Water Saving Irrigation Automatic Agricultural Controller under Vishvakarma Yojana

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Abstract - *For weather monitoring system and irrigation controller we need to measure different parameters that are atmospheric temperature, humidity, soil temperature, etc. A soil moisture sensor was modeled, simulated and tested for achieving, with low-cost, accurate and reliable measurements. Rain water harvesting is an excellent means of supplementing water for use on site if the process is permitted by state and local laws. Using rain water, where appropriate, conserves portable water consumption. Rain water harvesting describes processes in which precipitation that falls on a site is diverted, captured and stored for use on-site, as opposed to allowing it to run off, evaporate or infiltrate into the soil. Depending on its intended use, the captured precipitation may require treatment. Hence current research focuses on precision agriculture, soil conservation and crop irrigation scheduling and water quality control for increasing water use efficiency. There is a need to develop new indigenous irrigation controller to improve farm productivity Today drip irrigation is necessary to control the level of water on earth. Drip irrigation system is provided the root to zone of plant drop by drop which results in saving of huge amount of water. With the water requirement in irrigation being large, there is a need for a smart irrigation system that can save about 80% of water. The prototype aims at saving time and avoiding problems like constant vigilance. It also helps in the water conservation by automatically providing water to the plants depending on their water requirements. It can also prove to be efficient in agricultural field.*

***Key Words*: Irrigation controller, Weather monitoring sensors, Irrigation scheduler, Storage tanks, Maintenance, Drainage, Rain water harvesting, Water productivity, Rooftop, Catchment Area, drip irrigation system**.

1.INTRODUCTION

The weather station is a facility either on land or sea with instruments and equipment for observing atmospheric conditions to provide information for weather forecasts and to study the weather and climate[3]. The measurements taken include temperature, humidity, moisture content, etc. Water is a basic component of all known life on earth[6].

Water can both sustain life in correct quantities when it is not available. Water as a result is a very precious natural resource that must not be wasted. If too much water is given to the plants then runoff, erosion, waste of water and plant life decreases. As we know that pumping irrigation in terms of design and construction of water conveyance facility is not so satisfactory for the farmer [3]. So, by introducing the water-saving irrigation schedule on-farm irrigation management the irrigation service has been improved. Recent technological advances have made soil water sensors available for efficient and automatic operation of irrigation system[5]. Automatic soil water sensor-based irrigation seeks to maintain a desired soil water range in the root zone. That is optimal for plant growth. Once system is setup and verified, only weekly observation was required. This type of system adapts the amount of water applied according to plant need and actual weather conditions throughout the season. This translates not only into convenience for the manager but into substantial water savings compared to irrigation management based on average historical weather conditions[1]. One of the ways to curtail cost of traditional, uneasy, bulky, less efficient and cost insensitive wired system is use the wireless soil moisture and temperature sensor, which allow linking between the points that are physically or economically different to access and in turn help in conservation of water and natural resources for desirable sustainable development. These sensors acquire the real time data monitoring of the soil moisture and temperature and augment switching ON/OFF of the motors. Rainwater harvesting is defined as the process of collecting and storing rain water for later productive use[1]. There are two main techniques of rainwater harvesting:

Storage of rainwater on surface for future use:

1. Recharge to ground water
2. Directly collected rain water can be stored for direct use or can be recharged into the groundwater [4].

1.1 Project Undertaken

The health of plant is influenced by many factors. Weather monitoring system will measure various parameters like temperature and humidity. One of the most important is being the ready availability of moisture in the soil. Irrigation without soil moisture monitoring is like driving a car without speedometer. Monitoring tells us that more than when and how much to irrigate. It helps improve the bottom line experience has proven that manipulating moisture levels allow a maximize growth days and increase fruitfulness of agricultural field. For to reducing the wastage of water we are using the single drip irrigation system because by using this method we can provide water to crop drop by drop so that we can save the water efficiently for our future use. Due to over population and higher usage levels of water in urban areas water supply agencies are unable to fulfill the demand from available sources. The matching of water supply and water demand may be difficult so by using the rain water harvesting is a crucial role to play in terms of economic and human welfare.

1.2 Block Diagram

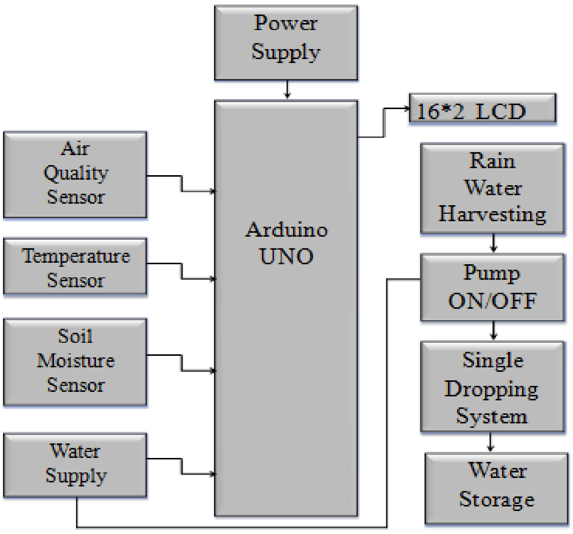

Fig 1 : Block Diagram of System

1.3 Block Diagram Description

The block diagram is the system block diagram of the water saving irrigation automatic agricultural controller. The mainly input parameters that are soil moisture sensor, temperature sensor & air quality sensor. The sensors integrate sensor elements plus signal processing but here we are using Arduino in place of PIC Microcontroller, because of its compactness. A unique capacitive sensor is used for measuring relative humidity while temperature is measured by a LM35 transistor. The applied technology guarantees excellent reliability and long term stability. Both sensors are coupled to 14 bit analog to digital converter and a serial interface circuit which is inbuilt in the arduino. A monitoring system generally refers to an automated system that simultaneously and continuously records one or more physical parameters such as temperature, relative humidity, wind flow, light intensity, soil moisture etc. Continuous monitoring of any sensitive environment helps to meet security and regulatory compliance needs. Monitoring temperature and/or humidity conditions is an essential ingredient of a wide range of quality assurance applications. Here we are using arduino LM335 for sensing the temperature of the soil. In the LM335 there are 3 pins which are analog input pin, ground and the input voltage pin. This circuit is operating on the input voltage 5V. And here we are using the A0 pin which is connected to the analog pin of the LM335. So it can sense the temperature at predetermined value. At the other hand there are also soil moisture sensor is used so with the help of that sensor we can measure the content of water in the soil and also it is depend on the depth of the soil level so from this we can also predict how much amount of water is required for soil. The dielectric medium of the strip is water.

1.4 Input Parameters that are used by the system

1.4.1 Atmospheric Temperature Sensor

The LM335, LM235, LM135 are precision temperature sensors which can be easily calibrated. They operates as 2-termina Zener and the breakdown voltage is directly proportional to the absolute temperature at 10Mv/° K. The circuit has a dynamic impedance of less than 1Ω and operates within a range of current from 450μA to 5Ma without alteration of its characteristics. Calibrated at +25° C, the LM335 has typical error of less than 1° C over a 100° C temperature range. Unlike LM335 has a linear output. There is an easy method of calibrating the device for higher accuracies. The single point calibration works because the output of the LM335 is proportional to the absolute temperature with the extrapolated output of sensor going to 0V at 0° K(-273.15° C). Errors in output voltage versus temperature are only slope. Thus a calibration of the slope at one temperature connects error at all temperatures. If the sensor is used in surrounding where the thermal resistance is constant, the errors due to the self heating can be extremely calibrated. This is possible if the circuit is biased with a temperature stable current.

1.4.2 Soil Moisture Sensor

YL-38 Soil Moisture Sensor is used to measure the moisture level in soil. It is widely used for performing experiments in courses like soil science, environmental science and botany. It can also evaluate the optimum soil moisture contents for various species of plants. We can place prongs of the sensors in the soil and check the moisture level. The YL-38 ranges from 0 to 45% volumetric water content in the soil. It operates on 3 Ma at 5v DC. Its operating temperature is from -40° to +60° C. The sensors has a four pins at one side, that are Vcc, GND,V0 and A0 and 2 pins on the other side to connect the prongs that are to be insert into the soil. The V0 pin is used for analog output. The sensor also has a Potentio Meter to celebrate the sensitivity of the sensor. Usually dry soil is made up of soil material and air pockets called pores or spaces. Approximately, their ratio would be 55% soil material and 45% pores. If we add some water to the soil, the pores begin to fill with that water and then the ratio would be 55% of minerals, 35% of pores spaces and 10% of water. This would be example of 10% volumetric water content. So, this is the main mechanism of YL-38 soil moisture sensor.

Formula:

$$W= (M_w / M_s) * 100$$

Where,
W = Moisture content
M_W = Mass of water in soil
M_S = Dry mass of soil

1.4.3 Air Quality Sensor

MQ135 adopts SnO2 as its gas sensitive material because SnO2 has low electrical conductivity in the clean air. So when surrounded by polluted air, the electrical conductivity of MQ135 will increase with the increase of pollutants, and the change in electrical conductivity can be converted to corresponding output signal. MQ135 has a high sensitivity to Ammonia, sulfide, benzene vapor, smoke and other harmful gas. It can detect various harmful gases, making it a cost-effective choice suitable for multiple applications. Standard testing temperature /humidity : 20℃±2℃/ 65% ± 5%RH, Standard testing circuit: Vc:5.0V±0.1V. Features of sensitive components under standard test condition: Heating resistor. Product model: MQ135. Product type: Semiconductor gas sensor. Standard Package: Bakelite (Black Bakelite). Target gas: Ammonia; methylbenzene; hydrogen. Standard circuit: Loop voltage Vc ≤24V DC. Heater voltage: VH 5.0V±0.2V AC or DC. Load resistance: Adjustable RL.

2 WORKING PRINCIPLE

The applied technology guarantees excellent reliability and long term stability. Both sensors are coupled to 14 bit analog to digital converter and a serial interface circuit. A monitoring system generally refers to an automated system that simultaneously and continuously records one or more physical parameters such as temperature, relative humidity, wind flow, light intensity, soil moisture etc. Continuous monitoring of any sensitive environment helps to meet security and regulatory compliance needs. Monitoring temperature and/or humidity conditions is an essential ingredient of a wide range of quality assurance applications. Here we are using UNO Arduino and LM 335, bread board for to sensing the temperature of the soil. This circuit is operating on the input voltage 5V. So it can sense the temperature at predetermined value. The below circuit shows the motors forward reverse connection in addition with the rain water harvesting circuit. And also there are the circuit for to motor fall on the terrace of the roof of the house. So we can easily catch that water into water catchment area and then into the water purifier circuit and also into the water storage tank for the single dropping irrigation system in to the garden. When the water level is at high or low or at exceed the higher limit. The following circuit diagram shows the water level alarm circuit. We are interfacing that motor circuit with Arduino. Arduino is use to provide the data to any equipment and it converted into the analog signal. And then it will give signal to the motor & then motor start to run. This pump is used where the pressure is needed to apply and this pump is operated on the 2.5 to 6v DC supply. It is made from the engineering plastic. Flow rate is about 80-120L/H. Outside diameter of water outlet is about 7.5mm/0.3". This pump has a rated voltage about 3.0 V dc supply.

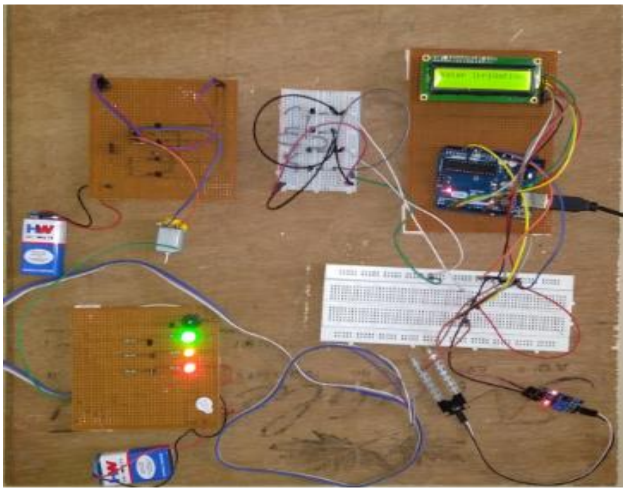

Fig 2 : Water Saving Irrigation Controller

And also rated voltage of this pump is about 2.7-3.3 V DC supply and also the rated current is about 60Ma. This pump is mainly used in the controlled fountain water flow, controlled garden watering systems, hydroponic system, fresh water intake or exhaust systems.

Date (8.30 am)	Atmospheric temperature (̊C)	Soil temperature (̊C)	Soil moisture (%)
12/10/17	31	30	32
13/10/17	28.5	29	28
14/10/17	29	26.8	32
15/10/17	27	29	35.1
16/10/17	31.2	30.6	29
17/10/17	28.7	30	37.2
18/10/17	26	29.2	29.5

Table -1: Quantity to be measured during testing

3 RESULTS

Here we have made the temperature sensor circuit interfacing with Arduino according to the atmospheric room temperature. So that here we are using LM 35 as a temperature sensor or temperature indicator. We are connecting Arduino with LM 35 Temperature sensor and according to that it will display the atmospheric temperature on the display. And it will change according to the weather atmospheric temperature. The output of the atmospheric temperature is shown in the below figure . Soil moisture sensor is use to know the water content into the soil and as per that we have to first choose the depth of water in the soil and as per that we have to make a program for the soil moisture sensor.

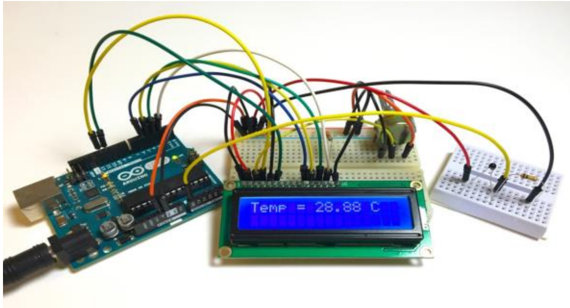

Fig 3 : Temperature Sensor Output

Soil moisture sensor has also three terminals, first is the analog pin then second is ground and the third is supply pin. According to that we have to connect the soil moisture sensor with that Arduino.

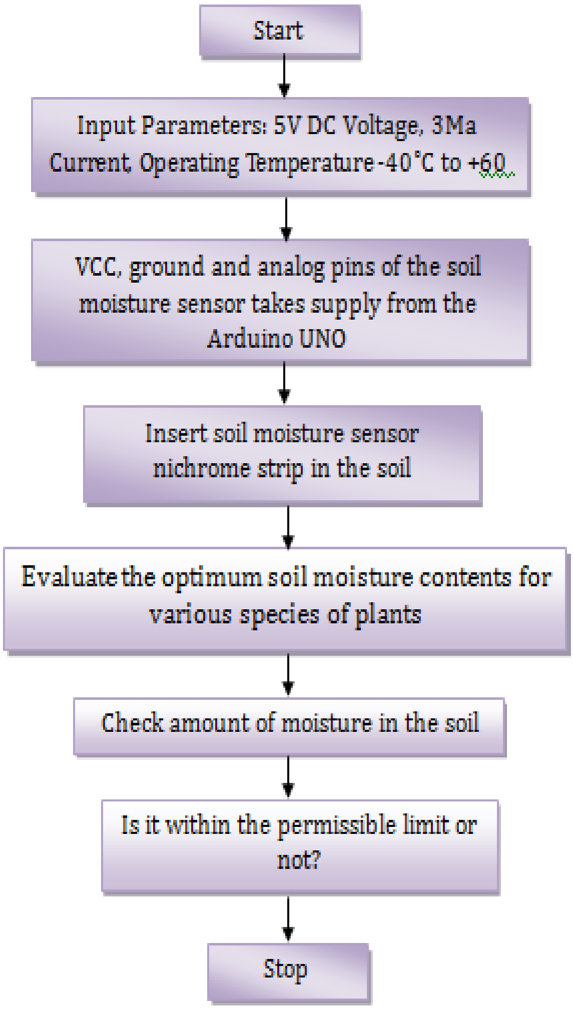

Chart 1: Flow Chart of Soil Moisture Sensor Output

Table -2: Moisture Content in Soil

Mass of Water in Soil	Dry mass of soil	Moisture Content
50	65	76.92
55	60	91.66
52	61	85.24
49	65	75.38

Capacity of the soil to store water

Soils hold different amounts of water depending on their texture and structure. The upper limit of water holding capacity is often called "field capacity" (FC) while the lower limit is called the "permanent wilting point" (PWP). For example, following an irrigation event that saturates the soil, there will be a continuous rapid downward movement (drainage) of some soil water due to the gravitational force.

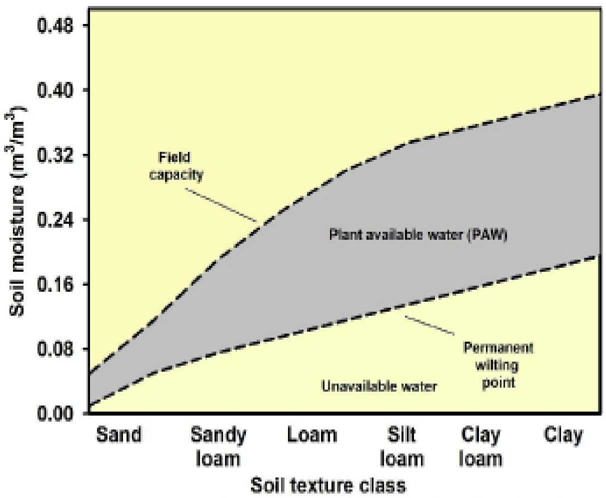

Chart 2 : General Relationship between plan available water, field capacity

During the drainage process, soil moisture decreases continuously. The velocity of the drainage is related to the hydraulic conductivity of the soil, in other words, drainage is faster for sandy soils compared to clay soils. After some time, the rapid drainage becomes negligible and at that point, the soil moisture content is called "field capacity". The wilting point is determined when the soil moisture is so low that the plant is not able to absorb water from the soil, and then the plant is permanently wilted and will die if water is not provided. However, most plants undergo substantial water stress well before this point and vegetables likely sustain substantial yield reductions long before reaching the permanent wilting point.

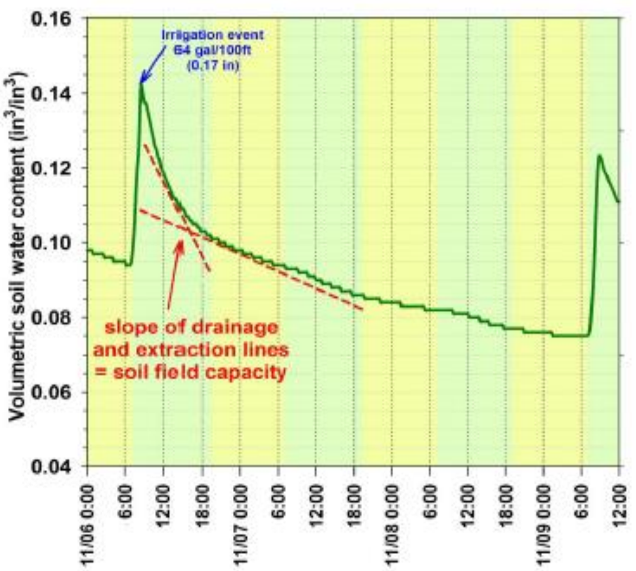

Chart 3 : Practical determination of soil field capacity for sandy soil after irrigation event

Calculate Safe Bearing Capacity of Soil on Site Procedure:

1. Excavate a pit of require depth. Equal to the depth of foundation.

2. Take a soil square cube of known weight and dimension.

3. Drop the square cube several times, from a known height on the bottom surface of excavated pit.

4. Calculate the average depth of impression made several times on the bottom surface of the excavated pit. Let "d" average depth of impression.

Calculation:

Calculate the ultimate resistance of soil using the formula given below.

$$R = (w * h) / d$$

Where,

R = ultimate resistance of soil (in kg)

d = average depth of impression (in cm)

w = weight of the solid square cube (in kg)

h = height of fall of solid cube (in cm)

3. CONCLUSIONS

By use of this technique we can reduced water consumption it can be set to lower and upper thresholds the maintain optimum soil moisture saturation and minimize plant wilting. It can contribute to deeper plate root growth, reduced soil runoff, less favourable conditions for insects and fungal disease. By using rain water harvesting technique, economic evaluation of water harvesting system possesses several complexities due to the problems in quantifying the hydrological impacts and the various benefits. There are some areas for to make water harvesting more efficient, developing a better understanding of catchment hydrology.

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