

Agriculture Robot for Cultivation of Paddy & Wheat Crops.

Prashant Kumar Sharma¹, Neha Kumari¹, Prashant Kumar¹, Aliya Kousar.N¹,

Dr.Ravishankar.C.V²

¹UG Students, Department of ECE, Sambhram Institute of Technology, Bangalore-97

²Professor & HOD, Department of ECE, Sambhram Institute of Technology, Bangalore-97

Abstract: Agriculture is an essential part of the survival of humans. The farmers who do agriculture spend most of their time ploughing the field and watering the field etc. In the Indian GDP agricultural sector share is 20.5%. In India, almost 50% population depends on the agricultural sector. So, the agricultural system in India is most important and should be advanced to reduce the efforts of farmers. Presently, In some rural villages, small landholding farmers still use work bulls for land preparations. These work bulls are also used in ploughing. And in other villages in which technology is not developed much, there farmers are using tractors for field preparation and ploughing.

Robotics is a fascinating field of engineering which provides many opportunities to explore the field. For controlling the robot manually one can make use of a Bluetooth module or Wi-Fi module. Farmers today spend a lot of money on machines that help them decrease labour and increase the yield of crops but the profit from these machines and the efficiency of these machines are very less. Hence automation is the ideal solution to overcome all the limitations. The proposed system is a boon to farmers which combines both robotics and agriculture. This mechanism is capable of moving around the field like a farmer, plough the field and sow the seed and also irrigate the field in a predetermined manner. In addition to this, it is also capable of crop cutting, re-plantation of paddy crops and monitoring the field through a wireless camera.

Key Words: Internet of Things, solar panel, DC motor, Arduino Mega, L293D motor driver, ESP 8266 node MCU

1. INTRODUCTION

Agriculture has been the backbone of the Indian economy and it will continue to remain for a long time. It is the science and art of farming. It includes many operations like the cultivation of the soil, production of crops and raising livestock. It is the most important enterprise in the world. Over the years, agricultural practices have been carried out by small-land holders using human labour and mechanical tools such as wooden plough, yoke, leveller, harrow, mallet, spade, big sickle etc. These tools are used in land preparation, seed sowing, weeding and harvesting. Modern agricultural techniques and types of equipment are not used by small landholders because these types of equipment are too expensive and difficult to acquire.

Agriculture is considered as the source of life, especially for human beings as it provides grains, cereals and many other raw materials. Today's agricultural field demands to find new

ways of agricultural operations to improve performance efficiency. In the field of agriculture, various problems are being faced by the farmers in the operations like seed sowing, ploughing, and waste plant cutting, etc. Also, the equipment's used to perform these operations are very heavy. Agriculture plays a vital role in the growth of a country's economy. Growth in the agricultural sector is necessary for the development of the economic condition of the country. So, agricultural development can contribute much to the country's development. We can develop agriculture by implementing robot technology in an agricultural field. By using robot technology, one can sit in a relaxed place and can do seeding, ploughing, sprinkling etc. by monitoring the robot motion. In other countries, robots are used to perform different operations in the agricultural field. We can make use of the robotics technology in the farming system to reduce the efforts of farmers and also to reduce time, energy and required cost. Various numbers of operations are performed in the agriculture field. So, the use of robotics in various agricultural activities will be efficient and helpful for farmers.

2. LITERATURE SURVEY

Darshan M and et al. [1] addresses that the various numbers of operations are performed in the agricultural field like seeding, weeding, waste plan cutting, ploughing etc. Very significant operations are seeding, ploughing, plant cutting. But the present methods of seeding, ploughing and plant cutting are problematic. The types of equipment used for seed sowing are very difficult and inconvenient to handle. So, there is a need to develop equipment which will reduce the efforts of farmers. This system introduces a control mechanism that aims to drop seeds at a particular position with the specified distance between two seeds and lines while sowing.

Tim Mueller-Sim and et al. [2] addresses the advanced system which improves agriculture processes like cultivation on ploughed land, based on a robotic platform. They developed a robotic vehicle having four wheels and directed by a DC motor. The advanced autonomous system architecture allows the developing of a completely new range of agricultural equipment based on small smart machines. These machines will cultivate the farm by considering particular rows and specific column at fixed distance depending on the crop.

P. Usha and et al. [3] addresses that the robot system is used to develop the process of cultivating agricultural land without the use of manpower. The paper aims to reduce manpower, time and increase the productivity rate.

Abdullah Tanveer and et al. [4] addresses that, Farming can be done using new technologies to yield higher growth of the crops. In this project, we are going to check temperature, light, humidity and soil moisture. The paper here is all about

automatic control features with the latest electronics technology using microcontroller and GSM phone line. The project works automatically and hence reduces the manpower.

Ankit Singh and et al. [5] addresses a project model for agriculture robot which describes the newer scenario of decreasing water tables, drying up of rivers and tanks and unpredictable environment presents an urgent need of proper utilization of water

Aditya kawadaskar and et al. [6] addresses that the bot performs basic elementary functions like picking, harvesting, weeding, pruning, planting and grafting. It is designed to minimize the labour of farmers in addition to increase the speed and accuracy of the work. The main feature of the robot is, the ability to find the grass in the field using image processing. For this, a special purpose webcam is used which will take photos inside the field and if the grass is found then the user will inform the robot to cut the grass in the crop field and also the user will pick the grass which has been cut by the robot. The image processing is used for analyzing the height of the plant. If the height of the crop is larger than the reference height then the cutting mechanism will be used by the robot to cut the crop.

Nikesh Gondchawar and et al. [7] addresses to develop a robot capable of performing operations like automatic ploughing, seed dispensing etc. It also provides manual control when required and keeps tabs on the humidity with the help of humidity sensors. The main component here is the Arduino Mega that supervises the entire process. Initially, the robot tills the entire field and proceeds to plough, simultaneously it dispenses seeds side by side. On the field, the robot operates on automated mode, but outside the field is strictly operated in manual mode.

Amrita Sneha.A and et al. [8] addresses that this paper strives to develop a robot capable of performing operations like automatic ploughing, seed dispensing. It also provides manual control when required and keeps tabs on the humidity with the help of humidity sensors. The main component here is the AVR Atmega microcontroller that supervises the entire process. Initially, the robot tills the entire field and proceeds to plough, simultaneously dispensing seeds side by side. The device used for navigation is an ultrasonic sensor that continuously sends data to the microcontroller.

3. COMPONENTS REQUIRED

Hardware Used

Arduino Mega

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Motor Driver L293D

The L293D is a popular 16-Pin Motor Driver IC. As the name suggests it is mainly used to drive motors. A single L293D IC is capable of running two DC motors at the same time; also the direction of these two motors can be controlled independently. It works on the concept of H-bridge. H-bridge is a circuit that allows the voltage to be flown in either direction. As you know voltage needs to change its direction for being able to rotate the motor in a clockwise or anticlockwise direction, Hence H-bridge IC is ideal for driving a DC motor.

ESP Node MCU

NodeMCU is a low-cost open-source IoT platform. NodeMCU can be powered using a Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

Soil Moisture Sensor

The Soil Moisture Sensor uses capacitance to measure the water content of soil (by measuring the dielectric permittivity of the soil, which is a function of the water content). Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of the soil is reported in percent. When the moisture in the soil is less than the set threshold, the output remains low. The digital output can be connected to a microcontroller to sense the moisture level. The sensor also outputs an analog output which can be connected to the ADC of a microcontroller to get the exact moisture level in the soil.

Temperature Sensor (DS18B20)

Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20 to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20 distributed over a large area.

Humidity sensor (DHT11)

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use but requires careful timing to grab data. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and outputs a digital signal on the data pin (no analog input pins needed). It's very simple to use, libraries and sample codes are available for Arduino and Raspberry Pi.

DC Motor

DC Motor – 200RPM – Torque: 2 kg-cm- 12Volts geared motors are generally a simple DC motor with a gearbox attached to them. This can be used in all-terrain robots and a 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. DC Geared motors with robust metal gearbox for heavy-duty applications are available in the wide RPM range and ideally suited for robotics and industrial applications. It is very easy to use and available in the standard size.

Mini Submersible water pump

Mini DC 3-6V Mini Submersible water pump For Fountain Garden Mini water circulation System DIY project. This is a low cost, small size Submersible Pump Motor which can be operated from a 3 ~ 6V power supply. It can take up to 120 Liters per hour with a very low current consumption of 220mA. Just connect tube pipe to the motor outlet, submerge it in water and power it. Make sure that the water level is always higher than the motor. A dry run may damage the motor due to heating and it will also produce noise.

Nozzle

A nozzle is often a pipe or tube of varying cross-sectional area, and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, and pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy.

Software Used

Arduino IDE
Blynk (Application)

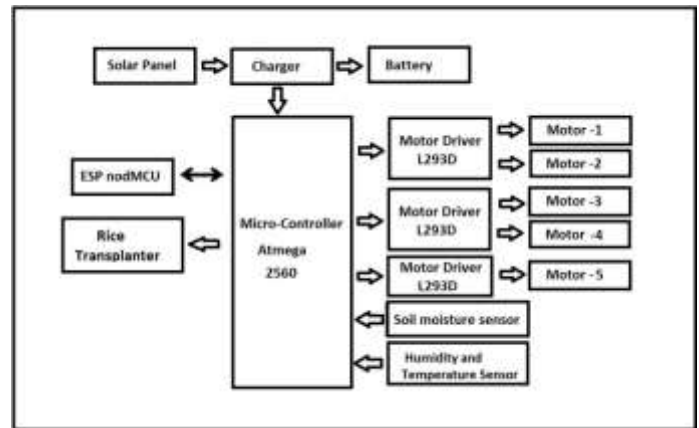
4. ADVANTAGES:

- Robotics technology reduces the efforts of farmers and also it reduces time, energy and required cost.
- Various numbers of operations are performed by Farmobot like seed sowing, ploughing, weeding, cutting, sprinkling pesticides and re-plantation etc.
- It decreases labour and increases the yield of crops.
- The robot does not get sick or tired and they do not need the time off.
- The robot does not get sick or tired and they do not need the time off.
- Productivity will be increased to a lot extent.
- It completes a large amount of work in less time.

5. DISADVANTAGES:

- It costs a lot of money to make or buy robots.
- They need maintenance to keep them running.
- Many farmer who are dependent on farming work, can lose their jobs.
- Complexity is increased.

BLOCK DIAGRAM OF PROPOSED SYSTEM



6. APPLICATION:

a) Crop cutting

The Blades are attached to the DC motor in front of the robot which effectively cuts the crop. A crop cutter is a machine utilizing one or more revolving blades to cut a crop surface to an even height.

b) Ploughing

The Plough arm made of screws moves down and ploughs the soil and is lifted after completion of ploughing. The first and foremost step in farming is ploughing. The process is done to loosen the soil and create a path or tracks on the farmland to sow the seeds uniformly. The structure and the design of the plough tool depend on the various constraints such as the type of soil to be ploughed and the depth required based on the type of crop that has to be grown and so on.

c) Seeding

The next major step in the process of farming is seeding. Seeds are dropped from the drum seeder using the rotating mechanism at equal intervals. Seeding usually depends on the type of crops being grown and the type of seeding varies over a variety of crops.

d) Sprinkling

Sprinkler Irrigation is a method of applying irrigation water that is similar to rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air and irrigates the entire soil surface through spray heads so that it breaks up into small water drops which fall to the ground.

Sprinklers provide efficient coverage for small to large areas and are suitable for use on all types of properties. It is also adaptable to nearly all irrigable soils since sprinklers are available in a wide range of discharge capacity.

e) Re-plantation

The re-plantation mechanism of Farmobot includes a seedling tray, seeding tray shifter, plural pickup forks. The seedling tray is like a shed roof where a mat type of rice nursery is set. When the rice transplanter is brought into the field, the seedlings were fed on the seedling trays. Then the tray shifts seedlings like a carriage of typewriters as pickup forks get seedlings from the tray and put them into the ground. The

Pickup forks act like human fingers by taking seedlings from the tray and pushing them into the farm fields.

George Kantor, "A Ground-Based Agricultural Robot for High- Throughput Crop Phenotyping", IEEE International Conference on Robotics and Automation, Singapore, May 29 - June 3, 2017.

f) Temperature Sensor

The DS18B20 is a 1-wire programmable temperature sensor from maxim integrated. It is widely used to measure temperature in hard environments like in chemical solutions, mines or soil etc. The constriction of the sensor is rugged and also can be purchased with a waterproof option making the mounting process easy. It can measure a wide range of temperature from -55°C to +125° with a decent accuracy of ±5°C. Each sensor has a unique address and requires only one pin of the MCU to transfer data so it is a very good choice for measuring the temperature at multiple points without compromising much of your digital pins on the microcontroller.

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[5] Ankit Singh, Abhishek Gupta, Akash Bhosale, Sumeet Poddar, "Agribot-An Agriculture Robot", International Journal of Advanced Research in Computer and Communication Engineering, Vol. 4, Issue 1, January 2015, ISSN - 22781021.

g) Humidity Sensor

The DHT11 is a commonly used temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

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h) ESP NodeMCU

The NodeMCU ESP8266 development board comes with the ESP-12E module containing the ESP8266 chip having ten silca extensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi/Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

[8] Amrita Sneha.A, Abirami.E, Ankita.A, Mrs. R.Praveen, Mrs. R.Srimeena, "Agricultural Robot for Automatic Ploughing and Seeding", IEEE International Conference on Technological Innovations in ICT (TIAR 2015).

NodeMCU can be powered using a Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

7. CONCLUSIONS

In agriculture, by using the solar operated Farmobot robot we can easily reduce farmer's efforts and time. The machine required less manpower and less time compared to the traditional method. We hope this will satisfy the partial thrust of Indian agriculture. So, in this way, we can overcome the labour problem that is the need of today's farming in India. In future, the robot also runs on PLC and SCADA with full automation.

Research efforts are now beginning to invest more in the development of multi-robot vehicles as platforms for a robot farming system. These vehicles include an IOT based robot that can provide various operations such as ploughing, seeding, cutting, re-plantation of paddy crop etc. With the development of a robot farming system, food production can be increased considerably and economically and we can also easily reduce farmer's efforts and time.

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