International Journal of Students' Research In Technology & Management
Vol. 3 (04), April 2015, ISSN 2321-2543, pg. 325-327

AGRO SENSORS

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***Abstract*—Soil nutrient is detected by the use of ISFETs and the corresponding current is obtained from it according to the variation in concentration of the nutrient in soil and their Ph. The use of metal oxide coated semiconductors for gas detection is high nowadays. The Ion sensitive field effect transistor has the electrode. This on reaction with the analyst changes its resistance value and corresponding signals are generated and the transducer unit in the sensor gives the varying current output. This could be then processed that is converted to voltage, amplified and then given to a window detector where in the voltage obtained from the sensor could be tested for it be in between two reference voltage levels and these reference voltage levels represent the level of nutrients in the soil either it is deficient, in surplus or in sufficient amounts. This could be used to make the LEDs glow. It proves to be an easy way of observing the soil nutrient content even by an illiterate. The checking of soil nutrient content could be automated and made periodic by the use of microcontroller, the feedback mechanism involving the soil's nutrient content value as the common input and the ideal or required value as the reference input.**

***Index Terms*— Introduction, ISFET, non-inverting amplifier, Window detector**

I. INTRODUCTION

Much advancement has been done in agriculture focusing the increasing of crop yield. But the use of fertilizers to increase the yield proves to be a threat to the crop protection and the further use of field for successive cultivation and crop rotation.

Instead there can be a way in which the technology could be used to achieve a farmer-friendly environment. Chemical sensors shall be used to detect the composition of nutrients in the soil and this could be converted to an electrical parameter such as change in resistance/inductance/capacitance or electrical polarization etc.

The chemical sensor generally gives the output in the form of a physical signal and that could be processed by signal processing unit. After the signal is processed it is given to the display unit to view the output. Here, an idea of using LEDs instead of display unit would help even a common man to infer the nutrition level in the soil.

The soil consists of many nutrients and 3 among them are the most essential nutrients namely nitrogen, phosphorous, potassium. Though these minerals are available in larger amounts the propotion used by the plants is very less.the nutrients may be available in any form say soild, liquid, and gas or even as ions. Sodium chloride dissolves in water easily to give sodium ions (Na+) and chloride iopns (cl-) whereas there are nutrients that does not dissolve easily into ions in water.

Depending upon the choice of the mineral to be analyzed the choice of sensor varies. It may be a metal oxide sensor or a sensor that uses polymers working on the principle that this polymer on reaction with the analyst deforms in shape. This gives the information about the nutrient. More precisely the use of ion sensitive field effect transistor gives best results in soil nutrient detection.

II COMPONENTS OF AGRO SENSORS:

The block diagram representation for the working of the agro sensor is shown in figure 1

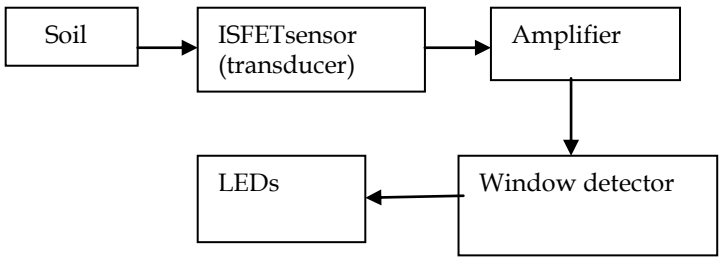
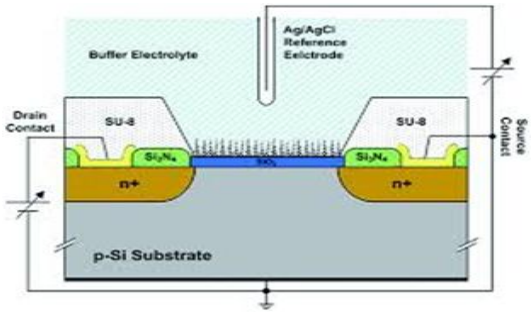


Figure 1

The soil that is being tested is inspected by using the ISFET. The anayst acts as the gate electrode.

III ISFET



The ion sensitive fiels effect transisitors could also be used for the detection of variation in the pH of the soil.

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This works on the basis of change in ion concentration which is converted to corresponding potential differences. It happens according to the Nernest equation

$\Delta\phi = RT/F \ln ai1/ai2$

Where,

R- Gas constant

F- Faraday constant

T- Absolute temperature (K)

fi= Activity Coefficient

Ion concentration ai=fi.ci

So the change in the concentration is converted to the corresponding current values.

IV. NON-INVERTING AMPLIFIER

The potential difference that comes out as the output from the sensor is amplified. An ideal amplifier is to have an inifite input resitance, zero output resitance, infinite open loop voltage gain, inifinte bandwidth. Even though idealization of amplifiers is not possible, the operational amplifiers almost match with the ideal characteristics. A comparision of the ideal opamp with the practical one is given in the table 1.

The operational amplifier works in two modes:

1. Inverting amplifier,
2. Non-Inverting amplifier.

Compared to the inverting amplifier ,the input resistance of the non-inverting amplifier is extremely large as it draws negligble amount of current from the sorce.the opamp in the non inverting mode is as shown in the figure 3.

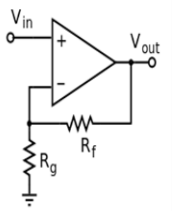


Figure 3

V. WINDOW DETECTOR

The window detector is used to compare the given input voltage between any two threshold voltages. This differs from the comparator in a fact that only the comparison of the input voltage with a single reference voltage is possible, whereas in a window detector it is possible to compare between various voltage levels. The resistance values chosen determine the threshold voltage levels.

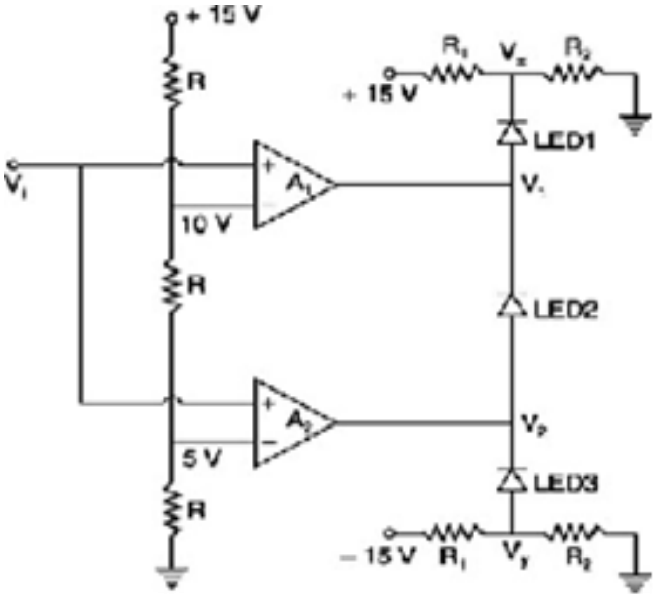


Figure 4

The circuit in figure 4 has two non-inverting comparators. It divides the total voltage into three equal voltage steps with the help of the 3 equal resistances. Here the total voltage 0f 15 is divided in 3 steps. The voltage available after resistor 1 is 5v and that after next resistor is 10v. The voltage that is available across the resistors is given to the inverting end of comparators 1 and 2 respectively. This is compared with the voltage obtained from the ISFET.

VI. WORKING OF AGRO SENSORS:

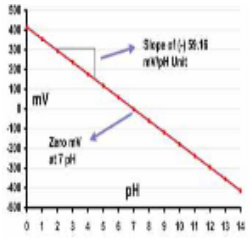
The ISFET sensors are beinginstalled in the soil following the precautions to protect it from water. The sensors detect the level of nitrogen and phosphorous present in the soil and give the output in terms of millivolts. The variation of voltage with pH is as shown in figure 4.

The voltage available from the sensor is amplified using amplifier with a high gain. This amplified voltage is given to a window detector which is used to compare the amplified voltage with reference voltage. The window detector has 3 different ranges i.e. from 1V to 5V, 5V to 10V, 10V to 15V. Depending upon the resistance values the desired threshold voltages could be obtained and the output from the operational amplifiers causes either of the 3 LEDs to glow. Thus the output voltage from window detector make the appropriate LED forward biased and makes it glow. The variation of pH and the voltage level is given in the graph1

VII. CONCLUSION

Thus the use of agro sensors has applied the emerging technique of pH measurement. This differs from the conventional method in a way that more precise pH relation with Mv is obtained in this. It is also cost effective and

with better perfomance, since the components of it is just simple.



ACKNOWLEDGEMENT

We thank Dr.M.Nandhini Gayathri B.Tech (EEE), M.Tech (Power electronics and drives), Ph.D. (Drives and Controls), who has published 15 papers in International journal and presently working as an Assistant Professor III in SASTRA University.

REFERENCES

[1] Journal of the Electrochemical Society, 150 ~2! S11-S16 ~2003Sensors, Chemical Sensors, Electrochemical Sensors, and ECS Joseph R. Stetter,*, zWilliam R. Penrose,* and Sheng Yao*

[2] University of Hawai'i - College of Tropical Agriculture and Human Resources

[3] Chemical sensors by Dónal Leech

[4] Soil Science Extension North Carolina State UniversitySteven C. Hodges

[5] Linear integrated circuits- D.RoyChoudhury, Shail B. Jain

[6] Mimic of a Gas sensor, Metal Oxide Gas Sensing Mechanism, Factors Influencing the Sensor Performance and Role of nanomaterials based gas sensorsby John BoscoBalaguru, B.G.J ayaprakash

[7] Field-Scale Variability of Soil Properties in Central Iowa Soils by C. A. Cambardella,T. B. Moorman,T. B. Parkin,D. L. Karlen,J. M. Novak, R. F. Turco and A. E. Konopka