Automated Farming and Nutrition Deficiency Detection using Swarm Bots

T. Rajasekar, M. Arun Kumar, K. Mohamed Ismail, M. Sabarimuthu

Abstract: ***Agribusiness has a critical job in the financial texture of India. Agronomy does not have sufficient workforce to exert in field due to migration of people and hence automation of farming can be used to get divest of day-to-day farming hitches. To contribute an elucidation to these glitches, the steered rover for drilling, seed sowing, and detection of victual rift using Artificial Intelligent system. Recovery system has been offered to lessen the human exertion and to speed up the work, henceforth weakening the measure of equipment required for its usage without bargaining the nature of administration. Surveying the leaf using image processing the farmer can easily be notified about the deficiency in the crops through communication protocol.***

Key-words: Drilling, Seed Sowing, Nutrition Deficiency Detection, Retrieval System, Communication Protocol, Swarm Bots.

I. INTRODUCTION

For decades, agriculture has been concomitant with the production of crucial food crops. It assumes a basic job in the whole existence of a given economy. Farming is the foundation of the financial arrangement of a given nation. In the contemporary generation most of the countries do not have ample skilled manpower in the agricultural sector, so it's necessary to automate the sector to overwhelm this problem. The objective of our automated swarm bot is helps to reduce the labor force and to lug out the agricultural task. It is a robust and feasible model with multi-functionalities as per the demand in the agricultural field. Currently, there are many agricultural vehicles like weed detector, agrochemical dispersal, terrain levelling needs manpower. But the proposed vehicle is an autonomous robot that can perform many operations like drilling, seeding, and victual rift detection. Theresults show the reduction of time taken for drilling and seeding, and it provides accuracy in spacing level between each seed. Solitary robot is powerless particularly when a minor broken piece of the robot may influence the whole framework and it's challenging to visualize what will occur.The automated swarm robotics can accomplish a similar capacity through between bunch collaboration and exploits reusability of the straightforward specialists and the ease of development and support. The infected leaf is surveyed using support vector machine and provides the fertilizer to avoid increasing the major damage of diseases to the process. A diagnostic system using Neural Network (Support Vector Machine) would analyze the inadequacy indications a lot sooner than human eyes could perceive. It additionally proposes basic activities in the component for high effectiveness of the framework and straightforward correspondence convention to guarantee quick moderate information trade. This will empower the ranchers to receive fitting therapeutic activity in time.

II. METHODOLOGY

The automated farming swarm robot is powered on and placed in the corresponding areas. The instruction is given to the robots however wireless modules. On reception, drilling mechanism is first enabled which consists of drill and to and fro rotary in order to drill the loosened soil according to the controller data. Secondly, seeding mechanism is empowered to drop seeds one by one at the respective places from the seed tank which is placed over the bot. Once the plantation process gets over, the bots persistently screens the harvests all through the development time frame.Recovery framework is utilized to screen the harvests as the camera captures the leaf samples and MSVM algorithm is used to identify and classify the sample leaf.

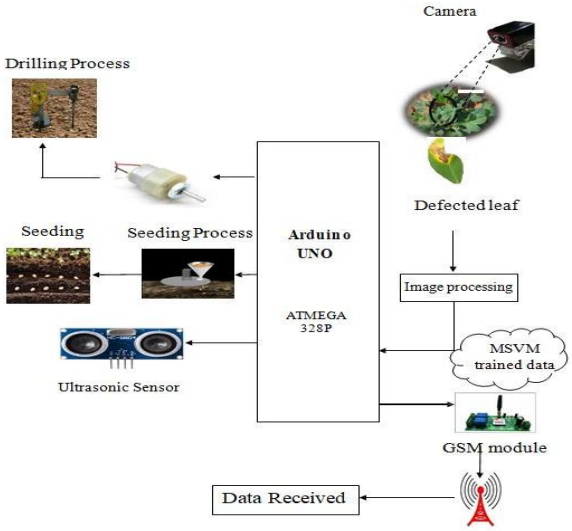

Fig.1. Block Diagram of the design

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III. HARDWARES

A. Arduino Uno

Arduino Uno turned out to be progressively famous controller as a result of its extremely valuable highlights. It is exceptionally advantageous to oversee control inside it and it had an element of implicit voltage guideline. It is much opted to operate in an agricultural environment because it consumes very less power. In our swarm bot the ultrasonic sensors, drilling unit, seeding unit, camera and GSM module are connected to the microcontroller.

B. L293D Driver

Drilling module is interfaced to the Arduino Uno microcontroller through L293D Driver.We used1000 rpm motorwhich is utilized to help the boring procedure for seeding process as speedier.

C. GSM Module

The automated farming robot receives the communication through GSM Module.The security methodologies institutionalized for the GSM module make it the most secure broadcast communications standard presently available.GSM will permit correspondence anyplace, whenever, and with anybody.

D. Ultrasonic Sensor

It is interfaced in the robot which prevents the collision to obstacles in the robotic path. It assigns partition by sending a sound wave at a specific repeat and tuning in for that sound wave to skirt back. By recording the sat back between the sound wave being delivered and the sound wave avoiding back, it is possible to discover the partition between the ultrasonic sensor and the item.

Fig. 2.Robot Design

IV. AGRICULTURAL PROCESSES

A. Drilling

Drilling module is positioned inside the robot intricate to the metal bar. Earth soil is different in different places; the hardness of the soil will vary. For that, the driller needs to be robust and shriller. To satisfy the requirements, we made a 12 mm earth leaf bit to drill the soil for placing the seed. Leaf drill bit is used in drilling process, since it can withstand corrosion and can efficiently perform drilling task in clay mud. It is connected to the end of the motor. A 1000 rpm motor is connected to the l293d. This drilling mechanism is controlled by Arduino Mega board to make a hole likewise one by one in a row with equal distance on given. The size of the hole can be varied by changing leaf bit with different dimensions.

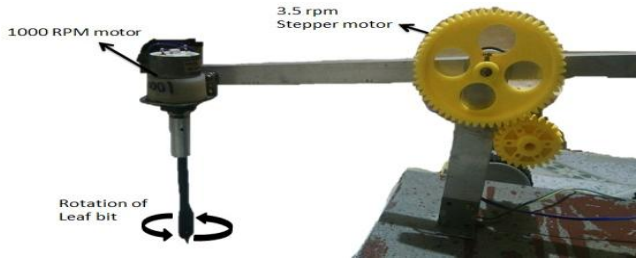

Fig.3. Drilling process

Leaf drill bit is used in drilling process, since it can withstand corrosion and can efficiently perform drilling task in clay mud. It is connected to the end of the motor. A 1000 rpm motor is connected to the l293d. This drilling mechanism is controlled by Arduino Mega board to make a hole likewise one by one in a row with equal distance on given. The size of the hole can be varied by changing leaf bit through different dimensions.

B. Seeding

Though a numerous number of operations accomplished in the agricultural field, the substantial operation is seed sowing. Seed tank is placed on the bot to place the seeds with some specific gap. Seeds are dropped individually from the hopper. The rotating disc which rotates continuously via 500 rpm motor is placed at bottom of the farm bot. When the hopper meets the hole of the disc, the seeds are dropped into the soil. By utilizing this instrument, we can plant seeds in particular rows and columns. This gauges the quantity of plants that has been put and furthermore the result of the item.

Fig. 4.Seeding process

C. Nutrition Deficiency Detection

Because of the combined expenses of harvest generation and to the advancing natural contamination by agrochemicals, mineral fertilizers ought to be applied all the more productively.The image processing analysis is used to find the nutrition deficiency of the plants. We have implemented the Multi class Support Vector Machine (MSVM) to extract the features like contrast, correlation, standard deviation, variance, homogeneity and skewness from the captured image.

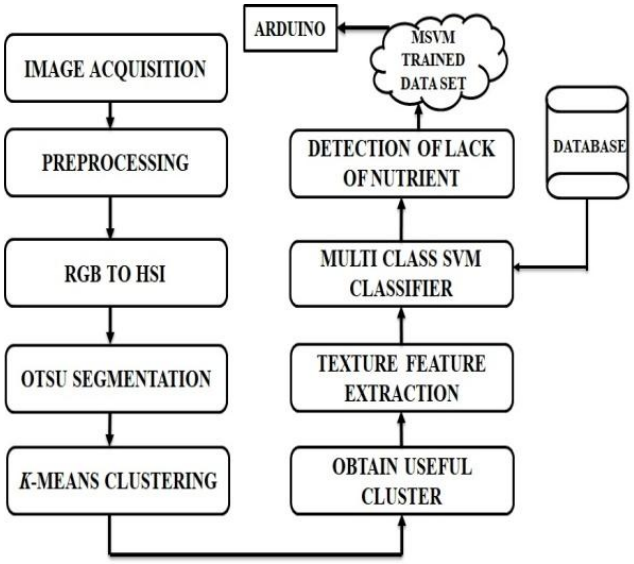

Fig. 5.Flow Chart of Image Processing Technique

The manifestations of victual break in plants are some of the time difficult to assess outwardly, consequently a computerized shading picture investigation is helped to decide critical changes in the shade of leaves of different plants developed under states of sustenance inadequacy.At the point when people see a shading object, the article is portrayed by its brilliance orintensity (I), hue (H), and saturation (S). It is represented in equation from (1) to (3).

$$H=\begin{cases}\boldsymbol{\theta} & ,\boldsymbol{if B<G}\\ \boldsymbol{360^0-\theta} & ,\boldsymbol{if B>G}\end{cases} \dots (1)$$

$$\boldsymbol{\theta=\cos^{-1}\left[\frac{\frac{1}{2}[(R-G)+(R-B)]}{\left[(R-G)^2+(R-B)(G-B)^{\frac{1}{2}}\right]}\right]} \dots (2)$$

$$\boldsymbol{S=1-\frac{3}{(R+G+B)}} \dots (3)$$

where RGB means Red, GreenandBluewhich represents the color of the pixel.

We implemented the clusteringmethod which segregatesdesiredinformation from the large number of collected data. We apply K-means cluster in the image processing analysis to extract the required plant nutrient deficiency from the infected leaf image. The color of the leaves indicates the nutrient deficiency of the particular plant.

Extracted texture features are listed below from equation (4) to (7):

Standard Deviation

The standard deviation is employed to survey the extent of collection or scattering of a huge amount of information respects.The low standard deviation shows that the information brings up out over a more extensive scope of qualities.

$$\boldsymbol{\sigma=\frac{1}{N}\sum_{i=1}^{N}\sqrt{(x_i-\mu)}} \dots (4)$$

Variance

The dispersion (with regard to the mean) of the gray level distribution was calculated by using formula:

$$\boldsymbol{variance=\sigma^2} \quad \dots (5)$$

Homogeneity

Returns a worth estimates the closeness of the distribution of components in the GLCM to the GLCM diagonal. Homogeneity is 1 for a diagonal GLCM. Inverse of complexity weight is homogeneity weight esteems, with weight diminishes exponentially free from the diagonal.

The equation is,

$$\boldsymbol{\sum_{i,j=0}^{N-1}\frac{P_{i,j}}{1+(i-j)^2}} \dots (6)$$

Skewness

Proportion of symmetry and the absence of symmetry were calculated by

$$\boldsymbol{\sum\frac{(I(i,j)-\mu)^3}{N\sigma^2}} \quad \dots (7)$$

where$\boldsymbol{P_{ij}}$ is the pixel value of the image.

The pixel level color and texture highlights are separated from the bunched leaf with the GLCM algorithm and they are used as input to the MSVM classifier. With the extracted texture features, the MSVM Classifier is trained and finally the leaf image is classified. Thus, the nutrition deficiency can be detected and farmers can be notified using GSM protocol.

V. RESULTS AND DISCUSSION

The web cam connected in the Arduino unocaptures the images of leaf and stored in the memory card. The captured images are collected from the memory card for further image processing.Mat lab tool is used for image processing inorder to find out the nutrient deficiency.

Automated detection of plant nutrient deficiency is an essential research. The Multi class Support Vector Machine (MSVM) is used to extract the required featured from the images of the plant. The edges of the leaves turn reddish brown which confirms that is affected by copper deficiency. Potassium deficiency results in yellowleaf-tints, browning at the leaf edge.The yellowing of plant leaves results from failure to develop the chlorophyll caused by Zinc deficiency.

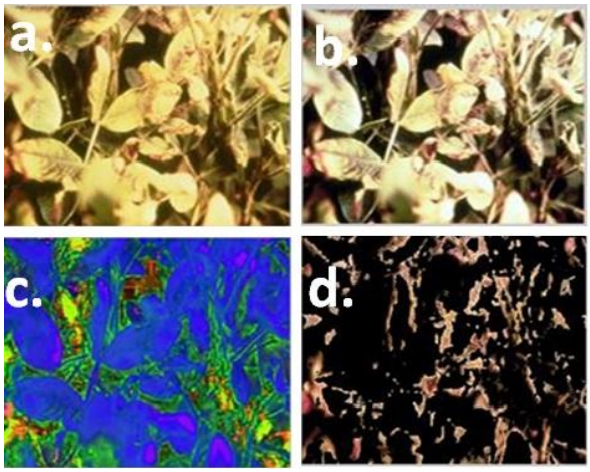

Fig-6. Testing of Copper Deficiency (a) Defected image. (b)Represents the enhanced image. (c) Transformed image from RBI to HIS. (d) Selected cluster image.

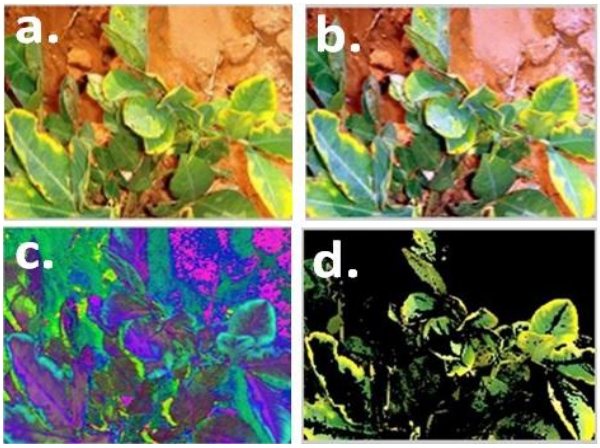

Fig-7.Testing of Potassium Deficiency (a) Defected image. (b) Represents the enhanced image. (c) Transformed image from RBI to HIS. (d) Selected cluster image.

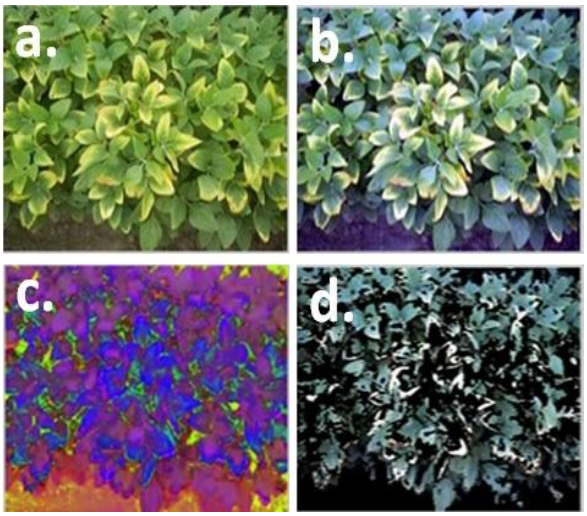

Fig-8.Testing of Zinc Deficiency (a) Defected image. (b) Represents the enhanced image. (c) Transformed image from RBI to HIS. (d) Selected cluster image.

Table-1: Features Extracted from Image Processing

Features of Texture	Copper Deficiency	Potassium Deficiency	Zinc Deficiency
Contrast	1.5537	1.6658	2.7889
Correlation	0.7276	0.7971	0.6772
Energy	0.5342	0.4918	0.2300
Homogeneity	0.8838	0.8909	0.8088
Mean	28.3022	32.9343	58.2297
Standard Deviation	59.3221	65.3936	73.0252
Entrophy	2.5366	2.7618	4.7124
RMS	7.3877	7.8282	10.9326
Variance	3.2922e+03	3.9043e+03	5.1237e+03

The table-1shows the extracted information from the image of nutrient deficient plants. The MVSM classifier is useful to compare and analyze the extracted features to the standard values stored in the database and identifythe Copper deficiency, Potassium deficiency and Zinc deficiency. The developed prototype can be used to capture the images and analysis of different plants in the field of agriculture.

VI. CONCLUSION

By implementing this swarm bots with its multitasking agricultural activities like drilling, seeding and spraying of fertilizers according to nutritional deficiency, we have overcome the difficulty of farmers. We have tested all the features implemented in this prototype on field successfully. For future developments, it can be enhanced by developing this system to check the quality of soil and seeds can be sprayed using drones. The same drone technology can be used to monitor the problems that would not be known from ground level which can be equipped with various kinds of technology like ultrasonic echoing devices and sensors.

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