ABSTRACT
This article addresses improvement in agriculture processes like automatic planting of seeds on ploughed land by using robot. We have developed a robotic vehicle having four wheels and steered by DC motors. The seed planting mechanism is fitted on the vehicle to plant the seeds in uniform manner. The enhanced agriculture robotic system architecture gives us the opportunity to develop a complete new range of agricultural equipment based on small smart machines. The machine will cultivate the farm by considering particular rows and specific column at fixed distance depending on different seeds. The obstacle detection problem will also be considered, sensed by infrared sensor. Forward movement of the vehicle can be defined by defining delay to microcontroller. Turning of the vehicle can be obtained by position encoder circuit which is fixed to one of the wheel. The complete assembly can be powered by using 12V rechargeable battery. The battery can be charged by using solar panel which is also mounted on robot. Assembly language is used in programming the microcontrollers. The whole algorithm, processing, monitoring are designed with dc motors, sensor and encoder circuit. The result obtained through activation unit is also presented.

KEYWORDS: Autonomous vehicle, cultivation processes, seed planting mechanism, obstacle detection.

INTRODUCTION
In India, near about 70% people are dependent upon agriculture. As compared to other fields globalization in agriculture system is less. So, it is necessary to make some advancement in this field. A man with pair of bullocks can be replaced by manned tractors. Because of this the man power can be reduced. To improve the accuracy man-less tractors can be introduced. But they failed to embrace the complexity of real world. To overcome this difficulty automated compact robot can be made to obtain specific results.

This paper presents advancement in agro-robotic system by considering a compact robot which will work automatically by using ATMEGA 89C51 microcontroller. It consist of IR sensor to detect any obstacle in front of vehicle. It has encoder IC which is placed at rear wheel to get exact 90 degree turning. By defining delay, we can find out specified distance travelled by robot. Seed planting mechanism can be done by fifth DC motor which is placed on the top of the vehicle. Rotating mechanism is used to have uniform distance between two seeds. Feedback mechanism is used to drive the fifth motor. It works when the vehicle is going straight line & it will not work while turning the vehicle and changing the row.

The whole assembly is operated on +12V rechargeable battery. The battery can be charged by placing solar panels on the vehicle.

CULTIVATION PROCESSES
There are so many different processes in the farming system like ploughing, seeding, fertilizing, weeding, harvesting, spraying etc. which require large amount man power. So, to reduce this problem from rural area, the advanced implementation in farming should be necessary. The various processes in farming are explained as below.

1. Seed bed preparation
The process of preparing a bed for cultivating a seed in ground is called as “ploughing”. It is primary farming process in which effectively mixing of top soil to prepare a seed bed is processed.

2. Seed mapping

The process of recording the geospatial position of each seed passively as it goes into the ground is called as “seed mapping”.

3. Seed placement
The process of placing seed at a particular seed position is called as “seed placement”. Rather than only record the position of each seed it would be better to be able to control the seed position.

4. Reseeding
This is the concept of being able to identify where the seed was not placed and can automatically place another seed in the same position.

METHODOLOGY
In this project, seed planting system for different crops is represented. As we are aware that, the distance between two seeds is different for each seed. The technique of seed planting in unploughed land is based on row per column with fixed standard distance. The distance between two seeds can be set by using different wheels depending upon number of teeth. As we change number of teeth of rotating wheel placed on robot for seed planting, we can get different readings for seed placement. The distance travelled by robot and distance between two rows can be set by defining delays to the microcontroller using software implementation.

The hardware implementation of project is shown in Figure 1. The system includes four 100rpm dc motors to drive the vehicle. It includes one 10rpm dc motor for seed planting mechanism, IR sensor, Position encoder, Buzzer, 12V rechargeable battery and a solar panel. This whole assembly is controlled by ATMEGA 89C51 microcontroller.

The dc motors of the vehicle are designed to move the vehicle in forward direction. These dc motors will rotate clockwise for defined delay. While moving the vehicle in forward direction if there is any obstacle present in front of vehicle, it can be detected by IR sensor which is placed at front side. When any obstacle is detected IR sensor will send the signal to microcontroller. At this time, vehicle will stop and buzzer will be ON until the obstacle is removed.

After defined delay, the robot can automatically turn left/right with 90° angle. Exact 90° angle can be obtained by position encoder. The distance between two rows is fixed. According to this robot will travel that distance and it will turn again 90° in left/right direction. So the robot will take 180° turn to go into second row. During second row, the turning direction is different i.e. right/left. Such process is repeated. In this way the working of this system takes place.

ROBOTIC SYSTEM
A robot is a combination of hardware and software on the basis of which it will do the particular work effectively. When considering this project following points can be considered.

1. Mechanical view
In this project, the design of robot plays a vital role. Because, we are using this robot in ploughed land where surface of the land is not uniform.

Fig. 1 Hardware implementation of Robotic system

Fig. 2 Design of Robotic system
As shown in fig.2, the robot consists of four vehicles which can be run by dc motors. The design of the system is compact, self operated and can work in small land for applications of cultivation in agriculture system. The system is designed such that it will go in a straight line without any mechanical errors. It consist of rotating gear type mechanism which consist of teeth. It can be rotated with the help
of dc motor. If the distance between two seeds is more then we have to use less number of teeth and if we want the distance between two seeds is less then we can use more number of teeth to this driving mechanism.

2 Solar Panel

Now a days, everyone is aware of natural resources available in life. The best natural resource for generation of electricity is from sun. This can be done by using solar panel.

Solar panel cab be work on photo-voltaic effect. A solar cell is a solid-state electrical device (p-n junction) that converts the energy of light directly into electricity (DC) using the photovoltaic effect. The process of conversion first requires a material which absorbs the solar energy (photon), and then raises an electron to a higher energy state, leading flow of this high-energy electron to an external circuit. A solar panel is used to charge the battery. Because of this the efficiency of the system is increased.

ALGORITHM IMPLEMENTATION

The algorithm of farm cultivation system is implemented as
1 Start the machine.
2 Initialise memory pointer.
3 Display the distance on LCD display board.
4 Check the whether the seed box is empty or full.
6 If it is empty, Buzzer will be ON and dc motor will OFF. If it is not empty, start dc motor.
7 Vehicle start to move in forward direction in straight line.
8 If any obstacle is detected, Buzzer will be ON and all dc motors will Stop.
9 If no, perform the current instruction.
10 After defined delay, Rotate vehicle 90° towards Right.
11 For defined delay, vehicle will go forward for short distance.
12 Again it will rotate 90° towards Right.
13 During second row after defined delay vehicle will rotate 180° in left direction. This process is repeated.

RESULTS AND DISCUSSION

The result of this project can be experimented on different seeds such as jawar, soya, wheat by considering different number of teeth to the wheel. When we are placing different seeds, the distance between two seeds will vary according to the requirement of user. So this system is flexible. While taking result, the performance of vehicle in ploughed land with and without load can be considered.

Here are some advantages of Enhanced agriculture robotic system over other systems.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Parameter</th>
<th>Manual</th>
<th>Tractor</th>
<th>Seed planting robot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Distance between seeds</td>
<td>Not fixed</td>
<td>Not fixed</td>
<td>Fixed</td>
</tr>
<tr>
<td>2</td>
<td>Sowing Technique</td>
<td>Manual</td>
<td>Manual</td>
<td>Automated</td>
</tr>
<tr>
<td>3</td>
<td>Seed wastage</td>
<td>More</td>
<td>Moderate</td>
<td>Less</td>
</tr>
<tr>
<td>4</td>
<td>Required energy</td>
<td>More</td>
<td>Moderate</td>
<td>Less</td>
</tr>
<tr>
<td>5</td>
<td>Accuracy</td>
<td>Less</td>
<td>Moderate</td>
<td>More</td>
</tr>
<tr>
<td>6</td>
<td>Man power</td>
<td>More</td>
<td>Moderate</td>
<td>Less</td>
</tr>
</tbody>
</table>

Table 1. Comparison of Seed planting systems

1 Distance between two seeds in row:
In ploughed land, we have taken different readings in a row for 6, 8 and 10 teeth. From these readings, we found that seeds are planted at defined distance. Table 1 shows different experimental readings.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Number of Teeth to the rotating wheel</th>
<th>Required distance between two seeds in mm</th>
<th>Actual distance between two seeds in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>45</td>
<td>42-44</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>75</td>
<td>68-72</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>150</td>
<td>143-145</td>
</tr>
</tbody>
</table>

Table 2. Distance between two seeds

2 Speed of vehicle depending upon moisture:
The speed of vehicle is only depends upon moisture level of soil. We have taken different results to the speed of vehicle as shown in Fig 3. The red column shows standard level of moisture for those seeds. The red column defines the good performance with characteristics as explained bellow.
CONCLUSION
This paper has presented progress towards achieving a future precision autonomous farming system. This system is designed to plant the seeds effectively. With this compact design of robot, it is possible to plant the seeds in ploughed land. The system can be automated by using IR sensor, solar panel, dc motor, position encoder. IR sensor will help to detect any obstacle present in front of vehicle.
This system can be operated on +12V rechargeable battery. The accuracy of seed planting can be obtained. This system will reduce labour problem in future. So this system will be the best replacement for currently used systems.

ACKNOWLEDGEMENTS
We are pleased to publish a paper on ‘Enhanced agriculture robotic system’. As it will help to improve the technical aspects in agriculture field. We are jointly made every possible efforts to eliminate all the errors in this paper.

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