International Journal of Research in Engineering, Science and Management
Volume 5, Issue 7, July 2022
https://www.ijresm.com | ISSN (Online): 2581-5792

Design and Development of a Multi-Tasking Autonomous Agriculture Robot using ESP32 Microcontroller

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Abstract*: With innovations in every field of our lives, agriculture is also a field that is getting impacted on a huge scale with technological innovations. Smart farming is aiding in boosting the quality and quantity of the yields. This paper discusses the design and development of an autonomous multitasking robot that can be used for digging the soil, sowing seeds, harvesting as well as irrigation. This robot works on solar energy and will also help in conserving non-renewable energy resources on a large scale thereby contributing towards a sustainability of our planet. The main aim is to provide smart farming at low cost without compromising on the efficiency of the processes involved. The primary aim of our project is to develop a multitasking agricultural robot, which can be used for agricultural processes like digging the soil, seed sowing, crop cutting(harvesting) and irrigation system. keeping in mind low cost and more efficient. This robot will derive its power from solar panel making it energy efficient and eco- friendly. A Multitasking robot for the field of Agriculture has been studied in this research. Now a day, precision agriculture by agricultural robots is the newly emerging technology in agriculture sector to save the time and energy that is wasted in repetitive farming tasks automation in farming processes is quite helpful. To design these sorts of robots there should be certain considerations and particular approach considering the agriculture environment in which it will be working. The working of an autonomous robot is based on field parameters i.e., length and width. Prototype of an agricultural robot is modelled for multitasking such as seeding, ploughing and harvesting with a separate irrigation system. It will also help in decreasing the use of non-renewable sources of energy and will not pollute the environment. The approach is now to develop smarter machines that are intelligent enough to work in an unmodified or semi natural environment.

***Keywords*: Smart farming, multitasking agriculture robot.**

1. Introduction

Robotics is influencing our lives in many fields some of which are Manufacturing, Education, Healthcare, Personal Technology, etc. Robotics is also impacting the agriculture field and this can have a considerable impact on the farm produce especially since agriculture plays an important role for the Indian economy. Farmers today can benefit from the technological advancements. Automation can help in boosting the efficiency of the various processes involved right from sowing to harvesting the crops. Technology can bring in disruptive changes over the traditional laborious methods. Smart farming can help bring in a cost-effective solution for the farmer. Agriculture robots can help the farmers in automating the laborious and repetitive tasks and provide the farmer with more time at his hand for devoting to other aspects of farming that can help in improvising the overall production.

With the rising population across the globe, there is a huge gap between the demand and supply of agriculture produce. Automating can definitely help in reducing this gap. This paper discusses the design and development of a prototype of a smart robot that is capable of performing various operations like sensing the soil moisture content, ploughing, seed dispensing and irrigation. The system based on the ESP32 microcontroller can run in the auto/manual mode. In the manual mode, the robot uses the wi-fi pairing app as the control device and helps in the navigation of the robot on the field.

Embracing new technologies will change the face of the agricultural sector.

2. Literature Survey

The authors in [1] have developed a robot that is capable of performing operations like humidity sensing, automatic ploughing and seed dispensing. The AVR AtMega Microcontroller is used for the monitoring and control. The robot tills the entire field and then proceeds to perform the ploughing operation while simultaneously performing the operation of dispensing the seeds on the tilled soil. The robot is operated in the “automatic” mode while it is on the field and in the “manual” mode while it is off the field. [2] discusses a robot system used for cultivating agricultural land without the use of man power. The main aim is to reduce the work of the farm labourers, and increase the productivity in any given span of time. The authors in [3] elaborate the use of new technologies to increase the farm yield. The paper discusses use of latest electronic technology based on use of Microcontrollers and GSM. In [4] the authors have discussed the scenarios having

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decreased water tables, drying rivers and lakes; unpredictable issues due to climate changes. The authors elucidate the dire need of effective utilization of water. The authors have used temperature sensors as well as moisture sensors at appropriate locations for monitoring the crops. A microcontroller-based system has been developed with threshold values of the temperature and the soil moisture and a control is maintained on the amount of water dispensed. The system is powered by photovoltaic cells and a duplex communication link based on a cellular internet interface that allows data inspection and irrigation scheduling is incorporated using a web page. Wireless sensor networks helped in the monitoring and control of the greenhouse parameters in precision agriculture. In [5] the authors have used Arduino Uno ATmega 328p Microcontroller for controlling the robot. Esp3266 wifi module is used for the communication. A soil moisture sensor is used for checking the water content in the soil. The node MCU ESP8266 microcontroller-based robot in [6] uses various sensors such as PIR, soil moisture and flame sensor. The authors in [7] discuss a solar based agriculture robot that uses a solar panel with 12V DC battery and performs functions like grass cutting and fertilizer spraying. In [8] the authors have developed a multitasking robot using PIC 18f 4520 microcontroller which performs operations like sprinkling water, ploughing, grass cutting.

3. Proposed System

The objective of this paper is to discuss the design and development of a system that is capable of performing most of the agriculture activities using a robot. The robot is controlled using an Android App specially designed for this system. It works over the Wi-Fi protocol The system is solar powered thereby ensuring conservation of electricity.

The system block diagram is as shown in Fig. 1.

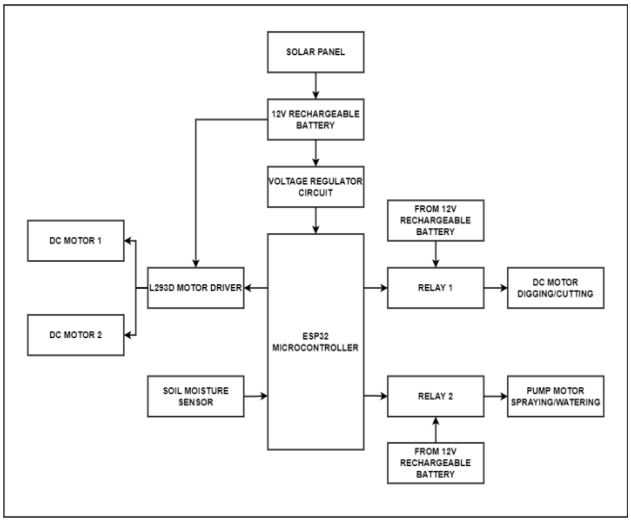

Fig. 1. Block diagram

The system is developed using the ESP32 microcontroller that also has an inbuilt wi-fi facility. A L293D motor driver is used for driving the two motors of the robot. ASG90 servo motor is connected for helping with the function of seed dispensing. A soil moisture sensor aids in sensing the moisture content of the soil. For cutting and digging, a dc motor is connected via a relay. A motor pump is used with a two-way sprayer nozzle for spraying and watering purpose. A mini solar panel is connected to a rechargeable lead acid batter for powering the robot. IC7805 fixed voltage regulator provides 5V DC regulated supply as required by the circuits. An Android app is designed using MIT App Inventor 2 for controlling the robot over wi-fi.

Fig. 4 and 5 illustrate the use of the solar panel and the base frame of the robot.

Fig. 2 shows the circuit diagram.

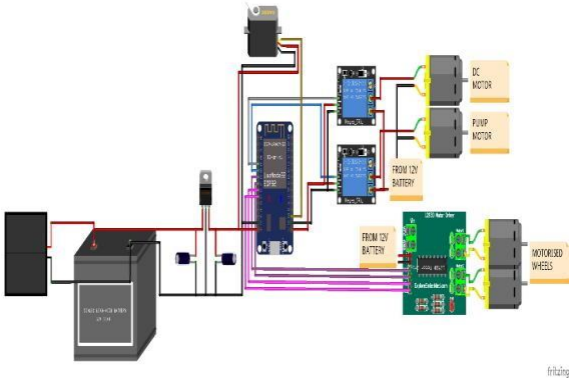

Fig. 2. Circuit diagram

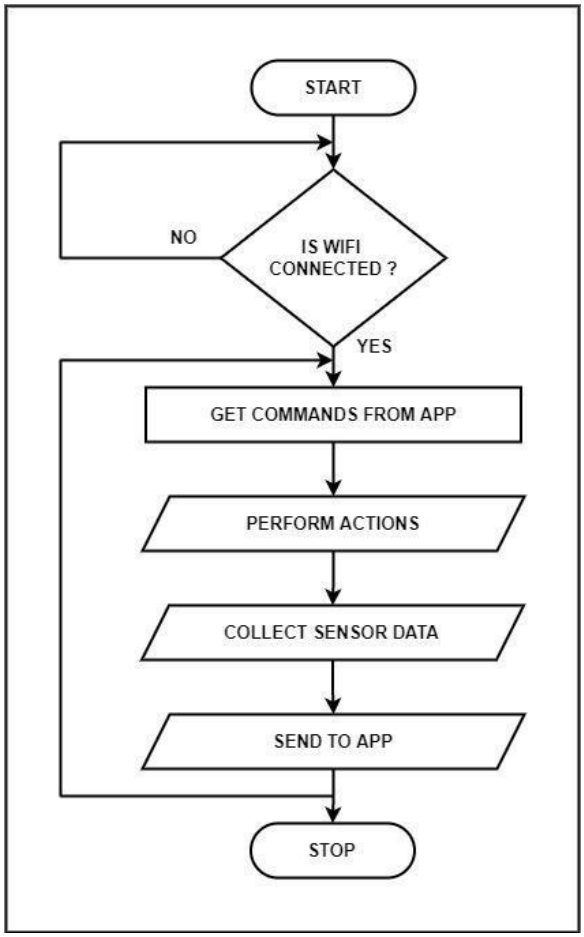

Fig. 3. Flow chart

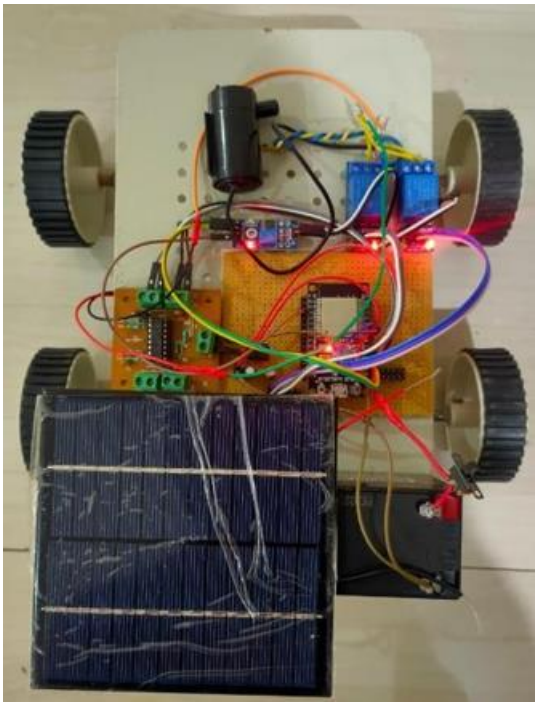

Fig. 4. Solar panel installation

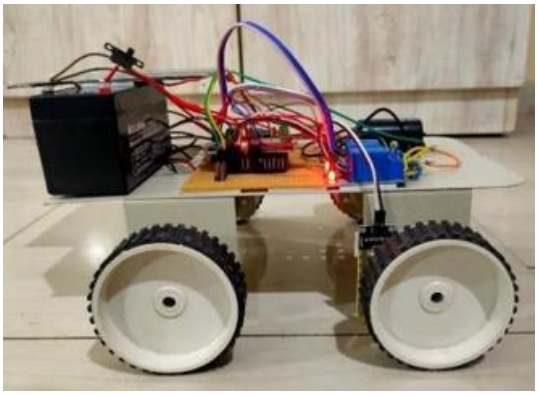

Fig. 5. Base frame of robot

4. Result

Software interface: An app is made using MIT app inventor 2 this is use to control all the activities of robot to mobile device with the help of wi-fi.

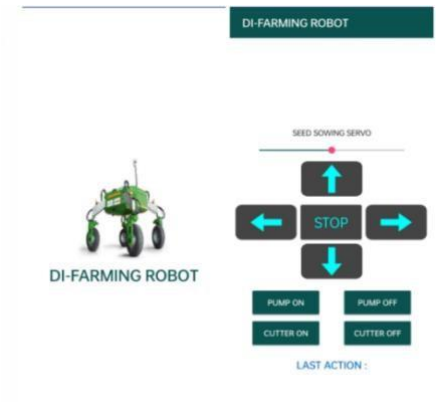

Fig. 6. Di-farming robot

Hardware interface:

Multi-tasking robot: The soil moisture senses the moisture present in soil, by using this information we can take appropriate decision. The various multi task such as ploughing, seed sowing, fertilizer spraying water sprinkling, moisture sensor and grass cutting can be done on request of user (Farmer).

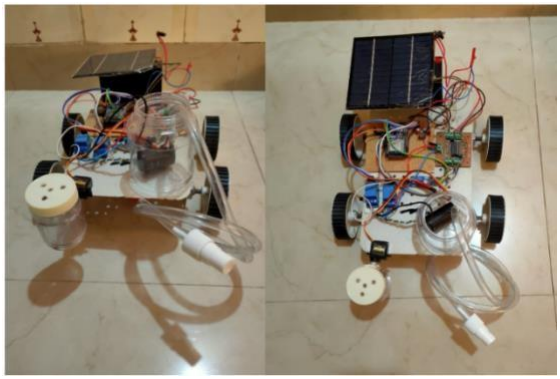

Fig. 7. Hardware setup

Table 1

Feature	Estimated time/m	Actual time/m
Seed Sowing	8 min	9.5 min
Watering	2 min	2.3 min
Spraying Pesticides	2 min	2.3 min
Grass Cutting	7 min	7.5 min

5. Conclusion

A prototype of a multi-purpose autonomous robot for agriculture has been successfully implemented and has been tested for various functions like ploughing, dispensing seeds, watering and spraying. The robot can help the farmers in labour-intensive and monotonous tasks thereby providing more time at hand for paying attention to other aspects of farming and the logistics involved.

The future work can include incorporating of Computer Vision for improving the efficiency of the robot.

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