

# Solar Powered Field Operations: Manure, Spraying, Seed Sowing and Crop under Sizing

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*Abstract-This paper proposes a “SOLAR POWER AUTOMATIC MULTIPURPOSE AGRICULTURE MACHINE” consisting of four function fertilizer injecting, pesticide spraying, seed sowing and crop control (canopy cutting). The essential objective of the fertilizing operation is to put the fertilizers at desired depth in a proper proportion & provide a cover of soil on it. To perform this operation it uses sensors to sense the obstacle (plant) and robotic arm to dig a hole and inject fertilizer for the roots of plant with the help of pipe. The machine can be charge by two ways either by solar power or by external supply. Traditional method of fertilizing is not efficient and requires lot of time and efforts too. Due to traditional method of agricultural process Indian farmer faces many problems about productivity of agricultural product than others. It is due to unbalance feeding of fertilizer and seeds without knowing actual requirement to a particular crop. On the other hand, pesticide spraying is one of the common operations in agriculture field requiring lot of efforts to carry pump. The conventional spraying system have their own difficulties such as they need lots of efforts to push liver up and down in order to create the pressure to spray. Besides these there is one more function called cutting which requires manual efforts to overcome this problems the machine can be used to visually detect weeds from the crop canopy and to destroy them mechanically. So the attempt has been made to develop multipurpose fertilizing machine which can perform simultaneous operation. It is essentially an electromechanical and automatic machine which is steered by DC motor and has four wheels. The machine can be remotely controlled and whole process is controlled by microcontroller.*

**Keywords-Field, Fertilizer, D.C. Motor, Solar panel, Microcontroller**

## I. INTRODUCTION

Farmer is the heart of Indian economy. To paint the realistic picture agriculture is still the biggest sector of India, employing almost 60% of the total workforce. So new technologies are needed to push

out yield frontiers, utilize inputs more efficiently and diversify to more sustainable and higher value cropping patterns. Indian agriculture is faced with great diversity of needs, opportunities and prospects. Farmers are facing problems due to unavailability of labour, traditional way of farming using non efficient farming equipment's which are time consuming and also increases labour cost. Besides this illiteracy, lack of awareness about recent development in the field of agriculture and poor socio-economic background of farmers are some of the reasons for the continuously decreasing agricultural productivity. This project is all about enhancement in seed sowing, pesticides spraying and feeding fertilizers to crops.

The automatic system plays an important role in all sections of societies, organization, industrial units. The objective of this project is to developed microcontroller base machine. This would help in on-farm operations like seedling, fertilizing, and spraying at predesign distance and depth [3]. The machine can be control remotely and solar panel is used to charge DC battery and can be directly charge through electrical supply and whole process is control by microcontroller.

## II. DESCRIPTION OF PROPOSED SYSTEM COMPONENT

### A. Solar Panel

A solar cell or photovoltaic cell converts light energy into electricity. The solar constant on earth is found to be  $1400 \text{ Wm}^{-2}$ . This is the solar constant at earth distance from the sun, of which 60% ( $840 \text{ Wm}^{-2}$ ) penetrates the atmosphere. This is the peak power at noon, when the sun is at the zenith and the sky is clear. Let us assume  $500 \text{ Wm}^{-2}$  solar power intensity every day for 10 h. The total energy available per day is thus  $5K \text{ hm}^{-2} \text{d}^{-1}$ .

In this project the 10W solar panel are used which charge 12V, 7.2Ah battery.

### B. Ultrasonic Sensor

There are two ultrasonic sensor are used having maximum distance range is 15ft and power supply is 5V. An ultrasonic sensor transmits ultrasonic waves into the air and detects reflected waves from an object (plant). The relationship between the distance up to the object  $L$  and the reflecting time  $T$  is expressed by the following formula [5]

$$L = C \cdot T/2$$

Where,  $C$  is the velocity of sound. That is, the distance to the object can be ascertained by measuring the reflection time involved in reaching the object. Fig. 1 shows block diagram of ultrasonic sensor.

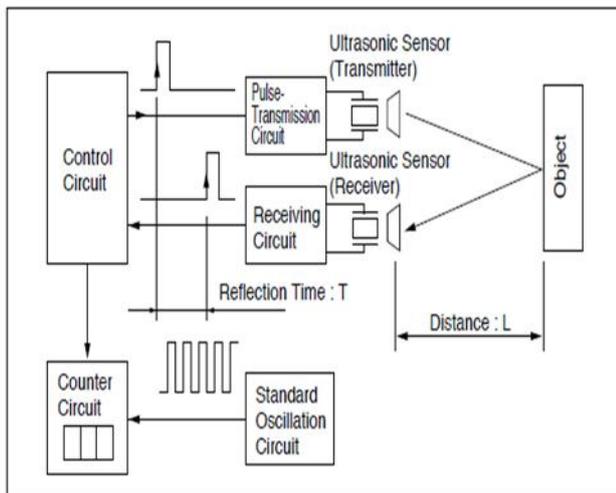


Fig. 1 Working of Ultrasonic Sensor

### C. Mother board

The motherboard consists of the PIC18F4620 micro controller, four crystal modes and operated in ten different oscillator modes [7]. The PIC microcontroller is the main controller which drives the entire machine. It gives command signals to the driver circuit which drives the PMDC motor to run the machine. Optocouplers are present in the motherboard these are optically coupled and electrically isolated with the driver circuit [1]. This protects the microcontroller and ensures that data leaves the microcontroller and no external data enters the microcontroller. To program the microcontroller Embedded C is made use of. The program controls the movement of the stepper motor and PMDC motor. The pin diagram are shown below in Fig. 2

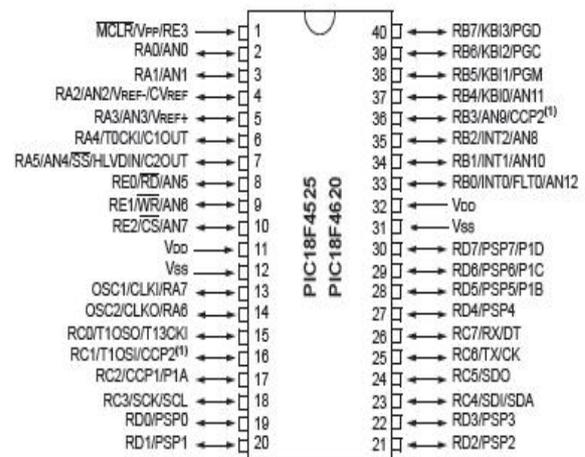


Fig. 2 PIC18F4620 Microcontroller

The core features of the PIC18F4620 are as follows

- 1) 100,000 Erase/Write Cycle Enhanced Flash Program Memory Typical.
- 2) 1,000,000 Erase/Write Cycle Data EEPROM Memory Typical.
- 3) Flash/Data EEPROM Retention: 100 Years Typical.
- 4) Self-Programmable under Software Control.
- 5) Single-Supply 5V In-Circuit Serial.

### D. Stepper Motor

There are 3 stepper motor are used two for fertilizer sowing and one for seed sowing below Table 1 shows specification and range of a stepper motor. A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. The advantages of stepper motor are the rotation angle of the motor is proportional to the input pulse and the motor has full torque at standstill.

Table I Range for Stepper motor

Sr. no.	Specification	Range
I.	Power	125 W
II.	Rated Voltage	12 Volt
III.	Rated Current	1.2 A
IV.	Rated Speed	200 rpm
V.	Rated Torque	70 Nm

### E. PMDC Motor

The permanent magnet DC motor (PMDC) are used to run the machine in field. There are four PMDC motor are connected to four wheels with the help of chain as shown below in fig. 3.

The stator is the fixed part of the motor, in which the rotor turns. The stator consists of a pair of permanent magnets aligned so that poles of opposite polarities forces each other. Thus one magnet has its North (N) pole close to the armature, while the other magnet has its South(S) pole close to the armature. Therefore, lines of magnetic field pass from one permanent magnet to other through the metallic armature. The rotor is the rotating part of the motor. It consists of a wire loop mounted on a rotary metallic armature.

Reasons for using PMDC motor over other motors

- 1) Desirable torque versus speed
- 2) Simple control of torque and speed
- 3) High electromagnetic power supply
- 4) Inverter set are not required

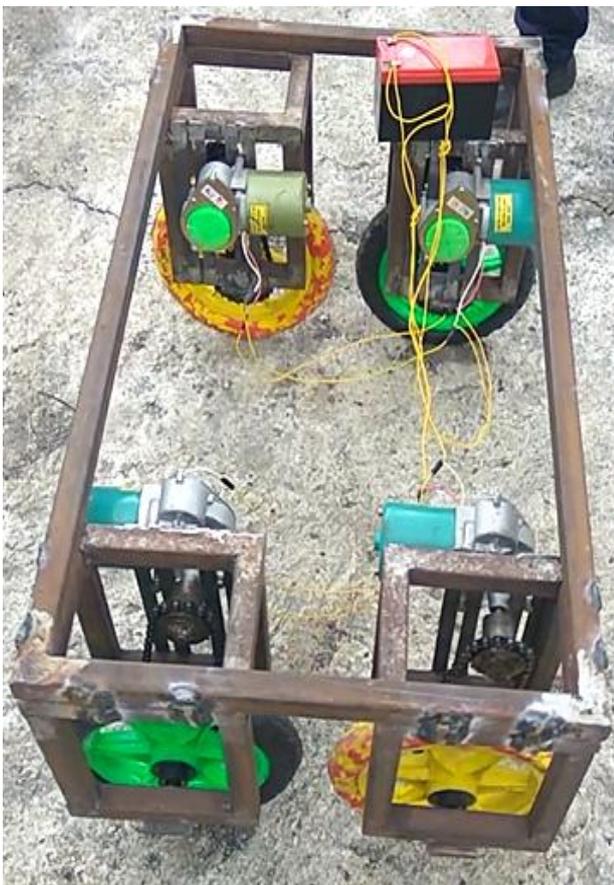


Fig. 3 Working Model

### III. WORKABILITY

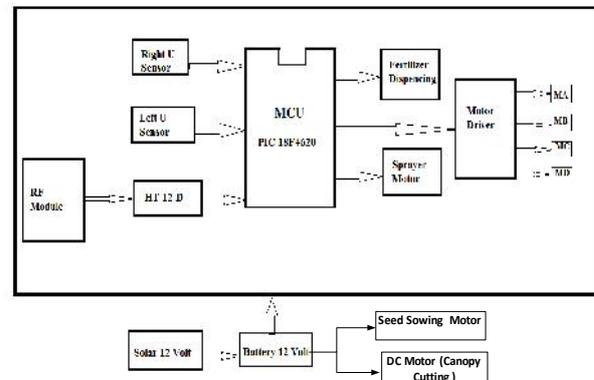


Fig. 4 Block Diagram of Multipurpose Agriculture Machine

### Power demand of machine

The total power (W) required for machine is energy (W) done in time (t). Energy is the force (F) needed to proceed times distance (x). Where, speed (v) is constant.

$$P = W/t = (F.x)/t = F.v$$

F can be determined by two ways: a slope angle ( ) and rolling friction (μ), which in field conditions consider as 0.1. The resistant force due to rolling friction is μ N, where N is the normal force, of the order of mg, where m is the machine mass and g= 9.81 m s<sup>-2</sup> is acceleration due to gravity. The resistant force due to slope up wards is m. g. sin( ), where, sin( ) is around 0.1 as well. When the work, for example fertilizer sowing, is denoted by W, the total energy requirement of the machine is:

$$F = (\mu + \sin( )) m.g.x + W$$

The total mass m consists of mass of machine, battery and mass of tank(m<sub>t</sub>) (fertilizer, seed, and water). The mass of battery (m<sup>b</sup>) can be determined by energy requirement E and energy density E<sub>b</sub>(kJ kg<sup>-1</sup>):

$$m_b = E / E_b$$

The force F is given by,

$$F = a (m_t + m_b) + W = a (m_t + E/E_b) + W$$

Where, x is the distance can be calculated by area and working width w:

$$x = A/W$$

We can now calculate the energy requirement by the machine and tank mass, the battery energy density in field area.

#### A. Fertilizer Sowing

The nutrients for the crop are delivered as NPK fertilizer. The necessary amount of fertilizer for the whole growing season is about 300 kg/acer<sup>-1</sup>. However, growing conditions of fertilizer for the upcoming season cannot be known in advance. Therefore the fertilization must be divided into several doses during the season, according to the growing conditions and the crop demand. At the initial time of fertilizer sowing could be 100 kg/acer<sup>-1</sup>. We assume that the additional fertilizer dose is applied of about 100 kg/acer<sup>-1</sup>. The robot does not need to carry this whole fertilizer all the time, since the mass reduces constantly during the work. The fertilizer sowing process can perform by pipe mechanism with the help of ultrasonic sensor. The sensor can sense obstacle (plant) and sowing pipe in soil at depth of 5 to 6 cm then fertilizer is feed in soil.

#### B. Pesticide Spraying

Sprayer is mounted at back side of machine. The sprayer is consist of two nozzle connected with a sprayer motor (12V, 1A). The spraying motor is used to spraying pesticide on crop. A spraying motor of high speed is used to spray pesticides at proper velocity and pressure. All pump water is stored in water tank so that there is constant supply even in bad weather condition.

#### C. Seed Sowing

The penetration level of seed is dependent on soil type and previous cultivation history but generally one can assume that cultivated soil layer (10-20 cm) [5]. However, in the seeding layer of soil (5cm) the penetration pipe will mostly never exceed 6cm depth in soil. For sowing with minimal soil disturbance small seed holes are needed. The length of the seed is about 5 mm and thickness 3 mm, so we need a round hole with 5 mm diameter. The holes can be made by continues penetration of pipe at a certain depth (6 cm) in soil.

#### D. Crop Control(*canopy cutting*)

Crop control is a task where machine have a great potential. The machine can be used to destroy crop canopy mechanically by using motor. If a machine is moving in the canopy during the growing season the row spacing must match the machine width or the machine track width. Only this way a machine can perform tasks in the field during the growing season.

#### IV. PRICE OF MACHINE

The solar cell (10W) price at the cheapest is currently about 100Rs/W<sub>p</sub>. Where, W<sub>p</sub> is the peak power (at 100W). Since we assume the sun intensity during the 10 hour period to be 50 W in average. So the total cost of solar cell is 100Rs/W. There are two battery (lead-acid 12V, 7.2Ah) are used each current price is 1000Rs. The four DC motor are used connected to four wheels each price is 1500Rs. Also three stepper motor are used for fertilizer and seed sowing each price is at 900Rs.

#### V. CONCLUSION

Indian agricultural productivity is very less compared to world stand-arts due to use of obsolete farming Technology coupled with this, lack of understanding of the need for Automation in the poor farming community has made things worse. These problems can be efficiently solved by adoption of this machine. The main purpose of this machine is to automate agricultural operation. Here with the help of machine the Seeds and Fertilizers are been displaced in the soil in the proper proportion hereby reducing wastage of Seeds and Fertilizers. This machine not only facilitates the fertilization operation but also provides cutting and spraying facility. This automatic way also reduces labor requirement and problem of carrying heavy load of Pests over shoulder. It is true that the initial cost of reposed system is little more but running cost is less. The machine can be designed with chain roller instead of normal wheel. Hence, machine can be applicable to real time agricultural field.

#### VI. REFERENCES

- [1] A. P. Godse, D. A. Godse, *Microprocessor and Microcontrollers*, Technical Publications Pune, First edition 2009
- [2] Abdurrahman, Mangesh Kolhi, UmeshKoriAhmadakbar *Solar Based Seed Sowing Robot* International Journal of computer Science Trends and Technology (UCST) - Volume 5 Issue 2, Mar-Apr 2017
- [3] Prof. P. S. Gorane, *Multipurpose Seed Sowing Machines* International journal of Advanced Technology and science-Vol. 4, Issue No.12 December 2016.
- [4] Jean Lamazou and Paul Lamazou *Single Seed Sowing Machine* US Patent 2991909 Patented - July 11, 1.961.
- [5] <http://www.murata.com/>
- [6] "Ultrasonic Sensor," Data Sheet
- [7] "PIC18F2525/2620/4525/4620" Data Sheet