

Agricultural Weeds Extinguisher with the use of ML

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Abstract - The issue of weeds in many agricultural fields, especially in the minor regions of India increases rapidly without any specific automated solution. In the past 20 years the disturbance of weeds has affected the agricultural crops in the field. Even with these technologies, there are no such existing technologies which can terminate weeds which grow in the cultivable lands, the only way to reduce the weeds have been carried out manually by plucking up individual weeds in the lands and ploughing a little with the use of agricultural tools. Gradually this takes about a week to cover at least half acre of agricultural land, even so this takes huge man power to complete the task. This paper illustrates the use of machine learning algorithms along with some technology that can be used to reduce the agricultural weeds by means of cheaper and also by saving man power.

Key Words: Agricultural weeds, terminate weeds, man power, Agricultural tools, Machine Learning Algorithm.

1. INTRODUCTION

Agricultural practice is an art, along with science in cultivating the soil to make growth of edible plants which has been carried out for nearly thousands of years around the world. In olden days people used to grow crops in order to survive from starving hunger in the form of agriculture. After passing days agriculture has been more stabilised and improvised around all over the world. In later days agriculture stands in 4th position of total earning in India across the country. The methods of agricultural practices have differed in recent times but the cultivating crops and edible plants remains the same even during these modern days.

Apart from cultivating and harvesting crops, the effect of small weeds affects the growth of plants and crops in recent days (i.e) the small plants which grows unnoticedly without any proper maintenance or nutrients would absorb all the required nutrients and nitrogen along with water from the main crop eventually affecting main crop's growth. An undeniable and expensive consequence of agricultural practices is the adaptation of weeds to agricultural systems.

Even after eliminating these weeds, the cultivable field will remain free from weeds for only a very few days, because these weeds can grow quickly in no time without any certain requirement. The only method which is used to eliminate the weeds from the field was to pluck those weeds with our free hands and plough the field with bare hands or raw agricultural tools.

This may sound easy but it takes over a huge manpower only for just a 50 cent of cultivable land, to make it clear it almost takes a week to complete the work along with huge cost. Even plucking the weeds off the fields won't be easy as it seems. Because farmers have to deliberately avoid the main crops and ploughing more extra lands in order to avoid the growth of more new weeds. There is no certain tool or chemical which can only reduce the growth of crop disturbing weeds. Due to these weeds, growth of crops affects in large scale and so the production of crops in agriculture decreases in number while the weeds increases along side. Hence the income over agriculture decreases rapidly along with food production all over the world. This is why eliminating the weeds in cultivable lands with the help of Machine learning and technical components will benefit the human beings.

2. CASE STUDY

Weed is a general term for any plant or a herb growing unwantedly. Ever since human beings first attempted the cultivation of plants in the name of agriculture, they had to fight the invasion by weeds into areas chosen for crops. Weeds are too common in growth in the areas of lawns and gardens. While some may be viewed as useful and attractive, most common types of weeds are considered a nuisance.

The definition of weeds may be defined as a plant in the wrong place. Weeds have been a great disturbance by interfering with diversity of human activities so many methods have been discovered to eliminate those weeds. These various methods of disposal of weeds vary with the nature of weeds itself, the means of hand disposal and

relation to the environment. Weeds around the golf court, cricket ground may seem useful and attractive as it can be used for decorative and ornamental purposes, but the growth of weeds in the field of agricultural sectors can be harmful and disturbing.

Certain unnamed plants with broad leaves and no efficient growth were found in the later 1600 first in the region of France, which later termed as 'weeds'. Weeds are responsible for significant crop yield loss along with a significant financial loss as well. With a focus on addressing this critical problem, the discipline of weed science has expanded over the past 50 yr into an amalgam of scientists and practitioners who ask a variety of questions to control the weed population for effective agriculture and employ a myriad of tools focused on understanding and managing weeds.

3. HISTORICAL METHODS OF WEED CONTROL

Weed scientists focus on how weed populations affect crop yield and also how to apply this knowledge to prevent, eliminate, eradicate or remove weeds, primarily through the use of herbicides, with the ultimate goal of maximizing crop production. In later periods many methods of weed control have been established and benefited.

3.1 Chemical Method

Chemical weed control method takes place over a prolonged time, sea salts, certain chemicals, industrial oils were first used to eliminate the weeds. Certain herbicides containing sulphates, nitrates, copper, iron and sulphuric acid were proved to be more efficient in controlling the weeds. The application was spraying on empty lands of cultivable soil in mixture with water. Soon sodium arsenite which is extremely costly became more efficient and popular all over the world for means of weed control. A great advantage of chemical over other weed control is the ease of application. This is particularly true in cereal croplands, pastures, rangelands, forests, and other situations where an airplane can be used. Many millions of acres are treated from the air each year, and the modern equipment for treating row-crop land with herbicides has made for weed control increasingly convenient.

3.2 Mechanical Method

Mechanical weed control methods began when the humans were out of chemical herbicides or agricultural tools and started to pull out the weeds using

bare hands through man power to attempt growth of single plant species. This became the start of monoculture, a method which later became a dominant agricultural practice. From pulling off the weeds with the use of hands, humans devised simple tools such as the spud, the knife, and the hoe to eliminate weeds. The first effort towards agricultural tools turned away from simple hand method to mechanized method in the 17th century near the region of England. Since then, there was a continuous improvement of agricultural tools which have been used to remove certain weeds off the field. Despite these improvements it is later came to know that weed knives injure crop roots, especially late in the tillage season. Moreover, agricultural tools can spread perennial weeds instantly, bringing about rapid infestation of whole cultivable fields.

3.3 Biological Method

Effort to reduce the weeds in means of Mechanical and chemical have been common throughout the world but as a new method in this field of reducing weeds there comes Biological method. An early report of 1902 suggests that certain employment of insect species can reduce the growth of weeds around the plants without any harm to cultivated plants in the field. In later development of Genetic Engineering, there comes the first genetically modified insects which can only eliminate weeds without affecting the cultivated crops. Since most of the Biological methods include Genetic Engineering, most probably costs a lot.

4. MACHINE LEARNING IN FIELD

For the purpose of making classification among the group of plants or crops, it is necessary to make a quick classification of all the crops in the cultivable field. In this special case we can use the impact of Machine Learning algorithms which can play a major role in Artificial Domain. As humans acquire knowledge either through skillful learning or via mere failure, that's how Human beings are educated and learned following these many cultural developed years. Unlike educating humans, training the computer with mere datas and algorithms have been implemented in recent years and it plays a major role in everyday life. The focus of this field was learning which the developer termed this statement as training a computer or model. Likewise training the computer, it can act independently without any of the external commands or being programmed. The main

algorithm which can be used for this process is termed as "Random Forest or Random Decision Forest Algorithm".

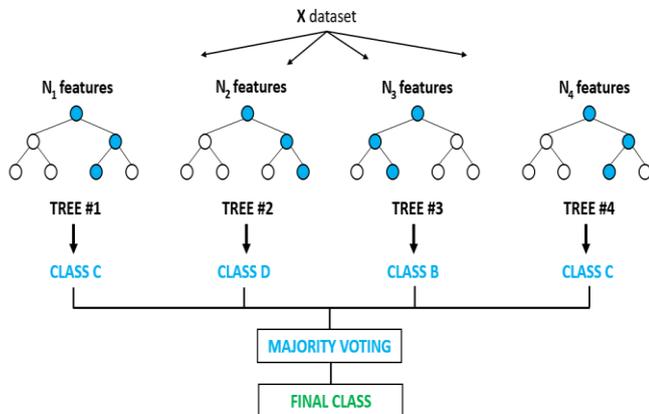


Fig 1: Random Forest Algorithm Descriptive Diagram

Random Forest algorithm or Random Decision Forest algorithm is a part of supervised classification. The name itself suggests that this algorithm can be used when there are a large number of variables present like a forest. In short there is a large number of relationships between the number trees in the forest and the result it can get, when the number of trees increases the accuracy of the result also increases. Hence larger the number of trees, larger will be the accuracy rate for the prediction.

The decision tree is termed as a decision supported tool, which often uses a tree like graph to show the possible consequences. When the target user inputs the training dataset into the decision tree algorithm, it later formulates its own set of rules which paves the way for its prediction. The Random Forest algorithm can use both classification and regression tasks at the same time, and it can also be modeled for categorical values and missing values in the dataset.

Apart from using Machine Learning in the process, Neural Networks might also be used in order to make a clear view to avoid hitting the borders of the cultivable field. For the operational robotic arm on the front part as well as the back part, separate Machine Learning codes would be used in the field. Modern use of codes for the robotic arm won't be necessary as it requires only a little basic state of Algorithm just to make an arm operate on the field.

4.1 Undergoing Task

The workflow process of a random forest algorithm is of two stages. The first and foremost stage is the classification and creation of dataset, then later undergoes the second task which is to make prediction of the dataset from the rules framed earlier.

The pseudocode of the Random forest creation algorithm is as follows.

- I. Randomly select "K" features from the total "m" features where $k \ll m$
- II. Among the "K" features, calculate node "d" using the best split point
- III. Split the node into daughter nodes using the best split
- IV. Repeat the a to c steps until "l" number of nodes has been reached
- V. Build forest by repeating steps a to d for "n" number times to create "n" number of trees

In the next stage there comes the random forest prediction which later makes the prediction from the dataset created.

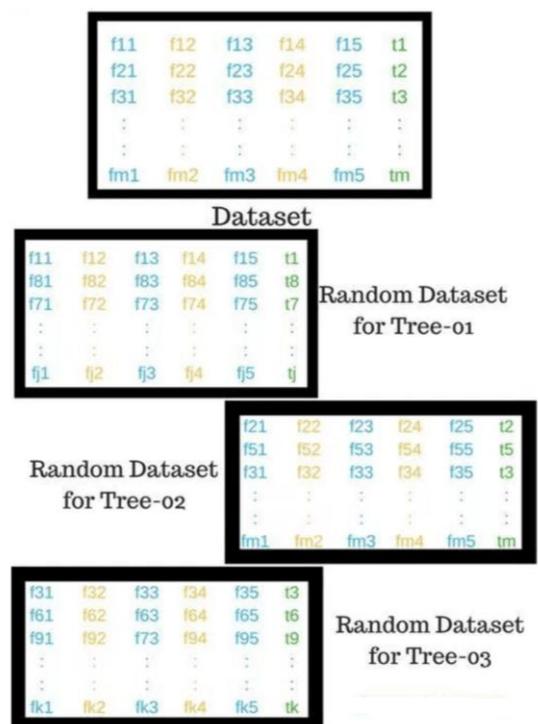


Fig 2: Random Forest creation representation

1. Takes the test features, and then use the rules of each arbitrary created decision tree to predict the outcome and stores the predicted outcome (target).
2. Calculates votes for each and every predicted target.
3. From the random forest algorithm consider the high voted predicted target as the final prediction.

5. MODUS OPERANDI

Automation of work has developed over a wide range in recent years with perfect output accuracy. In this similar way farmers can use an automated bot which can extinguish or remove the weeds automatically without being explicitly programmed or manual method. By this method of weed removal financial expenses can be saved especially in the weed reduction either in the raw uncultivated area (i.e) empty agricultural field or in the cultivated area.

Primarily the weeds in the cultivable fields should be cut or sliced with a blade containing a high powered DC motor with an approximate Speed of 20,000 RPM connected through a 24V Battery. Then eventually the field should be ploughed neglecting the cultivated crops automatically with the use of High powered DC motors containing 30Kg per cm torque along with 300RPM speed. The ploughing can be easily made with the use of a drill like a structured metal blade which should only contain 3 teeth at its end. These blades and the ploughing drill should be connected with a robotic arm containing 2 axis controlled by 20kg per cm servo motors. The exact method to make this bot is followed in the below steps.

5.1 Methology

Initially the body or the chassis of bot should be only 20 to 30 cm wide so that it can move even in the narrow regions in between the two cultivated crops. Bot is fixed with four DC motors containing a speed of 60RPM as a wheel which is followed by Tractor like structured wheel tyres in such a way the bot can even move in the regions of terrain soil.

Raspberry Pi 4 can serve as a micro controller as such a Machine learning algorithm and code could be easily programmed. Sooner two cameras for the prediction of cultivable crops at the front and back of the bot. First camera will be used to classify the crops and

weeds to the bot, in order to ignore the cultivated crops and slicing the weeds from the field. The slicer should consist of two highly sharpened blades which are externally fixed with a robotic arm containing two servo motors to operate the arm. The slicer is internally fixed with a High speed rotating DC motor of 20,000 RPM motor attached with the blade.

Eventually following the front robotic arm there is also a fixed robotic arm of same axis and two servo motors in which the ploughing drill is externally fixed. The ploughing drill should consist of a 30 kg per cm High powered DC motor with a rotational speed of 300 RPM alongside there should be a camera fixed at the back facing the drill. Drill which is fixed at the back could plough away the area with the help of camera and motors were the frontal slicer cuts off all the weeds in its part neglecting the cultivated crops with the help of camera which classifies the crops and weeds through Random forest machine learning algorithm explicitly programmed for this cause. A 24V battery is required to make a complete circuit of the Bot which is also suitable for the powered motors and servo motors.

5.2 Schematic Representation

Apart from making this bot in an easy way, a schematic representation of the bot should be required in order to get a clear perception. The schematic representation of Bot is provided below.

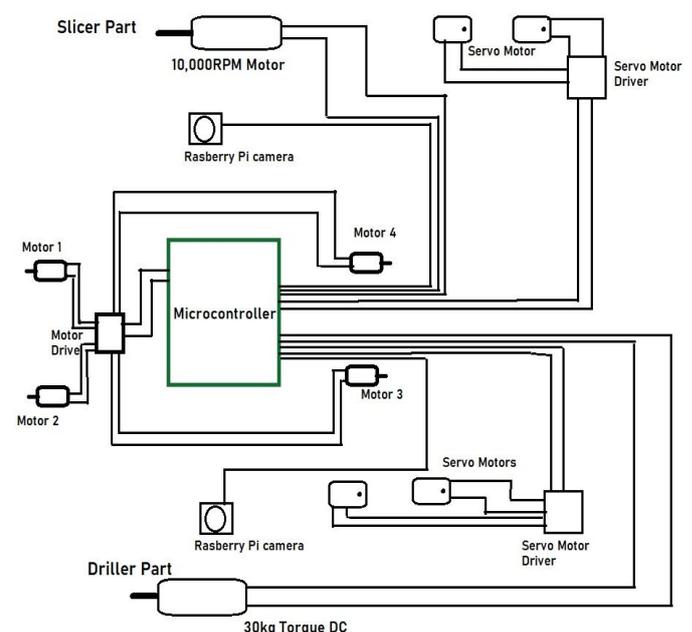


Fig 3: Schematic representation of Bot

NOTE: The battery which should be used for this bot has not been connected in this schematic diagram.

6. THEORETICAL WORKING

As the circuit connection was made in a correct order, once if the bot is turned on it moves forward then the camera plays a role in this movement by predicting the cultivated crops and avoiding it, making the robotic arm to chop only the weeds off the field. Random forest algorithm predicts the weeds and crops making its decision only to cut the weeds neglecting the stem of cultivated crops.

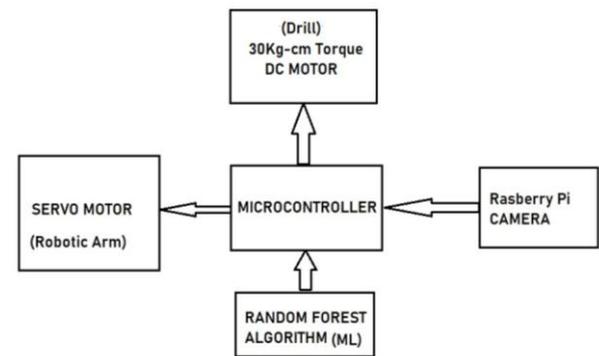


Fig 5: Block diagram of Second cycle

7. CONCLUSIONS

According to research by Agricultural scientists, in India approximately 80% of the cultivated groundnuts lack sufficient nutrients and minerals due to growth of weeds which later causes 40% decrease in the production rate of groundnut. This later caused financial loss to the farmers and also to the government. Since humans automate their day to day works sufficiently this weed reduction should also be made automated.

The Weed extinguisher bot may also cost a lot but compared to the cost spent to manual weed eradication method per year for an acre of cultivated land, it costs really much less. Hence it is necessary to make an alternative suggestion or automated idea for the process of weed eradication only in those cultivated areas. Apart from weed eradication, it may also be used in the process of ploughing the field automated.

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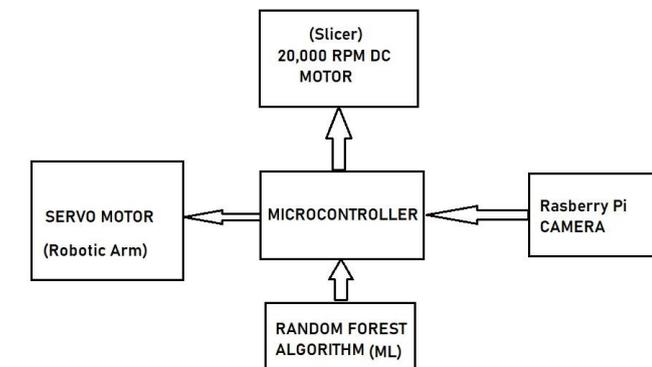


Fig 4: Block Diagram of First cycle

Gradually the drilling part of bot comes into position (i.e) fixing its teeth into the ground upon a certain level. Then the backside camera detects the cultivated crops and makes the robotic arm of the drill to deliberately avoid those areas with crops. This process takes place continuously until all the weeds are removed and ploughed from the soil. Besides this process, it can be used as a multi purpose robot serving as only for ploughing the field automatically and also for chopping the weeds respectively.

To assure there are two cycles which take places simultaneously and these two cycles are independent of each other.

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