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SMART IRRIGATION SYSTEM

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Abstract:*The following work is carried out to prevent the wastage of water in agriculture and to enhance watershed management. In order to achieve this, we have adopted some latest technologies in the agricultural applications. This has given a modernized approach towards the irrigation system and enabled automation of plant irrigation. Here we control the water flow by measuring the soil moisture level. In addition to this, we have also used some other sensors like the raindrop sensor, temperature and humidity sensor and ultrasonic sensor to study the environmental factors and to monitor the plant growth respectively. Thus, by incorporating the modern instrumentation techniques in the traditional agriculture, it is possible for us to develop a sustainable practice. Also, the labor availability for agriculture is posing to be a huge problem. Our project serves as a better solution for the problems mentioned above and can be implemented for any kind of land masses including greenhouse farming***.**

I. INTRODUCTION

The Need of this project "Smart Irrigation System" is to adopt the advancements in Mechatronics for managing the water requirements of crops in agriculture. The following work utilized some sensors like the moisture sensor, rain drop sensor, temperature and humidity sensor and ultrasonic sensor for measuring various parameters like soil moisture content, atmospheric temperature, etc., As an initiative, the project is applied in Greenhouse farming and the readings were noted down periodically. This project mainly aims at avoiding the wastage of water as it is at a huge stake for future generation. Also, we have focused on automating the entire irrigation process without any human intervention. The data obtained from the sensors were processed using Arduino and were used to control the water flow. This ensures correct amount of water being supplied to the field.

II. COMPONENTS USED

A. Soil moisture sensor

Instructions Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

Operating voltage: 3.3v to 5v.
On-board LM393 comparator.
On-board power indicator LED.
Number of pins: 2.

Fig. 1 Soil moisture sensor

B. Temperature and Humidity sensor

Humidity is the presence of water in air. The amount of water vapoUr in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapour also influences various physical, chemical, and biological processes. Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. Hence, humidity sensing is very important, especially in the control systems for industrial processes and human comfort. Controlling or monitoring humidity is of paramount importance in many industrial & domestic applications. In semiconductor industry, humidity or moisture levels needs to be properly controlled & monitored during wafer processing. In medical applications, humidity control is required for respiratory equipments, sterilizers, incubators, pharmaceutical processing, and biological products. Humidity control is also necessary in chemical gas purification, dryers, ovens, film desiccation, paper and textile production, and food processing. In agriculture, measurement of humidity is important for plantation protection (dew prevention), soil moisture monitoring, etc. For domestic applications,

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humidity control is required for living environment in buildings, cooking control for microwave ovens, etc. In all such applications and many others, humidity sensors are employed to provide an indication of the moisture levels in the environment.

Measurement range: 20 to 90% RH; 0 to 50ºC
Humidity accuracy: ±5% RH
Temperature accuracy:±2ºC

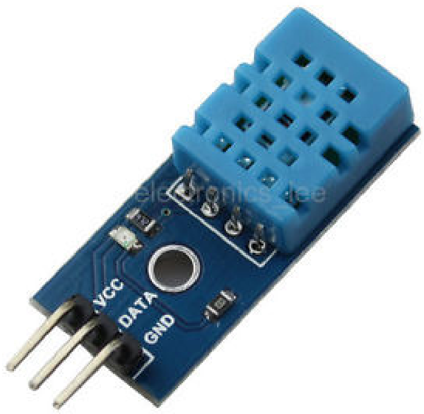

Fig.2 Temperature and Humidity sensor DHT11

C. Rain drop sensor

A rain sensor or rain switch is a switching device activated by rainfall. There are two main applications for rain sensors. The first is a water conservation device connected to an automatic irrigation system that causes the system to shut down in the event of rainfall. The second is a device used to protect the interior of an automobile from rain and to support the automatic mode of windscreen wipers. An additional application in professional satellite communications antennas is to trigger a rain blower on the aperture of the antenna feed, to remove water droplets from the mylar cover that keeps pressurized and dry air inside the wave-guides. Rain sensors for irrigation systems are available in both wireless and hard-wired versions, most employing hygroscopic disks that swell in the presence of rain and shrink back down again as they dry out. An electrical switch is in turn depressed or released by the hygroscopic disk stack, and the rate of drying is typically adjusted by controlling the ventilation reaching the stack. However, some electrical type sensors are also marketed that use tipping bucket or conductance type probes to measure rainfall. Wireless and wired versions both use similar mechanisms to temporarily suspend watering by the irrigation controller. Specifically they are connected to the irrigation controller's sensor terminals, or are installed in series with the solenoid valve common circuit such that they prevent the opening of any valves when rain has been sensed.

Operating voltage: 3.3 to 5v DC
Operating current: <20mA

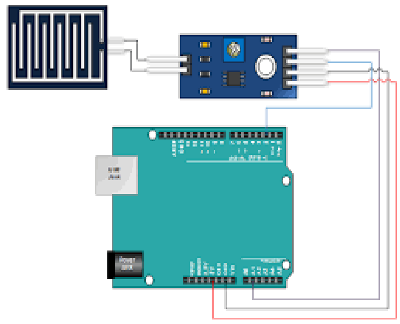

Fig.3 Raindrop sensor

D. Ultrasonic sensor

Ultrasonictransducers are transducers that convert ultrasound waves to electrical signals or vice versa. Those that both transmit and receive may also be calledultrasound transceivers; many ultrasound sensors besides being sensors are indeed transceivers because they can both sense and transmit. These devices work on a principle similar to that of transducers used in radar and sonar systems, which evaluate attributes of a target by interpreting the echoes from radio or sound waves, respectively. Active ultrasonic sensors generate high-frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions, convert it to an electrical signal, and report it to a computer.The purpose of ultrasonic sensor in this project is to monitor he plant growth regularly. This is done by measuring the distance between the plant and the sensor.

Humidity resistance: 60º C, 90-95% RH
High temperature storage: 100º C
Low temperature storage: -40º C
Operating frequency: 40kHz

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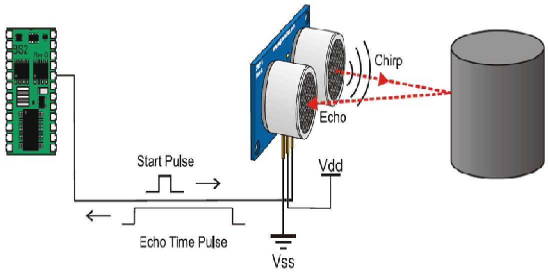


Fig.4 Ultrasonic Sensor

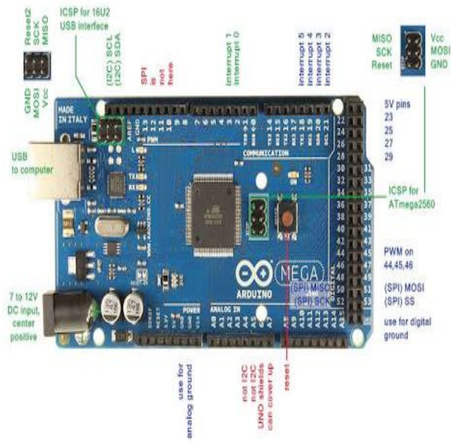


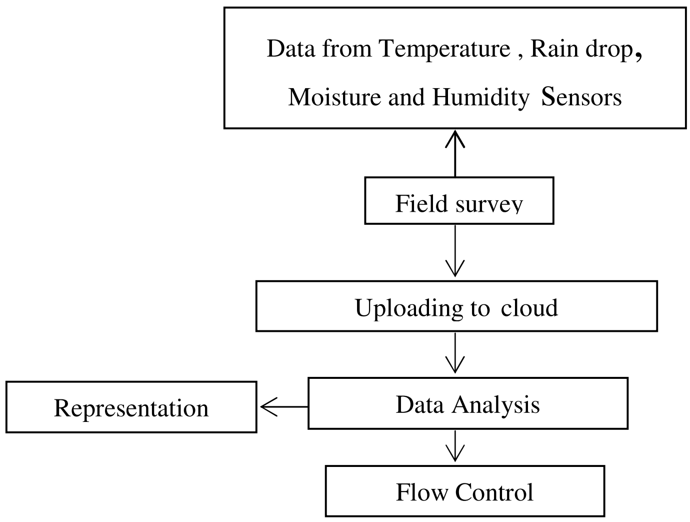
Fig.5 Arduino ATmega2560

E. Arduino mega 2560

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.The Mega 2560 is an update to the Arduino Mega, which it replaces.

Microcontroller	:ATmega2560
Operating Voltage	:5V
Input Voltage (recommended)	:7-12V
Input Voltage (limits)	:6-20V
Digital I/O Pins	:54 (of which 14 provide PWM output)
Analog Input Pins	:16
DC Current per I/O Pin	:40 mA
DC Current for 3.3V Pin	:50 mA
Flash Memory	:256 KB of which 8 KB used by boot loader
SRAM	:8 KB
EEPROM	:4 KB
Clock Speed	:16 MHz
It belongs to Common microcontroller families:	
Intel	: 4004, 8008, etc.
Atmel	: AT and AVR
Microchip	: PIC
ARM	: (multiple manufacturers)

III. BLOCK DIAGRAM DESCRIPTION



IV. DESCRIPTION

A. Problem Faced In Agriculture

At present, we will not be able to count the number of problems faced by the farmers as it has been increasing day by day. Among them, water scarcity is one of the major problem faced by farmers all over the world. The main cause for water scarcity is the increase in population which has increased the demand for water. Also many industries have evolved which consumes enormous amount of water. These factors have reduced the water availability for agriculture. This has made us to adopt "Watershed

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Management" to conserve water for agriculture as much as possible.

B. Water Requirements for crop

This is based on both the temperature range of your climate and the amount of precipitation. Take a close look at the area in which you are going to plant your garden. If the ground tends to be very moist, choose plants that can tolerate constantly wet soil, and even standing water. If you live in an area that suffers from frequent droughts, however, select plants that can tolerate going long periods without water, especially in light of the frequent watering restrictions imposed on such areas. If you are lucky enough to live in an area that has a balanced climate, you have a wider range of choices for your plants.

Water management in agriculture is very much important in-order to face the water scarcity. In this project we have adopted some latest technologies to conserve the water. Each plant requires its own soil moisture level for perfect growth. The volume of water required by different plants is measured and available online. So, our objective is to monitor the moisture content of water continuously and supply water when the water is required. In-order to achieve this, we have to keep track of various parameters like soil moisture (water content) , atmospheric temperature, rainfall and plant growth.

Crop	Water Requirement (mm)
Rice	900-2500
Wheat	450-650
Sorghum	450-650
Maize	500-800
Sugarcane	1500-2500
Groundnut	500-700
Cotton	700-1300
Soybean	450-700
Tobacco	400-600
Tomato	600-800
Potato	500-700
Onion	350-550
Chillies	500
Sunflower	350-500
Castor	500
Bean	300-500
Cabbage	380-500
Pea	350-500
Banana	1200-2200
Citrus	900-1200

Table 1. Water requirement of various crops

V. WORKING

A. Figures and Tables

In order to measure these parameters we need some devices. Hence we use various sensors like the soil moisture sensor, temperature and humidity sensor, ultrasonic sensor & raindrop sensor. The data will be obtained as voltage values .These values will be interpreted using Arduino by connecting the sensors to it. Here, analysis of data is made and compared with the default moisture level of soil.

If the moisture level falls below the required value, then the solenoid coil in the flow control valve will get energized and will increase the flow of water by opening the valve. When the required amount of water is supplied the sensor value will become equal to the desired value. At this stage, the solenoid will be reenergized and the valve will close thus stopping the water flow for the crops.

The moisture requirement changes depending upon the growth of plant, atmospheric temperature and rainfall. So, these parameters are also measured and a feedback signal is sent. This project thus, not only conserves water but also automatically waters the crops without a need for human knowledge. Thus we have implemented automation in water management thus fulfilling the objectives of the project.

The readings are taken periodically from the sensors and they are stored in a cloud so that the farmer can access them for future reference. Also, the datas are plotted in the form of graph so it makes it easy for the farmers to understand the values easily.

Fig.6.1 Sensor mounting(1)

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Fig.6.2 Sensor mounting(2)

VI. Software Description

A. Arduino IDE

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio. The Arduinoprovides the Arduinointegrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consist of two functions that are compiled and linked with a program stub main() into an executable cyclic executive program:

setup(): a function that runs once at the start of a program and that can initialize settings.

loop(): a function called repeatedly until the board powers off.

After compiling and linking with the GNU toolchain, the Arduino IDE employs the program to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware.

B. Program

```
constinttrigPin = 2;
constintechoPin = 4;
void setup()
{

Serial.begin(9600);
}

void loop()
{
 // put your main code here, to run repeatedly:
intsoil_moisture=analogRead(A0); // read from analog pin A3

Serial.print("analog value:");
Serial.print(soil_moisture);
if(soil_moisture>198)
{

 Serial.println("dry soil");
 }

if((soil_moisture>185)&&(soil_moisture<196))
{

 Serial.println("Humid soil");
}

if(soil_moisture<185)
{

 Serial.println("in water");
}

long duration, inches, cm ;
pinMode(trigPin, OUTPUT);
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
pinMode(echoPin, INPUT);
duration = pulseIn(echoPin, HIGH);
inches = microsecondsToInches(duration);
cm = microsecondsToCentimeters(duration);
Serial.print(inches);
Serial.print("in, ");
Serial.print(cm);
Serial.print("cm");
Serial.println();
```

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```
delay(100);
}

longmicrosecondsToInches(long microseconds)
{

return microseconds / 74 / 2;
}

longmicrosecondsToCentimeters(long microseconds)
{
return microseconds / 29 / 2;
intsensorValue = analogRead(A5);
Serial.println(sensorValue);
delay(100);
}
```

C. Sample Output

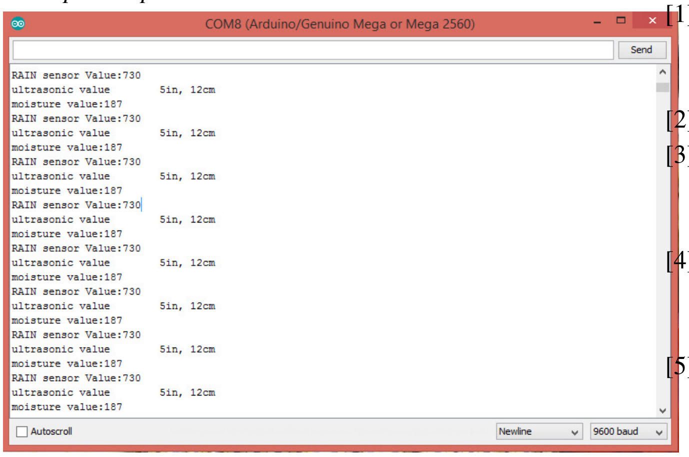

Fig.7 Sample Output

Duration	Session	Moisture sensor (mm)	Ultrasonic sensor (cm)	Raindrop sensor
Week-1	Morning	195	10	730
	Evening	210	10	730
Week-2	Morning	190	10	730
	Evening	210	10	730
Week-3	Morning	186	10	730
	Evening	194	10	730
Week-4	Morning	199	9	730
	Evening	208	9	730
Week-5	Morning	182	9	730
	Evening	200	9	730

Table. 8 Data analysis

VII. CONCLUSION AND FUTURE PLAN

With the above work we have concluded with the following findings,

Since the water consumptions varies with the crop and the environment, by automating the irrigation process it is possible to avoid the excess usage and wastage of water This project is proposed to support aggressive water management for the agricultural land. Microcontroller in the system promises about increase in systems life by reducing the power consumption resulting in lower power consumption. Automated irrigation system has a huge demand and future scope too. It is time saving, led to removal of human error in adjusting available soil moisture levels and to maximize their net profits in accordance to factors like sales, quality and growth of their product.

In future we are planning to store the analysed data in cloud for reference and also we can add some smart features if needed according to the future necessity.

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