

NPK Measurement in Soil and Automatic Soil Fertilizer Dispensing Robot

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Abstract: The major aim of this robot is to measure the N (nitrogen), P (phosphorus) and K (potassium) contents of soil and according to result add the necessary element in the soil. The N, P, and K amounts in the sample are determined by comparing the solution to a color chart. This can describe the N, P, K amounts as high, medium, low, or none. There are two terms i.e. macronutrients (nutrients required in large amounts) and micronutrients (nutrients required in smaller quantities). Nitrogen, Phosphorus, Potassium are requires in large quantity in soil. "NPK measurement in soil and automatic soil fertilizer dispensing robot" is going to check the amount of the three main fertilizers which are nitrogen, phosphorus and potassium in the soil and dispense the required deficient nutrient. The existing system has a NPK kit to test the soil but the dispensing of fertilizers need to be done manually. This problem will be rectified in the proposed system. This system will saves labour time and get better results with minimum amount of fertilizers.

Keywords-Nitrogen,phosphorus,potassium(NPK); macronutrients; micronutrients; nutrient

I.INTRODUCTION

NPK rating (or N-P-K) is used to label fertilizer based on the relative content of the chemical elements nitrogen (N), phosphorus (P), and potassium (K) that are commonly used in fertilizers. The three elements promote plant growth in three different ways.

- N – Nitrogen: promotes the growth of leaves and vegetation.
- P – phosphorus: promotes root and shoot growth
- K – potassium: promotes flowering, fruiting and general hardiness

Unlike the N number, the numbers for P and K do not reflect the amount of elemental phosphorus and potassium in the fertilizer. Rather they represent the amount of oxide in the form of P_2O_5 and K_2O that would be present in the fertilizer if all the elemental phosphorus and potassium were oxidized into these forms.

- The fertilizers are present in the ratio of 18–51–20 by weight: 18% elemental (N)
- 22% elemental (P), and
- 16% elemental (K)

Microcontroller: It is a Integrated Circuit chip which processes the input data according to the specified programme and gives the required output.

Color Sensor: It detects the color based on the combination of three basic color components namely Red , Green and Blue and send the value of the color detected.

Actuator: Actuator is a assembly of DC Motor and a shaft connected to the dispenser which controls the dispensing of soil fertilizer according to the input from the microcontroller.

NPK Measurement Kit: Based on the amount of nitrogen, Phosphorus and potassium in the soil the chemicals used in the kit change the colour of the solution containing soil to give an approximate measure of the three basic components of soil present.

II.BLOCK DIAGRAM

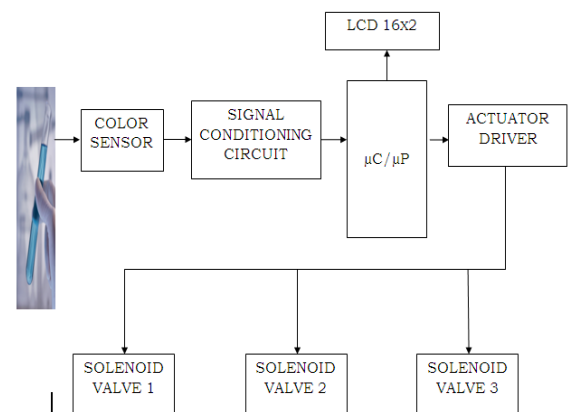


Figure 1. Block Diagram

- NPK measurement kit senses the amount of nitrogen, phosphorus or potassium in fertilizers.
- Depending upon the amount of the component in fertilizer the color of solution changes.
- Color sensor senses the color change and sends it to microcontroller in the form of electrical signal.

- Microcontroller then compares this signal with the reference value stored in it and gives command to actuator drive.
- An actuator drive then gives command to solenoid valves to release the specified amount of fertilizer.
- The valve converts electrical signal from actuator into mechanical energy which, in turn, opens or closes the valve mechanically to dispense the fertilizer.

III. OPERATIONAL OVERVIEW

Many applications or systems have been developed to increase the crop growth. This is one of the them but the unique quality of this system is that it dispenses the desired quantity of only that macronutrient which is deficient in the soil. Thus individual testing of each component helps the crop. The program written is also user friendly so that the thresholds can be changed very easily as per requirements.

Initially the system design contained solenoid valves for controlling the dispensing of the fertilizers. But it is suitable for only liquids, hence we have used a circuitry of relays and DC Motors. This system is flexible to measure and dispense any type of fertilizer other than NPK as well. The only requirement is that the tests conducted for measurement should have a unique colour so that the colour sensor can detect it.

Thus we successfully designed and built the desired system.

A. Color Sensor

A green field NPK measurement kit precedes the color sensor. It gives either blue, gray or pink color at its output depending on the fertilizer being tested-whether it is nitrogen, phosphorus or potassium.

The color sensor will detect this color and convert it into an electrical signal i.e. it will act as a transducer.

This electrical signal is then passed on to the signal conditioning circuit.

B. Signal Conditioning Circuit

The signal conditioning circuit is used for converting the input from color sensor into a form suitable for the microcontroller. The output from the color sensor is analog in nature and the microcontroller being digital needs digital input. So the signal conditioning circuit basically consists of an ADC.

C. Microcontroller

Microcontroller is the heart of the auto dispensing robot. It controls all the peripherals on the basis of the input from the signal conditioning circuit. In this circuit we are going to use a simple 8-bit microcontroller like 89S51. Depending on the input from the color sensor, the microcontroller will dispense the required amount of fertilizer in the soil.

D. Actuator Drive

The actuator drive or actuator is a motor which is used for controlling the solenoid valve. The actuator controls whether a valve needs to be opened or closed. It gets

the input from the controller to decide whether the valve needs to be opened or closed and for what time.

E. Solenoid Valve

The solenoid Valve is an electromechanical valve or opening. It open or closes when it gets a electromechanical input. Here the input is provided by the actuator drive. According to the input it opens and closes and hence dispenses the fertilizer stored in the right amount.

F. LCD

LCD stands for liquid crystal display. It is used in this circuit to display the amount of fertilizers in the soil so that we can check whether the amount of fertilizer being dispensed is correct or no. We are going to use a 16x2 LCD i.e. it has 16 characters and 2 lines of display capacity.

IV. HARDWARE AND SOFTWARE SPECIFICATIONS

Softwares Used.

- ORCAD.
- Meid.
- Flash Magic
- Multisim

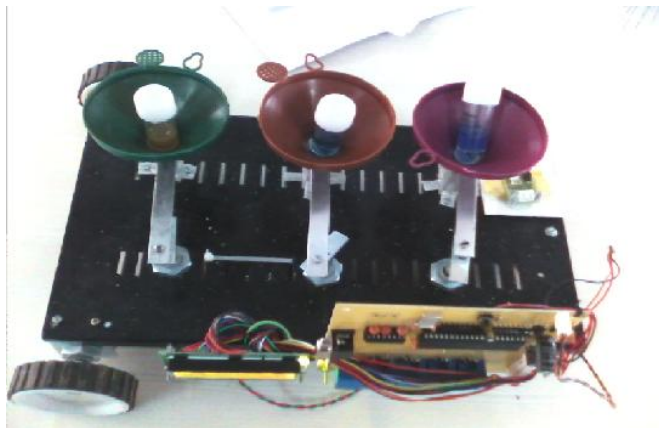
Hardwares used.

AT89V51	Microcontroller
LCD's	16 x 2 Character LCD
MAX232	
Colour Sensor	SUNROM
Transformer	
Push Buttons	
Resistors	
Connectors	
Capacitors	1000uF/25V 100uF/25V 10uF/63V 33pF 0.01uF
Crystal	11.0592MHz
Diode	
40 Pin & 16 Pin Base	
PCB Manufacturing	
NPK Measurement Kit	
Mechanical Structure	
DC Motor	12V 10 rpm
DB-9 Female Connector	
Relay	12V NO
Battery	12V
Transistor	

V. WORKDONE

Till this date of presenting this paper physical parts have mostly be designed like PCB layout, connections on boards, interfacing of different components, wiring, installation of motor and transformers. Also the

different relays and connectors well attached to the board . Robot is also assembled and on top this the whole board is connected which will carry the weight of all the switches, connectors, relays, battery, printed circuit board and other components.



Final System

VI. OBSERVATIONS

- 1st sample from agricultural land .
- pH soil content = 7 i.e neutral or good soil.

For potassium test

- No. of count drop =9 drops i.e potassium content in soil is very high . so no need to put the potassium fertilizer .
- L (colour sensor output) = 20 >15(threshold value put in the microcontroller)

For Nitrogen test

- Colour of the comparator matches with the value of 420 kg/hectare which is low medium for this soil sample . so this need to be dispensed in the field .
- L = 18 or 16 < 30(threshold value for Nitrogen in the programme)

For Phosphorus test

- Colour of the comparator matches with the colour where the value is 7kg/hectare, which is very low so it need to be dispensed .
- L = 15 < 50 (threshold value for phosphorus in the microcontroller)

VII. CONCLUSION

By doing research on this paper I get to conclude that we can help our farmers much advanced manner. And also with the help of this robotic technology we increase the farm productivity. So which in case good for the farmer and at last for the country. Many applications or systems have been developed to increase the crop growth. This is one of the them but the unique quality of this system is that it dispenses the desired quantity of only that macronutrient which is deficient in the soil. Thus individual testing of each component helps the crop.

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