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SMART IRRIGATION SYSTEM

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ABSTRACT:

The key objective of the paper is to monitor the soil's moisture content during its dry and wet conditions with the aid of a moisture sensor circuit, calculate the corresponding relative humidity and irrigate it based on its nature using a PC based LabVIEW system, NI myRIO, IOT, GSM and an automatic water inlet setup which can also monitor and record temperature, humidity and sunlight, which is constantly modified and can be controlled in future to optimize these resources so that the plant growth and yield is maximized.

A record of soil moisture, temperature, rainfall is maintained in a database for backup. This backup is used for weather forecasting and directs the farmers regarding the type of crop to be cultivated in future. IOT gives the whole information to the operator about the irrigation. In this paper, we experiment for different soils suitable for different crops in various climatic parameters that govern plant growth and allow information to be collected at high frequency and with less labor requirements.

Keywords: soil moisture, irrigation, LabVIEW system, NI myRIO, IOT, GSM

1. Introduction:

Aim is to develop a wireless three level controlled smart irrigation system to provide irrigation system which is automatic for the plants which help in saving water and money. The main objective is to apply the system for improvement of health of the soil and hence the plant via multiple sensors. Appropriate soil water level is a necessary pre-requisite for optimum plant growth. Also, water being an essential element for life sustenance, there is the necessity to avoid its undue usage. Irrigation is a dominant consumer of water. This calls for the need to regulate water supply for irrigation purposes. Fields should neither be over-irrigated nor under-irrigated. The objective of this thesis is to design a simple, easy to install methodology to monitor and indicate the level of soil moisture that is continuously controlled in order to achieve maximum plant growth and simultaneously optimize the available irrigation resources on monitoring software LabVIEW and the sensor data can be seen on Internet. In order to replace expensive controllers in current available systems, the Arduino Uno will be used in this project as it is an affordable microcontroller. The Arduino Uno can be programmed to analyze some signals from sensors such as moisture, temperature, and rain. A pump is used to pump the fertilizer and water into the irrigation system. The use of easily available components reduces the manufacturing and maintenance costs. This makes the proposed system to be an economical, appropriate and a low maintenance solution for applications, especially in rural areas and for small scale agriculturists. This research work enhanced to help the small-scale cultivators and will be increase the yield of the crops then will increase government economy.

Over time, systems have been implemented towards realizing this objective of which automated processes are the most popular as they allow information to be collected at high frequency with less labor requirements. Bulk of the existing systems employ micro-processor based systems. These systems offer several technological advantages but are unaffordable, bulky, difficult to maintain and less accepted by the technologically unskilled workers in the rural scenario. The Internet of Things (IoT) is transforming the agriculture industry and enabling farmers to contend with the enormous challenges they face. The industry must overcome increasing water shortages, limited availability of lands, difficult to manage costs, while meeting the increasing consumption needs of a global population that is expected to grow up to 70% by 2050. India's major supply of financial gain is from agriculture sector and seventieth of farmers and general folks rely upon the agriculture. In Republic of India most of the irrigation systems square measure are operated manually. These antique techniques square measure replaced with semi-automated and automatic techniques. The on the market ancient techniques square measure like ditch irrigation, terraced irrigation, drip irrigation, system. The global irrigation situation is classified by redoubled demand for higher agricultural productivity, poor performance and decreased accessibility of water for agriculture. These issues are befittingly corrected if we have a tendency to use machine-controlled system for irrigation.

Automating farm or nursery irrigation permits farmers to use the correct quantity of water at the correct time, regardless of the provision of labor to show valves on and off. Additionally, farmer's mistreatment automation instrumentation is able to scale back runoff from over watering saturated soils, avoid irrigating at the incorrect time of day, which will improve crop performance by making certain adequate water and nutrients once required. Those valves are also simply automated by mistreatment controllers. Automating farm or nursery irrigation permits farmers to use the correct quantity of water at the correct time, no matter the provision of labor to show valves on and off. They lack in an exceedingly featured mobile application developed for users with acceptable user interface. It solely permits the user to observe and maintain the wetness level remotely in no matter of time. From the purpose of reading and performing at remote places the developed microcontroller primarily based irrigation system will work perpetually for indefinite fundamental measure, even in sure abnormal circumstances.

1.1 Objectives: To improve and stabilize the crop yields of smallholder olive farmers through the implementation of sustainable irrigation systems.To promote water management practices that optimizes the volume and timing of water distribution. To generate positive economic consequences for farmers and their families. Minimize year to year yield fluctuations, leading to higher and more stable farm income.

2. Proposed Method:

2.1 Solar Power Based Smart Irrigation System:

EXPERIMENTED BY- Department of Electrical and Electronics Engineering, Amrita University Ettimadai, Coimbatore, India.

AIM-Cost effective solar power can be the answer for all our energy needs. Solar powered smart irrigation systems are the answer to the Indian farmer. This system consists of solar powered water pump along with an automatic water flow control using a moisture sensor. It is the proposed solution for the present energy crisis for the Indian farmers. This system conserves electricity by reducing the usage of grid power and conserves water by reducing water losses.

They proposed to utilize the solar energy from solar panels to automatically pump water from bore well directly into a ground level storage tank depending on the intensity of sunlight. While conventional methods include pumping of water from bore well into a well and from this well onto field using another pump, our system uses only a single stage energy consumption wherein the water is pumped into a ground level tank from which a simple valve mechanism controls the flow of water into the field. This saves substantial amount of energy and efficient use of renewable energy. A valve is controlled using intelligent algorithm in which it regulates the flow of water into the field depending upon the moisture requirement of the land. In this system we use a soil moisture sensor that detects the amount of moisture present in the soil and depending upon the requirement of level of moisture content required for the crop the water flow is regulated thus, conserving the water by avoiding over flooding of crops.

Proposed irrigation system mainly consists of two modules- Solar pumping module and automatic irrigation module. In solar pumping module a solar panel of required specification is mounted near the pump set. Then using a control circuit it is used to charge a battery. From the battery using a converter circuit it gives power to the water pump which is submerged inside the well. Then the water is pumped into an overhead tank for storing water temporarily before releasing the water into the field. In automatic irrigation module the water outlet valve of the tank is electronically controlled by a soil moisture sensing circuit. The sensor is placed in the field where the crop is being cultivated. The sensor converts the moisture content in the soil into equivalent voltage. This is given to a sensing circuit which has a reference voltage that can be adjusted by the farmer for setting different moisture levels for different crops. The amount of water needed for soil is proportional to the difference of these two voltages. A control signal was given to a stepper motor whose rotational angle is proportional to the difference in voltage. The stepper motor in turns controls the cross sectional area of the valve to be opened controlling flow of water. Therefore the amount of water flowing is proportional to the moisture difference.

2.2 Smart Irrigation System Using Arduino:

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AIM-This paper design a model of automatic irrigation system which is based on microcontroller and solar power was used only for source of power supply. Various sensors are placed in paddy field. Sensors sense water level continuously and give the information to farmer through cellular phone. Farmer controls the motor using cellular phone without going in paddy field. If the water level reaches at danger level, automatically motor will be off without conformation of farmer

The aim of this paper is to modernize agriculture technology by programming components and built the necessary component for the system. The system is real time based and extracts the exact condition of paddy field. There is one central node used which to control other node. The main function of RF module is to pass the message to the node and operate the system

3. Hardware Description:

3.1 Ni My Rio (Reconfigurable Input Output):The National Instruments myRIO-1900 is a portable reconfigurable I/O (RIO) device that students can use to design control, robotics, and mechatronics systems. This document contains pinouts, connectivity information, dimensions, mounting instructions, and specifications for the NI myRIO-1900.

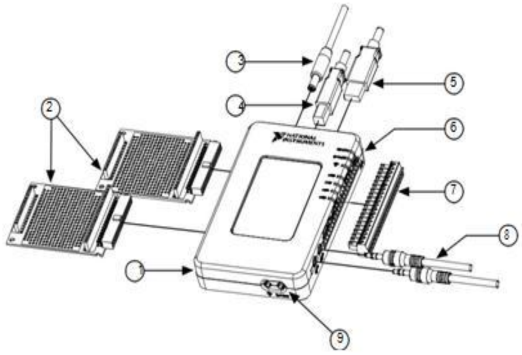

Figure 3.1: NI MyRIO-1900

1. NI MyRIO-1900
2. MyRIO Expansion Port (MXP) Breakouts (one included in kit)
3. Power Input Cable
4. USB Device Cable
5. USB Host Cable (not included in kit)
6. LEDs
7. Mini System Port (MSP) Screw-Terminal Connector
8. Audio In/Out Cables (one included in kit)
9. Button 0

4.Pin Connections Of Internal Project Modules:

4.1 Hardware Connections:

1. Connect myRIO to PC using USB cable RS232.
2. Soil moisture sensor, temperature sensor, light sensor are the analog sensors and thus connected to analog input-output port of myRIO (port A, B or C). Rain sensor here is the only digital sensor used and thus connected to digital input-output port of myRIO

4.2 Soil moisture sensor:

1. Soil moisture sensor’s Analog pin is given to port A- pin 3 of the RIO.
2.Its V_{cc} pin is given to the common terminal on the bread board which is given to port A- pin 1(+5V) of the RIO and its GND terminal is given to port A- pin 11/pin 12.

4.3 Temperature sensor:

1.Temperature sensor’s V_{cc} pin is given to the 5V pin (in Port C) of the RIO and its GND terminal is given to the common ground on the bread board which is connected to the AGND (Analog ground) pin of the RIO.
2.An analog input is fed to AI0 (0+) pin and AI0 (0-) is given to AGND probably through a common ground on the bread board.

4.4 Rain Sensor:

1.Rain sensor’s V_{cc}pin is given to the 5V pin (in Port C) of the RIO and its GND terminal is given to the DGND (Digital ground) terminal of the RIO.
2.Digital output (DO) pin of the sensor is given to DIO0 pin of the RIO.

4.5 Light sensor:

1. Connect a 100Ω resistor in series with light sensor.

2. Connect sensor's one end to AIO (1+)-port C and AIO (1-) to AGND.
3. Give sensor's another end to +5V of RIO.

4.6 Motor Driver:

Input Voltage section-

1. Positive pin is connected to +5V of the RIO
2. Negative pin is given to digital ground (DGND). Motor

section- (Motor output)

- Positive pin is connected to positive terminal of the water pump used.
- Negative terminal of the water pump is given to negative pin of the motor output.
- In addition to these, we also make use of two control pins for controlling themotor.

Port C- DIO3

Port C- DGND

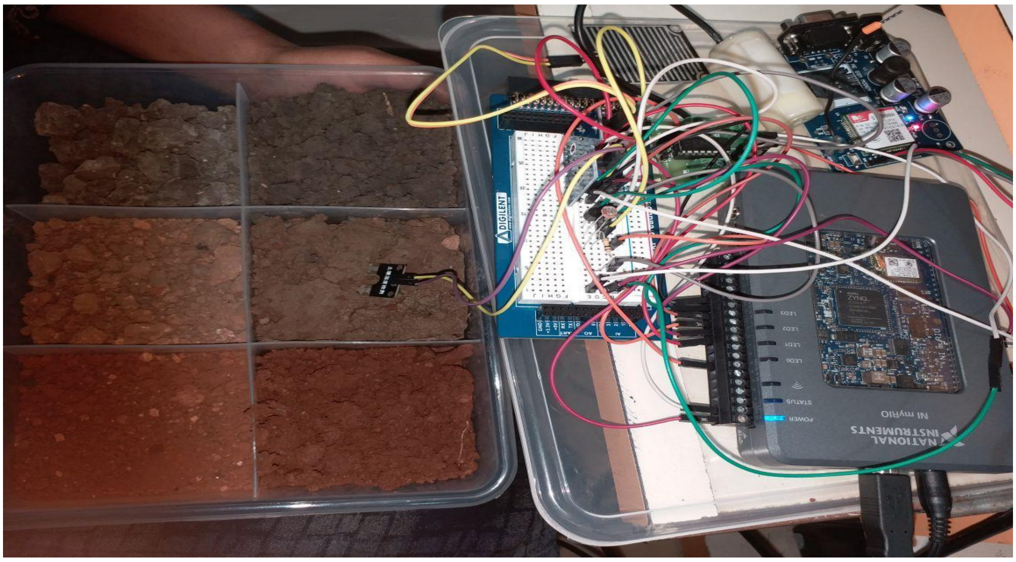

Figure 4.1: Hardware connections testing in different soils

5 .Proposed methodology:

This paper emphasizes on the fact that the technique which is incorporated here to monitor the soil's moisture content, enables agriculturalists feasibility of humidity measurement and a conventional automatic irrigation with the potential for eliminating excessive irrigation cycles thereby saving water to a significant extent. Besides the normal modes of measurement and analysis, Lab VIEW stands unique as grooming software in the field of Instrumentation and control engineering, which facilitates engineers to work in one platform with infinite possibilities along with a sophisticated control system. Effective crop treatment and water management is the major requisite in most of the cultivating estates in semi-arid regions. Monitoring the soil's nature, estimating it's moisture content and controlling it concurring to the necessity, proposes a potential solution to endorse landsite irrigation management and thus, to treat desiccated fields and provide prominent yield to producers.In the field of agriculture the most important part is, to get the information about the moisture content of soil.

The paper is designed to develop an automatic irrigation system which switches the pump motor ON/OFF on sensing the moisture content of the soil. In the field of agriculture, use of proper method of irrigation is important .This project is implemented in the Lab VIEW environment by interfacing MyRio. Corresponding to the surface's atmospheric conditions, transmission of the sensed voltage signal from the hardware circuitry on the Rio interfaced to a PC with Lab VIEW , which uses a development environment that is powerful and intuitive which could rapidly develop a user interface for data visualization and automatic irrigation of the soil. The advantage of using this method is to reduce human intervention and still ensure proper irrigation.

5.1 Block Diagram:

This section elaborates the assessing and controlling of the moisture content in the soil using Lab VIEW. The hardware and software implementation are discussed here below. The block diagram shows the flow of how the complete process is carried out

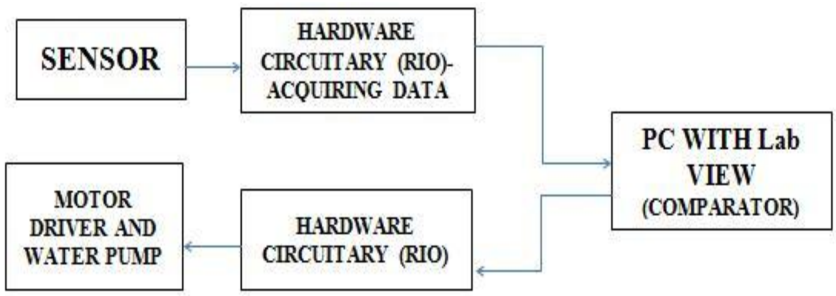

Figure 5.1: Basic block diagram of monitoring and controlling moisture content in the soil

6. FLOW CHART:

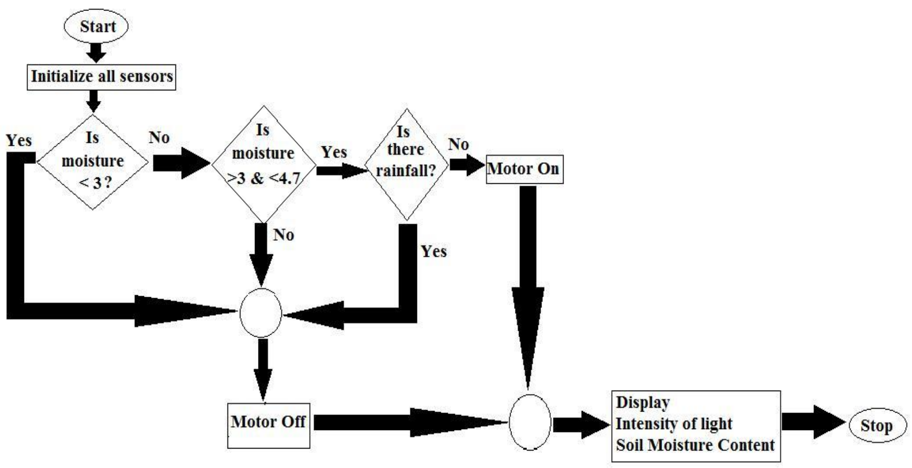

Figure 6.Flowchart for motor control

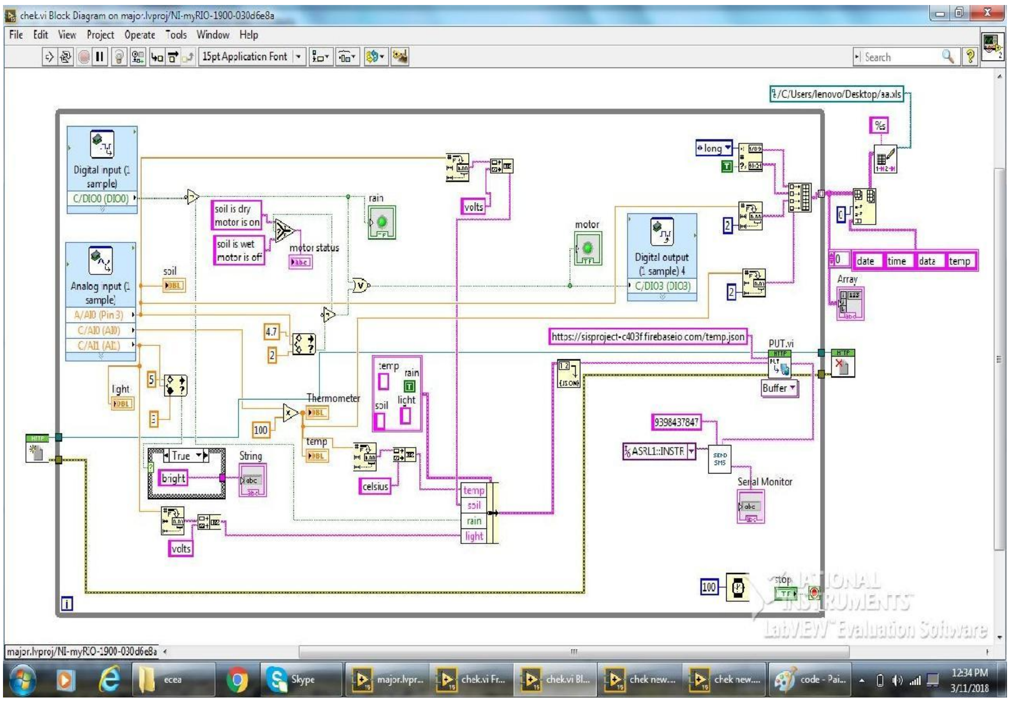

Figure 6.1: Software code which obeys the flowchart

6.1.1 DRY CONDITION (WITHOUT RAIN):

5. If the sensed signal is greater than the threshold voltage for every particular soil, it means it executes the true condition and thus the soil is dry.
6. The above statement is based on the property of the moisture sensor, i.e., if the sensed value is greater than or equal to the threshold voltage, then the soil is dry and also if there is no rain.
7. Because the condition is true, the Boolean LED will glow ON and the water pump should turn ON in order to irrigate the plant.

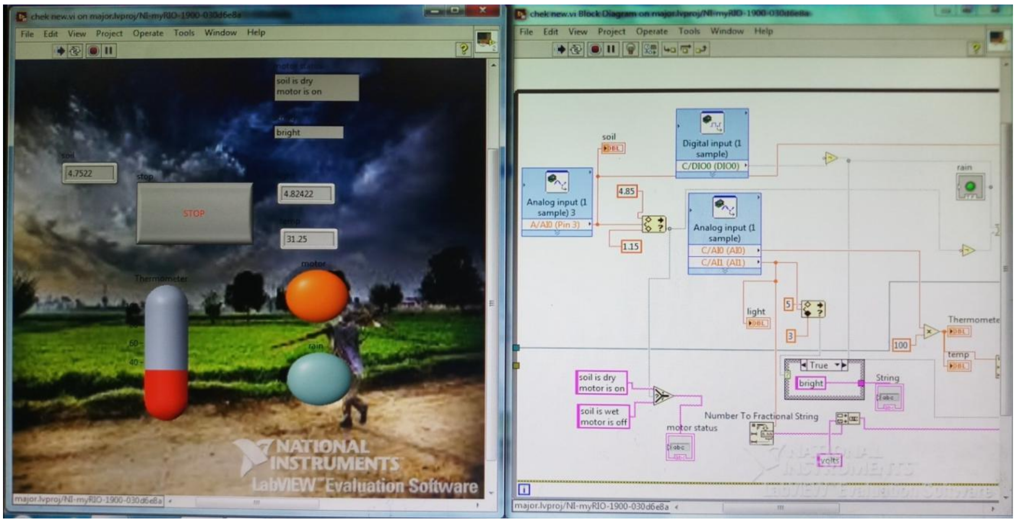

Figure 6.2: Front panel output in dry condition (without rain)

6.1.2 DRY CONDITION (WITH RAIN):

6. If the sensed signal is greater than the threshold voltage for every particular soil, it means it executes the true condition and thus the soil is dry.
7. The above statement is based on the property of the moisture sensor, i.e., if the sensed value is greater than or equal to the threshold voltage, then the soil is dry.
8. Because the condition is true, the Boolean LED will glow ON and the water pump should turn ON in order to irrigate the plant.
9. When it’s raining, even though the soil is dry, automatically motor gets turned OFF.
10.After the rain stops, it again checks the condition of soil moisture and work accordingly.

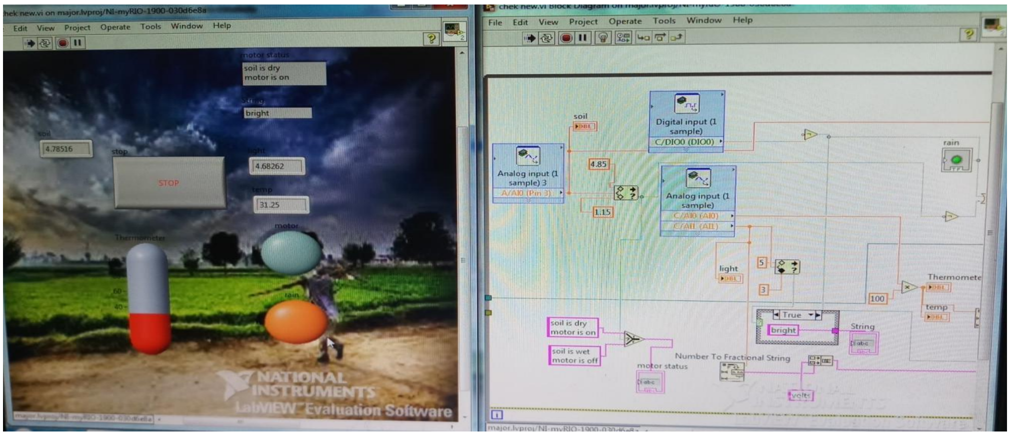

Figure 6.3: Front panel output in dry condition (with rain)

6.1.3 Wet Condition:

8.If the sensed signal is less than the threshold voltage for every particular soil, it means it executes the false condition and thus the soil is wet.
9.above statement is based on the property of the moisture sensor, i.e., if the sensed value is less than the threshold voltage, then the soil is wet.
10.Because the condition is false, the Boolean LED will glow OFF and the water pump should turn OFF because the plant has excess of water content in the soil, irrespective of rain

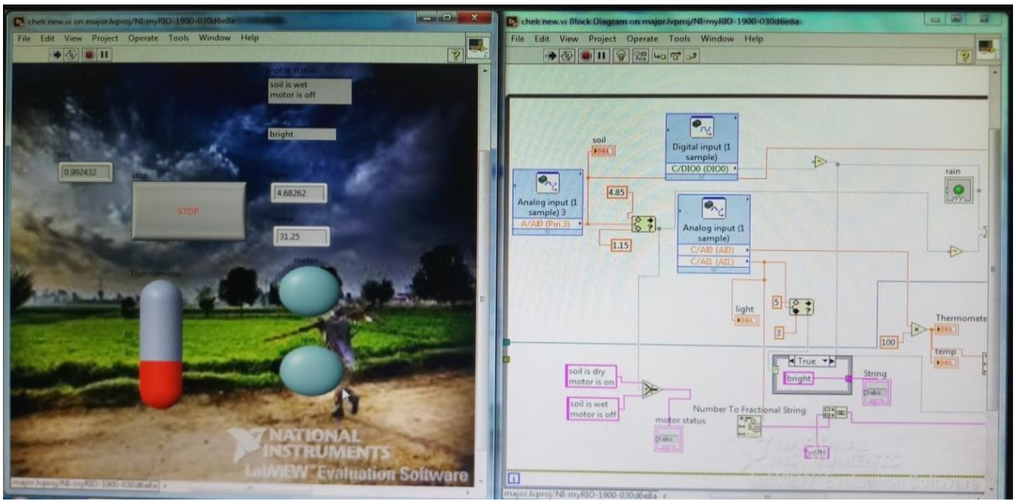

Figure 6.4: Front panel output in wet condition

6.2 Execution Process:

After giving the hardware and software connections as mentioned above, the process of implementation is this paper is discussed below:

9. After constructing the block diagram in the software (Lab VIEW) and giving the hardware connections, click run simulation.
10. The functional process of this project has 4 main conditions. They are dry condition and wet conditions with and without rain.∴
11. These conditions are verified by keeping the soil sensor in the soil.
12. When the sensor is kept in soil, the sensor senses analog voltage value and is given to port-A pin-3 of the RIO.
13. This analog voltage is then compared with the threshold voltage of different soils (Black, Red, Clay).
14. Then the result is given to the NOR gate which has 4 cases.

RAIN	**SOIL MOISTURE**	**MOTOR CONDITION**
Low(No Rain)	Low (Dry)	ON
Low (No rain)	High (Wet)	OFF
High	Low (Dry)	OFF
High	High (Wet)	OFF

Table 6.1: NOR gate condition

7. Experimental Results:

7.1 Results

Figure7.1: output in dry condition (without rain)

Figure7.2: Output in dry condition (with rain)

Figure 7.3: Output in wet condition

Type of soil	Time	Dry Condition(V)	Wet Condition(V)	Temperature
Red	10:20:25AM	4.95	1.56	29.34
	12:10:12PM	4.86	1.61	29.79
	2:35:34PM	4.82	1.95	29.21
Black	10:23:27AM	4.57	1.40	29.30
	12:12:15M	4.56	1.43	28.52
	2:36:34PM	4.56	1.49	29.14
Clay	10:25:29AM	4.47	1.22	28.61
	12:15:18PM	4.42	1.27	28.78
	2:38:34PM	4.39	1.30	29.26

Table 7.1: Experimental output

10. Red soil consists of less moisture content and hence it absorbs water quickly.
11. Black soil keeps moisture for longer time, so it require less water and its absorption level are slower than red soil.
12. Clay consists of more water. It requires less water and absorbs very slowly compared to red and black soils

8. Conclusion:

This paper involves establishing a contemporary design technique of monitoring and controlling the moisture level of soil using LabVIEW. Providing comprehensive tools that need to build any measurement or control application in dramatically less time. The project also includes rain sensor, which is very important in the project to avoid unnecessary power wastage. No longer only are farmers able to generally use much less water to grow a crop, they're able to increase growth yields and the satisfactory of the crop by using better management of soil moisture at some point of vital plant growth degrees. Embedded system for computerized irrigation of an agriculture subject gives an able solution to assist web page- precise irrigation control that permits producers to maximize their productivity whilst saving the water.

9. Future Scope:

We can interface LCD screen in order to display the current status of the soil moisture content levels, percentage of water utilized to water the plant, duration of time for which the water pump is ON, etc. We can also show the graphical representation of the moisture content levels in the soil. To improve the efficiency and effectiveness of the system, the following recommendations can be put into consideration. Option of controlling the water pump can be given to the farmer. The farmer may choose to stop the growth of crops or the crops may get damaged due to adverse weather conditions. In such cases farmer may need to stop the system remotely.The idea of using IOT for irrigation can be extended further to other activities in farming such as cattle management, fire detection and climate control. This would minimize human intervention in farming activities.

10. References:

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