# IoT Based Agricultural Robot for Monitoring Plant Health and Environment

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## Abstract

Nearly three quarters of Indian families depend on agricultural income. Almost all crops suffer from plant diseases and insects like Tungro virus, moths and butterflies. Farmers find it difficult to identify actual disease. According to Indian crop survey, on an average scale of 80 percent of crops get damaged due to disease and insects. If the problems are known before then diseases can be prevented. There is a scope for improvement in these fields using IoT Technology. So, we are designing an IoT based robot that will monitor the crop and also the environment around the crop. This system uses machine learning technique to identify the problem and takes measures to prevent diseases and insects that harm the crops. Different sensors are used to study the environment, and a camera to detect the plant type and disease. A number of prototype guidance systems have been developed but have not yet proceeded to commercialization. Our crop monitoring system is efficient and affordable which will help the Indian farmers.

**Keyword:** IoT, Agriculture, plant health, Crop monitoring.

## I. INTRODUCTION

Agriculture is a major occupation in India. Some of the major problems in the Indian agriculture are, rising of input costs, lack of skilled labours, scarcity of water resources and crop monitoring. To overcome these problems, the automation technology [1] was used in agriculture. The automation in agriculture could help farmers to reduce their efforts. The IoT plays a vital role in various fields such as industrial, medical, automobiles etc., The IoT technology is gradually increasing its productivity in agricultural field. The IoT technology is being developed for irrigation system, soil health monitoring, environment monitoring, etc., All of these functions have not yet performed using a single IoT platform.

Our project is concerned with the farmer and the cultivation land. It uses a camera [2] and all the sensors which are used to monitor the agricultural land. It can be used from the plantation period to harvesting period. It detects plant type and calculates the area of the field itself. The robot monitors the field, checks the soil health based on moisture level and Ph level. The plant health is judged based on its leaf colour. The robot prompts farmer, if any problem associated with the field is found in local language. It works on batteries which are charged using solar panels.

This project uses Arduino Uno (ATMEGA 328) uses Harvard architecture 8-bit RISC processor core which acts as a slave for Raspberry Pi Board, a credit card sized computer. It has 64 bit quad core processor, on-board Wi-Fi, Bluetooth and USB boot capabilities, also ARM-compatible central processing unit. The gripper arrangement is used to remove weeds and to spray

fertilizers and pesticides to the land. The Arduino IDE is used to write the code into the Arduino board. We can also program the raspberry pi board using python programming language.

## II. LITERATURE SURVEY

At KVK Bhramavara, we collected the data regarding deficiency of nitrogen in paddy. We also collected data regarding potassium deficiency in paddy where a yellow border and tip of that leaf is burnt. Along with data latitude, longitude and altimeter values are collected.

**Designing an Autonomous Soil Monitoring Robot (IEEE -2015)**

Patrick M. Piper and Jacob S. Vogel designed an autonomous soil monitoring rover to expedite data collection. The rover will be able to autonomously navigate through a field and avoid obstacles. It will gather data on soil moisture and temperatures at a set of given points and relay the information back to the farm manager. The vehicle is equipped with a stevens hydra probe II used to sense the soil moisture and temperature

**Application of Computer Vision Technique on Sorting and Grading of Fruits and Vegetables (JFPT-2012)**

Mahendran R and Jayashree GC et al presented an idea of sorting and grading of fruits by image analysis. This paper presents the application of image analysis and computer vision system to evaluate the quality of products in the field of agriculture. Computer vision is a novel technology for acquiring and analysing an image by using computers to control machines or to process it. The techniques used in image analysis include image acquisition, image pre-processing and image interpretation, leading to quantification and classification of images and objects of interest within images.

**Robots for Precision Agriculture (National Conference on Mechanisms and Machines-2007)**

Satish Kumar KN, Sudeep CS et al presented a multi-purpose agricultural robot to implement precision irrigation, fertilizer addition and de-weeding apart from continuous monitoring of crop and soil conditions. This will involve efficient utilization of water resources, intensive plant and soil monitoring, condition-based use of fertilizers and the ability to work in unstructured environments.

**Agribot (International Journal of Advanced Research in Computer and Communication Engineering-2015)**

Ankit Singh, Abhishek Gupta et al presented an idea that Agribot is a robot designed for agricultural purposes. This Bot performs basic elementary functions. The main feature of the robot is the ability to find the grass in the field using image processing. For this a special purpose web cam which will take photos inside the field and if the grass is found then the user will inform the robot to cut the grass in the crop field and also the user will pick the grass which has been cut by the robot.

**Autonomous farming robot with plant health indication (IJATES-2015)**

K.V. Fale and P. Bhureamit et al designed an autonomous intelligent farming robot which indicates plant health by observing the colour of their leaves and the height of the plant. It also notes environmental conditions such as temperature, moisture and humidity. It will water the plants according to their needs by observing soil moisture and humidity. The main feature of the robot is the ability to sense the health of the plants using image processing. webcam will take the photo inside the field and analyses the growth according to the height, colour of the leaves, etc.

## III. PROPOSED SYSTEM

Fig.1 shows the block diagram of the proposed system where the raspberry pi

board comprises of ARM-compatible central processing unit acting as a master controller. Arduino UNO acts as a slave controller with inbuilt sensors, gripper and gear motor arrangement, indicator such as LED etc., The proposed system integrates all the functions such as removing weeds, irrigation, fertilization, monitoring of crop and environment into a single IoT robot and perform the operation automatically.

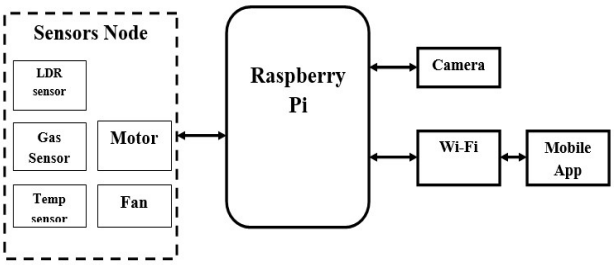


Fig 1: Block Diagram of Proposed System

The gripper arrangement with arm is used for removing weed and spraying the pesticides to the plants whenever required. The camera is used to observe the health of the plant, and to detect the insects in the field. The requirement of water is identified by the soil moister sensor and also by checking the environment temperature and humidity. The level of fertiliser and pesticide can be detected using water level switch sensor. If the water resource and pesticides are insufficient an alerting buzzer sound is produced and it also prompts to farmer's cell phone. To move along in the field, it uses chained roller for gripped movement.

## IV. METHODOLOGY OF PROPOSED WORK

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 high torque motors and the rest being gear motors. The robot is capable of doing four separate functions.

1. Crop monitoring
2. Soil fertility check
3. Irrigation System
4. Environment monitoring

These functions will be working in different modes. Programming of different modes is done separately. The sharp sensor gives input to the robot by measuring the length and breadth of the field. Arduino is programmed in such a way that, after getting the data of length and breadth of field, mode will be selected in which the robot is made to work.

Mode 1. Detect the plant type: This mode checks the plant type by its leaf size and pattern using machine learning technique. There on deciding the plant type, we are going to check other conditions based on plant type.

Mode 2. Detect plant and soil health: When we know the plant type, we can check the condition of the plant in accordance of it's need. Some crop needs more nutrients in soil where as some crop needs less and colour of some deficiency shown on the plant leaf may vary in colour and visibility.

Mode 3. Detect the Moister level of the soil: The moister level for all the crops is not same. Some may need more moister level where as some need less moister level. So, we have an effective irrigation system, where it will be working on accordance with plant's need.

Mode 4. Checking the Environment condition: Every crop need its own likely environment where it will grow faster and yields more. So, when we check the environment, we come to know that the crop yield more or not. If not, we can take some precautions.

To check the fertility of the soil we are going to use the soil moister sensor and Ph sensor. Based on the output of these two sensors and the colour of the crop leaves, we can decide the fertility of the soil and the health of the plant. The Ph sensor can decide on soil nature and moister level where as the colour of leaf can tell us about the fertility of the soil and its health.

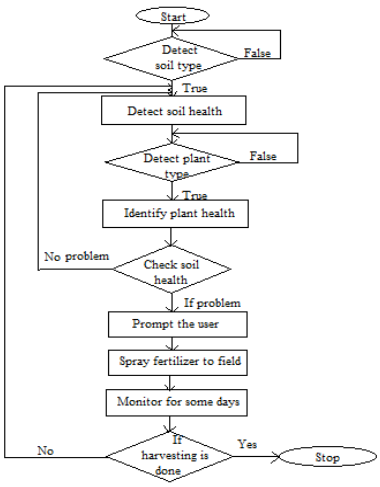


Fig 2. The flow chart of the proposed work.

The robot is going to work by detecting the soil type (colour of soil) in the initial stage. After detecting the soil type it's going to check what type of crop has been planted. Based on plant, it will check the plant health and soil health. If there is no problem in the soil fertilization level and plant, then it will loop these processes. If there is some problem in the plant or soil, then it will log the problem and prompts the farmer and it will take the necessary precautions for the plant and soil and it will monitor for some days. If the problem ends, then again it will check for the problems. If there is no problem and, if the crop is harvested then our robot will stop working until next plantation is done.

## V. CONCLUSION

Using this IoT Robot, we can monitor the plant health and detect the insect attacks, also conserve the water in the filed using irrigation system. It will spray the pesticide if necessary. The Robot will help the farmer to monitor the progress of crop efficiently. By monitoring the environment, we can expect more yield from the crop. Hence, we can conclude that it can be applicable in real time agricultural field.

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