GSM based Automated Irrigation System: An Efficient Water Management

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Abstract- India has a population as much as 17.7% of the world's population but has only about 4% of the world's freshwater resources. Much of these are unevenly distributed. More than 72% of people depend upon farming which is one third of the total population of the country. Average annual rainfall is 300–650 millimeters (11.8–25.6 in), but is very unreliable. In 2018–2019 Irrigated area accounts for nearly 48.8 per cent of the 140 million hectare (mha) of agricultural land in India. Biggest problems faced by farmers in India, only nearly half of the cropped area are under irrigation. Irrigation is the most important agricultural input in a tropical monsoon country like India where rainfall is uncertain, unreliable and erratic India cannot achieve sustained progress in agriculture unless and until huge cropped area is brought under assured irrigation. The only recommended solution to this issue is modernizing irrigation system using smart technologies. This paper aims at developing the GSM based automated irrigation system which provide adequate water required by crop by monitoring the moisture of soil and climate condition in order to prevent the wastage of water resource. It will also have many advantages for farmers.

Keywords- Automation, Soil Moisture Sensor, Smart Irrigation, Arduino, Temperature sensor, Micro-controller, GSM Module. Smart Agriculture.

Introduction

The aim of this paper presents a smart irrigation system suitable for use in places where water scarcity is a challenge. In many parts of India, even when irrigation is practiced, it is manually operated. Irrigation is the artificial process to provide water to the field being cultivated. Traditionally in dry region of the country water had to be supplied to the field through hand pump, canals, tube well etc. These types of conventional irrigation system had several problems such as increase in workload of farm labor and often it lead to problem such as over-irrigation or under-irrigation and leaching of soil. Smart irrigation system is thereby believed to be a major solution. So here making GSM based Automated Irrigation System using Arduino, which automatically provides water to crop field and keep farmer updated by sending message to cell phone. In this irrigation System, Soil Moisture Sensor checks the moisture level in the soil and if moisture level is low then Arduino switches on a water pump to provide water to the plant. Water pump gets automatically off when system finds enough moisture in the soil. Whenever system switched On or off the pump, a message is sent to the user via GSM module, updating the status of water pump and soil moisture. This system is very useful in Farms, gardens, home etc. This system is completely automated and there is no need for any human intervention [1-2].
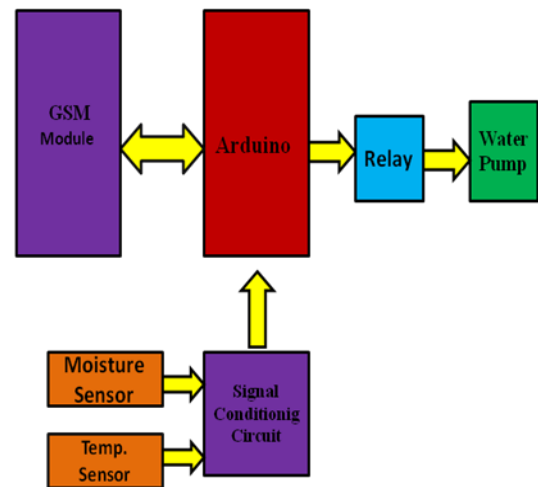
System Architecture

Fig. 1 Automated irrigation system architecture

Fig.1 presents the overall system architecture of scheme, here the sensors such as soil moisture sensor and temperature sensor incorporated in agriculture field, the sensed data from sensors are processed by signal conditioning circuit and compared with pre-determined threshold values of various soil and specific crops. The sensors data from agriculture field are fed to the Arduino processor which is linked to user android mobile via GSM module. In this automated irrigation system, moisture sensor checks the moisture level and if moisture level is found low then Arduino switches on water pump. Water pump gets automatically off when system finds enough moisture in the soil. Whenever system switched on or off

the pump, a message is sent to the user via GSM module, updating the status of water pump and soil moisture [3-5].

Hardware requirements

Arduino Uno

The **ArduinoUno** is an opensource microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.[4] It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

Technical specifications

Microcontroller: ATmega328P

Operating Voltage: 5 V

Input Voltage: 7-20 V

Digital I/O Pins: 14

DC Current per I/O Pin: 20 mA

Flash Memory: 32 KB

 SRAM: 2 KB

EEPROM: 1 KB

Clock Speed: 16 MHz

Dimensions: 0.70" X1.70

Weight: 25 g

GSM Module

In this work **TTL SIM800 GSM module** is used. The SIM800 is a complete Quad-band GSM/GPRS Module which can be embedded easily with Arduino Uno microcontroller. SIM900 GSM Module provides an industry-standard interface; the SIM800delivers GSM/GPRS850/900/1800/1900MHz performance for voice, SMS, Data with low power consumption. The design of this SIM800 GSM Module is slim and compact.

Soil Moisture Sensor

The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value. When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil

conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower. This is an easy to use digital soil moisture sensor. Just insert the sensor in the soil and it can measure moisture or water level content in it. It gives a digital output of 5V when moisture level is high and 0V when the moisture level is low in the soil. The sensor includes a potentiometer to set the desired moisture threshold. When the sensor measures more moisture than the set threshold, the digital output goes high and an LED indicates the output. When the moisture in the soil is less than the set threshold, the output remains low. The digital output can be connected to a micro controller to sense the moisture level. The sensor also outputs an analog output which can be connected to the ADC of a micro controller to get the exact moisture level in the soil.
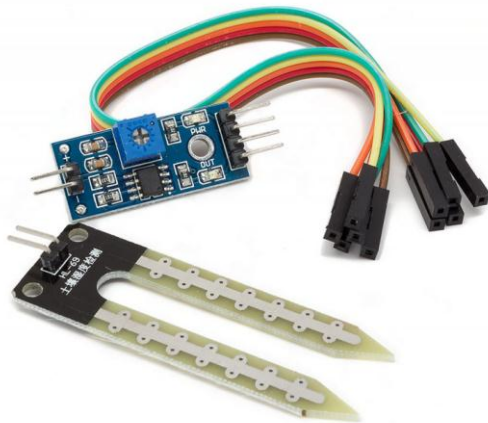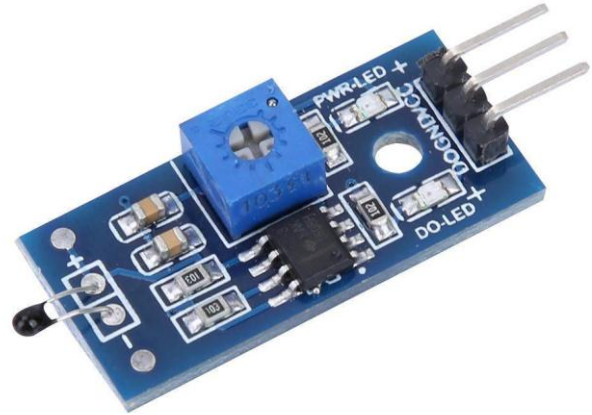
Temperature sensor

NTC Thermistor temperature sensor module is low cost, small size module. It is very sensitive to ambient temperature. It is generally used to detect the temperature of the surrounding environment. Through potentiometer adjustment, it is possible to change the temperature detection threshold. The temperature detection range of the module is between 20 and 80 degrees Celsius. Generally, the 4 wire method of thermistor measurement is the most accurate because there is effectively no current flowing in either of the measurement cable wires and therefore no added resistance due to the cable wires.

Software requirements

In this paper the open-source Arduino Software (IDE) used in which it is easy to write code and upload it to the board. It runs on Windows and Linux. The environment is written in Java and based on Processing and other open-source software. The Arduino nano microcontroller is an easy to use up till now powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open source, which means hardware is reasonably priced and development software is free.

Circuit & Working

The circuit consists of Arduino Uno which is brain of the project. A 9 V relay is utilized to turn on / off the water pump. Two DC jacks which will power the Arduino and GSM module. Working of this **GSM based Automated Irrigation System** is quite simple. First of all, it is a **Completely Automated System** and there is no need of manpower to control the system. Arduino is used for controlling the whole process and GSM module is used for sending alert messages to user on his mobile phone. If moisture is present in soil above the threshold value then there is conduction between the two probes of Soil Moisture sensor and Arduino Pin D7 remains Low. When Arduino reads LOW signal at D7, then it sends SMS to user about "Soil Moisture is Normal. Motor turned OFF" and water pump remains in off state. Now if Moisture present in soil below the threshold level then Pin D7 becomes High. Then Arduino reads the Pin D7 and turns on the

water motor and also sends message to user about "Low Soil Moisture detected. Motor turned ON". Motor will automatically turn off when there is sufficient moisture in the soil. GSM module is used for sending SMS to the user. A LM317 Voltage regulator is used to power the SIM800 GSM module. Its operating voltage rating is 3.8V to 4.2V. Below is the Circuit Diagram of Power Supply given to the TTL SIM800 GSM Module:
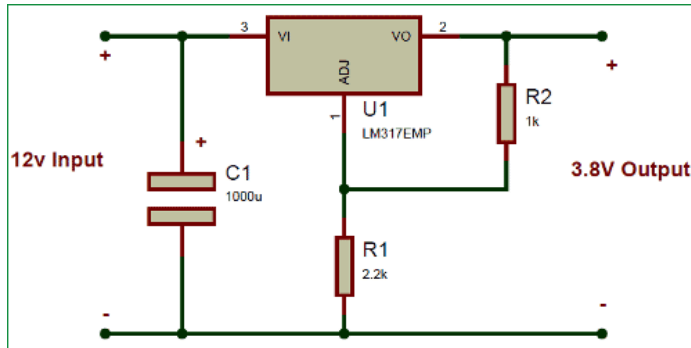
Future scope

A lot of future scope are available that can be used with this work to improve the efficiency and effectiveness of the system, the following recommendations can be put into consideration. The idea of using IOT for irrigation can be implemented with this system. Other activities in farming such as cattle management, fire detection and climate control can be introduced with this system. This system can be improvised by adding a Webscaper which can predict the weather and water the plants/crops accordingly. If rain is forecasted, less water is let out for the plants.

Conclusion

Irrigation play a vital role for economic in any developing countries like India. Over the years, professionals involved in irrigation implemented manual method of irrigation. The manual method has lots of drawbacks and is quite unreliable for irrigation of big areas. Irrigation has direct impact on cost and production of final product. This system aims to eradicate the traditional manual method of irrigation which needs to be improved over the time. This prototype has many advantages which make it a good alternative to the current approaches since it facilitates the farmers to assist them in daily needs of the monitoring and controlling the field environmental parameters with minimum cost and user friendliness.

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