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Multi-Tasking Agricultural Robot

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***Abstract*: The main purpose of making this robot is to provide affordable, compact, multi-purpose robot to farmers for their agricultural use. It is a Multi-tasking Robot use solar energy to various operations which performs various operations such as grass cutting, fertilizers and pesticides spraying, plouging and seeding in farms. Also it includes ultrasonic sensor in which it detect obstacle and give indication to user, it also gives beep sound indication at robot side. It suggests a proper direction to move the robot. All these operations are performed by using solar energy so it does not need any external power supply that gives us a wide range to cover with the robot. This robot is control by joystick hence human efforts would be minimize. As it includes multiple operations it is cost effective. It also send message indication to owner via a mobile application which makes it user friendly as well.**

***Keywords*: Solar panel, Microcontroller, Joystick, Ultrasonic Sensor, DC Motor.**

1. Introduction

In early days cutting grass, plouging could not be easily accomplished. Moving the grass cutters and plough which was powered with a standard motor was inconvenient. In old models grass cutter that is operated on engine created noise pollution and air pollution at the same time. Even though electric solar grass cutters and plough are environment friendly, they can be an inconvenience.

Along with motor powered plough, electric grass cutters are also hazardous and cannot be easily used by all. Solar based multi-tasking agricultural robot is a robotic vehicle powered by solar energy that is capable of cutting grass, ploughing and sowing by a very high speed motor. As its name implies 'multi-tasking', so along with grass cutter it also provides fertilizer and pesticide spraying, ploughing and sowing.

The system uses 12V batteries to power the vehicle movement as well as to the motors those are used for all four operations. We also use a solar panel to charge the battery so that there is no need of charging the battery externally with any means of electric supply. The grass cutter motor, ploughing motor, seeding motor vehicle motors and even a motor to which a fertilizer tank is connected are interfaced with PIC18F4520 which controls the working of all the motors. Here five relay modules are used one for operating all motors. It is also interfaced to a wireless protocol called ZigBee through which the vehicle is commanded to go forward, backward, left and right to perform recommended operations.

The advantage of this Multi-tasking agricultural robot is that it does not require any fuel or petrol to work, as it works on the solar energy. The circuit model is less complex.

2. Literature survey

Due to autonomous robotics fields are gradually increasing productivity in agriculture field. Some of the major problems in the Indian agricultural are rising of input costs, accessibility of skilled labors, lack of water resources and crop monitoring. To overcome these problems, the automation technologies with robots were used in agriculture. The automation in the agriculture could help farmers to reduce their efforts [2]. The robot which perform only two operations like digging hole in field that is ploughing in the field and then planting a seed at a regular interval and cover the plough area with soil. To drop the seed stepper motor is used and to dig a hole, spike wheel is used [6].

Table 1
Comparison of proposed model with same model available in market

Sr. No.	Old Model	Proposed Model
1.	This system is controlled by using only one controller i.e Arduino.	In this system two controllers are used one for robot and another one for remote.
2.	To select the particular function of robot manual switches are use they are built on Robot body.	Remote is use for controlling the function and moving the robot for particular direction joystick is use.
3.	There is no obstacle detector.	Ultrasonic sensor is use to detect the obstacle and buzzer use for indication.
4.	Human can drive the robot.	Robot itself moves only functions are selected through the user.
5.	Rechargeable battery use for power supply hence electricity required for charging the battery.	Solar powered rechargeable battery use for power supply hence the electricity charges are reduced.

Traditional harvesting method is highly labor intensive and inefficient in terms of both economy and time. Reduce the harvesting cost to about 35-45% of total production cost this robot is designed to reduce harvesting cost [8].

3. System overview

The system is designed for the increase production and accuracy work in agriculture. Description of different components used in block diagram is given below,

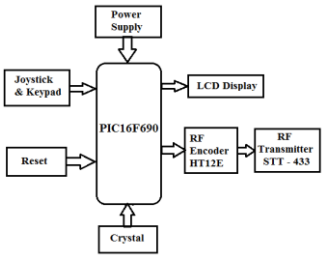

Fig. 1. Block Diagram of Remote

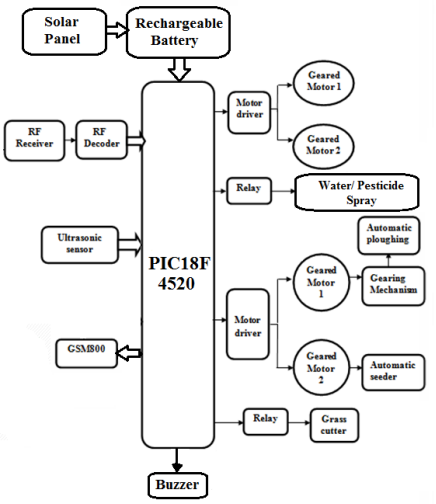

Fig. 2. Block Diagram of Robot

A. Solar panel and battery section

This is power supply section; we are using the solar panel of with 12V DC battery. Solar panel is used for generating solar energy. This solar energy is then stored into the battery. Once the energy is stored, then this energy is transferred to each device of the circuit.

B. Controller Section

Here we are use two controller PIC16F690 and PIC18F4520. The reason of using two controllers is that, PIC16F690 use for Remote operation control and PIC18F4520 use for Robot control purpose. Both controllers are simple for understanding and programming. The PIC18F4520 is used for controlling DC motors. Here the DC motors are used as the wheels of our robot, the Johnson motor is attached to a blade which is used for cutting grass and one more motor for fertilizer tank, for pumping the water or pesticide in the tank. The ON & OFF of the Johnson motor and the tank motor is controlled by the relay circuit which is also controlled by the PIC18F4520. The four DC motors are driven by the DC motor driver having IC by using this IC the two pairs of DC motors are short circuited to each together. Where one pair of motors is out of phase with another pair of motors, so that are commanded for moving in left or right direction the working goes smooth.

C. ZigBee Section

As we know ZigBee is a protocol. We are using here the ZigBee (CC2500) chip, for controlling the robot, which have low power consumption limits transmission distances to 10–100 meters. It requires 5V supply for operating and is interfaced to the PIC through which they transmit and receive their data among each other. The ZigBee chip is connected to the controller, where first they will handshake with each other and then further data is processed.

As if it transmits letter F then the DC motors will run in FORWARD direction, if letter B then it will move in BACKWARD directions. And similarly if it transmits the letters L & R then the pairs of the DC motors going out of phase will move in LEFT & RIGHT directions. Once the motors are commanded they will start their respective function of cutting grass, pumping and spraying the fertilizer, ploughing and seeding.

D. DC Motors

Here we are using 4 DC motors for driving the wheels of the robot having torque of 60 rpm. A Johnson motor use for the blade that is used for grass cutting, one more for pumping and spraying the fertilizer, pesticide or water from the tank and other two motors use for ploughing and seeding.

E. Sensor

Ultrasonic sensor is to detect the obstacle. If any obstacle detect it gives indication at remote side, on LCD display “Obstacle is detect” and at robot side buzzer gives beep sound.

F. Joystick & Keypad

Joystick pointer keeps moving in the direction of the joystick pointing and stops moving when joystick returns to its upright position. It gives the direction of robot i.e. forward, backward, left and right. Extra buttons and triggers are used to assign commands or initiate actions like ploughing, seeding, Grass cutting, spraying pesticides and stop all the actions.

Analysis of the parameters for grass cutting, ploughing, seeding, fertilizer & water spraying is shown in tables 1 to 4 below

Table 2
Grass-cutting Function

S. No.	Parameter	Values obtained by proposed model
1.	Torque of the motor	4 kg-cm
2.	Speed of the blade connected motor	7500 RPM
3.	Distance covered by the model	11.4m
4.	Time taken by the proposed model	1 min

Table 3
Ploughing Function

S. No.	Parameter	Values obtained by proposed model
1.	Torque of the motor	4 kg-cm
2.	Speed of the motor	10 RPM
3.	Distance covered by the model	11.4m
4.	Time taken by the proposed model	1 min

Table 4
Pesticide & fertilizer spraying function

S. No.	Parameter	Values obtained by proposed model
1.	Torque of the motor	4 kg-cm
2.	Speed of the blade connected motor	10 RPM
3.	Area covered by proposed model	5.2m x5.2m
4.	Time taken by the proposed model	1 min

Table 5
Seed Sowing Function

S. No.	Parameter	Values obtained by proposed model
1.	Torque of the motor	4 kg-cm
2.	Speed of the motor	10 RPM
3.	Area covered by the model	5.2m x 5.2m
4.	Number of seeds sowed for minute	30

From the above tables it is analyzed that the prototype model of proposed system can be used to perform ploughing, seeding, grass cutting and water spraying covers 11.4 m distance and 5.2m x 5.2m per minute.

4. Conclusion

Multi-tasking agricultural robot has successfully implemented and tested for various functions like ploughing, seeding, grass cutting and water spraying. It was developed by integrating agricultural robot using C programming. The advantages of Multi-tasking agricultural robots are reducing human intervention, ensuring proper irrigation and efficient utilization of resources. The proposed system is mainly used solar power supply for working and for crop establishment, plant care and selective harvesting. In future, it can be extended by using soil monitoring and cameras for performing the same operations without human operator for measuring the various parameters like soil condition.

S. No.	Parameter	Traditional	Tractor	Robotic
1.	Speed	Slow	High	Very high
2.	Man power	More	Moderate	Less
3.	Time required	More	Less	Less
4.	Sowing technique	Manually	Manually	Automatically
5.	Required energy	High	Very high	Less
6.	Yield of crop	Low	Moderate	High

A. Applications

1. *Nursery:* By using this Robot row to row spacing can be adjusted and required seed spacing can be achieved as well as variety of seed can be sow.
2. *Farm:* In farm it is used for planted seeds in all the rows of the farming plot are watered and fertilizer is sprayed on all the plants. Some crops need fertilizers and water when the seed germinates and the plant begins to grow.
3. *Greenhouse:* In greenhouse the irrigation and fertilization operation performed precisely.

References

[1] Xue Jinlin, XU Liming, “Autonomous Agriculture Robot and its row guidance”, IEEE 2010.
[2] L. Hassan-Esfahani, A. Torres-Rua, A. M. Ticlavilca, A. Jensen, M. McKee, “Precision Agriculture Using Unmanned Aerial Vehicle Multispectral Imagery”, IEEE 2014.
[3] Kannan S. A, Renjith G, Karishma. Raju, Anju Parvathy N, Soumya Sunny, Amrutha. I. Nair: “Agricultural Automation with Field Assisting Robot” IJARSE, 2017.
[4] Gulam Amer, S. M. M. Mudassir, M.A Malik, “Design and Operation of Wi-Fi Agribot Integrated System”, IEEE International Conference on Industrial Instrumentation and Control, May 2015
[5] D. C. Slaughter, D. K. Giles, and D. Downey, “Autonomous robotic with weed control systems: A review,” Elseveir Computer Electroni. Agric, vol. 61, no. 1, pp. 63–78, 2016.
[6] S. Umarkar and A. Karwankar, “Automated Seed Sowing Agribot using Arduino," in IEEE Conference on Communication and Signal Processing, April 2016, pp. 1379-1383.
[7] M. D. I. Sujon, R. Nasir, M. M. I. Habib, M.I. Nomaan J. Baidya and M.R. Islam “Agribot: Arduino Controlled Autonomous and Multipurpose Farming Robot for Small to medium scale cultivation," in IEEE conference on intelligent autonomous systems, March 2018, pp. 155- 159.
[8] H. Pota, R. Eaton, J. Katapriya and S. D. Pathirana, “Agricultural robotics: A streamlined approach to realization autonomous farming,” in IEEE conference on industrial and information systems, 2007, pp. 85-90.
[9] S. Kareemulla, E. Prajwal, B. Sujeshkumar, B. Mahesh, and V Reddy, “GPS based Autonomous Agriculture Robot,” in IEEE International conference on design innovations for 3Cs compute communicate control, 2018, pp. 100-105.
[10] HC-05 - Bluetooth Module, https://components101.com/wireless/hc-05-bluetoothmodule", accessed on September 2018.
[11] Saurabh Umarkar and Anil Karwankar, “Automated Seed Sowing Agribot using Arduino Uno,” IEEE 2016.
[12] Masood Ul Hassan, Mukhtar Ullah, Jamshed Iqbal, “Towards Autonomy in Agriculture: Design and Prototyping of a Robotic Vehicle with Seed Selector” IEEE 2016.