PC BASED AUTOMATIC IRRIGATION SYSTEM

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ABSTRACT

In certain areas of India, where agriculture is the major source of income, climate dry and unfavorable conditions often revolt and damage crops. This project ill help the agricultural sector to conserve water and provide crops with the necessary amount of water required. Even with less rain and water sources farmers will be able to use the available amount of water to the best with the help this system. Even in terms of man power, this proposed system will require almost no manual help. From the trouble of watering the fields to controlling the pump, everything will be taken care of by the system. All of this will
be covered by a process where soil moisture will be sensed by a sensor and it will be controlled by a pump as directed by a controller.

Keywords: Capacitive Moisture Sensor, Irrigation System, Microprocessor Based Controller, Pneumatic Valve, Soil Moisture Control.

I. INTRODUCTION

In a developing country likea India a majority of the people live life by farming. It can roughly be said that agriculture is the main backbone of India. At the same time with the growing rate of population in the country a huge supply-demand problem is being faced. As a result inadequate food supply, malnutrition, etc. are becoming growing problems of the society. In spite of having enough farmlands, farmers are failing to produce enough food mostly because of man power or inadequate fresh water supply due to the uneven geological diversity across the country. So to cope up to that problem this project is being proposed. This project will not only reduce the necessity of human labors but also open up the gates to conserve fresh
water and execute proper farming at the same time. With the help of this project rain-less monsoon will not be a very big disadvantage as the limited water from bore-wells and local water bodies can be put to use using this technology.

1.1 Proposed System

The proposed system will be a closed process loop where the applications of process control, control systems, digital signal processing will be used. The loop will consist of a capacitive sensor and transducer with AC signal which will record moisture level from the process. The signal from the transducer will be forwarded to the instrumentation amplifier. The amplifier, which will still be working on AC will forward it signal to a rectifier and filter. The rectifier will convert the AC signal to DC signal and the filter will determine the amplitude of the DC signal and check if it is not too high for the next few blocks to work. After the rectifier and filter block, the signals will be forwarded to the Zero, Gain & Span Adjustment block where the signals from the capacitive sensors will simply be adjusted according to the calibration set in it. That calibrated signal will be forwarded to the PC separated by an Opto-isolater. The PC will act as the controller and compare the calibrated signal of the sensor with the user input set-point. After comparison it will generate a signal that will determine whether the moisture in the process is more or less than the set point. The generated signal from the PC will be forwarded to the final control element, once again separated by an opto-isolater, according the PC generated signal the final control element will open or close and control the level of moisture in the process.

II. BLOCK DIAGRAM

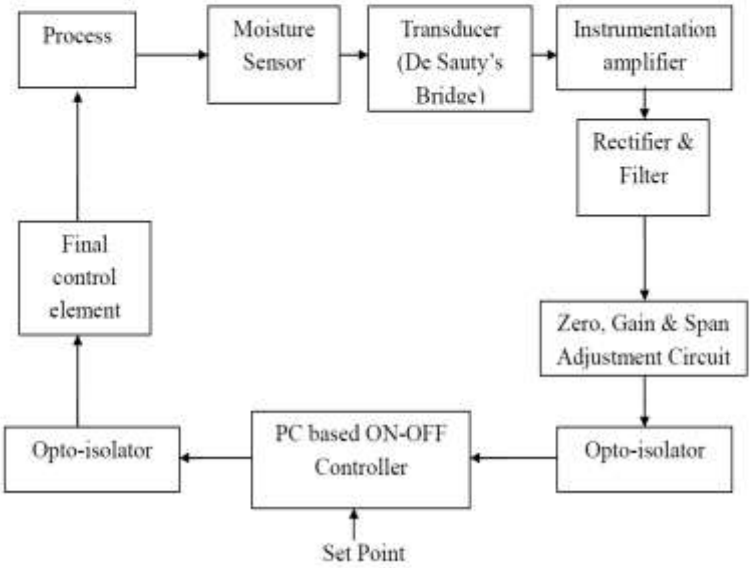
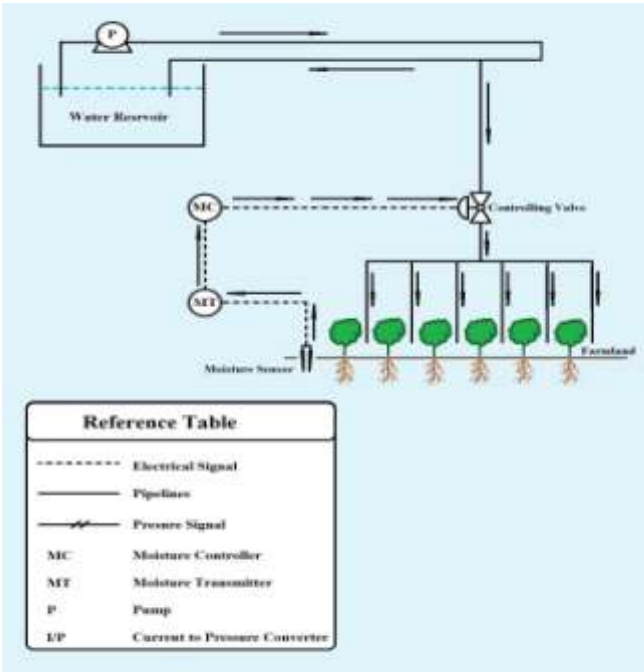


Fig. 2.1 - Overall Block Diagram of The Proposed Project.

The above figure (Fig. 1.1) shows an rough block diagram of the proposed project. As described in section 1.1 the figure acts as a closed process loop where moisture is controlled by a valve as per the direction of the PC.

2.1 P-I Diagram



2.2 Moisture Sensor

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. Since analytical measurement of free soil moisture requires removing a sample and drying it to extract moisture, soil moisture sensors measure some other property, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on soil type. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments are used by farmers or gardeners.

In our proposed project we are trying to develop our own sensor with the application and logic of capacitors and their capacitance. So what we are trying to use here can be called capacitive moisture sensor.

2.2.1 Capacitive Moisture Sensor

The sensor we are developing will consist of a parallel plate capacitors. The parallel plate capacitor will be probed inside the soil of he farmland where the soil will act as a dielectric medium. Now we know that a typical equation of capacitance as shown in Fig 4.1, is:

$C = \varepsilon_0 A/4\Pi d$

(1) Where, A = Area of the parallel plates overlapping

d = Distances between the plates and

ε_0 = absolute permittivity of the dielectric.

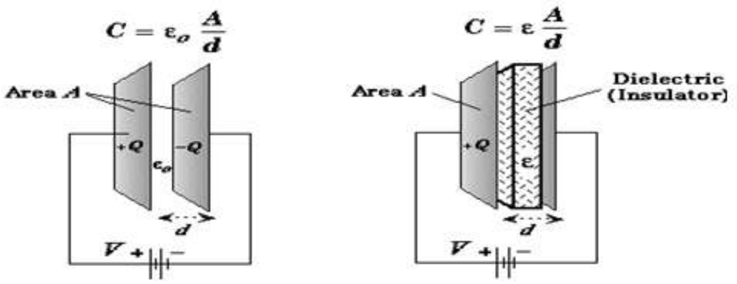


Fig. 2.3 Parallel Plate Capacitors

Now, from (1), we can see that capacitance is dependent on the dielectric permittivity, so change in dielectric permittivity will change in capacitance and in turn the voltage drop across it. This voltage change will denote the moisture content in the soil. Of course the sensor needs to be calibrated before that.

From tested materials it has bees seen that wood pellets are cylinder-shaped with uniform diameter and usually vary in length. For the pelleting process wood is dried, milled and pressed through a matrix. Lignin, which is a natural component of wood, serves as a binding agent in the pelleting process and no further additives are required. For the investigations carried out, the material diameter was 6 mm and the length of the material was in the range from 3 mm to 32 mm. Even though a moisture content of 10 % or

12 % will affect the calorific value of wood pellets only by a few per cent, any amount of energy to heat up and to evaporate bound water is taken from the combustion and makes this process less effective at the combustion site. Detecting small changes in material moisture, as expected for a variety of applications, is of course a central issue with electrical measurement.

2.3 Transducer (De Sauty's Bridge)

The transducer here has been selected to be De Sauty's Bridge. This bridge provide us the most suitable method for comparing the two values of capacitor if we neglect dielectric losses in the bridge circuit. The circuit of De Sauty's bridge is shown below.

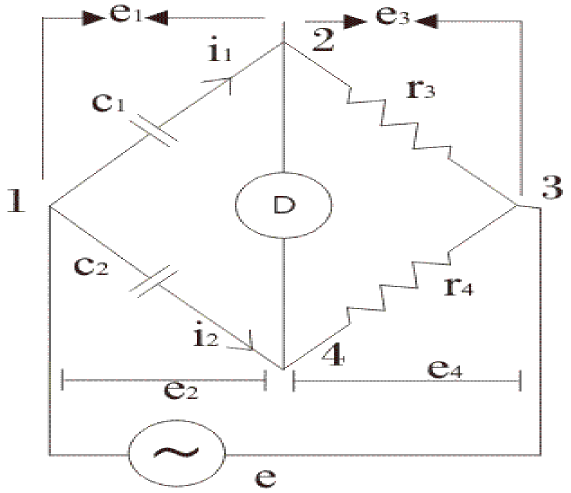


Fig. 2.4 De Sauty's Bridge

At balance condition we have,

$$\frac{1}{j\omega c_1} \times r_4 = \frac{1}{j\omega c_2} \times r_3$$

It implies that the value of capacitor is given by the expression

$$c_1 = c_2 \times \frac{r_4}{r_3}$$

In order to obtain the balance point we must adjust the values of either r_3 or r_4 without disturbing any other element of the bridge. This is the most efficient method of comparing the two values of capacitor if all the dielectric losses are neglected from the circuit. We will balance the bridge according the requirement of moisture. Due to the change of of moisture capacitance of the capacitop will vary & as a result we will get an unbalanced voltage which we will fed to the signal conditioning circuit.

2.4 Instrumentation Amplifier

As the output of any sensor is very low,the Instrumentation amplifier is generally used to increase the signal level.Instrumentation amplifier is a type of differential amplifier that has been outfitted with input buffers, which eliminate the need for input impedance matching and thus make the amplifier particularly suitable for use in measurement and test equipment. Additional characteristics include very low DC offset, low drift, low noise, very high open-loop gain, very high common-mode rejection ratio, and very high input impedances. Instrumentation amplifiers are used where great accuracy and stability of the circuit both short- and long-term are required.

Although the instrumentation amplifier is usually shown schematically identical to a standard op-amp, the electronic instrumentation amp is almost always internally composed of 3 op-amps. These are arranged so that there is one op-amp to buffer each input (+,−), and one to produce the desired output with adequate impedance matching for the function.

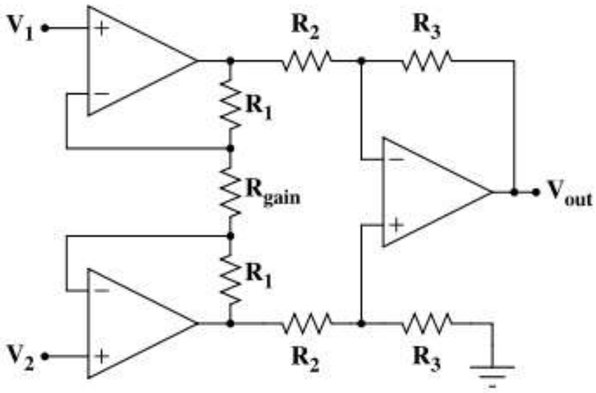


Fig 2.4 The Most Commonly Used Instrumentation Amplifier Circuit is Shown In The Figure.

2.5 Rectifier & Filter

Output of the Transducer is AC signal, so to convert this signal to DC wehave to use rectifier and filter. RC and other filters are very widely used in selecting signals and rejecting noise. A low pass filter may be considered as a filter that allow the DC but attenuate the AC component of a signal that is passing through it. Conversely, a high pass filter can pass the high frequency signal through it thus it is used it sort high frequency components in a purely AC signal. Capacitor may be considered as high frequency accepter and low frequency rejecter.

2.5.1 Low Pass Filter

A first order low pass RC filter is simply an RC series circuit across the input, with the o/p taken across the capacitor. We assume that the o/p of the circuit is not connected, or connected only to high impedance, so that the current is the same flowing through the R and C.

At high frequencies, the capacitor shorts out the i/p to the high frequency signal and hardly affect the low frequency signal. So this circuit is behaves as high frequency signal.

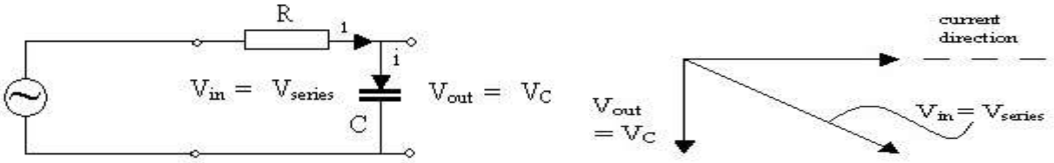


Fig 2.5 Low Pass Filter

2.6 Zero, Span & Gain Adjustment

2.6.1 Zero Adjustment

The output voltage from the sensor is amplified to 1-5 V by the amplifier in the measuring circuit. That is zero of the input voltage is to be adjusted at IV. This zero may not be adjusted by bridge potentiometer in one of the ratio arms. But this potentiometer should be kept at a value so that the bridge is almost balanced at zero level condition.

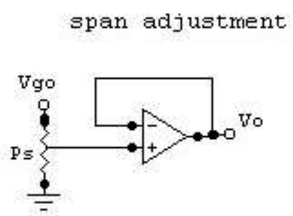


Fig 2.6 Span Adjustment

2.6.2 Span Adjustment

This network is required to adjust the final indication within the whole span of the instrument. It consists of the network as shown in Fig. below

2.6.3 Gain Adjustment

This network is needed to adjust the gain of the instrument. This amplifies the output of the zero adjustment networks so that after amplification the signal is sufficient to drive the output indicator throughout its whole range. A simple amplifier circuit having variable feedback resistance in inverting mode is used for this network.

2.7 Opto-Isolator

Even in most demanding industrial application, in spite of use of instrumentation amplifiers and proper application of grounding and cabling techniques, there may be serious problems in ground loops extremely high common mode voltages and very low failure current requirements. All these problems can be solved with an isolation amplifier hybrid integrated circuit.

The usual Opto isolator circuit generally consists of a Light Emitting Diode (LED) and a phototransistor or a photodiode. But the phototransistor or a photodiode is more expensive than the Light Dependent Resistor (LDR). So in the present project an LED LDR based Opto-isolator circuit has been designed. The

LED-LDR pair is enclosed in a black-coated chamber in the form of a black PVC tube surrounded by clack cover.

An Opto-isolator Circuit has been shown in the following Fig.

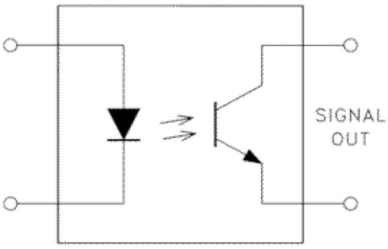


Fig. 2.7 Opto-isolator

2.8 Pc Based On/Off Controller

We use NI Lab View to develop ON OFF Controller. To fetch the signal from Opto-Isolator to NI LabView DAQ Assistant of the software is used. One comparator is chosen to compare the transducer output and the given set-point.. The set-point is given manually over here and the output of the comparator will sent to the final control element by using another DAQ Assistant. We are using NI Lab View as the controller here as it will be easier to develop the controller in the future.

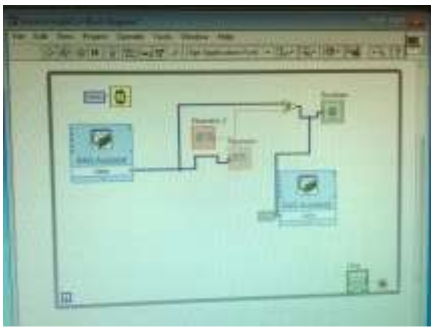


Fig 2.8 Using on off Controller in NI Lab View

2.9 Final Control Element

Final control element is used to manipulate the controlling variable(flow rate of water), such a way that controlled variable (moisture) is at its set point value. We have chosen electronic valve as final control element. As the signal from the controller is electronic so it will be easier to use an electronic valve. We can also use a solenoid valve as a final control element.

III. CONCLUSION

The system provides with several benefits and can operate with less manpower. The system supplies water only when the humidity in the soil goes below the reference. Due to the direct transfer of water to the roots water conservation takes place and also helps to maintain the moisture to soil ratio at the root zone constant to some extent. Thus the system is efficient and compatible to changing environment.

3.1 Application and Scope

1. Saves water - Studies show that drip irrigation systems use30 - 50% less water than conventional watering methods, such as sprinklers.
2. Improves growth - Smaller amounts of water applied over a longer amount of time provide ideal growing conditions. Drip irrigation extends watering times for plants, and prevents soil erosion and nutrient runoff. Also, because the flow is continuous, water penetrates deeply into the soil to get well down into the root zone.
3. Discourages weeds - Water is only delivered where it’s needed.
4. Saves time - Setting and moving sprinklers is not required. A timer delay as per environment can be added to the system for automatic watering.
5. Helps control fungal diseases, which grow quickly undermost conditions. Also, wet foliage can spread disease.
6. Adaptable - A drip irrigation system can be modified easily to adjust to the changing needs of a gardener lawn.
7. Simplest Method - Start by drawing a map of your garden and yard, showing the location of plantings. Measure the distances required for lengths of hose or plastic tubing to reach the desired areas.

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