

Agricultural Robot: Intelligent Robot for Farming

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Abstract: With the advancement of science and recent technologies the attention of scientist is getting directed towards two field – Farming and Robotics System. But the combination of two technologies can serve efficiently for many problems by overcoming the limitation of previous technologies. Robotics technologies alone serve very well for the various problems in the field of engineering, medical, military, industry evolution and other various areas of development and requirements, but here we pile together the new advancement in agriculture with robotics to develop the agriculture system which can be used in more complex dynamic systems. This technology provides optimum and efficient solution for wide ranges of production with their merits and demerits. This robotic system is named as agricultural robot. This paper provides a detail review of the Robot.

Keywords: Movement, Agricultural robot, Arduino, Robot Architecture, Agricultural Functions.

I. INTRODUCTION

Farmers are the backbone for food production. In India, about 56% people are dependent upon agriculture to earn livelihood as shown in the figure (Fig. 1). But technical advancement in agriculture is lesser as compared to other field. Farming has been done by the human being with the help of pair of bullocks and after that by tractors. Therefore, farming system deals with impression of direct implementation, which provide wide range to appropriately defined systems with greater flexibility and mobility. Now due to increasing population the demands are also increasing, so to minimize the use of resources and to maximize the output farmers should involve technology (to reduce the wastage of seeds, water, pesticides and fertilizers, etc.) in field of agriculture.

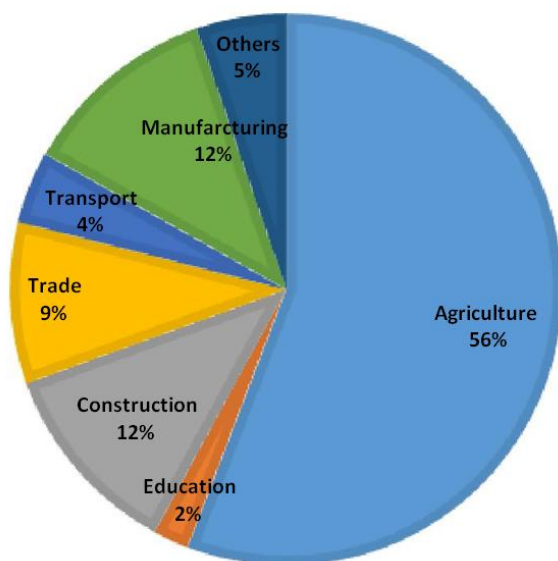


Fig. 1 Employment Contribution

Agricultural Robot is one such machine with the capabilities to perform efficient work which is possible

with the help of different computation algorithm. The improved specification helps to design, smartly control, and to make agriculture safe and suitable for everyone. In this paper the author suggested that robot will start seeding and maintain soil moisture simultaneously. [1].

II. AGRICULTURE BASICS

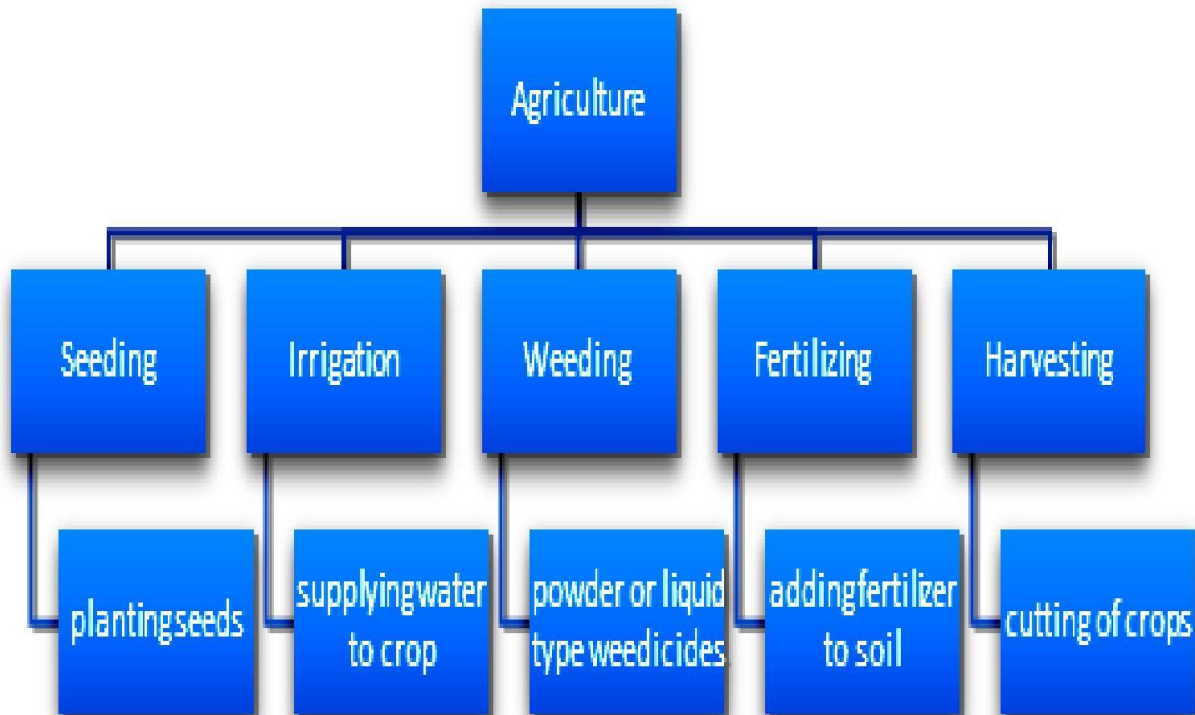
Farming by the traditional manual methods is in use since the commercialization of agriculture. But with the advent of population growth rate, increasing scarcity of food agriculture should see a boom, instead it has been observed that more and more people are leaving agriculture as an option for earning livelihood. Prominent reasons for this, are envisioned as below:

- Land: The amount of land is inversely proportional to population. And as a result the availability of agricultural land is decreasing. So the need of the era is to increase the yield with lower input on a limited amount of land.
- Urbanization: India is speeding towards globalization, reducing the interest of youth in farming and moreover a difficulty faced by people living in cities to monitor crops on regular basis is a major downfall.
- Disabilities: Disabled people and women found it difficult to manage crops and even people far from field are unable to monitor their crop on regular basis.
- Ease: Change in human mind set and lifestyle, with more demand of comfort and to reduce man power needed in farming.
- Labour: Lack of availability of labour, leading to reduced care of crops.
- Health Problems: Health problems by manual sprinkling of pesticide and weedicide in the fields.
- Seed: Uneven spreading of hybrid seeds leading to randomized growth of crops. For seeding more man

power is required and also it is a slow process when they are spreading seeds.

(like seeding, manuring, weeding etc.) as shown in Fig. 2. The various shortcomings of manual work done can be overcome by robotic systems [8].

Robots used in agriculture are intelligent machines designed to replace humans in the progressions of crops



Various merits associated with robotics involvement in agriculture are as:

- Describe Input and Output with the help of variables which make interpretation about the system and interaction with system easy.
- Robustness is high since it reports the uncertainties, imprecision and disturbances.
- Performance can be easily modified as per requirements.
- Algorithm is designed for microcontroller and built the hardware to drive motors.

The robotic vehicle is implemented using control unit, relay, motor driver and various types of sensors. It is used for development in productivity and multitasking [3]. Agriculture robot can be control by on system mounted control board [4]. The mobile robot, drops seeds and is capable of sensing the watering needs of the soil [6].

III. AGRICULTURAL ROBOT MODEL

Multifunctional system elements mean faster return on investment. The smart mechanization system of agriculture robot helps the people to establish efficient agriculture system.

For establishment of seedbed preparation, seed mapping, depth of seed placement. Simple system is designed to record the position of seeds dropped on land [2].

1. Module A: Hardware (Transducers & Actuators)

The model is used for dispensing out the solid and liquid at a particular rate and interval with the help of sensors as shown in Fig 3.

i. Ultrasonic Sensors

The system utilizes four ultrasonic sensors (HC-SR04) for four direction detection. The back sensor is mounted on a 9g micro-servo to be able to rotate 180° for aligning.

ii. Orientation Sensor

The orientation reading (Yaw, pitch, roll) from orientation sensor in android mobile are taken which is mounted on the robot itself.

iii. Soil moisture sensor

The soil moisture sensor measures the water content in the soil.

iv. Driving Motors Driver (L298N based)

Motor driver board based on L298N is used to drive the motors for motion.

v. Voltage Divider

Voltage divider is used to provide two voltage lines for 5V and 12V distinctive operations.

vi. Solid Dispensing Mechanism

A uniquely designed mechanism for seed and fertilizer

dispensing is made. It consist of two rotating mounted for proper dispersal.

vii. Liquid Dispensing Mechanism

The dispensing mechanism consists of pump. The pump controls the rate of flow of liquid out from the container.

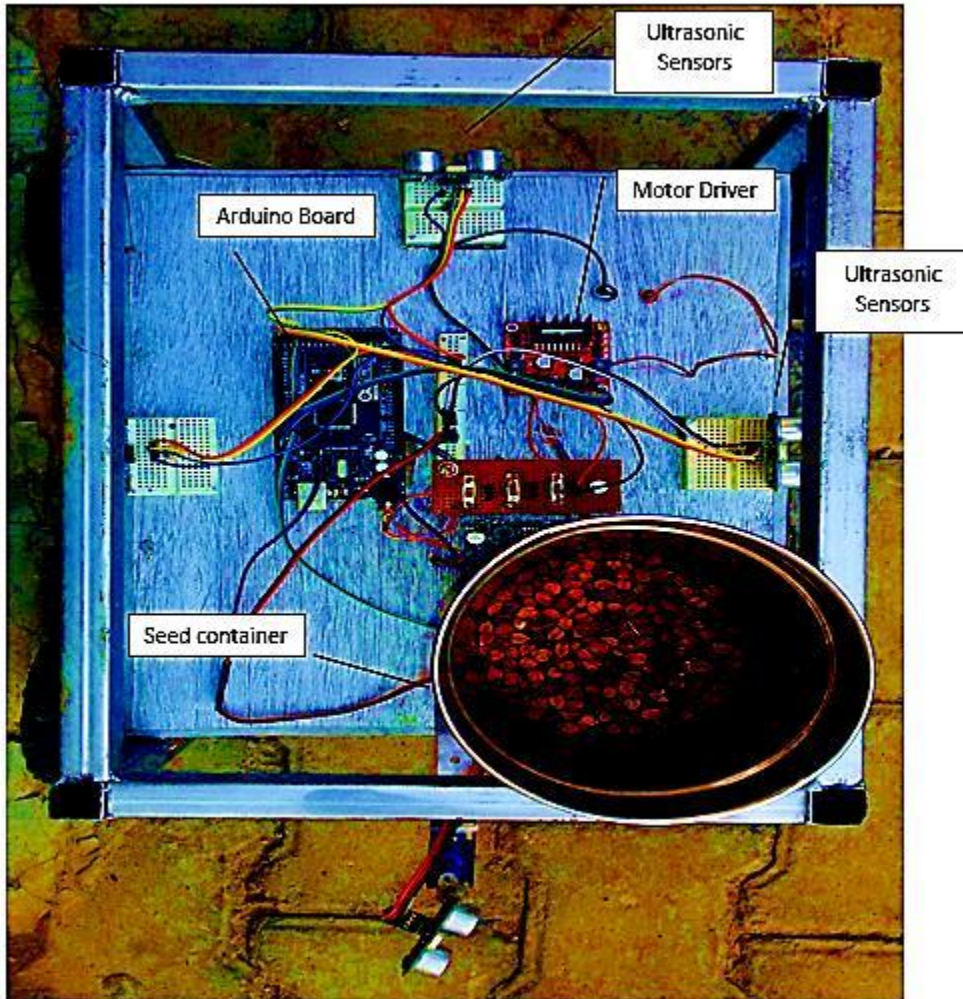


Fig. 3 Complete Assembly of Agricultural Robot

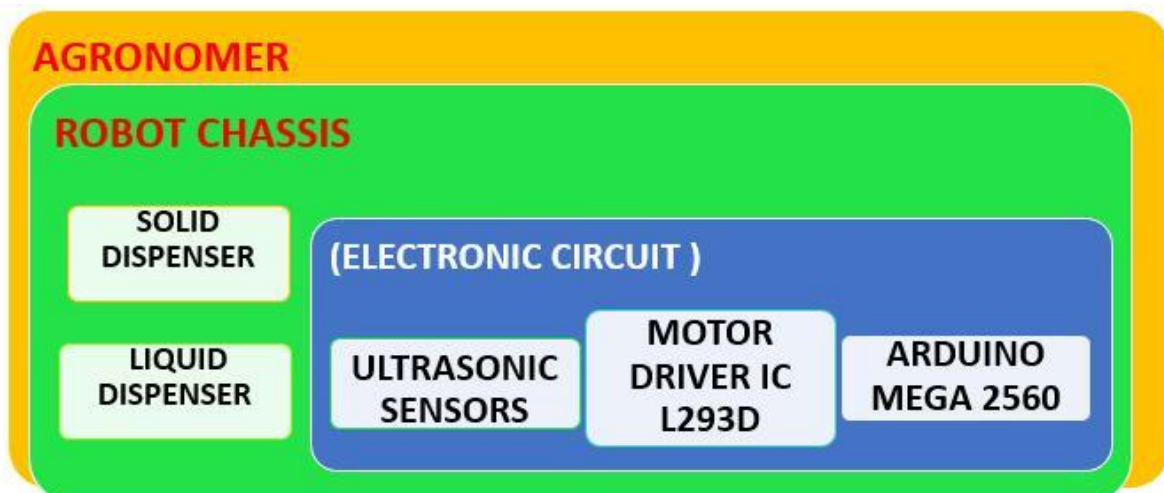


Fig. 4 Agricultural Robot configuration

2. Module B: Software (Processing in Arduino)

Arduino is programmed using Arduino IDE. The software consists of different algorithms and dedicated methods to perform various operations required.

The algorithms take processed data from sensors through Arduino and produce desired output which in turn helps in controlling of actuators. The real time speed control comparing this algorithm with the other ones, this algorithm is better than the others with respect to the accuracy of speed, but at the same time it is slower Arduino unit, stepper motor [4].

The sensors process the data for reactive output as for ground detection, alignment, row motion, dispensing of materials. The most important driving skill is row motion control with orientation and turning of Agricultural robot in next row.

IV. METHODOLOGY

Seed planting mechanism is implemented using DC motor which is placed on the vehicle. Rotating mechanism is used to have uniform distance between two seeds. When the vehicle is going in straight line it works and it will not work while turning the vehicle and changing the row.

Detection moisture content in the soil by soil moisture sensor is done and it is capable of taking the decision of switching ON/OFF water pump. According to instructions and the specified rate, fertilizers are spread on soil by same mechanism. The similar goes for using the weedicides on the crop. The weedicides are sprayed according to a pre-set rate. The aim of the designed system is check moisture of soil. Instead of using line follower, obstacle detecting sensor is used for live streaming.

V. OPERATIONS

Yield potential is preserved during the whole farming process using the hardware described above. Immediate detection of seeding deviations (over or under desired rates), operator is instantly alarmed enabling a more advanced, real time control.

i. Operation – Moisture Test



Fig. 5 Soil Moisture Sensor

Agricultural robot is designed to intelligently maintain the required ratio by using peculiar analog soil moisture sensor (so that moisture content can be varied, unlike digital sensor). The soil moisture sensor is used to test the moisture content of soil, is as shown in Fig. 5. This device shows high, when shortage of moisture in the soil, else the output is low. This sensor can be used for automatic watering of the plants and crops or to show the output on screen.

ii. Operation – Selection and Rate

The keypad or any other input device is used to select operation as (Seeding, Irrigation, Manuring, and Weeding) from it by pressing the button or performing any other activity for selection depends on the type of input device and corresponding rate for dispensing of solid and liquid.

iii. Operation - Seeding

For planting seeds the soil must be at some particular moisture value. It first checks the soil moisture content by soil moisture sensor and data is given to the Arduino board.

If the content of water is low as set by user the water is supplied to the soil. After it seeds are dropped using a complexly self-designed seed dispensing mechanism in a particular rate mentioned by the user..

iv. Operation – Irrigation

Irrigation is limited to first few times due to growth of crops. The moisture content of soil is checked by analog sensor. And the water is feed using a PWM controlled water pump till moisture content reaches the level set by user through application

v. Operation – Manuring

Manuring here refers to providing soil with manure or fertilizer.. The both types of organic and inorganic manure (fertilizers) can be used for agriculture. It can be used to provide most commonly used vermicompost and urea.

vi. Operation – Weeding

Agricultural robot supports the weeding operation to kill the weeds that are unwanted plants with the crop. The agricultural robot helps the user to avoid manual spraying of weedicides which may cause toxicity if sprayed manually.

Weedicides are in powdered form which are mixed with water to be used. The weedicides are sprayed by using pressurized water pump. The amount of weedicide that is to be sprayed is set by user.

In all scenarios, the comparison of costs and benefits of commercial use of autonomous vehicle with conventional operations. The changes in investments, daily working hours, labour costs, and changes of speed of work are included for developing the autonomous vehicle

Table 1

S. No	Factors	Manual	Tractor	Agricultural robot
1	Man Power	More	Moderate	Less
2	Time Required	More	Less	Less
3	Sowing Technique	Manually	Manually	Automatically
4	Distance between seeds	Not Fixed	Not Fixed	Fixed
5	Wastage of Seed	More	Moderate	Less
6	Required Energy	High	High	Less
7	Pollution	No	Yes	No
8	Display	No	No	Yes

VI. CONCLUSION

This paper present Agricultural robot robotic system for agriculture which can be modelled by various purposes using algorithm for comfort to farmers and can be interfaced by using Arduino board and various types of sensors. Various aspects shows Agricultural robot serves better result than manual system. It is expected that recent trends in robots shall make it to be used in enhanced role in future. In agriculture, Agricultural robot can be experienced for several advancements. Implementation of Agricultural robot has significant saving in terms of time, efficiency and saving the wastage of resources and reduced utilization of manpower should pay the cost once the system is activated. The scope of the system, especially in metro cities, is located in places where people are unaware of farming. Agriculture is more valuable compared to others fields for occupation. The utility of technology with agriculture consider for automation. The Farming System is a suitable system which aids to sure that it has wide scope for improvement, which in turn eases the agricultural system for the farmers and ultimately helps in effective crop productivity

[7] Vijaykumar N Chalwa, Shilpa S Gundagi, "Mechatronics Based Remote Controlled Agricultural Robot", International Journal of Emerging Trends in Engineering Research, ISSN 2347 – 3983, Volume 2, No.7, July 2014.
[8] Knoll, Florian, et al. "Plant root exit point search algorithm for weed control applications in organic farming." Instrumentation.

REFERENCES

[1] Blackmore, B. S., S. Fountas, T. A. Gemtos, and H. W. Griepentrog. "A specification for an autonomous crop production mechanization system." In International Symposium on Application of Precision Agriculture for Fruits and Vegetables 824, pp. 201-216. 2008.
[2] Al-Beeshi, Bashayer, Bashayer Al-Mesbah, Sara Al-Dosari, and Mohammed El-Abd. "iPlant: The greenhouse robot." In Electrical and Computer Engineering (CCECE), 2015 IEEE 28th Canadian Conference on, pp. 1489-1494. IEEE, 2015.
[3] Amritanshu Srivastava, Shubham Vijay, Alka Negi, Prasun Shrivastava, Akash Singh, "DTMF Based Intelligent Farming Robotic Vehicle, An Ease to Farmers" International Conference on Embedded Systems (ICES) ,Coimbatore, ISBN978-1-4799-5025-6, pp. 206-210 ,July 2014.
[4] Celen, I. H., E. Onler, and E. Kilic. "A Design of an Autonomous Agricultural Robot to Navigate between Rows." In 2015 International Conference on Electrical, Automation and Mechanical Engineering. Atlantis Press, 2015.
[5] Stoychitch, Mihaylo Y. "an algorithm of linear speed control of a stepper motor in real time." Annals of the Faculty of Engineering Hunedoara-International Journal of Engineering 11, no. 3 (2013).
[6] Shivaprasad B S, Ravishankara M N, B N Shoba, "Design and Implementation of Seeding and Fertilizing Agriculture Robot", International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 3, Issue 6, pp. 251-255, June 2014.