. These motor drivers manage four DC motors for navigation and movement, a seed sowing mechanism, and weeding mechanisms. The smartphone sends commands through the Blynk app to the Raspberry Pi, enabling efficient and remote operation of various agricultural tasks.

RESULTS AND DESCUSSION

The implementation of the multipurpose farming robot control system yielded promising results in terms of functionality and performance. The robot successfully executed various tasks, including planting seeds, watering plants, and detecting and removing weeds, demonstrating its versatility and utility in agricultural operations. The system's smartphone interface, which offers users simple controls and instantaneous feedback, is one of its primary benefits. Farmers can easily command the robot to perform specific tasks, adjust parameters such as planting depth and watering frequency, and receive notifications about crop health and environmental conditions.

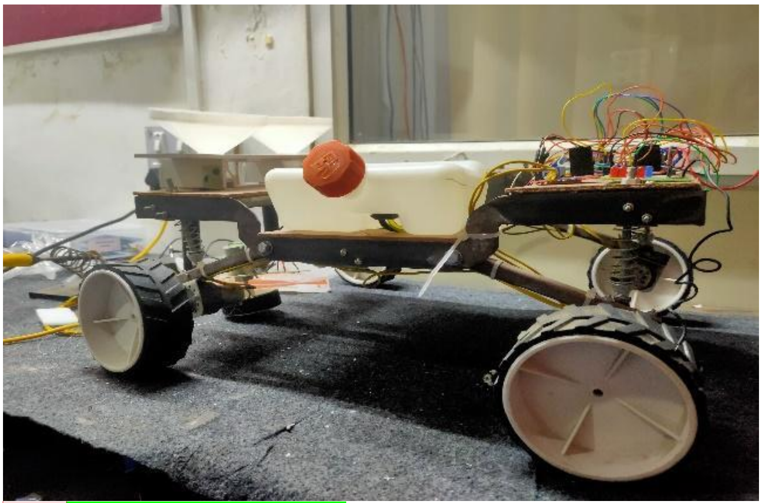

Figure 2. Multipurpose farming robot.

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CONCLUSIONS

The feasibility and effectiveness of utilizing smartphone-controlled technology, specifically leveraging the Blynk platform, to operate a multipurpose farming robot. Through rigorous research, development, and testing, established a versatile system capable of performing various agricultural tasks remotely, thereby enhancing efficiency and productivity in farming practices. The integration of Blynk provided a user-friendly interface for controlling the robot, allowing farmers to remotely monitor and manage agricultural operations with ease. Additionally, the multipurpose functionality of the robot, encompassing tasks such as seeding, watering, and pest control, offers a comprehensive solution to address diverse agricultural needs. Furthermore, this system highlights the potential of IoT (Internet of Things) technology in revolutionizing traditional farming methods, promoting sustainability, and mitigating labor shortages in the agricultural sector. By harnessing the power of automation and remote connectivity, farmers can optimize resource utilization, minimize manual intervention, and improve overall crop yield and quality. Looking ahead, further enhancements and refinements can be made to the system to cater to specific crop requirements, environmental conditions, and scalability considerations. Continued collaboration with stakeholders, including farmers, researchers, and technology developers, will be essential in advancing the adoption and implementation of such innovative solutions in agriculture. Overall, this system represents a significant step towards modernizing farming practices and addressing the challenges faced by the agricultural industry in the 21st century.

REFERENCES

1. AgriSys: A Smart and Ubiquitous Controlled Environment Agriculture System Authors: Aalaa Abdullah, Shahad Al Enazi and Issam Damaj.
2. Rajalakshmi, Mrs. S Devi Mahalakshmi IOT Based Crop-Field Monitoring and Irrigation Automation "the international conference on Intelligent systems and control (ISCO), 7-8 Jan 2016 published in IEEE Xplore 2016.
3. Tanmay Baranwal, Nitika, Pushpendra Kumar ateriya "Development of IoT based mart security and monitoring services for Agriculture" 6th International Conference – Cloud System and Big Data Engineering, 978-14673-8203-8/16, 2016 IEEE.
4. Nelson Sales, Artur Arsenio, "wireless sensorand Actuator System for Smart Irrigation on the Cloud" 97 -1-5090-0366-2/15,2nd World forum on Internet of Things (WF-IoT) Dec 2015, published in IEEE Xplore Jan 2016.
5. Design and Implementation of a Connected Farm for Smart Farming System Authors: Minwoo Ryu, Jaeseok Yun, Ting Miao, Il-Yeup Ahn, SungChan Choi, Jaeho Kim.
6. Smart Design of Microcontroller Based Monitoring System for Agriculture Authors: Nilesh R. Patel, Pratik G. Choudhary Pawan D. Kale, Nikesh R. Patel, Gau Ravikumar N. Raut, Asif Bherani.
7. Providing Smart Agricultural Solutions to Farmers for better yielding using IoT Authors: M.K. Gayatri, J. Jaya Sakthi, Dr. G.S. Ananda Mala
8. Ms. Aditi D. Kokate, Prof. Priyanka D.Yadav, Multipurpose Agricultural Robot, International Advanced Research Journal in Science, Engineering and Technology National Conference on Emerging trends in Electronics & Telecommunication Engineering (NCETETE 2017), ISSN (Online) 2393-8021 ISSN (Print) 2394-1588.
9. Parameshachari B D et. Al Optimized Neighbor Discovery in Internet of Things (IoT), 2017 International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT), PP 594-598, 978-1-5386- 2361-9/17/$31.00 Â©2017 IEEE.
10. A. A. Chand et al., "Design and analysis of photovoltaic powered battery-operated computer vision-based multi-purpose smart farming robot", vol. 11, no. 3, pp. 530, 2021.
11. Rajkumar, M.N.; Abinaya, S.; Kumar, V.V. Intelligent irrigation system—An IOT based approach. In Proceedings of the 2017 International Conference on Innovations in Green Energy and Healthcare Technologies (IGEHT), Coimbatore, India, 16–18 March 2017; pp. 1–5.
12. Flores, K.O.; Butaslac, I.M.; Gonzales, J.E.M.; Dumlao, S.M.G.; Reyes, R.S.J. Precision agriculture monitoring system using wireless sensor network and Raspberry Pi local server. In Proceedings of the 2016 IEEE Region 10 Conference (TENCON), Singapore, 22–25 November 2016; pp. 3018–3021