Implementation of an automated irrigation system: Smart irrigation system (paper subtitle)

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Implementation of an Automated Irrigation System

Smart Irrigation system (*paper subtitle*)

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***Abstract*— The main aim of this paper is to develop an automated irrigation system based on sensors which are interfaced to the microcontroller unit. The sensors used in this paper are temperature and humidity sensor DHT11 sensor and soil moisture VH400. These sensors are interfaced to the microcontroller unit and the whole unit was placed under the root zone of the plant. The main motive of using microcontroller is to send an SMS to the mobile phone of an owner who is in the remote location. The sending of SMS is done by using SIM900A module which is also interfaced to the microcontroller unit. The irrigation system is tested under different temperatures and humidity levels of different plants under normal and wet conditions. The use of soil moisture sensor is to limit the water content to the particular areas. Throughout all the values obtained in wet and normal conditions are proved to be intuitive.**

***Index Terms*— DHT11 sensor, VH400 sensor, SIM900A module, Microcontroller unit.**

I. INTRODUCTION

Today agriculture uses 85% of water for irrigation purposes only. This percentage may increase because of increased population growth and food demands. Thus water shortage is one of the problems in the world [1]. Today most efficient plant monitoring systems are occurring day by day by using optical and IR images of plants [2]. Water is essential for every human beings, animals and plants. It is also a basic need for every human being . The wastage of water is the major problem in most of the agriculture. This can be reduced by using different methods developed for conservation of water [3]. There are many techniques to control or save the wastage of water. The first one is the ditch irrigation scheme, where the ditches are dug out and seeds are planted in a row. There are tubes like siphon tubes are used for the movement from main ditch to the canals. Drip irrigation is also the most efficient method for irrigation; in this the water drops at the root zone of plant in a dripping motion [5]. Sprinkler system is also an irrigation based system, where it uses sprinklers, sprays or guns are on the tubes. The water flows through the tubes and at some ends there are sprinklers to sprinkle the water in those areas. The sprinkler will be activated only when the temperature and humidity sensor at the root zone exceeds the threshold value. Rotary systems are the best irrigation system suited for especially larger area . The rotary system consists of mechanical driven sprinklers moving in a circular motion because for sprinklers can reach distances up to 100 feet. So system amounts less water to sprinkle in a larger area over a period of time. To automate the cotton crop irrigation, remote canopy temperature is used by infrared thermometers [6]. In this process a threshold of temperature is maintained. Whenever canopy temperature exceeds the particular threshold of temperature the system triggers. For optimizing the cotton yields and usage of water, most of the irrigation systems are automated rather than the manual irrigation system. Plant Evapotranspiration (ET) is an alternative parameter to estimate the crop irrigation needs. ET is the combination of two terms such as evaporation and plant transpiration. Evaporation means vaporization of water to air from soil, canopy interception [7] and water bodies. Transpiration is the process of vaporization of water from leaves and also from stems and flowers. The systems based on ET will allow the water savings up to 42% [8]. In recent years WSN nodes became more popular because of applications such as in vehicle monitoring and to control the robots. For measuring the soil moisture content of the paddy fields by using TINY OS based IRIS nodes [12]. There are several solutions to measure the data in the irrigation field; the most popular on is ZigBee transmission of data from end devices. But using these devices the distance between the two nodes is between 10 to 100 meters only. So most of the applications uses GPRS based systems to transmit the data to the remote area [14]. The ZigBee based transmission is used in the agricultural field in order to collect data from different sensor nodes. Now a day's wireless sensor networks play an important role in food industry and also in agriculture. The examples of such systems are monitoring of environment continuously, to maintain precision in agriculture, RFID based traceability systems etc [13].The SIM900A is a GSM/GPRS based wireless modem. In the automated irrigation system, it plays an important role in communication of the temperature and humidity and also the soil moisture [9] content sensor values to the remote area. This can be done by using the AT commands. The GSM/GPRS modem is interfaced to the microcontroller unit [9]. For remote monitoring, GPRS based systems are employed on wireless sensor networks for monitoring the temperature and humidity data continuously or periodically [15]. The motive of the paper is to transmit the sensors data which is under the root zone of the plant to the remote person using GSM/GPRS modem [10].

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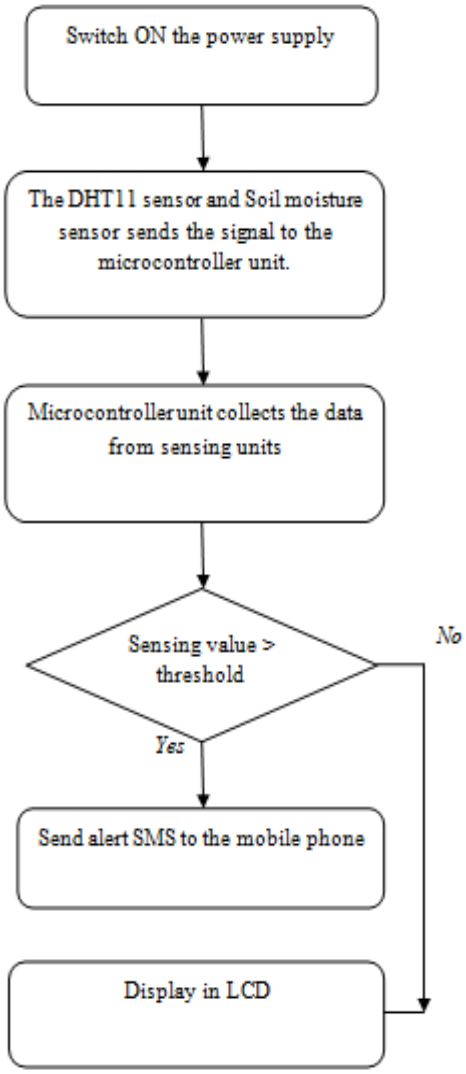
II. Proposed Work

In the proposed algorithm, according to the power supply given to the arduino board, the sensors will start working. The DHT11 sensor senses the temperature and humidity of particular root zone of the plants and on the other end the Soil moisture sensor is also interfaced to the microcontroller unit sends the corresponding values to the microcontroller unit for every 5minutes. The main aim of the microcontroller unit is to check the data values which was send by the sensors and was compared with the predefined threshold which was programmed in the microcontroller unit. When the sensor data value does not greater than the threshold value then the microcontroller displays these values in the LCD display. Whenever it is greater than the threshold value then the microcontroller unit sends the alert SMS to the mobile phone of an owner who is in the remote area.



III. Block Diagram

The Block diagram implementation of an automated irrigation system using GSM/GPRS modem is shown in Fig.1.

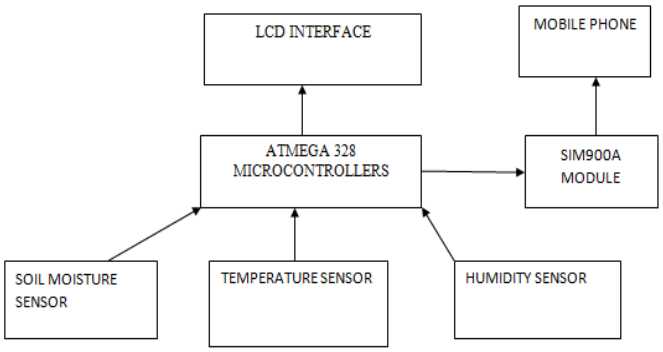


Fig.1. Block Diagram.

The automated irrigation system consists of two units are control unit and sensing unit. The control unit consists of microcontroller which controls the execution of operation and the sensing unit consists of different sensors such as DHT11 sensor and soil moisture sensor. The microcontroller used in this project was the ATMEGA328 microcontroller. The arduino board consists of inbuilt ATMEGA 328 microcontroller unit. The DHT11 sensor and soil moisture sensors are interfaced to the ARDUINO board. The sensing units send the corresponding data values continuously for every 5minutes to the ARDUINO board. The board displays the current temperature and humidity of a particular root zone by using an LCD display which is also interfaced to the board. The ARDUINO board gets the data values from the sensing units and these values are compared with the predefined threshold that was programmed in the microcontroller unit. When the data values of the particular sensors are greater than the threshold, then the ARDUINO board sends an SMS to the mobile phone of an owner who is in the remote location. The sending of an SMS is done is through SIM900A module which is interfaced to the ARDUINO board. This module communicates with microcontroller by AT commands.

A. Soil Moisture Sensor

The Soil moisture sensor unit consists of soil moisture sensor and LM393 comparator chip. The soil moisture sensor is used to detect the soil moisture. The soil probe is dip in to the soil such that when the soil moisture is LOW the module output is HIGH indicated by using RED led on the comparator chip. This sensor measures the dielectric constant of the soil by using transmission line techniques. This circuit consists of four pins such as power supply pin, ground pin, analog and digital pins. The analog pin A0 connected to the analog pin of ARDUINO board and digital D0 pin connected to the digital pin of ARDUINO board. This sensor is a dual output mode in which analog output is more accurate. The operating voltage is up to 5V.

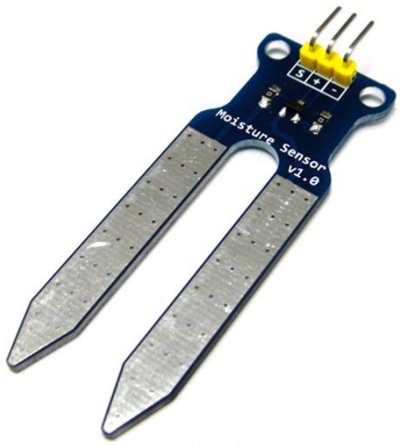


Fig.2. Soil Moisture Sensor

B. DHT11 sensor

DHT11 sensor measures both the temperature and humidity of root zone of the plant. This sensor consists of three pins named as power supply, ground and another is data pin used measure the data of the sensor. This sensor has protecting shield above that which withstand in any climatic conditions. This sensor has a high reliability and excellent long terms stability. This sensor is used at the root zones of the plants, such that it measures both temperature and humidity at a time. The measured data is send to the analog pins of an ARDUINO board such that it coverts in to the digital output and displays both values using the LCD.

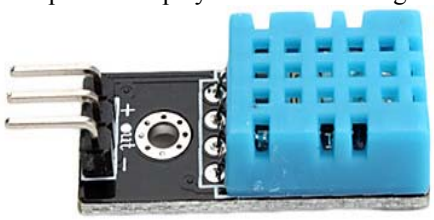


Fig.3. DHT11 sensor

C. ARDUINO board

ARDUINO is an open source physical computing platform based on a simple microcontroller board and a development environment for writing software for the board. It has 14 digital pins, 6 analog pins, 16 MHZ crystal oscillator, a USB connection, a power source jack and a reset button.

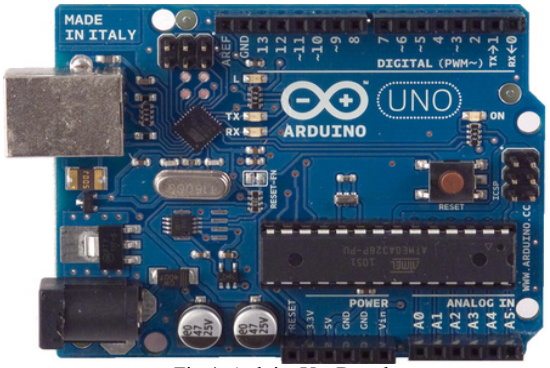


Fig.4. ArduinoUnoBoard

D. SIM900A Module

SIM900A module is used to send the data from the microcontroller unit to the mobile phone by using AT commands. First put the SIM card in the SIM slot given in the SIM900A module. The receiver and transmitter pins of this module is connected to the transmitter and receiver pins of the ARDUINO board and also connect the ground and VCC pins of both ARDUINO and SIM900A modules. The list of AT COMMANDS used in this paper is mentioned below:

TABLE I

Command	Description
AT	To test the condition of modem
AT+CSMINS?	To check if modem has SIM or not
AT+CMGF=1	To set the communication to text mode
AT+CMGS	To send SMS from the GSM modem
AT+CREG	To check whether the SIM is registered with the network.
AT+CMGD	Command to delete an SMS
ATE1	Command to on the ECHO

IV. Implementation And Results

An automated irrigation system is done by using the ATMEGA 328 microcontroller and sensors such as temperature and humidity sensor, soil moisture sensor. The DHT11 sensor is used to measure the temperature and humidity of a root zone of plants in dry and wet conditions. According to the obtained results, the threshold can be set such that the microcontroller unit sends an SMS to the mobile phone of an owner.

TABLE II

RH%	C(AIR)	F(AIR)	C(WET)	F(WET)
20	30	86	16	61
35	30	86	19	66
35	35	95	23	73
65	35	95	29	84
80	35	95	32	90

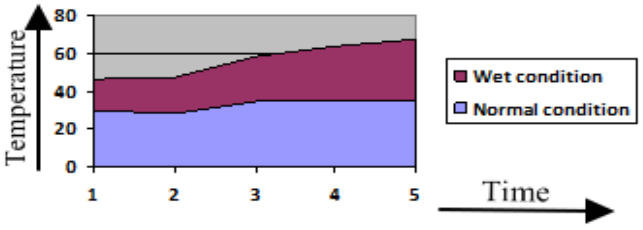


Fig.5. Normal Vs Wet Condition

From the table II graph can be ploted by using the values in the table. The threshold can be set according to the values obtained under different conditions.the threshold must be choosen in the range of 40 to 30 degrees centigrade, because the most of the

values fall on those ranges during normal and wet conditions. The threshold may vary from place to place because it may not be constant at one region.

V. Discussion On Results

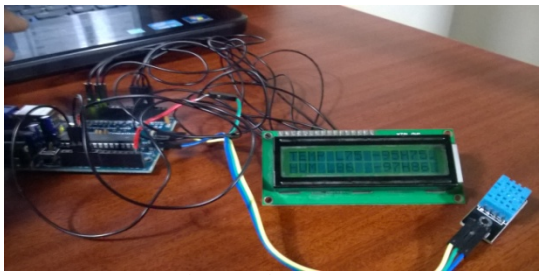


Fig.6. Hardware setup.

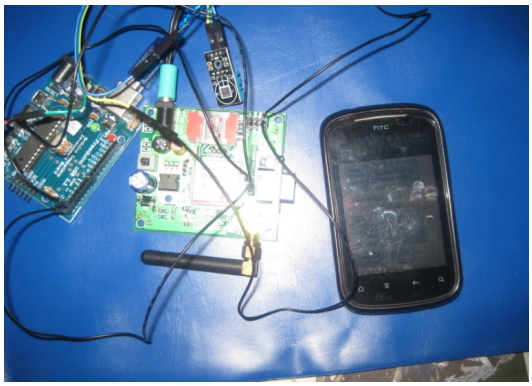


Fig.7. Overall Module Output

The SIM900A module is interfaced to the microcontroller unit such that it communicates with the SIM900A module by AT commands. This communication can be done only when the microcontroller unit receives a value which is greater than the threshold value. The microcontroller send the alert SMS and also send the particular exceed value of an temperature or humidity or soil moisture value to the owner in consecutive SMSs.

Fig.8. Outputs of an SMS received.

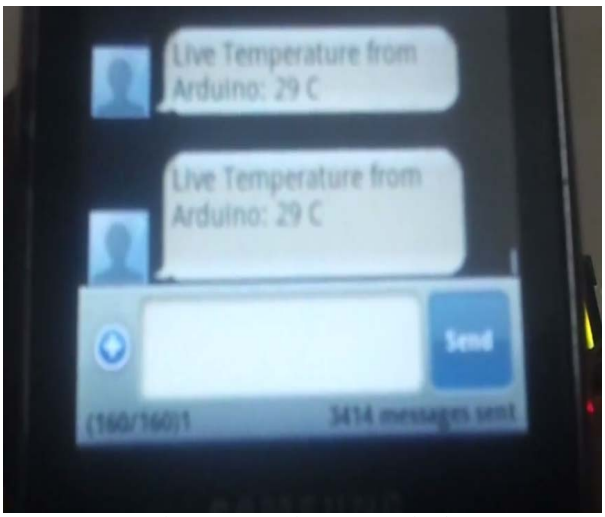


Fig.9. Outputs of an SMS received.

VI. Conclusion

The automated irrigation system was implemented using the ARDUNIO board by interfacing sensors to the microcontroller unit. The microcontroller unit continuously monitors the sensors data and if the sensors data exceeds a particular threshold value then the microcontroller unit sends an alert SMS to the mobile phone of an owner who is in remote location. The different values for the DHT11 sensor is measured under different climatic conditions and set the threshold value based on those practical values. This system can be extended by using WSN nodes for transmit data and also using data base systems to store the data at the field. The overall system can be powered up using solar cells to maintain the system in low cost.

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