

Soil Nutrient Tester and Air Purification System

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Abstract— Crops can be injured when exposed to high concentrations of various air pollutants. Injury ranges from visible markings on crop leaves, to reduced growth and yield, to premature death. The development and severity of the injury depends not only on the concentration of the particular pollutant but also on a number of other factors. These include the length of exposure to the pollutant, the plant species, its stage of development as well as some environmental factors. Some of these pollutants may directly affect the soil leading to infertile and acidic soil content. This will lead to low yields. Although the requirement of particular nutrient is determined by the plant in the soil, some of the nutrients are necessary for all the plants in great amount known as Macro moles or Macronutrients. Root environment of the plant can be changed by supplying the nutrient from outside the soil i.e. fertilizers. However proper distribution of fertilizer is required for proper crop production. Over and under provisioning of the fertilizer can harm the crops. Hence, with the help of a sensor system the soil nutrients can be determined continuously. The primary aim of this system is to develop a sensitive and reliable sensor system and air purification system for monitoring the nutrients in the soil sample and to reduce the amount of pollutants in the air.

I. INTRODUCTION

Air has physical properties and a chemical composition that are vital parameters of life for both plants and animals. Temperature, water vapor, movement, oxygen, and carbon dioxide in the atmosphere have a direct effect on food and fibre production. Air quality is changed by introduction of contaminants into it, and agricultural activities using such air may be affected adversely. Damage to plants by air pollutants is related to meteorological conditions, particularly temperature inversions in the atmosphere. The effects of air pollution on plants and animals may be measured by the following factors:

- (1) Interference with enzyme systems;
- (2) change in cellular chemical constituents and physical structure;
- (3) Retardation of growth and reduced production because of metabolic changes;
- (4) Acute, immediate tissue degeneration.

Some of these pollutants may directly affect the soil leading to infertile and acidic soil content. Although the requirement of particular nutrient is determined by the plant in the soil, some of the nutrients are necessary for all the plants in great amount known as Macro moles or Macronutrients. Poor growth and a

variety of disorders such as leaf discoloration (chlorosis) can be caused by a shortage of one or more plant nutrients. This can be avoided by addition of fertilizers. However proper distribution of fertilizer is required for proper crop production. Over and under provisioning of the fertilizer can greatly reduce the harvest production rate. Thus, the device is fabricated keeping the above things in mind and all the problems are eradicated by able and reliable automation.

The device used in this project aims to fully automate the process of soil nutrient testing as well as air purification. The device automatically tests the nutrients present in the soil and if there is any deficiency of nutrients, it adds the required nutrients to the soil. Along with that, it detects the pollutants present in the air and eliminates it.

Manual collection of information for chosen variables can be intermittent and deliver varieties from inaccurate estimation taking; this can cause complications in controlling any vital factors. Therefore with the help of an automatic device, human errors can be reduced. With the large magnitude of research and development carried out in the embedded system market it's only apt that the ever growing agricultural sector gets a technology boost.

II. LITERATURE REVIEW

In [1], the authors have created a device with an MCU and color sensors that determined the RGB values by using Gizduino X as the MCU and TCS3471 for the first sensor and an LDR-RGB color sensor. A program was made using vb.net that processed the data and provided nutrient recommendations for every plant included in the soil test kit. The device utilised optical detection method based on absorption principle. It was implemented in this study due to the optical characteristics owned by NPK soil. LEDs are utilized as the light source as the soil interacts by absorbing the light. The remaining light is detected and the absorption rate is evaluated using photodiode. The output from the photodiode is manipulated using Arduino microcontroller, as a result the output current is converted and is displayed as output voltages.

In [2], gas sensors and particle pollution sensors are used to detect various kinds of pollutants. A gas sensor is transducer that detects gas molecules and produces an electrical signal with a magnitude proportional to the concentration of the gas. Modern semiconductor gas sensors are capable of detecting different gases. Along with gas sensors, pic micrcontroller, and Zigbee communication module is used. It measures and records concentration of different polluted gases such as CO, CO₂, LPG

along with Temperature. Additionally it detects quality of the air and dust particles in the air. It was evident from the study that no technology or mechanism is available to control the pollution as it is completely related to erratic human behaviour. In [3], optical transducer, LEDs and photodiode with Arduino microcontroller are used as an alternative method of determination of the deficiency of N, P or K in the soil. This study utilized the soil test kit by using MCU (microcontroller unit) and sensors in the analysis of soil samples. The soil test kit used color indicators that required good vision. Color indication has become a burden to people with vision impairment specifically color blindness, but with this device this problem was eliminated. The device was tested using three soil samples with ten trials each nutrient and pH. was a big help in providing standard recommendations to lessen human errors. Color comparison and looking for plant recommendations was eliminated to shorten the time analysis of soil samples.

III. METHODOLOGY

In the proposed method we continue the concept of automatic soil nutrient testing and detection of air quality and have made it very efficient for future use.

A. Hardware and Software design

In this system we have used NPK soil sensor along with PIC16F877 microcontroller. NPK soil sensor is used to measure the soil macronutrients i.e. Nitrogen, Phosphorus and Potassium. PIC16F877 microcontroller is used to store the preset values and compare with the real time values simultaneously. The software that is used is MP Lab IDE. In addition to this, there is an aspect of measuring air quality, which is proposed by using an air quality sensor.

B. Detection of nutrients present in the soil

In this step, for every instant of time, the sensors keep evaluating the nutrients present in the soil. This is done with the help of the NPK sensor.

C. Data Processing

This process is similar to that of evaluation. It refers to comparing the real time values that are obtained with the preset values that are stored in the memory of PIC16F877. Once it is compared, the difference is being stored and this date is then used in the proceeding step to add the required amount of nutrients.

D. Automatic addition of nutrients

Based on data provided in the previous step, addition of nutrients is done. If there is any deficiency of nutrients present in the soil, it is indicated and simultaneously the relay and pump will be activated. This is used to spray the adequate amount of deficient nutrient's solution directly into the soil.

E. Air quality detection and purification

In this step, the aspect of air quality detection is done. With the help of appropriate air quality sensors, the quality of air is sensed. Again with the help of PIC16F877 the data will be

processed and incase the air is polluted, the relay will be turned on and the polluted air will be purified.

F. Data transmission and updation

All the information provided in the previous steps are transmitted and updated wirelessly into the user's mobile phone at every instant of time. This is done so that the user can monitor the condition and environment of the field without having to be present physically.

IV. RESULT



Fig 1 : Different parameter readings displayed on the lcd screen

V. FUTURE WORK AND CONCLUSION

With the help of the soil nutrient tester and air quality Sensor, the premature death of the plants can be reduced. There will be an increase in the crop yield. By using the automated system, the interference of manual labor can be reduced. Hence, preventing any way of human errors and also less time will be consumed.

In future, the system can be used to provide automatic irrigation of the plants.

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