iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** III **Month of publication:** March 2019

DOI: http://doi.org/10.22214/ijraset.2019.3349

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue III, Mar 2019- Available at www.ijraset.com

Irrigation Control System by Using GSM, For Farmers for Efficient Use of Water, Power and Crop Planning"

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Abstract: ***In today's times, nothing is more important than using our natural resources effectively and appropriately. With drastic climatic changes there also arises a need to maintain equilibrium by properly utilizing our natural resources. A major sector contributing to economy in our country is Agriculture. With the advent of technological innovations and up-gradation to new farming techniques, there is a need to upgrade our irrigation systems to use water efficiently. This paper presents a novel way to implement the smart irrigation system which is implementable at ground basis and also provides an ease of use for the users who are not very well updated with the technology. A smart irrigation system will replace the disadvantages of manual work and can be of great use to the farmers as well as small gardening sectors.***

The proposed work makes the process of smart irrigation possible with the use of moisture sensor, temperature and humidity sensor to monitor the soil moisture content.

The sensors are then connected to a processing unit which processes the information and controls the motor operation as on or off according to the threshold value. This update is also provided to the user through a GSM module. The system is implementable at village levels and is easy to use for one and all irrespective of knowing technology or not because it is not using a very complex system for update of motor on / off rather it is using a GSM system which is nowadays being used by one and all . The system is thus very useful on a practical basis and user friendly. Smart irrigation facilitates healthy growth of plants and avoids wastage of water.

Smart Irrigation system can also be modified and designed according to the crop or plant type water needs. The system shall also be implementable at urban style of gardening systems or small gardens or lawns. This paper presents various features that a good irrigation system must possess. The sensors used can be added or removed according to a particular application; this project uses very essential sensors that have been proved to be useful in irrigation systems according to the literature survey done and practical analysis as well.

Index Terms: Irrigation technique, GSM module, Adriano, Sensors

I. INTRODUCTION

Agriculture is a sector which has seen continuous technological up gradations in farming techniques. In today's time it is also important to upgrade the present irrigation systems being used which are purely manual in nature. At the present era, the farmers have been using irrigation techniques in India through manual control in which farmers irrigate the land at the regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which crops get dried. Water deficiency can be detrimental to plants before visible wilting occurs. Slowed growth rate, lighter weight fruit follows slight water deficiency. This problem can be perfectly rectified if we use automatic microcontroller based drip irrigation system in which the irrigation will take place only when there will be acute requirement of water.

The manual irrigation system comes with its disadvantages like the exact soil moisture content is not measured but the work is done purely on basis of conventional techniques used since ages to turn on and off the motor. To conserve and save water, it is also necessary that we use water effectively.

As the proposed system has a provision of being powered by solar energy, it removes all the disadvantages of being dependent on electricity. Smart Irrigation system will be of advantage to areas that has scarcity of water supply and farming has to be carried efficiently. Another advantage of the system is that excess water is not a good choice for crops the same way water in fewer amounts also doesn't promote growth of crops hence this system makes use of sensors which give the accurate data as to when the motor should be turned on and off. This system is implementable at small gardening sectors and maintaining farmhouses remotely. The GSM module provides the added advantage of knowing the status of motor's working.

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II. SOIL MOISTURE

Soil moisture is an important component in the atmospheric water cycle, both on a small agricultural scale and in large-scale modelling of land/atmosphere interaction. Vegetation and crops always depend more on the moisture available at root level than on precipitation occurrence. Water budgeting for irrigation planning, as well as the actual scheduling of irrigation action, requires local soil moisture information. Knowledge of the degree of soil wetness helps to forecast the risk of flash floods, or the occurrence of fog. Soil water content is an expression of the mass or volume of water in the soil, while the soil water potential is an expression of the soil water energy status. The relation between content and potential is not universal and depends on the characteristics of the local soil, such as soil density and soil texture.

The basic technique for measuring soil water content is the

Gravimetric method. Because this method is based on direct measurements, it is the standard with which all other methods are comparedThe capacity of soil to retain water is a function of soil texture and structure. When removing a soil sample, the soil being evaluated is disturbed, so its water-holding capacity is altered. Indirect methods of measuring soil water are helpful as they allow information to be collected at the same location for many observations without disturbing the soil water system. Moreover, most indirect methods determine the volumetric soil water content without any need for soil density determination.

A soil moisture sensor can read the amount of moisture present in the soil surrounding it. It's a low tech sensor, but ideal for monitoring .This is a must have tool for a smart irrigation system. This sensor uses the two probes to pass current through the soil, and then it reads that resistance to get the moisture level. More water makes the soil conduct electricity more easily (less resistance), while dry soil conducts electricity poorly (more resistance)

III. METHODOLOGY

The technique used for automatic irrigation discussed in this paper is adopted after reviewing and analyzing the literature.

A. Hardware and Software Components

The process has to be done both on software and hardware. The required equipment is as follows:

1) PC with Arduino software
2) Arduino Nano
3) Soil moisture sensor
4) Humidity sensor
5) Temperature sensor
6) GSM module
7) Relays
8) LCD 20*4 display
9) DC motors
10) DC fan

B. Arduino Nano

Arduino is genesis of the proposed system. The center of all operations taking place in the system. Components are connected to Arduino through different ports and are dependent on its instruction. Arduino Mega 2560 has been used because of its versatility. It has 54 digital I/O ports. There are 16 analog inputs, 4 UART's, 16 MHz crystal oscillator, USB port, power port, reset button and ICSP header. The flash memory is 256 Kb and EPROM memory is 4 Kb [4]. All the data from sensors comes directly in Arduino which processes it and sends the signal forward. The Arduino commands further process whether to start or stop the motors. Basically, the code is being fed into Arduino will judge the moisture condition of soil and decides if motors need to be turned on or off. The code is written on Arduino software and transferred to the device using USB cable. C language is used in code and threshold values for upper and lower points are defined in the code.

C. Sensors

The participation of sensors in automatic irrigation is most important. They play vital role to make the system automatic. Without them, the process cannot be imagined as automatic. Three different sensors have been used. These three sensors measure three different parameters. The sensors include:

1) YL 69
2) DHT11
3) LM35

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YL 69 is the soil moisture sensor. They sense the water content in soil. These are most important as the information forwarded by them is most relative regarding water requirement. The sensor has two prongs which are submersed in the soil. It has 4 ports. Ports are for GND, VCC and outputs for analog and digital values.
DHT11 is the humidity sensor. They detect the water content in atmosphere. The high humidity may increase dampness in soil. LM35 is the temperature sensor. They judge the temperature of environment. The advantage of LM35 is its feature that it always gives temperature in Celsius further calculations is not required to convert output to get temperature in Celsius. The latter two sensors are used to make the system more reliable. These two sensors are left in open environment. They constantly give the value of temperature and humidity. When the temperature or humidity level of environment alter, it may affect the moisture level of soil so to eradicate any changes that may fluctuate the process of irrigation these sensors send signal to Arduino to take some action. In the design, if humidity level goes above our defined value then to mild its effect the Arduino sends signal to DC fans located near the sensors. The DC fans automatically turn on themselves and kept on running until normal conditions are achieved.

D. GSM Module
SIM900D has been used for GPS purpose. This module makes the system wireless. The status of undergoing process will be updated to user via SMS. This module is connected to the Arduino board.

System Block Diagram

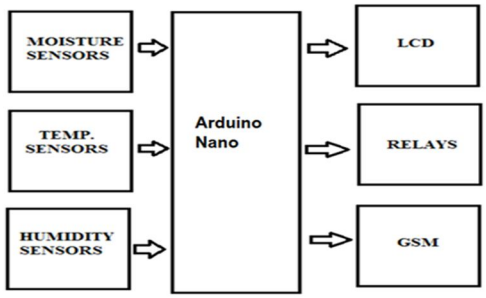
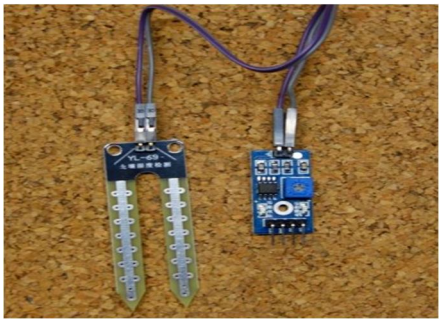


Fig 1. Block diagram of system

IV. WORKING

A. Soil Moisture Sensor
The soil moisture sensor or the hygrometer is usually used to detect the humidity of the soil. So, it is perfect to build an automatic watering system or to monitor the soil moisture of your plants.The sensor is set up by two pieces: the electronic board (at the right), and the probe with two pads, that detects the water content (at the left).
The sensor has a built-in potentiometer for sensitivity adjustment of the digital output (D0), a power LED and a digital output LED



B. Temperature and Humidity Sensor
The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old

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C. GSM

GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed easily.

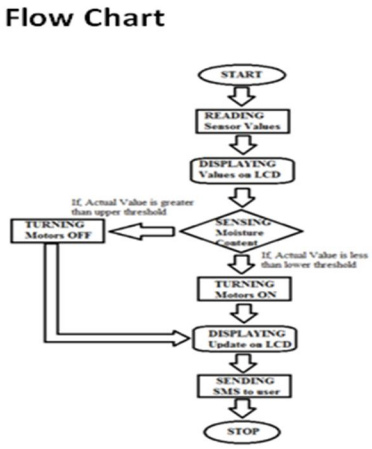
D. Arduino Nano

1) It comes with an operating voltage of 5V, however, the input voltage can vary from 7 to 12V.
2) There are 14 digital pins which can be configured as input or output and 8 analog pins incorporated on the board. More or less all these analog pins can be used and configured exactly the same way as digital pins.
3) Digital pins are used as input pins when they are interfaced with sensors while driving of load is carried out when digitals are used as output.
4) Functions like pinMode() and digitalWrite() are used to control the operations of digital pins while analogRead() is used to control analog pins.
5) There is one limitation using Arduino Nano i.e. it doesn't come with DC power jack, means you cannot supply external power source through a battery.
6) This board doesn't use standard USB for connection with a computer; instead, it comes with Mini USB support.
7) Tiny size and breadboard friendly nature make this device an ideal choice for most of the applications where sizes of the electronic components are of great concern.

When the smart irrigation system starts, the sensors sense the parameters and gives appropriate values of the sensed data. A threshold value is decided above or below which the motor On and Off operation will take place. The threshold value can be customized according to the user needs. The data received from sensors is then processed , the arduino is programmed as follows , when the received data is smaller than threshold value i.e, the soil moisture content is less the motor will get turned On and the owner or the user shall get updated by receiving a SMS from the GSM module attached in the system. When the soil moisture content is greater than the threshold value , the motor gets switched off through a relay and this status will also be sent to the user

V. FLOWCHART

The flowchart shows the step by step process of a smart Irrigation system. In the code, there are basically two threshold values i.e upper and lower. The code carries these two values and are defined by user. The actual value of water content in soil is read by the moisture sensors which are submersed in soil. The code compares this value with the two user defined threshold values. Flowchart of Automatic Irrigation process If actual value happens to be below than the lower threshold value, the code will generate a signal that will turn motors on. The process will be autonomous and the dried part of soil gets moisturized. The values of moisture level are constantly compared with the threshold values in code and if actual moisture value crosses the upper threshold value then again code will send the signal of turning off the motors. Fig.2 represents the basic flowchart diagram of this project. The process starts with sensors reading the value and displaying them on LCD. As the value of moisture falls below the lower threshold point, the motor starts and if the content climbs the upper threshold value the motors shuts off. In either case, user will get a SMS first of undergoing process. The status of motors is also displayed on LCD.



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VI. FUTURE WORK / CONCLUSION

This project can be modified by powering it with Solar cells so that it becomes more efficient even at the places with frequent power cuts. More Sensors can be attached to to extend the application of this project to more varied places like maintaining small gardens, lawns etc. This paper presented a novel approach for implementing an efficient way of automating the irrigation system although many more modifications can be done with the ever changing environmental conditions.

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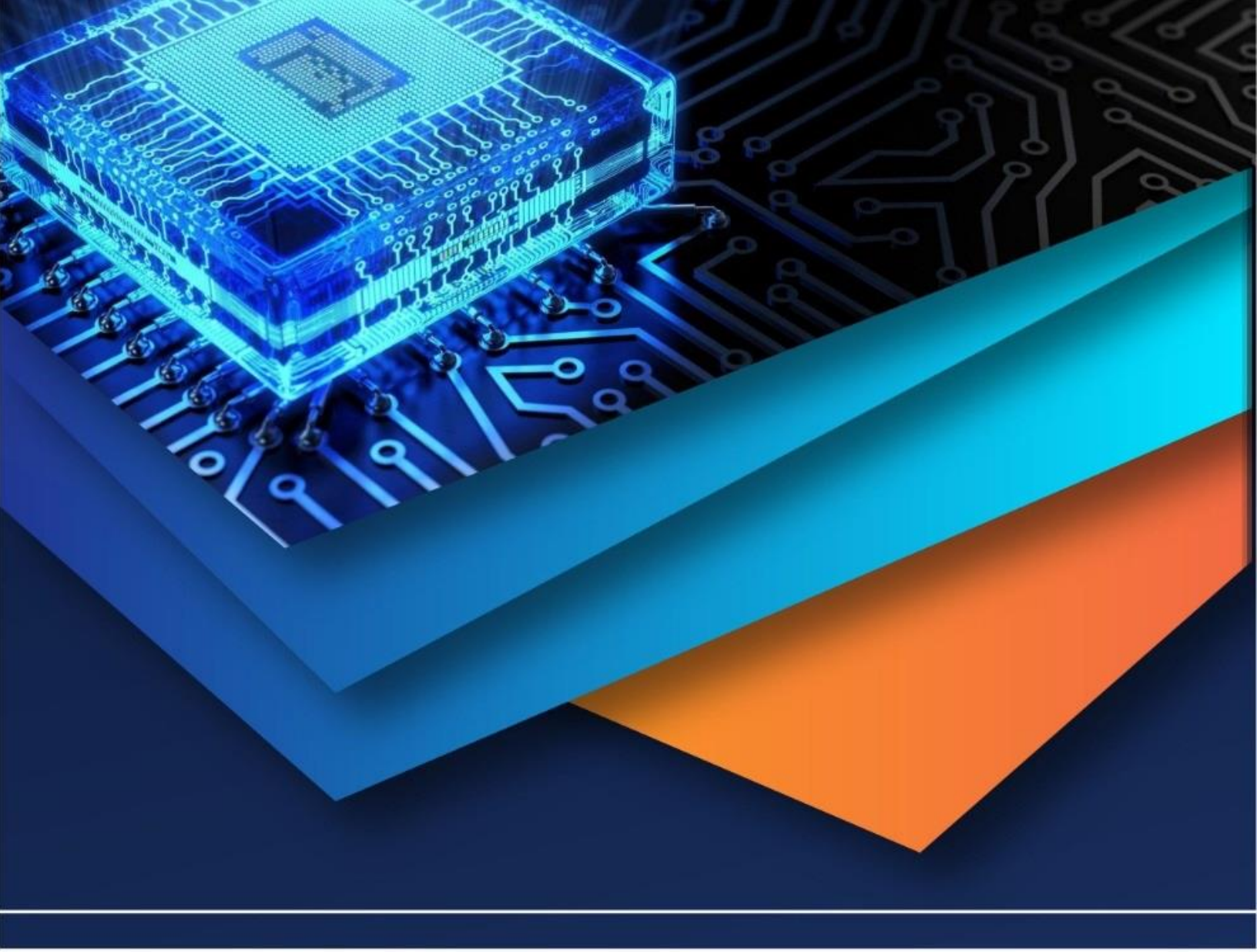

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