AGRICULTURAL ROBOT

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Abstract : **Agriculture contributes to a major portion of India's GDP. Two major issues in modern agriculture are water scarcity and high labour costs. These issues can be resolved using agriculture task automation, which encourages precision agriculture. In recent years, robotics in agriculture sector with its implementation based on precision agriculture concept is the newly emerging technology. The main reason behind automation of farming processes are saving the time and energy required for performing repetitive farming tasks and increasing the productivity of yield by treating every crop individually using precision farming concept. Designing of such robots is modelled based on particular approach and certain considerations of agriculture environment in which it is going to work. These considerations and different approaches are discussed in this paper. Also, prototype of an autonomous Agriculture Robot is a four wheeled vehicle which is controlled by LPC2148 microcontroller.**

The main area of application of robots in agriculture is at the harvesting stage, digging, ploughing and seeding. This robot is designed to replace human labour. The jobs involved in agriculture are not straightforward and many repetitive tasks are not required to do, so the agricultural industry is behind other industries in using robots. This paper represents a robot capable of performing operations like automatic ploughing, seed dispensing and pesticide spraying. It also provides manual control when required.

***IndexTerms* - Agribot, LPC2148,sensors, ploughing, seed dispensing, GPS, disease detection.**

I. INTRODUCTION

In India generally the traditional seed sowing methods includes the use of animal drawn funnel and pipes driller or drilling using tractor. Earlier method requires labour and a very time and energy consuming. Whereas in tractor based drilling operators of such power units are exposed to high level of noise and vibration, which are detrimental to health and work performance. The emphasis in the development of autonomous Field Robots is currently on speed, energy efficiency, sensors for guidance, guidance accuracy and enabling technologies such as wireless communication and GPS.

Many agriculture operations are automated nowadays and many automatic machineries and robots available commercially. Some of the major operations in farming which are under research and automation are seeding, weeding and spraying processes. When it comes to designing a robot for automating these operations one has to decompose its idea into two considerations which are agriculture environment in which robot/system is going to work and precision requirement in the task over traditional methods. Based on this for seeding process, considerations which are taken into account in terms of environment are: robot must be able to move in straightway properly on bumpy roads of farm field, soil moisture content may affect the soil digging function, sensors to be selected for the system must be chosen by considering farming environmental effects on their working. Apart from these three other requirements are in terms of accuracy required in the task and these are: digging depth, particular optimal distances between rows and plants for certain type of crop, rows to be sown at a time and accurate navigation in the field. Whereas the other processes like weeding, spraying and harvesting, for which functioning depends on seeding stage by knowing the exact location of crop and then making those operations on it accordingly. So the major stage of all subsequent operations is maintaining a precision in seed sowing process. When considering the physical aspects of the vehicle or robotic system, farmer's present condition in particular area plays a major role in designing these aspects. Considering facts of farming industry of India, system to be developed must have advantage over traditional methods and tractors in terms of cost, speed, accuracy in operation for which it is designed, fuel consumption and physical energy required by human for it. Plant diseases are important factors because its affects human being as well as animals etc. that's why as it can cause significant reduction in both quality and quantity of crops in agriculture production. Therefore, detection and classification of diseases is an important and urgent task.

Traditionally farmers identify the diseases by naked eye observation method. Some researchers have used image processing techniques for fast and accurate detection of plant diseases and identifying the diseases in an early stage only and control them. When some diseases are not visible to naked eye but actually they are present, then it is difficult to detect it with the naked eye. And when it is visible it will be too late to detect disease and can't help anymore. Earlier, microscope is used to detect the disease, but it become difficult as to observe each and every leaf and plant. So, the fast and effective way is a remote sensing technique. Detection and recognition of diseases in plants using machine learning is very fruitful in providing symptoms of identifying diseases at its earliest. For small scale farmers, early identification of disease is very much possible and able to control the insects by organic pesticides or by the use of minimal amount of chemical pesticides. For large scale farmers frequent monitoring and early identification of disease is not possible and it results in a severe outbreak of the disease and pest growth which cannot be controlled by organic means. In this situation farmers are forced to use the poisonous chemicals to eradicate the disease in order to retain the crop yield. This problem can be solved by automating the monitoring process by use of advanced image processing techniques and machine learning.

The main reason behind automation of farming processes are saving the time and energy required for performing repetitive farming tasks and increasing the productivity of yield by treating every crop individually using precision farming concept. Designing of such robots is modeled based on particular approach and certain considerations of agriculture environment in which it is going to work. These considerations and different approaches are discussed in this paper. Also, prototype of an autonomous Agriculture Robot is presented which is specifically designed for seed sowing task only. It is a four wheeled vehicle. Its working is based on the precision agriculture which enables efficient seed sowing at optimal depth and at optimal distances between crops and their rows, specific for each crop type.

The proposed work also aims in making the automated system easily available for the farmer's using the device for early detection of the diseases in plants. Robotic technology is included in this system a field robot goes through the field and captures the images of the leaves and processing of the image is done using the processor that is integrated in it. After the evaluation of the diseases the result is sent to the farmer/owner of the field in the form of SMS. The steps involved in disease detection are Digital image acquisition, Image pre-processing (noise removal, Color transformation, and histogram equalization), K-means Segmentation, Feature extraction, and classification using the support vector machine algorithm which is a supervised learning algorithm. The processing that is done by using these components is divided into two phases. The first processing phase is the offline phase or Training Phase. In this phase, a set of input images of leaves (diseased and normal) were processed by image analyzer and certain features were extracted. Then these features were given as input to the classifier, and along with it, the information whether the image is that of a diseased or a normal leaf. The classifier then learns the relation among the features extracted and the possible conclusion about the presence of the disease. Thus the system is trained. India is well known for its agriculture production. Most of the population is dependent on agriculture. Farmers have variety of options to cultivate crops in the field. Still, the cultivating these crops for best harvest and top quality of production is done in a technical way.

So the yield can be increased and quality can be improved by the use of technology. Generally, whenever there is disease to a plant, we can say that leaves are the main indicator of the disease caused to the plant. Mostly we can see the spots on the leaves of it due to disease. However when the amount of disease to the plant is large then the whole leaf gets covered by the disease spots.

II. DESIGN AND IMPLEMENTATION

An automated system can be represented as block diagram shown in above Fig 1. It explains the operation of whole agricultural automation system.

Image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video, such as a photograph or video frame. The basic unit of image is pixels. The group of pixels will form an image. Here in proposed system for processing an image we have used MATLAB.

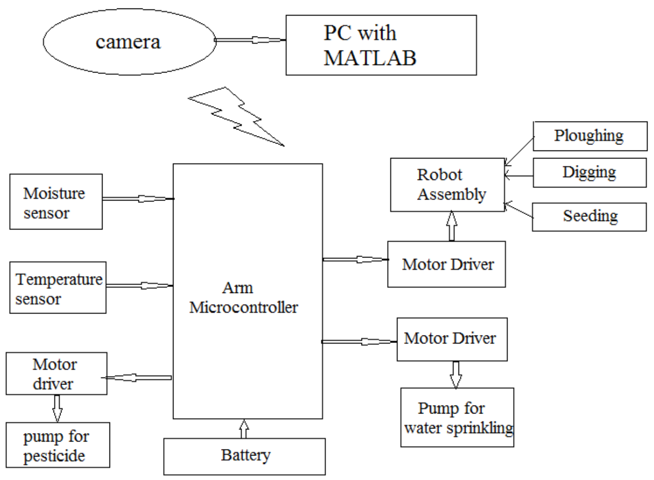

Fig 1 Block diagram of Agriculture Robot.

An image is processed for disease detection in below steps:

STEP 1:- Firstly image has captured by camera is in the YCbCr form then it is converted into RGB.

STEP 2:- In second step RGB image is converted into HSV image. HSV is named for 3 values: Hue, Saturation and Values. This color space describes colors (hue or tint) in terms of shade (saturation or amount of gray) and their brightness value.

STEP 3:- In step 3 HSV image converted into Hue image

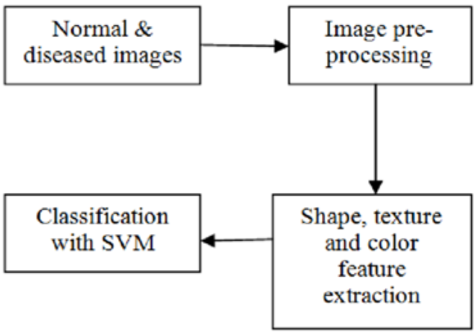

Fig 2 Steps followed to detect disease.

Main steps are data collection which contain normal and diseased images, image pre-processing, and feature extraction and classification Real data of sugarcane images are collected from sugarcane field's survey in Malang. Observation is conducted by capturing photos of sugarcane leaf on a paper. There are 200 data of normal sugarcane leaves and 200 data of sugarcane leaves with rust disease.

After collecting the image data, these images are pre-processed. Firstly, leaf area that represents rust disease are selected. After that, these images are resized to 100 x 100 pixels to reduce computational time. The contrast of these images are enhanced to a maximum value.

To extract shape feature, the color image is processed to be a binary using Otsu thresholding. Combination of color, shape and texture feature of an image are used in feature extraction. To extract color feature, image is transformed from RGB to LAB color. Table 2 shows feature extraction used in this research. Then shape, texture and color feature extraction are used to identify rust disease in sugarcane. SVM is used to classify normal and diseased images. All features from these images are extracted and classified into normal and rust disease. After that, accuracy is calculated from several combination of features.

On the other hand, color feature results in 87% accuracy because leaf with rust disease has different color from normal leaf. Normal leaf have no lession on its surface. Leaf with rust disease have lession on its surface so it is different in texture. The differences are also on its color, normal sugarcane leaf is green on all its surface but leaf with rust disease have yellow until brown lession on its surface.

Texture has the highest accuracy in single feature testing, 96.5 %, because normal and rust disease have different texture that can be analyzed from energy, contrast, correlation and homogeneity. When group of features are used, combination of color and texture feature has the highest accuracy of 97.5%, because diseased image have different value of energy, contrast, correlation and homogeneity from normal leaf image. When shape and texture are combined, it yields a 96% accuracy. Color and shape yields 86.5% accuracy. It is because shape cannot represent the pattern of sugarcane rust disease well. A combination of shape, texture and color results a 97.5 % accuracy.

III WORKING OF AGRIBOT

An Agribot performs the operations sequentially. The flow is as shown in Fig.2 When the system is ON, Initialization of LCD takes place and also light movements of robot can observed because of H-BRIDGE (IC L2932). The control switch can be either switched ON/OFF depending on the mode the user wants (automatic/manual). If the switch is ON automatic mode is selected, the further process is done automatically and if switch is OFF then the manual mode is selected. The command (for the work to be done) is given to the Robot through the Wi-Fi module incorporated in the system. The Robot then starts operating based on the command given i.e., seeding, ploughing and levelling of the soil. The system checks for level of moisture content in the soil. If the moisture level is equal to or more than optimal soil moisture level than the pump is OFF and if it falls below the optimal moisture level than the pump is turned on to maintain the soil hydration level. The system also checks if the crop is infected by any kinds of microbes or if any diseases are found. If a disease is found, then the Robot sprinkles the suitable pesticide on it.

The agricultural robot will be using a chassis as a base to connect and assemble everything on it will be consisting of four motors. Two of which are toy motors and the other being gear motors. The robot is capable of doing four separate functions.

1. Digging
2. Hopper
3. Leveler
4. Disease Detection

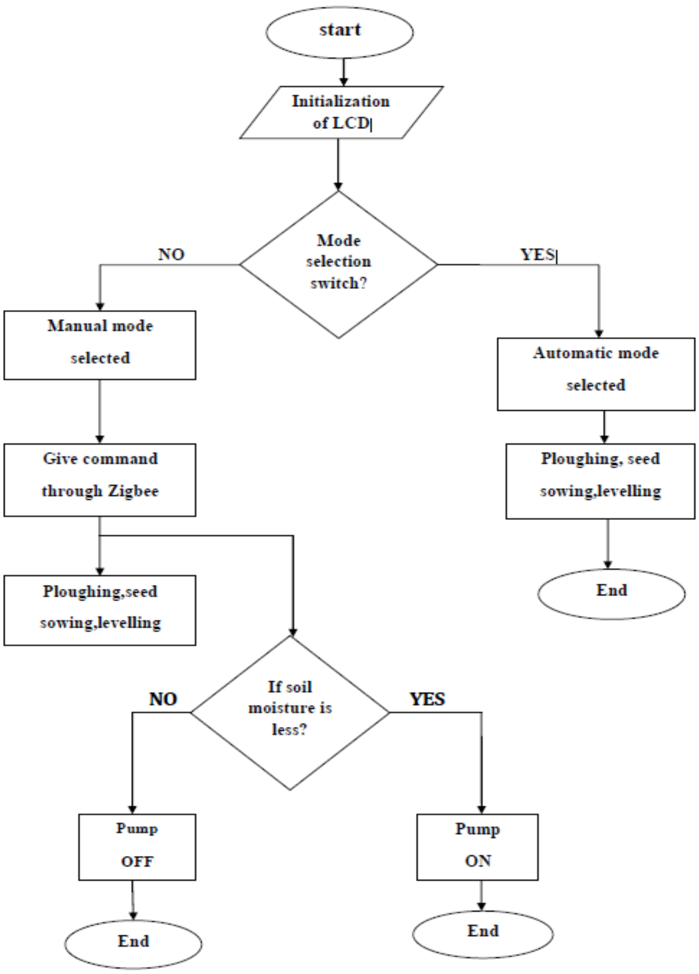

Fig 3 Flow chart of Agribot working.

These will be working in different modes. Programming of different modes will be done separately the different modes.

The results can be seen from accuracy that is calculated from several combination of features. Table 3 shows classification accuracy. When single feature is used, shape feature has the lowest accuracy of 51% because rust in sugarcane has various shape of lesion so it is difficult to analyze it by solidity, extent, minor axis length and eccentricity of image. But, normal and diseased images have different shape. Healthy leaf has no lesion and rust diseased leaf has lesion, so system can recognize the pattern.

MODE 1: DIGGING

A new technology for sowing the seeds in a particular order is followed. The seeds are placed with some specific gap between them and which is different for every crop. So in order to overcome the problem, robot which will itself dig the soil and place the seeds.

MODE 2: HOPPER

Hopper is used to carry seeds and to drop the seed at a particular hole that is being dig by Agribot.

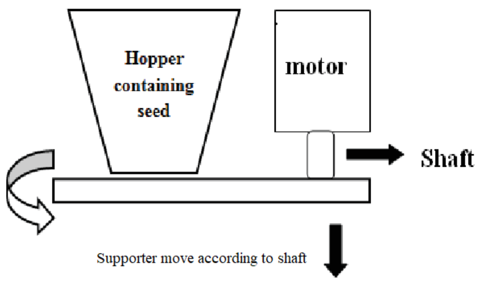

Fig 5. Hopper

MODE 3: LEVELER

Leveler is placed at front of the robot. This will help to make an uneven surface to a flat shape. This will work simply by making Front actuators come down. When robot starts moving forward, the even surface has up’s and down’s leveler will make all the area to flat surface. This is very compatible for leveling gardens, small areas, closing gaps, etc.

Fig 6. : Leveler

IV CONCLUSION

Agricultural Automation Robot using ARM proposed shows an initial outcome that most of these systems that which work autonomously are more flexible than traditional systems. The benefits of reduction in labour costs and restrictions on the number of daily working hours significantly improved. Thus, it has made possible to automate the most significant working routines. The paper presents a low cost, low power & simple system for device control. This system will have high application in farming, gardening and Agri-University. The chassis handles the complete weight of solar panel, battery and the hardware mounted on Agribot which is able to perform each and every operation skillfully and successfully.

This paper also proposes a leaf image pattern classification to identify disease in leaf with a combination of texture and color feature extraction. Initially the farmers sends a digital image of the diseased leaf of a plant and these images are read in MATLAB and processed automatically based on SVM and the results were shown. The results of thisworkt are to find appropriate features that can identify leaf disease of certain commonly caused disease to plants. Firstly, normal and diseased images are collected and pre-processed. Then, features of shape, color and texture are extracted from these images. After that, these images are classified by support vector machine classifier. A combination of several features is used to evaluate the appropriate features to find distinctive features for identification of leaf disease. When a single feature is used, shape feature has the lowest accuracy and texture feature has the highest accuracy. A combination of texture and color feature extraction results highest classification accuracy. A combination of texture and color feature extraction with polynomial kernel results in good classification accuracy. Based on the classified type of disease a text message was sent to the farmer.

With fully-automated farms in the future, robots can perform all the tasks like mowing, fertilizing, monitoring of pests and diseases, harvesting, tilling, etc. This also enables the farmers to just supervise the robots without the need to operate them. The work can be enhanced to any other kinds of crop. Hence, it can be applicable to the real time agricultural field.

V REFERENCES

[1] D. Ramesh and H. P. Girishkumar, “Agriculture Seed Sowing Equipment: A Review”International Journal of Science, Engineering and Technology Research, 2014, volume 3, Issue 7, Pp-1987-19992

[2] Laukik P. Rut, Smit B. Jaiswal and Nitin Y. Mohite, “Design, development, and fabrication of agricultural pesticides with weeder”, International Journal of Applied Research and Studies, 2013, volume 2, Issue 11, Pp-1-8

[3]Sridhar H.S “Development of Single Wheel Multi-Use Mutually Operated Weed Remover”, International Journal of Modern Engineering Research, 2013, Vol. 3, Issue.6, Pp-3836-3840

[4] Tim Mueller-Sim, Merritt Jenkins, Justin Abel, and George Kantor, “The Robotanist: A Ground-Based Agricultural Robot for High-Throughput Crop Phenotyping,”2017 IEEE International Conference on Robotics and Automation (ICRA) Singapore, May 29 - June 3, 2017.

[5] SajjadYaghoubi et al., "Autonomous Robots for Agricultural Tasks and Farm Assignment and Future Trends in Agro Robots," International Journal of Mechanical & Mechatronics Engineering IJMME-IJENS, vol.13, no. 03, pp. 1-6, June 2013.

[6] M. priyadarshini, Mrs. L. Sheela, “Command based self-guided digging and seed sowing rover”,International Conference on Engineering Trends and Science & Humanities, ISSN: 2348 – 8379, ICETSH-2015.