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Utilisation of Reject Water from RO Purifiers for Garden Irrigation

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I. INTRODUCTION

Water purifiers are a necessity and most households have atleast one to filter tap water into drinking water. Some Purifiers use reverse osmosis technique for filtering out dissolved particulate matter and minerals. Hence it is necessary to study reverse osmosis firsthand. Reverse osmosis is carried about by applying external pressure greater than osmotic pressure across the semi permeable membrane to desalinate and demineralize water. Dissolved content moves from higher concentration fluid to lower thereby cleaning water. In this process a lot of reject water is generated. For almost 16 litres of purified water, 20 litres is emitted out as reject water. Since the amount of water wasted is considerable it is necessary to conserve it. This reject water can be used to water garden plants, but only before testing reject water for the TDS count.

II. RELATED STUDIES

Most of the garden irrigation systems are manual. For small house gardens plants are watered using pipes, hoses and even buckets. Slightly advanced version of watering systems include time based sprinkler system which is reduces the need for manual supervision drastically.Time clock controllers, or timers, are an integral part of an automated irrigation system. A timer is an essential tool to apply water in the necessary quantity at the right time. Research showed that, timers can lead to an under- or over-irrigation if they are not correctly programmed or the water quantity is calculated incorrectly These systems water plants without taking into consideration whether water is actually required . This incompetency is often tied with the need to man these systems. Though the systems are automated, they need to be supervised. After careful analysis of available garden irrigation system, an automated system was devised that made use of reject water. It is an intelligent system, performing myriad operations and not just watering plants. It not only overcomes discrepancies of other irrigation system, but also helps in water conservation.

III. PROPOSED SYSTEM AND DETAILS

Reject water is collected in a storage tank, tank capacity is almost 30 liters. Tds meter is mounted on the tank to give indication of the total dissolved solids in the water. Tds meter measures the electrical conductivity, more the dissolved solids more is the conduction. It converts this electrical charge into equivalent ppm figure which is indicated on the small LCD display. Any automated system functions well because of the field elements (sensors) involved and the micro controller used. The Atmegaarduino is the micro controller used, it acts as an interface between the hardware and the program code thereby effectively controlling the control element. The Controller received signals from two types of sensors moisture and humidity. The fc 28 moisture sensor relays the real time values of moisture content in the soil and Dht 11 sensor gives the ambient humidity and temperature readings. For irrigation moisture and humidity are the two most crucial parameters that need to be considered. Soil moisture and its availability is one of the primary factors involved in making irrigation decisions. Humidity and ambient temperature readings help in figuring out the chances of precipitation, which eliminates the need for irrigation. Hence moisture and humidity sensors were chosen to relay their readings to the Controller to achieve timely irrigation. Moisture content in the soil is the primary indication that the plant needs water. Reduction in soil moisture is a primitive sign of loss in soil water potential before more obvious signs like wilting,leaf shedding show. The fc 28 moisture sensor was selected as a suitable choice for moisture sensor after conducting test experiments. To check it's reliability and it's genuineness of raw values it was transmitting an experiment was conducted. Six known soil samples were watered one for a week and the trend in transmitted voltage was seen, depicted in graph 1. The graph confirmed that the voltage readings were in coherence to the watering pattern and hence to the moisture content in the samples.

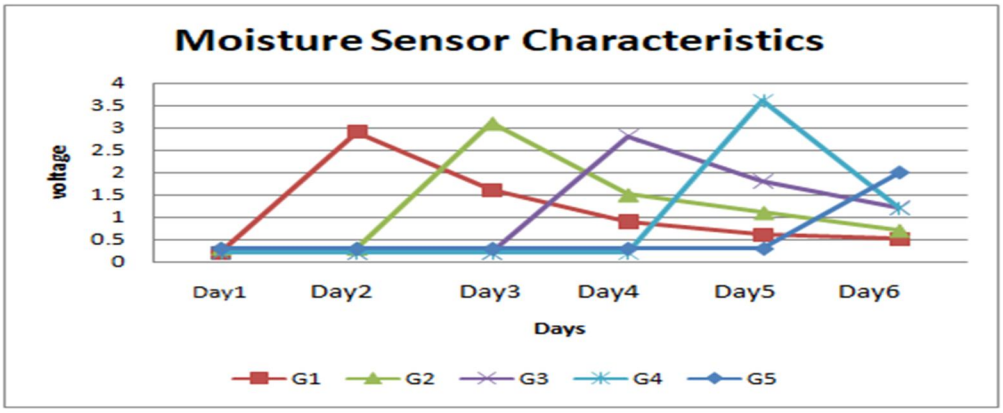

Fig. 1- Moisture Sensor Characteristics

After initial testing of moisture sensor, it was interfaced along to the Arduino. Arduino was programmed such that when the moisture content from both the sensors fell below 65% and the humidity was lesser than 50 % the pump was made to turn on. This condition was decided after careful analysis. Since BOTH moisture and humidity values were needed to decide if water is to be given AND logic helped to chalk out suitable outcomes to use. If 1= moisture content below 65 AND 1= humidity lesser than 50 then -

Table 1. Boolean Truth Table

Moisture	Humidity	Pump
0	0	0
0	1	0
1	0	1
1	1	1

1= Pump on
0= Pump off

The Boolean truth table shows pump action for almost all cases. Consider case 3 – M=1&&H=0, indicates moisture in soil is below 65 but humidity is above 50%. Pump is not turned on as higher humidity may indicate slight precipitation.

Pump control is achieved by Pulse Width Modulation.PWM technique allows adjustment of average power to the pump by switching power on off at a fast rate. Pump speed is varied using L298N driver and Arduino board.The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The Enable A and Enable B pins are used for enabling and controlling the speed of the motor. PWM signal from Arduino is connected to this pin .The Input 1 and Input 2 pins are used for controlling the rotation direction of the motor A, and the inputs 3 and 4 for the motor B.

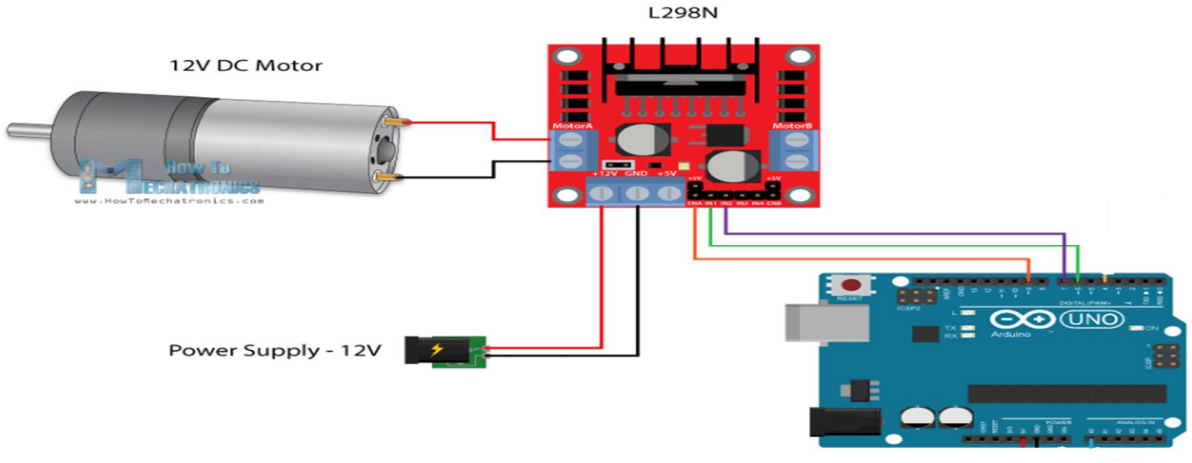

Fig. 2- Circuit Diagram

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The system is then linked to a Bluetooth module. HC-05 is a Bluetooth device used for wireless communication with Bluetooth enabled devices (like smartphone). It communicates with microcontrollers using serial communication .Bluetooth terminal application on the phone is used to connect to the HC-05 Bluetooth module. Data is sent from the Smartphone using the Bluetooth terminal application.

IV. BLOCK DIAGRAM DESCRIPTION

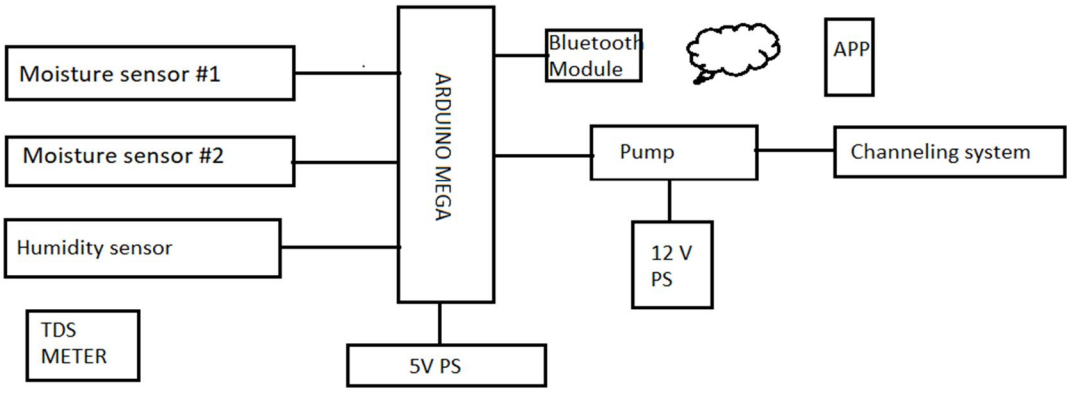

Fig. 3- Block Diagram

Fig2 shows the basic flow of the system. Reject Water is stored in the tank and is checked for the TDS count. The Controller, Atmega 2560 receives readings from the moisture sensors embedded in the soil and the humidity sensor. The Controller is programmed to turn pump on when the moisture level in soil decreases below the set point. The water then leaves the tank and through the sub channels it waters the area around the roots of the plant. The field components are moisture sensors and water pump. The Controller, Humidity sensor and the LCD display are placed in a housing kept at a remote location. The LCD displays Moisture sensor readings along with real time values of temperature and humidity. The figure below shows the text displayed on the LCD screen-

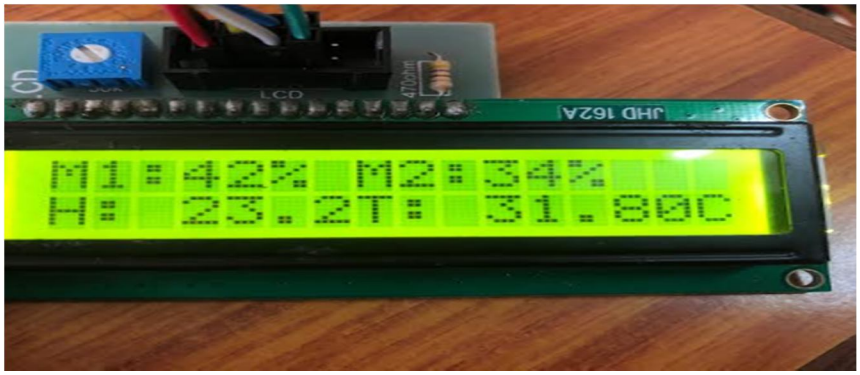

Fig. 4- Results displayed on LCD screen

V. CONCLUSION

Thus, the proposed system fulfills its desired objective of automated garden irrigation by re-using waste water. It reduces human efforts in plant irrigation as well as proves as an innovative step towards water saving. With the help of Bluetooth module, the user can control the system through a mobile application, from anywhere within the house. The mobile application provides an option of manual override making the system extremely suited to the user's requirements.

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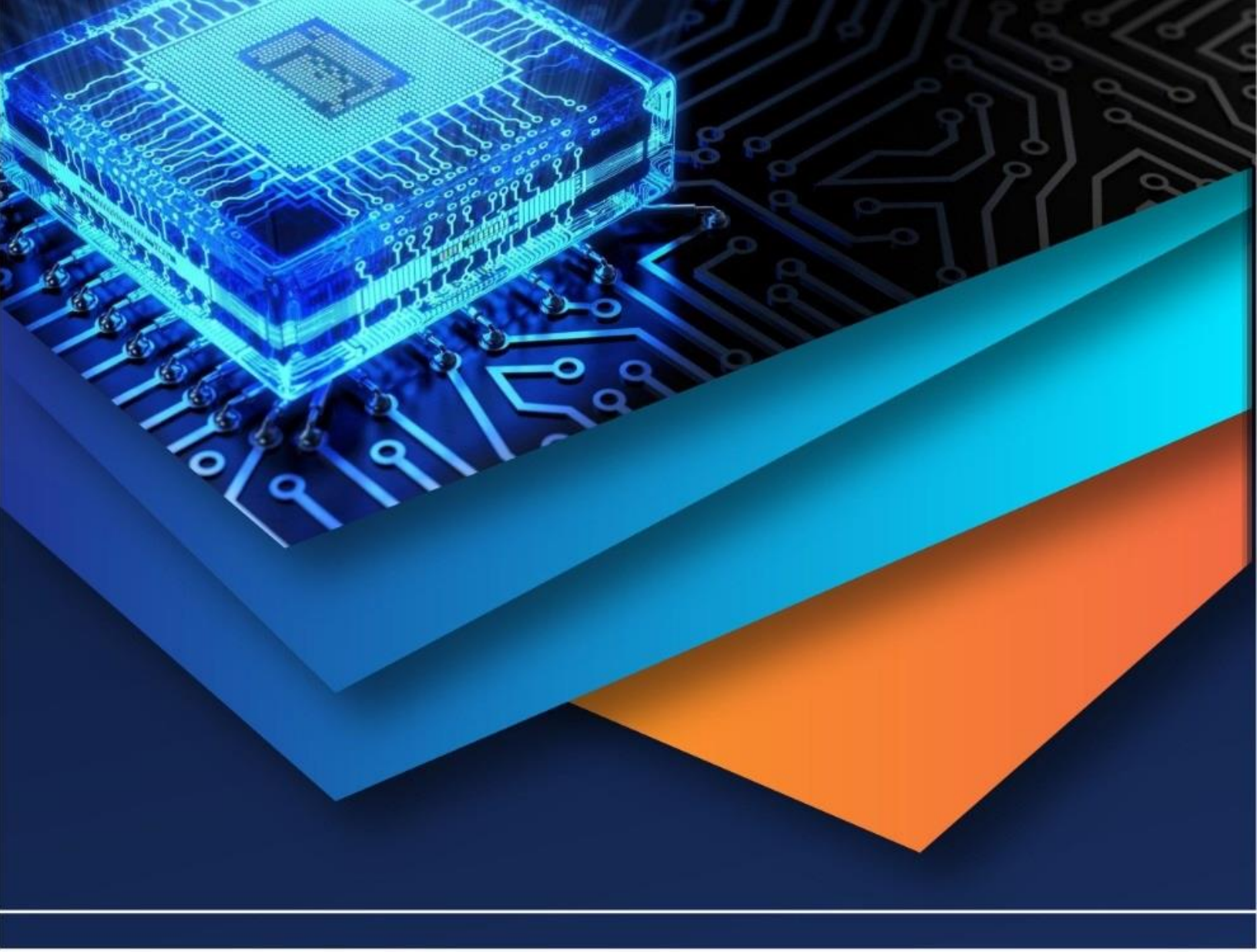

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