An Autonomous Polyhouse Robot for Plant Health Indication and Detection of Plant Disease using Image Processing

Miss. Wable Aparna 1 Miss. Bhongal Manisha Babasaheb 2 Miss. Yeole Kajol Mukund 3
Miss. Bedke Amruta Acchutrao 4
1,2,3,4 Department of Electronics & Telecommunication Engineering
1,2,3,4 SCSCOE, Rahuri, India

Abstract— Agriculture is very labor intensive field and is only the field where the robots are not included. Since, many industries are trying to reduce this human labor by making robots and machines. A vision-based row guidance method is used to guide a robot platform which is designed self-operating to drive through the row crops in a field according to the design concept of open architecture. Then, the offset and heading angle of the robot platform are discovered in real time to guide the platform on the root of recognition of a crop row using machine vision. And the control scheme of the platform is suggested to carry out row guidance. Here we are designing a autonomous intelligent poly house robot which shows the plant health by observing the color of their leaves and based on the height of the plant. The robot also notes the surrounding environmental conditions of the plant like temperature, moisture and humidity so that the robot will decide about health of plant and will display it on the LCD. The robot also has watering mechanism it will provide water to the plants according to their requirement by observing soil moisture and humidity. It also detects the plant disease and provides the necessary pesticide according to the type of disease.

Key words: Autonomous Polyhouse Robot, Plant Health Indication

I. INTRODUCTION

In this project, we are going to make a robot which uses line follower method to drive through the row crops. After all, a unique system has been described for Plant Research which makes use of a number of electrical and computer systems engineering theories. A prototype robotic arm has been designed, developed and constructed, which is integrated with motors, controllable using specific electronic components and computer software. A number of sensors are integrated into the robotic system including color, proximity, temperature and humidity systems. The system requires the use of vision, with custom algorithms being developed to identify plant health. The whole system will be integrated into a fully automated package. This allows the system to automatically return to specified sites at set time intervals to identify small changes in growth rates and leaf color. This provides the potential for plant nutrient levels and the immediate environment to be adjusted in response to continuous sensing resulting in perfect fast growth with minimum human input.

The function of a poly house is to create the optimal growing conditions for the full lifecycle of the plants. Using various autonomous measuring stations will help to monitor all the necessary parameters for creating the best effective environment in the poly house. The robot equipped with sensors is capable of driving to the end and back along crop rows inside the poly house. For traditional climate monitoring and control systems, all sensors are mounted on robotic vehicle in the poly house and connected to the device performing the control tasks.

II. SYSTEM DESIGN

A. Block Diagram Description:

In this project we are designing the polyhouse autonomous Robot which will sense the conditions in real time. For this, we are analyzing the field parameters such as, temperature, humidity, soil moisture etc. The Robot will also have watering mechanism and is a completely autonomous robot. The main characteristic of the Robot is the ability to sense the health of plants using Image processing. For this we are using a special purpose camera which will take photos inside the field and send this data through ZigBee to PC, so that MATLAB software in the PC can analyze the growth according to the height, colorization of leaves etc. So, according this we can conclude the percentage of healthy
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In a given area, a line follower method using IR line sensors is presented to guide the robot platform which is driven along plants in row. The offset and heading angle of the platform are calculated by detecting the black line in real time to guide and control the platform. This also helps to detect and identify plants and find accurate and stable navigation information from the sensor output. The captured image by JPEG serial camera is then sent to PC by ARM7 controller which is then processed by using image processing technique. Various parameters measured by platform are also sent to PC through ZigBee. The result of image processing is then processed and sent to robot unit. Also soil moisture sensed moisture sensor helps microcontroller to decide whether plant needs water or not. If moisture level is low then plant is watered through pump.

The proposed unit also has a control section for turning on lights, fan and exhaust systems for temperature, humidity and illumination control of the area. This is done using a microcontroller and relay circuit which receives command through ZigBee unit. The robot is made line follower using IR sensors.

1) **Power Supply**

Power supply is the first and the most important part of our project. For our project we require +12v regulated power supply with maximum current rating 500 mA. Virtually every piece of electronic equipment, e.g., computers and their peripherals, calculators, TV and hi-fi equipment, and instruments, is powered from a DC power source, be it a battery or a DC power supply. Most of this equipment requires not only DC voltage but voltage that is also well filtered and regulated.

2) **Zigbee Module**

The X Bee/X Bee-PRO ZB RF Modules are designed to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices.

3) **IR Sensor**

Infrared sensor is used to detect obstacles in front of the robot or to differentiate between colors depending on the configuration of the sensor. The sensor emits IR light and gives the signal when it detects the reflected light. An IR sensor consists of an emitter, detector & associated circuitry. The circuit require to make sensor consists of two parts emitter circuit and receiver circuit. The emitter simply an IR LED and detector is simply IR photodiode which is sensitive to IR light of the same length as that of emitted by the IR LED. When IR light falls on the photodiode. Its resistance and correspondingly its output voltage, change in proportion in the magnitude of IR light received. This is the underlying principle of working of IR sensor.

4) **LM35**

In our project we are using LM35 to measure temperature of the environment in poly house environment. It draws about 60 micro amperes from its supply and possess a low self-heating capability.

5) **Humidity Sensor Module (ST-HS 220)**

This module converts the relative humidity to output voltage and can be used in weather monitoring application. Hence it is use to monitor the humidity in our poly house environment.

6) **Soil Moisture Detection Module**

This is a simple and easy moisture sensor which is used for the detection of soil moisture. The output of module is at
high level, hence soil moisture is detected. Using this sensor it provides the watering mechanism automatically when required to the plants or crops in the poly house. Due to this the continuous requirement of labour is reduced.

7) Camera (RG-CAM-1)
Here one wireless camera used for image processing which captures the image of plant and also detect the health of plant through image processing.

8) ARM 7 Controller
ARM controller is used as the hardware platform. It is the controlling unit, to which all other components (Voice recognition, Motors, Transreceiver modules etc.) are interfaced. Two such controllers are used in this project, one at the Transmitting end and one at the Receiving end.

9) DC Motor and Motor Drive
DC Motor is based on principle of to convert the electrical signal into mechanical motion. In this Project DC Motors are used to control the motion of robotic arm. This motor controller would prevent the motor from breaking or burning, and it would also prevent a short circuit from happening. Since the motors chosen for the project were small and did not need huge amounts of current to operate, the speed controller could actually have a low amp value.

10) Water Pump
This is a mini submersible type water pump that works on 12V DC. It is very simple and easy to use. Just dip the pump in water connects the suitable pipe and power the motor to start pumping water. Hence used widely in poly house for providing water to the plants when required & also this motor is small compact and light weight. It can be controlled by our microcontroller using our DC motor Drivers or one of our Relay boards.

11) Relay (RW/RWH)
Mostly the high end industrial application devices have relays for their effective working. Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. But they differ according to their applications. Most of the devices have the application of relays.

12) Microcontroller:
Microcontroller is used as the hardware platform. It is the controlling unit, to which all other components are interfaced. Two such controllers are used in this project, one at the Transmitting end and one at the Receiving end.

13) Light Sensor:
A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used is shown in the figure below.

14) LCD Display:
It is used for user interface. It show the command given by user. The LCD displays used in these early digital watches were very different from the LEDs they replaced. While even a tiny LED display consumes a few mW of power, the LCD consumes just microwatts of power. Hence, the LCDs are over 1000 times more efficient at their job than the LED

III. PLANT DISEASE DETECTION AND INDICATION
Diseases of poly house crops can be caused by pathogenic bacteria, fungi, viruses, and phyto-plasmas. Many abiotic or non-infectious conditions mimic diseases or lead to plant disease. It is important to be able to distinguish between the two. If a disease is suspected and a pesticide is applied to remedy the situation caused by an abiotic stress, then undue expense, labor, risk has occurred.

Planning an integrated pest management (IPM) program for disease control includes sanitation techniques, monitoring techniques, and management strategies. Pesticides should only be used when monitoring reveals that they are required. The use of pesticides as a first response to a disease outbreak is typically due to poor planning. The basis of a successful IPM program should include five key components; prevention, regular monitoring, accurate diagnoses, appropriate action thresholds, and effective management methods.

In our project, robot is also capable of detecting various diseases taking place in poly house crops and also provides the necessary pesticide required for it according to the requirement. Various types of diseases taking place in poly house Ralstonia Wilt, Foliar Nematodes, Crops Viral Diseases, Xanthomonas Leaf Diseases, Downy Mildew, etc.

IV. CONCLUSION
The proposed system is open architecture so any one can make this type of system using any way or path. The system uses image processing to observe the leaf color which increases further accuracy of the system as it identifies color very specifically than human. The system also observes different environmental conditions such as humidity, soil moisture and temperature which human cannot measure.
accurately by open eyes to decide the plant health so the accuracy of the system is high. It also involves watering mechanism which reduces human labor and we can reduce labor further by modifying the system further for other agricultural work such as picking, harvesting, weeding.

The proposed unit also has a controlling section for turning on lights, fan and exhaust systems for temperature, humidity and illumination control of the area. This is done using a microcontroller and relay circuit which receives command through ZigBee unit. The robot is made line follower using IR sensors.

Also our robot is capable of detecting the diseases and providing the necessary pesticide when required.

REFERENCES


