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A Multipurpose Cognitive Agricultural Robot

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Abstract—***Agriculture is the major habituate of human life. Present days suffer from increased population and decreased agricultural productions. Automation is required to speed up the work and to get greater benefits. Robots play a major role in work automation. Robots have many fields of application in agriculture. Harvesting automation has been currently used. This paper provides implementation of a robot that is used for multiple purposes such as ploughing and seeding in agriculture. The main focus is on Ploughing and seeding automation. This robot is constructed in such a way that it can perform both the works of ploughing and seed spreading at the same time. It is capable of spreading the seeds in the fields while ploughing itself. It is built with the cognitive ability to detect the obstacles and also the end of the fields. The robot can take appropriate actions when it is supposed to the unexpected conditions. The constructed robot has been experimented with simulated environment within the limited distances with groundnuts used as the seeds to spread. In real time it can be used for longer distances and the seeds can also be changed depending on the requirement by increasing the sensor capacity and power requirements of the motors used. This robot serves as a multipurpose robot for agricultural application.***

Index Terms— Cognitive robot, multipurpose robot, agricultural robot

I.INTRODUCTION

A robot is an electromechanical device which performs complex tasks easily by software programming. It is used as a mechanical and artificial agent. Agricultural robots are used in the automation of various biological systems such as agriculture, fishery, horticulture and forestry. Automation of conventional works in agriculture has resulted in increased yields and benefits for the cultivators. This also resulted in decreased time and cost.
Cognitive robotics is an emerging branch of research in engineering. Cognitive Robotics is concerned with the Cognitive activities such as perception, vision, prediction, Action, remembrance, acquisition and analysis. Cognitive robots can learn from experience, from teachers and from other sources to develop the ability to deal with their environment according to the situation. The primary goal of a cognitive robot is to take appropriate actions in the real world situations.

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II. WHY TO USE ROBOT IN AGRICULTURE

Robots have been used to perform the various agricultural tasks automatically. Conventional agricultural methods are ancient and consume human energy. Human need rest while robots can work continuously and don't need rest. Robots can work in hazardous environments where user may not be able to go and work. Robots can be used to detect the presence of diseases, weeds, infections by the insects and other damages to the crops and their parts. Robots can work with smaller sized wheels even in muddy soils.

Agricultural robots are preferred more over the others. Robots perform agricultural operations such as spraying, weed control, fruit picking, watching the farms 24 hours and reporting. Use of robots enables the farmers to reduce the environmental impact, increase efficiency and precision and manage the plants in a new way.

Some of the techniques involving agricultural robots are the agricultural processes like fertilizing, ploughing, seeding, weeding, spraying, harvesting etc. All these agricultural processes require man power and need more time. Hence the agricultural robots are used to perform all these works automatically and efficiently.

III. SCOPE OF THE ROBOT

The present work aims at designing a smart cognitive robot which can be operated automatically. The goal is to develop a low cost robot that can operate with less power consumption, and can move in all the directions in the fields and take appropriate actions according to the situation. The main intention of this robot is to help farmers to lessen their manual labor, time and cost. It also enables the farmers to improve their products and get more benefits.

The objective is to fabricate a prototype of a multipurpose cognitive agricultural robot that can perform the following tasks:

- Dig the soil while going forward and place the seeds in the pathways at uniform spacing.
- Change the direction when the end of the field is detected and go to next line and travel in opposite direction to do the same task.
- The robot can automatically operate in the fields once the seeds are loaded and started.
- When an obstacle is faced by the robot in the middle of the field, then it will stop and seeks the appropriate action to be taken by the farmers.

IV. DESIGN OF THE ROBOT

This project aims at design of a multipurpose cognitive agricultural robot which is used to automatically dig the soil, sow the seeds and take appropriate actions in case of obstacles automatically. The whole system of robot works with battery power. The design is shown in figure 2.

- The base frame of the robot is made with four wheels connected by rotating belts. They are connected and driven by DC motors.
- The front end of the frame is provided by a cultivator to dig the soil.
- A Funnel made up of light weight metal sheet is placed on the top of the frame to hold the seeds and the seeds flow through the funnel through a drilled hole on the shaft to the digged soil through a pipe like arrangement.
- The whole robot requires the 12V battery to operate the system.
- Sensors are used to detect the end of the field and also the obstacles in the middle of the field.

V.OPERATIONS PERFORMED

The robot is designed to perform three operations. Ploughing, Seed Spreading and Direction Changing. Once the switched on and filled with the seeds, the robot moves forward digging and dropping the seeds at uniform distances till it reaches the end. Then it changes its direction to the left, moves forward for the specified space and turns right and moves backward direction till it reaches the opposite end. On the other end, it turns right for specified distance and the left and moves forward. This process will be continued till the end of the field. The robot is programmed to stop in three cases: When work completed, When an obstacle in the middle, and When no seeds or power.

VI. EXPERIMENTAL RESULTS

The operations performed by the designed robot have been controlled using ATMEL microcontroller. It has been programmed in C Language. Groundnuts were used as test seeds to be spread. The field has been arranged for one square meter area with equal spacing. The robot has been tested in the normal case. No obstacles were placed, and the robot has perfectly moved forward, digging the soil and placing the seeds. This robot has taken the left and right directions simultaneously when it encountered the end of the field and moved in opposite direction as shown in the figure.

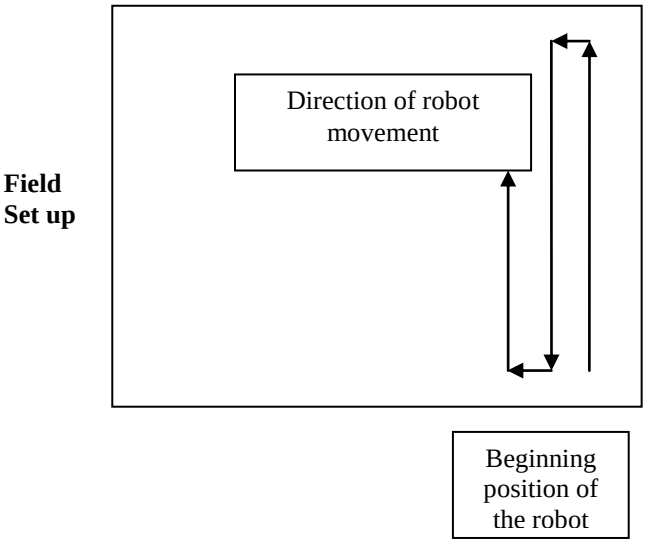

Fig 1: Field arrangement and the robot movement

The other case is where the robot is placed with an obstacle in the middle of the field and tested. When the obstacle was obtained before the end distance, the robot has stopped and waited for the farmer to take appropriate action.

VI I. CONCLUSION

In agriculture the use of robots enhances the productivity and reduces the human effort and cost. The automation of various agricultural activities by robots are envisioned. It has been described that the present robot can perform better and can automate more than one work simultaneously. This robot can be effectively used by the farmers.

In future this robot can be enhanced with some more cognitive capabilities and also to take appropriate actions even in the absence of the farmers. It can be induced with human interaction and also learning from experience.

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Fig 2: A Multipurpose Cognitive agricultural robot