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Research Article

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Integration of Soil Moisture Sensor Based Automated Drip Irrigation System for Okra Crop

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ABSTRACT

The soil moisture based automated drip system was integrated and evaluated for okra crop in year 2019 at Plasticulture Farm of College of Technology and Engineering, Udaipur Rajasthan for deciding optimum time for irrigation on the basis of moisture availability in the soil. The soil moisture sensor works on electrical resistivity. As the moisture content of the soil increases, the electrical resistivity of the soil decreases. The value of resistivity changes in to volumetric water content of soil. The sensor sends command to irrigation controller at 1 hour interval. If soil moisture goes down to the threshold value of moisture content then controller starts the pump. While, moisture content reaches at threshold value then system off automatically by micro controller. The results shows that when resistance of soil increases the voltage on controller output port was equal or more than 24 VAC which shows starting command for pump. When resistance of soil decreases then sensor indicates optimum moisture availability at that time output voltage of controller was nearly to zero voltage. Which indicate command for system off. The result shows good correlation between values of soil moisture content obtained by gravimetric method and sensor output voltage with a value of R^2 = 0.939. While, the value of R^2 was also found to be 0.920 which shows good correlation between soil moisture by measured by sensor and soil moisture content by gravemetric method. The result shows that good accuracy of this soil moisture sensor in measurement of soil moisture. The system found very convenient to switch on and switch off the pump when the water is applied, especially when farmer are busy in other agricultural operation. This technique saves large amount wastage of water as well as wastage of power (consumed by water lift pump) and increases yield of okra crop by maintaining optimum moisture content in rootzone during whole crop period.

Keyword: *Soil moisture based irrigation system, Electric Conductivity, Moisture content, Irrigation controller, Soil moisture sensor*

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INTRODUCTION

Water conservation is a upcoming issue for future in India due to increased demands from a growing population. One of the areas with the largest potential for reducing water consumption is agriculture. Water is the most precious resource on our planet. In present time shortage of water is major problem on global basis. It is very essential to measure it, control it, and conserve it, with the application of soil moisture sensor in agriculture in order to develop smart irrigation system. In present days farmers who use electrically-operated water pumps for irrigation find it very inconvenient to switch on and switch off the pump when the water is applied, especially when they are busy. So there is large amount of water wastage as well as wastage of power (consumed by water lift pump). However, there is a solution to get rid of this headache by using different kind of soil moisture sensor and controller.

MATERIALS AND METHODS

Study Area

A study on estimation of crop water requirement using CROPWAT model for mango crop under under drip irrigation was carried out for Udaipur district of Rajasthan. The study area is located between 24°35'31.5" latitude 73°44'18.2" longitude and at an altitude of 582.17 m above mean sea level (MSL). Udaipur comes under dry, sub-humid agro-climatic region. The average annual rainfall of Udaipur is 637mm, most of the rain received during the period of July to Sep. The hottest month is recorded as May and December is the coolest month of the year.

The section deals with the material required to integrated a resistance based soil moisture automated drip irrigation. In this system soil click sensor was used to detect status of soil moisture. The controller was consist of different component such as 240 VAC to 24 VAC transformer , Bread Board, 50 k POT, 10K Resistor, Jumper wire, 5V battery, Soil moisture probes, LM7805 Voltage regulator, LED, integrated circuit, transformer, capacitor, resistor, transistor, diode, electromagnetic relay. Diode was used for allow current go in only one direction (Fig 1). Capacitors were used to store energy by producing a charge imbalance. An electromagnetic relay was used which allows a relatively small voltage or current to control a larger voltage or current. A probe was placed at effective crop root zone at a distance of wetted diameter of dripper. A timer cum relay was installed between irrigation controller and pump starting panel. The 20 AWG wires were used to connect the soil moisture sensor module and controller.

Specifications of Soil moisture sensor:

The following specification of soil moisture sensor was maintained during its calibration, the sensor output was recorded in order to check performance accuracy to measuring the moisture content.

- Module Dimensions: Height: 4.5" (11.4 cm)
- Depth: 1.25" (3.2 cm)
- Width: 3.5" (8.9 cm)
- Operating Power: 24 VAC, 100 mA max
- Probe Dimensions: Height: 3.25" (8.25 cm) Diameter: 7/8" (2.22 cm)
- Wire to Probe: 1000 ft (300 m) max.

Programming of sensor:

The programming of soil moisture sensor was done with the following steps which can be modified with the help of module;

- Moisture Level: Calibrate the sensor with actual moisture level.
- Moisture Setting: fix required moisture content, in this study it was taken as 31 % for okra crop.
- Watering Interrupted: give a command to module in term of +/- of fraction of time
- Pause/Override
- Measurement
- Alarm

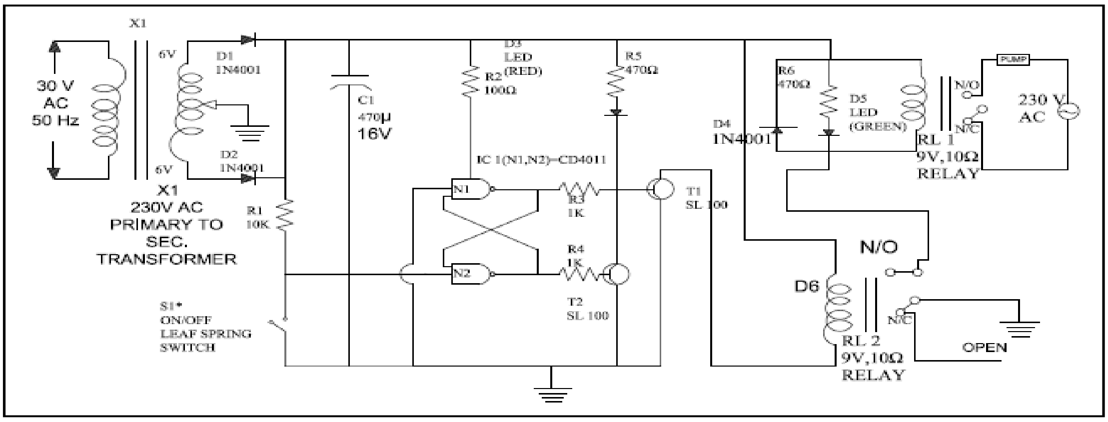

Fig. 1: Circuit of system connection.

RESULT AND DISCUSSION

In integration of system, one wire of probe directly connected to controller and another wire was connected with power supply. The neutral wire of pump was directly connected with neutral of power supply and phase wire is connected with timer. The one port of timer connected with 240 VAC supply and other port was connected with 24 VAC master port of controller which works as relay on the basis of command received by controller from the moisture sensor.

Performance evaluation of soil moisture sensor

The result found that, when there is no moisture in soil then probes allow maximum resistance more than 60 Ohms. Now, whenever both probe was come in contact with soil moisture or water then both the probe gets shorted because water/moisture is the conductor of current. And when probes get shorted then resistance was nearly zero. Thus performance was satisfactory without error.

Calibration of soil moisture sensor and working with controller

In order to determine the relationship between the sensor output voltage and soil moisture, an experiment was carried out for finding the soil moisture content using gravimetric method by collecting the soil samples at different moisture levels. A multimeter as shown in Figure 2 was used for measuring output voltage of sensor. When testing the voltage using multimeter connect the red test lead to "V Ω Ma" jack and black test lead to "COM" jack. Figure 3 shows a linear relationship between voltage and Soil moisture sensor. The gradient and intercept value from Figure 2 were -5.714 and 32 respectively. The moisture of the soil increased with a decrease in voltage value. Similar, results were reported by Agrawal et al. (2014). The soil moisture sensor switches on the motor through controller when soil moisture reaches below threshold value of moisture and switch off the motor when soil moisture reaches equal to threshold value of moisture.

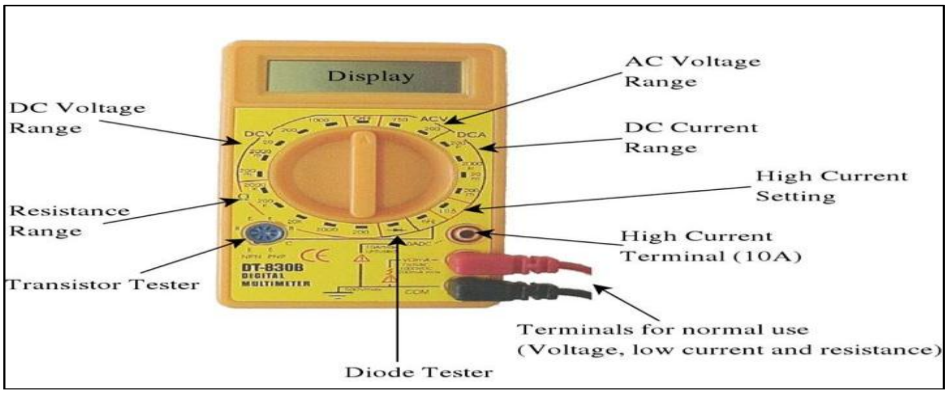

Fig. 2: Digital multimeter

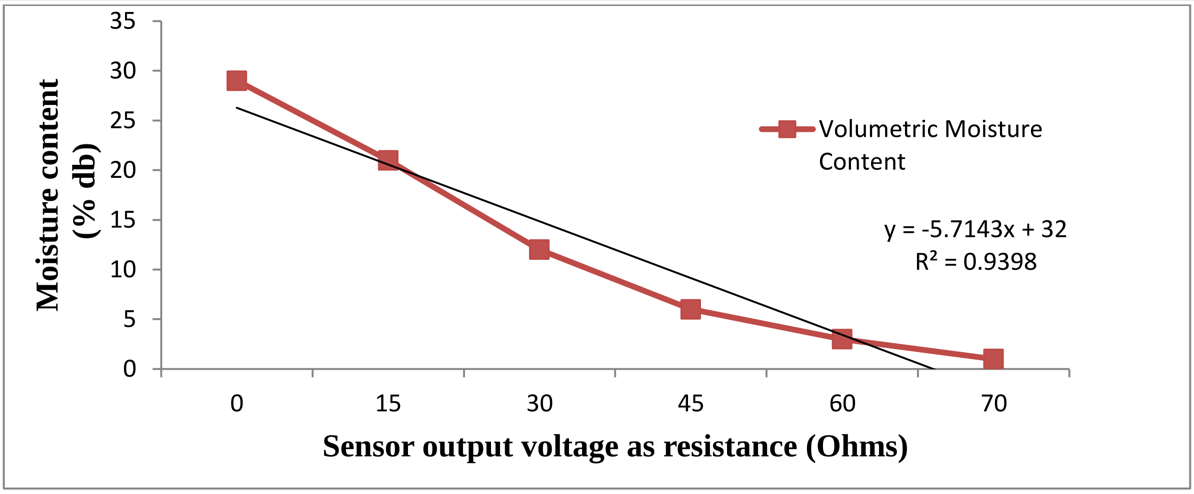

Fig. 3: Relationship between soil moisture and sensor output voltage

Mode of Communication System for controller through moisture content

In this study two means of communication between the system and the far user was found, first the volumetric soil moisture readings were sent via Short Messaging Service (SMS) on GSM network in built in controller or cellphone, and second the readings can be stored in memory card or data logger which can be transferred to a computer for analysis.

Evaluation of accuracy in measurement:

The soil moisture sensor was installed in okra field during 27 feb 2019 to mid June. A field experiment was carried out for finding the soil moisture content using gravimetric method by collecting the soil samples at different moisture levels. A relationship between soil moisture by measured by sensor and Soil moisture content by gravemetric method was also carried out in this study (Table 1).

Table 1: Performace evaluation of accuracy of sensor for moisture measurement

Date of sampling	Fresh weight of soil	Dry Weight	Gravimetric MC (wet basis) %	Bulk density	Volumetric Moisture content MC (%) by gravimetric method	Volumetric MC Measured by Sensor %
28-Feb-19	185	147	20.54	1.45	**29.8**	**30**
4-Mar-19	210	167	20.4	1.45	**29.7**	**30**
7-Mar-19	190	151	20.5	1.45	**29.8**	**30**
11-Mar-19	205	162	20.9	1.45	**30.4**	**30.5**
14-Mar-19	192	152	20.8	1.45	**30.2**	**30**
18-Mar-19	202	158	21.7	1.45	**31.6**	**31.2**
21-Mar-19	230	181	21.3	1.45	**30.9**	**31**
25-Mar-19	176	140	20.4	1.45	**29.7**	**30**
28-Mar-19	216	170	21.2	1.45	**30.9**	**31**
1-Apr-19	232	182	21.5	1.45	**31.3**	**31**

The fig 4 shows a linear relationship between soil moisture by measured by sensor and soil moisture content by gravimetric method at different soil sample. The gradient and intercept value from Figure 4 were 0.713 and 8.475 respectively. The value of R^2 was found to be 0.920 which shows good correlation between soil moisture by measured by sensor and soil moisture content by gravemetric method. The result shows that good accuracy of this soil moisture sensor in measurement of soil moisture. This sensor does not get corrosion over period of time (Zaier et al., 2015), and is sensitive to even small changes in soil water content (Bitella et al., 2014).

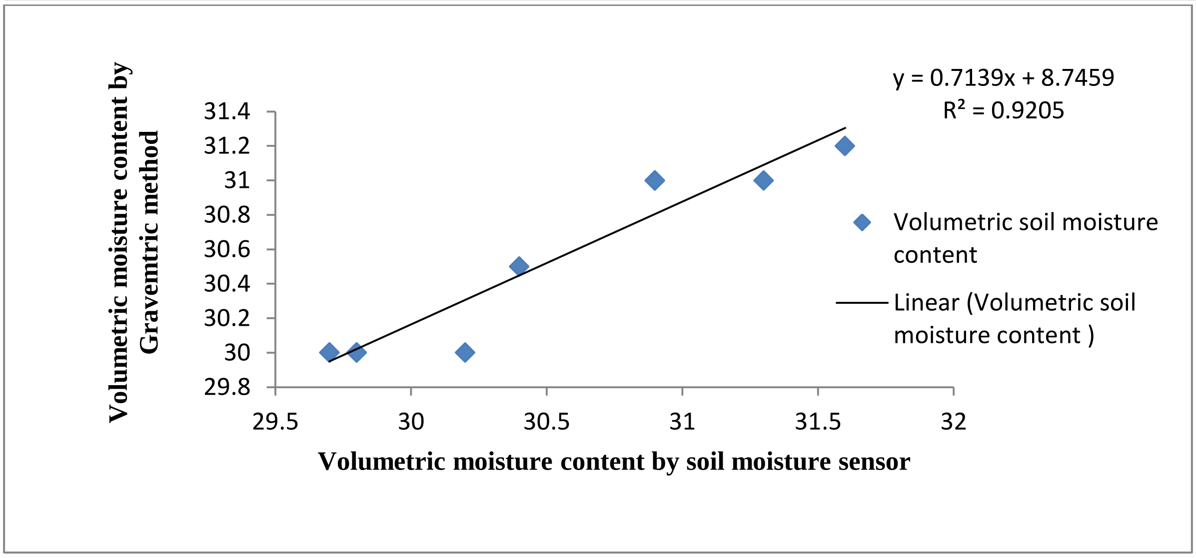

Fig. 4: Relationship between soil moisture measured through gravimetric method and sensor.

Fig. 5: Experimental view of sensor and automated drip system.

The system found very convenient to switch on and switch off the pump when the water is applied, especially when farmer are busy. It saves large amount wastage of water as well as wastage of power (consumed by water lift pump).

CONCLUSIONS

Thus result shows good correlation between values of soil moisture content obtained by gravimetric method and sensor output voltage with a value of R^2 = 0.939. When resistance of soil decreases then sensor indicates optimum moisture availability in the soil at that time output voltage of controller was nearly to zero voltage. Which indicate command for system off. The results shows that good accuracy of this soil moisture sensor in measurement of soil moisture with value of R^2 = 0.920. The soil moisture sensor was work properly under field condition for okra crop during whole experiment. The statistical analyses indicate that minor changeability existed between soil water contents by the sensors and the gravimetric method. This type of Soil moisture sensors based automated Systems can be used for monitoring automated drip system.

REFERENCES

Agarwal, S., Pandey, S., Kumar, S., & Chaudhery, K. (2014). Automatic irrigation system. *International Journal of Advance Research and Innovation 1*, 92-94.

Apparao, C. (2014). Field evaluation of automated drip irrigation system. M. Tech (SWE). Thesis submitted to ANGRU, Bapatla.

Bitella, G., Rossi, R., Bochichhio, R., Perniola, M., & Amato, M. (2014). A novel low-cost open- hardware platform for monitoring soil water content and multiple soil-air-vegetation parameters. *Sensors*, *4*, 19639-19659.

Kumar, S., & Singh, P. (2007). Evaluation and hydraulic performance of drip irrigation system. *Journal of Agricultural Engineering*, *44*, 104-108.

Kumar, J., Patel, N., & Raput, T.B.S. (2016). Development and integration of soil . moisture sensor with drip system for precise irrigation scheduling through mobile phone. *Journal of Applied and Natural Science 8*(4), 1959-1965.

Munyaradzi, M., Rupere, T., Nyambo, B., Makute, S., Chinyerutse, M., Hapanga, T., & Mashonjowa, E. (2013). A low cost automatic irrigation controller driven by soil moisture sensors. *International Journal of Agriculture Innovations and Research 2*(1), 1-7.

Kumar, N.D., Pramod, S., & Sravani, C.H. (2013). Intelligent irrigation system. *International Journal of Agricultural Science and Research 3*(3), 23-30.

Munyaradzi, M., Rupere, T., Nyambo, B., Makute, S., Chinyerutse, M., Hapanga, T., & Mashonjowa, E. (2013). A low cost automatic irrigation controller driven by soil moisture sensors. *International Journal of Agriculture Innovations and Research 2*(1), 1-7.

Ravi, S.K., Tapaswi, K., Lokesh, B., & Krishna, S.G. (2011). Smart sensor for agricultural chronology. (IJCSIT) *International Journal of Computer Science and Information Technologies*, *2*(6), 2650-2658.

Sharma, V., Singh, P.K., & Singh, Y.P. (2019). Application of Moisture Sensor with Micro Irrigation for Water Conservation in Smart Irrigation and Precision Agriculture, *proceeding of all India seminar* organized by The Institution of Engineer at Kota.

Zaier, R., Zekri, S., Jayasuriya, H., Teirab, A., Hamza, N., & Al-Busaidi, H. (2015). Design and implementation of smart irrigation system for groundwater use at farm scale. International Conference on Modelling, Identification and Control (ICMIC 2015), 18-20 Dec 2015.