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Design and Fabrication of Crop Analysis Agriculture Robot

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Abstract

Traditional methods are still followed in the field of agriculture, which are outdated in the current world of technology. There is a vast demand for automation in various fields of agriculture. In this paper an attempt is made to automate one of the fields of agriculture which is crop growth monitoring. The main objective of this paper is to monitor crop growth using modern tools and techniques, in order to reduce the time required, capital invested and labor required for the job when done manually.

Keywords: *agriculture; automation; image processing; micro controller;*

1. Introduction

Agriculture is the major source of economy in India. Agriculture is one of the oldest professions that exist in the world. The methods that were used in ancient days are still followed in a modern world. The methods used in the field of agriculture are very much outdated which has resulted in a huge loss to the farmers, hence there is a high demand for the use of modern tools and techniques to maximize the profit and get the good yield.

For crop growth monitoring, to identify weeds and to remove them the farmers need to get into the field manually, identify the respective plants and take necessary actions. Generally farmers spray the fertilizer and pesticide uniformly to all the plants irrespective of their need, even if the plants don't require the fertilizer or pesticide but is still sprayed to the plants which have resulted in a high content of chemicals in many vegetables and fruits.

In order to overcome all this, a robot is proposed using which the crop growth, weed identification and their removal, determine the amount of fertilizer and pesticide required and to spray as required based on the analysis.

By using the proposed robot it is possible to minimize the time required to complete the job, capital invested for the purpose, labor required to remove weeds and to reduce the wastage of the fertilizer and pesticide.

2. Methodology

The robot will be developed using a series of procedures as indicated in the flow chart:

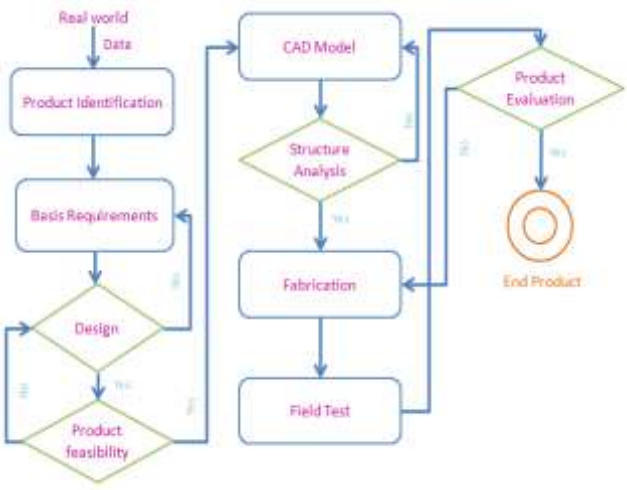

Fig1: Methodology for product fabrication

2.1 Product Identification

Based on the data obtained from the real world examination the area of interest for automation is identified. In this paper the area of automation is crop growth analysis and monitoring. In the current scenario the farmer does the job manually, he gets into the field to know about the growth of the plants, to identify the weeds and to spray the fertilizer and pesticide. Normally the farmer sprays the fertilizer and pesticide uniformly throughout the field to all the plants but some plants require lesser fertilizer and pesticides but are given with more of fertilizer and pesticide. The use of high amount of fertilizer and pesticide has resulted in the high content of chemical in the crop which makes the product harmful and unfit to consume.

In general one of the problems the farmers face is that, one of the plant get infected and the infection spread among other plants resulting in a loss.

By considering these facts with some of the other facts a robot is designed which the job at minimum costs, in less time and much accurately.

2.2 Basic Requirements

The purpose of the robot is identified in the above step, in this step based on the data obtained earlier step and by conducting various literature surveys the requirements of the robot are identified. This includes the requirements of the mechanical structure for its motion.

Some of the basic requirements of the robot are:

- Steering
- Motors
- Power supply
- Dimensions
- Control unit
- Streaming system

2.3 Steering

There are various types of steering mechanisms known, in the proposed robot Ackermann steering system is used because of its simple design and good accuracy. Ackermann steering method works on the principle of difference in the angle between the outside and inside wheels. This method is generally employed in road vehicles.

2.4 Motors

Motors are required for drive mechanism and steering mechanism. DC motors are used in this robot.

2.5 Power supply

Since the robot is made as a portable device it is prescribed to use batteries for the power supply. By considering the power necessity of the robot a 12V and 70Ah battery is used. A separate battery is provided for the hydraulic system to operate.

2.6 Dimensions

The robot resembles the shape of a rectangle. The width of the robot is equal to the width of the crop rows in the field, height of the robot is adjustable and the height depends on the height of the crop. Height of the robot is varied by using a hydraulic system.

2.7 Control Unit

The robot is controlled by using a RF controller by programming arduino board through a remote control system. Instructions are given for the robot to move in the necessary direction using a remote.

2.8 Streaming system

Image capturing is made by using a camera which is situated in the middle of the robot and is connected to the microcontroller which sends the images to the smart phone or laptop through Wi-Fi.

2.9 Design

With all the above requirements a basic design of the model which indicates all the features is developed. This design is just the basic design which will give a broader idea and design of the robot, which will be helpful in designing a cad model.

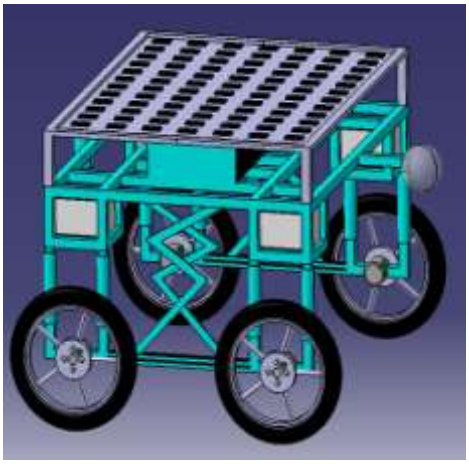

Fig 2: Basic Design

2.10 Product Feasibility

Based on the above design the feasibility of the product to fabricate, its working feasibility and various other parameters are examined. If all the parameters are feasible enough then the next step is carried on otherwise the necessary changes are made in the cad to obtain the required model.

2.11 CAD Model

By referring to the basic design a CAD model is designed using Autodesk Inventor software. CAD model represents the complete profile of the robot. CAD model indicates all the features and components of the robot.

2.12 Structural Analysis

The cad model that is developed will be made to undergo a structural analysis. The model will be simulated and be made to operate in a virtual environment. The simulation of the model will be done by using matlab. The working of the robot in a virtual environment is analyzed and if any changes are preferred then are changed in the CAD model if no changes are necessary then the model is proceeded to the next step.

2.13Fabrication

The model once satisfies the requirements to work in a virtual environment which resembles the real world then the model will be fabricated. Fabrication of the part involves various operations manufacturing processes like welding, soldering, etc. fixing of micro controllers, micro computers, coding the micro controller and micro computer, connecting the camera, etc.

The frame will be fabricated using Aluminium metal by welding. Wheels are attached to the frame to provide the motion to the vehicle, which are actuated by the motors that are powered using a battery. On the top of the vehicle is placed a micro controller and micro computer to which the camera is connected.

2.14Field Test

Once the robot is ready then it will be taken to the field to conduct a field test in order to determine the performance of the robot in a real condition. Here the robot will be subjected to varying conditions. This gives how the robot can perform in different conditions.

2.15Product Evaluation

As the robot undergoes the field test the next step will be to evaluate how effectively the robot can work in the real environment. If the robot is found to have certain lags while working in the field then the necessary changes are imparted by changing in the fabrication of the part. If the robot is found to work effectively and efficiently then the robot is ready.

3. Working Mechanism

The robot consists of micro controller which is coded to control the robot, controlling is done by a remote through RF. The micro controller used here is arduino. Camera is connected to a micro computer. Micro computer is placed in the robot to transfer the images clicked during the operation. Raspberry Pi micro computer is used in the proposed robot. Wi-Fi router is connected to the Raspberry Pi through which the micro computer is able to transfer the images to the streaming device for the processing.

The robot enters the field with the wheels on either side of row of crops. The robot operations are turned on by using a remote control. Robot is guided in different directions using the same remote control in the field. When the camera is turned on, it starts to take images continuously as the robot moves in the field. The camera sends these images to the Raspberry Pi micro computer placed in the robot which sends the images to the smart phone or laptop through Wi-Fi. These images are processed using an image processing tool.

The image processing is made in a matlab or an android app. The processing is made by comparing the images taken in the field with those which are pre loaded, that are reference images. Based on

comparison results the plants which are good, healthy, those which are under grown, infected and the weeds are indicated.

By the results, the amount of fertilizer and pesticide required for different plants are determined. Hence the fertilizer and pesticide are used as per the indication, which results in reducing the amount of fertilizer and pesticide wasted. Also reduces the chemical content in the crops making them edible.

Based on the analysis results the farmers are indicated to take necessary steps.

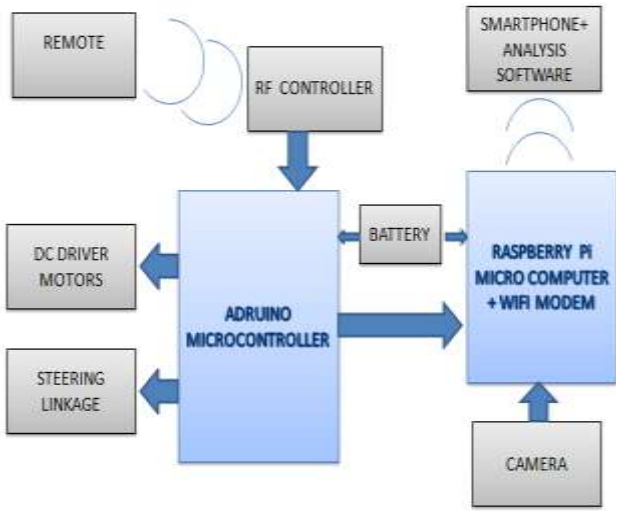

Fig 3: Working Mechanism

4. Product Expansion

The proposed robot deals with image processing and determining different types of crops in the field. As an expansion to the project the robot can be made to act as per the results of the analysis. The robot can be made to remove/burn the weeds, if any pests found then spray the pesticide only in the area where the pests are found, to spray the fertilizer to the plants which are under grown and to remove the infected plants thereby avoiding spreading of infection to other plants..

5. Conclusions

The proposed robot is expected to work effectively and efficiently in a varying environment. The robot will give accurate results without much deviation. This robot is going to minimize the various losses the farmers are currently facing. The time and capital invested on crop monitoring is reduced.

The robot is going to enhance entrepreneurship, since most of the farmers are poor and may not be able to afford to buy the robot but the service can be availed from an entrepreneur. The entrepreneur will take the tender of the land from the farmer and performs the operation in the field. Since the robot does the job at a higher speed it will not take much time hence the entrepreneur and farmer both will be benefitted by the robot.

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