A Modern Methodology Enabling Smart Agricultural System

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A Modern Methodology Enabling Smart Agricultural System

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Abstract-- Agriculture is the backbone of our country. However, in spite of all the development, Indians still follow the old methods. It is necessary for the farmers to have knowledge of the amounts of the macronutrients and micronutrients present in the soil. Lab testing method will not be able to visualize the soil nutrients for the live monitoring. This project is intended to provide the soil testing services at farmers door step by determining the amount of macronutrients present in the soil. Measurement of NPK contents of the soil is necessary to decide how much extra contents of these nutrients are to be added in the soil to increase crop fertility. This will improve the quality of the soil which in turn yields a good quality crop. To fulfill increasing demand of growing population over the years there is a need of increase in food production. To increase crop yield, fertilizers containing predominantly N, P and K are essential. Improper use of fertilizers in turn results in poor quality of fruits and vegetables, lagging in colour, size, taste and even quantity. Over-application of fertilizers has caused low fertilizer usage efficiency, resulting in low agricultural product quality, serious environmental pollution, etc. Quantity of NPK is dependent on crop type and on plant growth status. How much quantity of fertilizer to be used is further dependent on present contents of NPK in the soil. The project is implemented using a technology called WUSN which is used to detect the amount of NPK present in the soil and an automatic soil fertilizer dispensing robot is used to dispense only the required amount of fertilizers in the soil based on the data obtained by the sensors.

Keywords—Nitrogen-Phosphorous-Potassium(NPK), Wireless Underground Sensor Network(WUSN).

1. Introduction
To fulfill the increasing demands of growing population over the years there is a need of increase in food production. To increase crop yield fertilizers containing predominantly nitrogen(N), phosphorous(P) and potassium(K) are essential. Improper use of fertilizers in turn results in poor quality in fruits, vegetable lagging in color, size, test and even quantity. The three elements promote plant growth in three ways.

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

Quantity of NPK is dependent on crop type and on plant growth status. The fertilizers are present in the ratio of 18-51-20 by weight : 18% elemental(N), 22% elemental(P), 16% elemental(K).

The existing systems deals with the actual detection of NPK values of the soil using multimode plastic fiber optic sensor and other technologies like FPGA, Colour Sensors, IOT, etc.,

The present study deals with the detection of NPK values of the soil using content detection sensor. Along with this the soil moisture sensor, humidity sensor and water level sensors are used to monitor the soil parameters.
The soil moisture sensor detects the soil moisture. If the soil moisture is found to be dry, then the pump motor is used to provide water to the soil. The humidity sensor is used to detect the humidity presence. The data's are continuously updated to the server for monitoring purpose using WUSN. Also we have a robotic mechanism to provide pesticide based on the content detected. The pesticide provided is adjusted based on the content values. The robot is controlled using WUSN.

2. BLOCK DIAGRAM

The block diagram consist of the following parts:

A. Battery
B. Soil moisture sensor
C. Humidity sensor
D. Content detection sensor
E. Water level sensor
F. Microcontroller
G. Driver circuit
H. Robot mechanism
I. Pump motor
J. Driver circuit
K. UART
L. WUSN

![Block Diagram]

**Fig 1: Block diagram**

The soil moisture sensor detects the soil moisture. Humidity sensor detects the humidity of the soil. Water level sensor detects the level of the water in the soil.

Content detection sensor detects the presence of NPK in the soil. All these inputs are given to the microcontroller which compares these value with the reference value. If the amount of NPK is found to be deficient means the robot is used to dispense the required amount of fertilizers in the soil.
If moisture is found to be dry, pump motor is used to provide water to the soil. UART is the universal asynchronous receiver transmitter, which is used for serial transmission and reception of data. Driver circuit is used for controlling the robot and the pump motor. Whole system is operated using WUSN which is nothing but wireless underground sensor networks which are placed under the soil for wireless transfer of the data. It does not require any communicating medium.

3. TOOLS AND TECHNIQUES

A. Hardware:
   - Battery
   - Soil moisture sensor
   - Humidity sensor
   - Content detection sensor
   - Water level sensor
   - Microcontroller
   - WUSN
   - LCD

B. Software:
   - Embedded C
   - MPLAB Compiler

4. OPERATIONAL OVERVIEW

Many applications or systems have been developed to increase the crop growth. This is one of 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.

A. PIC16F877A

The term PIC, or Peripheral Interface Controller, is the name given by Microchip Technologies to its single-chip microcontrollers. PIC micros have grown to become the most widely used microcontrollers in the 8-bit microcontroller segment. The PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5x, PIC12Cxxx and PIC16C7x devices. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

Fig 2: PIC16F877A
B. HUMIDITY SENSOR

**INPUT:** 5V DC  
**OUTPUT:** ANALOG

**PURPOSE:** A humidity sensor senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity.

![Humidity sensor](image3)

**Fig 3: Humidity sensor**

C. WATER LEVEL SENSOR

**INPUT:** 5V DC  
**OUTPUT:** ANALOG

**PURPOSE:** Water Sensor water level sensor is an easy-to-use, cost-effective high level/drop recognition sensor, which is obtained by having a series of parallel wires exposed traces measured droplets/water volume in order to determine the water level.

![Water level sensor](image4)

**Fig 4: Water level sensor**

D. SOIL MOISTURE SENSOR

**INPUT:** 5V DC  
**OUTPUT:** ANALOG

**PURPOSE:** The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the water content.

![Soil moisture sensor](image5)

**Fig 5: Soil moisture sensor**
E. DRIVER CIRCUIT

The ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diode for switching inductive loads.

![Driver Circuit](image)

Fig 6: Driver circuit

F. CONTENT DETECTION SENSOR

Common laboratory conductivity meters employ a potentiometric method and four electrodes. Often, the electrodes are cylindrical and arranged concentrically. The electrodes are usually made of platinum metal. An alternating current is applied to the outer pair of the electrodes. The potential between the inner pair is measured. Conductivity could in principle be determined using the distance between the electrodes and their surface area using Ohm's law but generally, for accuracy, a calibration is employed using electrolytes of well-known conductivity.

Here, two inductively-coupled coils are used. One is the driving coil producing a magnetic field and it is supplied with accurately-known voltage. The other forms a secondary coil of a transformer. The liquid passing through a channel in the sensor forms one turn in the secondary winding of the transformer. The induced current is the output of the sensor.

5. FINAL PROTOTYPE

![Final Prototype](image)

Fig 7: Final Prototype
The final values will be displayed in the LCD which contains the appropriate percentage of the nutrient, namely, nitrogen (N), phosphorous (P), potassium (K) in the soil.

6. Conclusion
By doing research on this paper, I get to conclude that we can help our farmers in much advanced manner. And also with the robot technology we increase the farm productivity. Many applications or system have been developed to increase the growth of the crop. The main feature of this system is that it dispenses the desired quantity of only that macronutrient which is deficient in the soil. This helps to test the presence of individual nutrients in the soil continuously by the robot. The another advantage is that the data’s are transferred without any communication medium under the soil with the help of Wireless Underground Sensor Network.

7. FUTURE SCOPE
For the further development, this prototype can be enhanced by placing the content detection sensor, soil moisture sensor, humidity sensor and water level sensor in the robot which does the entire operation by itself.

8. REFERENCES
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