SMART IRRIGATION SYSTEM

A PROJECT REPORT BY

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ABSTRACT

India is the country of agriculture. Without agriculture we cannot have our food. For growing crops, irrigating field is one important factor. Irrigation is a scientific process of artificially supplying water to soil that is being cultivated. Productivity of agriculture does not depend on excess water supply but the actual required supply of water. To determine the water demand by a crop, we need to find the soil humidity. The soil humidity is directly proportional to the water required by the crop. As, mobile phone became an integral part of human life, it is very easy to handle the supply of water to the crop. In this project, we just show how to build the system of controlling water and coding the function of the system.

Keywords: Irrigation, Humidity, Productivity

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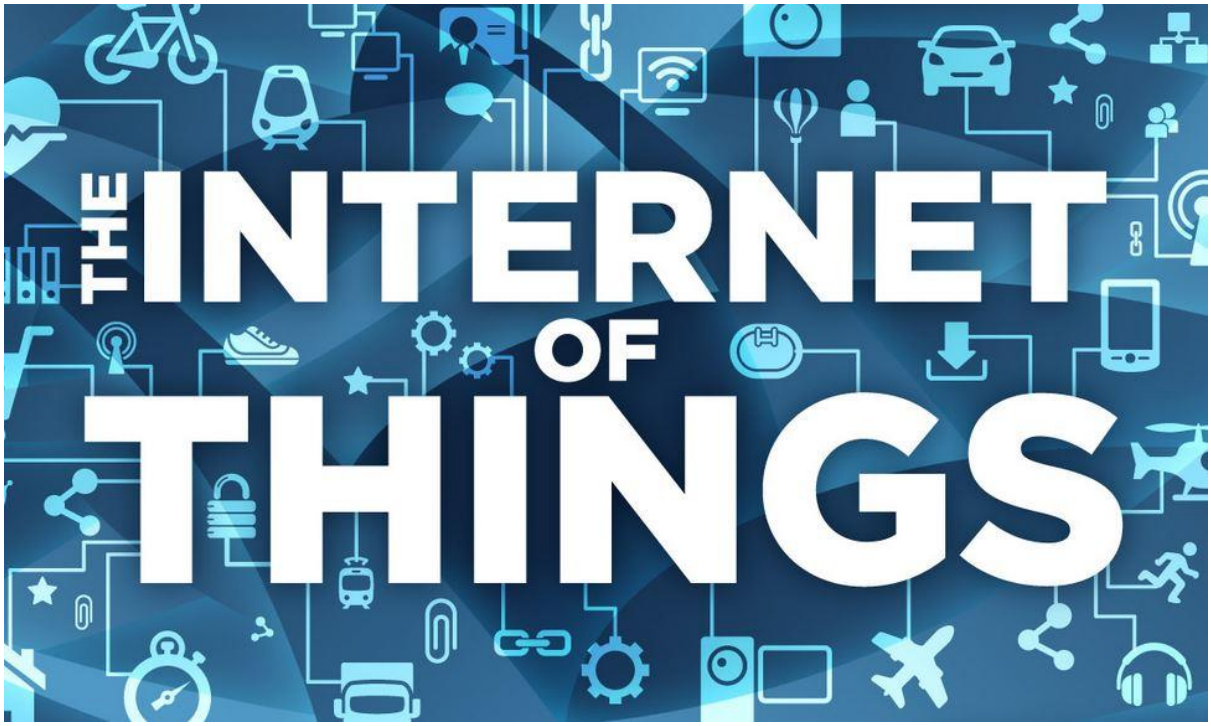
INTRODUCTION

The Internet of Things, most commonly known as IoT is a network of physical objects that are implanted with sensors, software, and other technologies to connect and exchange data with other devices and systems over the Internet. The Internet of Things (IoT) is a network of interconnected computing devices, mechanical and digital machinery, items, animals, and people with unique identities and the capacity to send data over a network without the need for human-to-human or human-to-computer contact. The confluence of numerous technologies, such as real-time analytics, machine learning, ubiquitous computing, commodity sensors, and embedded systems, has resulted in the evolution of things. The Internet of Things is enabled by traditional areas such as embedded systems, wireless sensor networks, control systems, automation. Internet of Things (IoT) is sometimes referred to as the Internet of Everything (IoE).



IoT is not a separate entity from the Internet, but rather an extension of it - a method of intelligently merging the physical and virtual worlds. IoT has emerged as one of the most important technologies of the twenty-first century in recent years. Now that we can link common objects to the internet via embedded devices, including kitchen appliances, automobiles, thermostats, and baby monitors, seamless communication between people, processes, and things is feasible.

While the concept of the Internet of Things has been around for a long time, recent breakthroughs in a variety of technologies have made it a reality. So, using this technology, we are going to build Smart Irrigation System virtually.

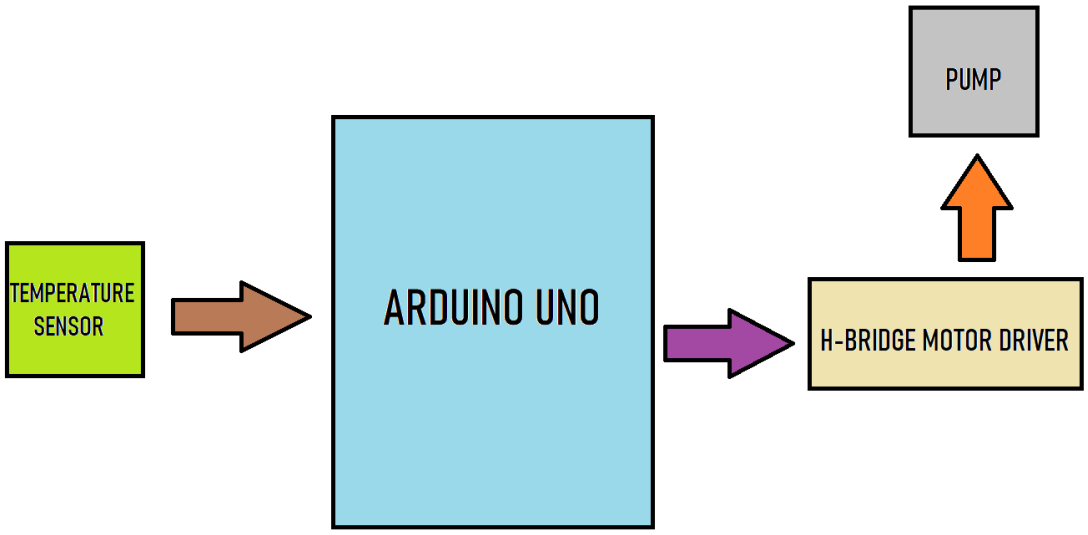
An Embedded System is a microprocessor-based computer hardware system with software that is designed to execute a specific task, either as a stand-alone unit or as part of a larger system. A real-time computing integrated circuit is at the heart of the system. It is a combination of a computer processor, computer memory, and input/output peripheral devices. Few examples of embedded systems are MP3 Players, Mobile Phones, Digital Cameras, DVD Players, GPS, and many more. Embedded Systems are sorted into 4 types based on their performance. They are Stand-alone Embedded Systems, Real-time Embedded Systems, Networked Embedded Systems, and Mobile Embedded Systems.

IoT devices are embedded within other devices to provide enhanced functionality without exposing the user to the complexities of a computer. Embedded Systems are part of IoT by taking two key components in terms of IoT devices and IoT gateway. Embedded Systems play an important role in the Internet of Things due to their unique characteristics and features. Embedded Systems are just a part of IoT. IoT itself includes many branches inside it.

DESCRIPTION AND BLOCK DIAGRAM

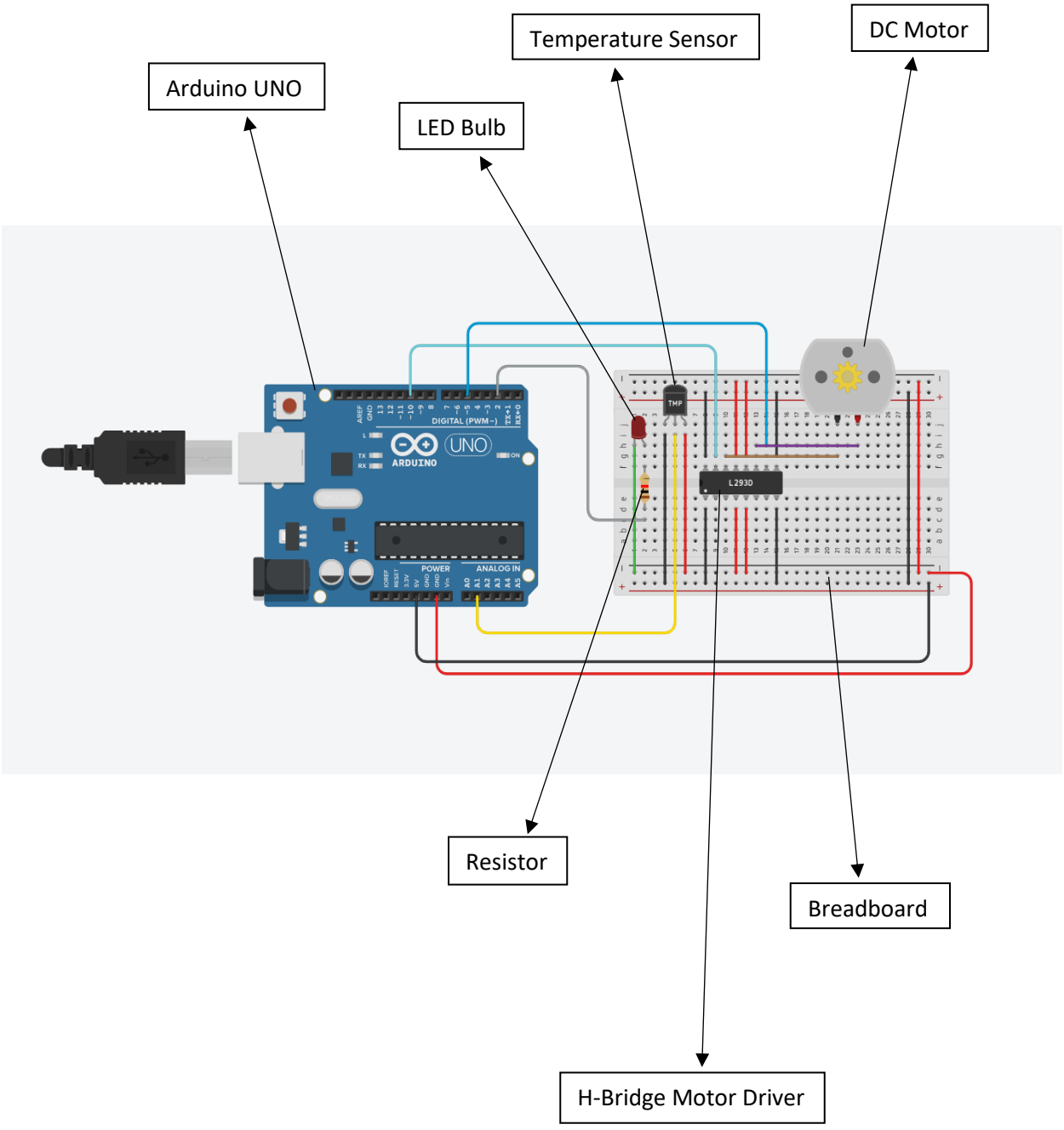
This idea of a smart irrigation system will help us to release water automatically based on the fertility of the soil. This method will help us to save water unlike overwatering in the traditional method. This can also be named a Smart Watering System as this will water plants or fields automatically based on the temperature of the soil.

The below image is the block diagram of our project. This block diagram simplifies the main theme of the project.



Here, we are going to connect our temperature sensor to Arduino Uno. While the H-Bridge Motor Driver which was connected to DC Motor(pump) is also connected to Arduino Uno. This can be technically explained as, when the soil temperature increases, Arduino will be sending the H-Bridge Motor Driver a message to turn on the DC Motor, so that water will be released from the pump and plants/fields will be moisturized. When the soil temperature is low, the DC Motor will be in an off state i.e., the pump will be in the off state.

CIRCUIT


Temperature Sensor
DC Motor
Arduino UNO
LED Bulb
Resistor
Breadboard
H-Bridge Motor Driver

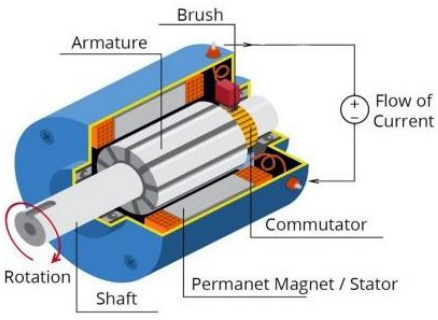
COMPONENTS REQUIRED

We are going to use regularly available components to work on this project. As mentioned previously, we are making this project virtually using Tinkercad Software. We will be using a DC Motor, H-Bridge Motor Driver (L293D IC), Arduino UNO, LED, Resistor, Temperature Sensor (TMP36), Breadboard, and Wires for connections. We will be learning about every component in this report.

- **Tinkercad Software:** It is free online software that helps us to make and create circuits and simulate them virtually without any components/hardware. It is simple and easy to use. It also helps us to code using the C++ programming language.

- **DC Motor:** A DC motor is any of the steady-state models of electrical motors that convert mechanical energy from electrical energy. In this, the input electrical energy is the direct current which is transformed into mechanical rotation. So, we can say that any electric motor that is operated using direct current (DC) is called a DC Motor.

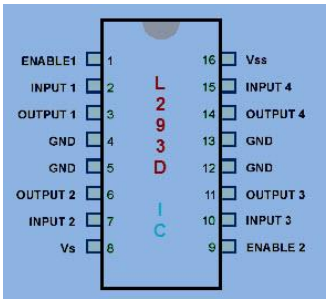
  A current-carrying conductor accumulates torque and has a propensity to move when kept in a magnetic field. In other words, when electric and magnetic fields collide, a mechanical force is created. This is the basis on which DC motors operate. Shunt DC motors are used in Centrifugal & Reciprocating Pumps, Lathe Machines, Drilling Machines, etc. While Series DC motors are used in elevators, cranes, conveyors, etc. Cumulative Compound DC motors are used in shears, heavy planers, etc. DC motors provide a wide range of speed control options when precision control is required. As a result, DC motors are used in industrial machinery that demands great accuracy.



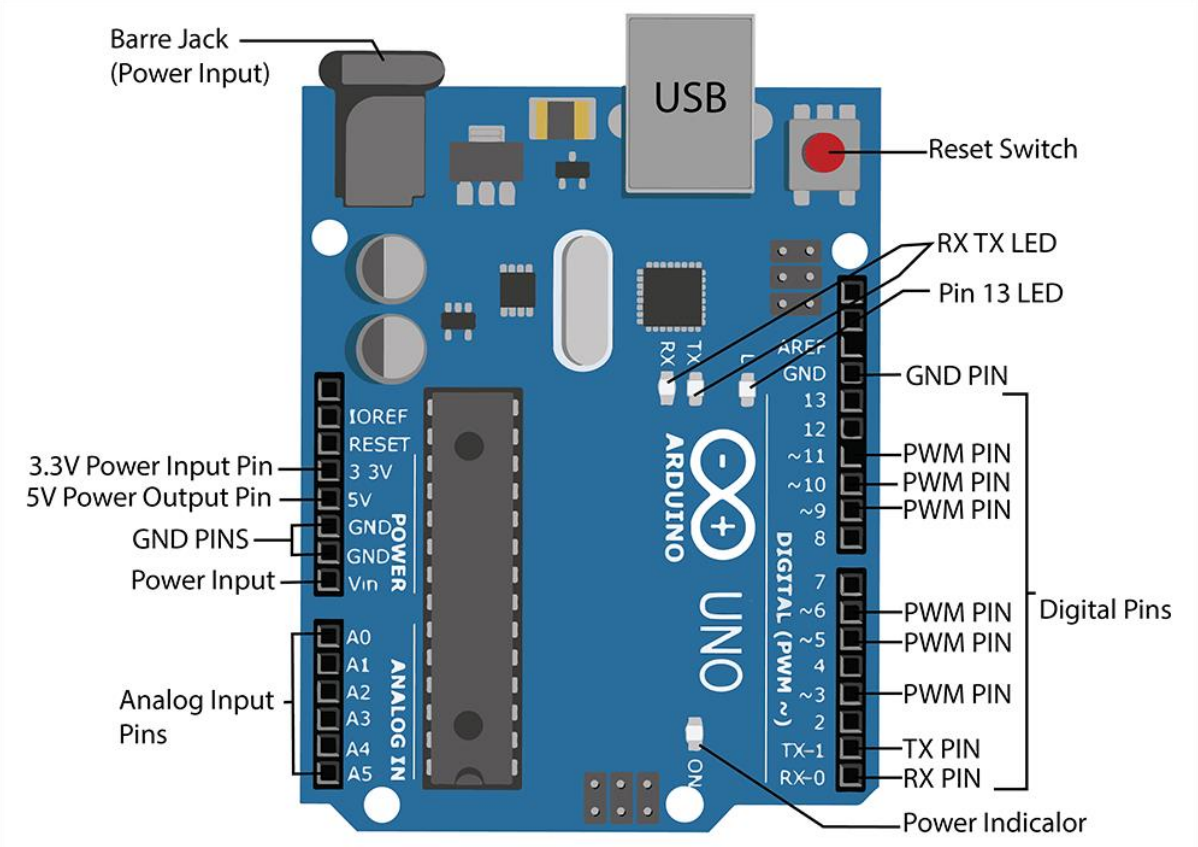
- **H-Bridge Motor Driver:** An H-Bridge is an electronic circuit that allows a voltage to be applied across a load in any direction. The L293D is a popular 16-Pin Motor Driver IC. It is capable of running two DC Motors at the same time and their directions can be controlled independently.

L293D Pin Configuration

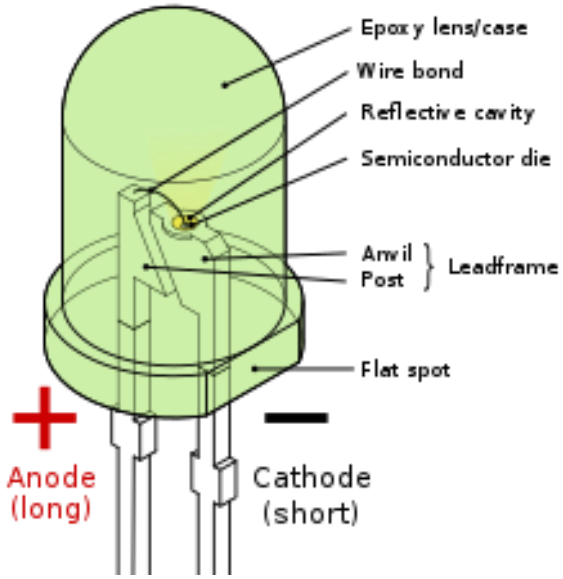
Pin Number	Pin Name	Description
1	Enable 1,2	This pin enables the input pin Input 1(2) and Input 2(7)
2	Input 1	Directly controls the Output 1 pin. Controlled by digital circuits
3	Output 1	Connected to one end of Motor 1
4	Ground	Ground pins are connected to ground of circuit (0V)
5	Ground	Ground pins are connected to ground of circuit (0V)
6	Output 2	Connected to another end of Motor 1
7	Input 2	Directly controls the Output 2 pin. Controlled by digital circuits
8	Vcc2 (Vs)	Connected to Voltage pin for running motors (4.5V to 36V)
9	Enable 3,4	This pin enables the input pin Input 3(10) and Input 4(15)
10	Input 3	Directly controls the Output 3 pin. Controlled by digital circuits
11	Output 3	Connected to one end of Motor 2
12	Ground	Ground pins are connected to ground of circuit (0V)
13	Ground	Ground pins are connected to ground of circuit (0V)
14	Output 4	Connected to another end of Motor 2
15	Input 4	Directly controls the Output 4 pin. Controlled by digital circuits
16	Vcc2 (Vss)	Connected to +5V to enable IC function



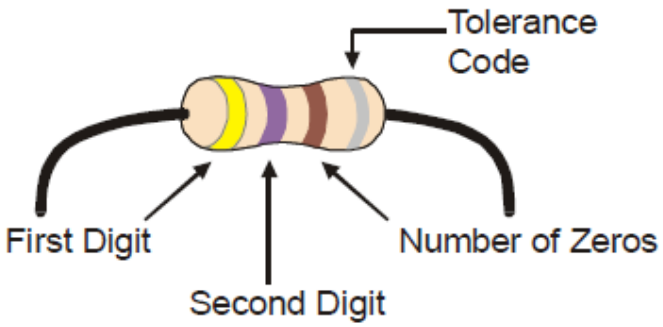
- **Arduino UNO:** Arduino is an open-source electronics platform that uses simple hardware and software to make it easy to use. It is a microcontroller board based on the ATmega328P. It has 14 digital pins. It can be simply connected with a USB cable to the computer or power with AC to DC adapter or a battery to get it started. The word 'UNO' means 'one' in Italic. Arduino UNO is programmed using the Arduino Software (IDE).

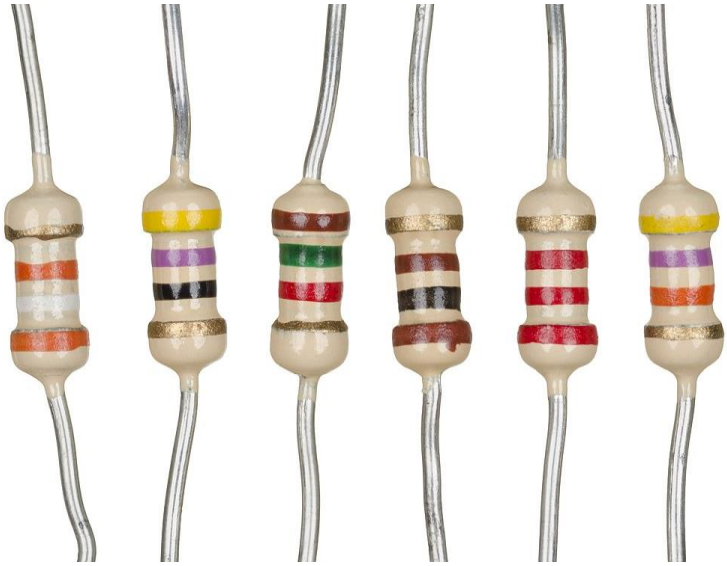


- **LED:** Light Emitting Diode commonly known as LED is a semiconductor that emits light source when current flows through it. LED were popular for their efficiency, color ranges, long durability. LEDs are defined as solid-state devices since the light is generated within the solid semiconductor material. The photon energy determines the wavelength of emitted light and as well as the color. Different semiconductors with different bandgaps produce different colors of light.

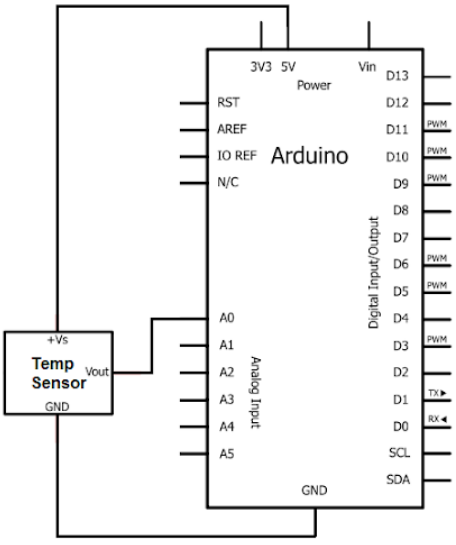


- **Resistor:** A resistor is a passive electrical component with the primary function to limit the flow of electric current. They have a specific and never-changing electrical resistance. They are used to limit current, divide voltages, pull up input/output lines. The SI unit of a resistor is Ohm. Each resistor has one connection and two terminals. Resistors are passive components which is they only consume power and cannot generate it. Modern resistors are made out of either carbon, metal, or metal-oxide film.

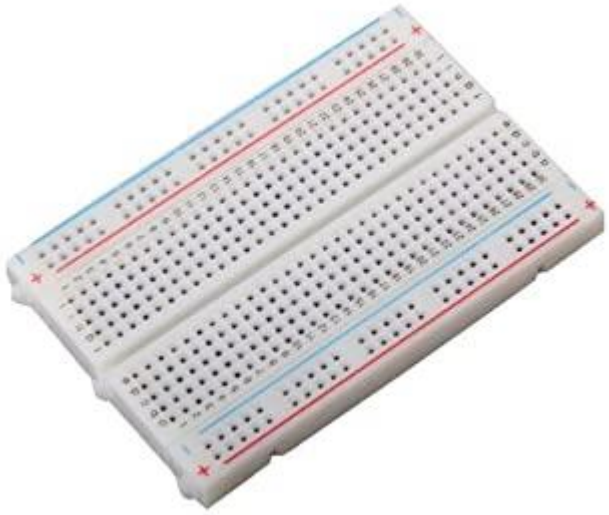




- **Temperature Sensor:** It is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record or monitor the temperature changes. In this project, we are going to use a TMP36 temperature sensor as it is a low voltage and precision centigrade temperature sensor. It provides a voltage output that is linearly proportional to the Celsius temperature. It doesn't need any external calibration. This device can handle temperature that ranges between -40°C to 150°C.



- **Breadboard:** It is a rectangular plastic board with a bunch of tiny holes in it. These holes will help us to insert electronic components into a prototype. This is used to build and test the early version of any kind of project. As we are making a prototype of the smart irrigation system, we are going to use a breadboard to connect components. There were breadboards available in Tinkercad. Here, I used Small Breadboard for my connections. You can choose any size of the breadboard for connections.



WORKING OF THE PROJECT

This project is all about not wasting water. There is a lot of wastage of water while doing agriculture. But we couldn't stop doing agriculture for saving water. Thus, we improvised technology to control the wastage of water. This project is all about controlling the wastage of water and releasing the water that needs to be used automatically.

This project doesn't intend agricultural lands but also plants that we usually grow at our houses.

This project will help us to release water based on the temperature of the soil. If the climate is sunny, equivalently the soil also will be hot. When the temperature of the soil crosses our set temperature, then the DC motor will be turned on resulting in water release. When the soil gets irrigated, then the temperature of the soil gets cool and the DC motor will stop when the coolness of soil decreases from our set temperature. This will help us to irrigate soil without human intervention and that too by controlling the wastage of water.

In my designed circuit, I used the H-Bridge Motor Driver which will be taking the information from the temperature sensor through Arduino and will be controlling the switching on/off of the DC Motor. I also included a resistor and a LED for the beautification of the project. This isn't much necessary. I included it so that the light of the LED will indicate that the DC Motor is on and the water pump is releasing water. And, when the temperature is low and the DC Motor is in an off state, then the LED will also be in an off state. So, this is how the project work and my design goes.

SOURCE CODE

The following code is the source code of the project which helps us to run the project as expected without any issues. I wrote the source code using the C++ programming language. The writing part of the code is also been done in Tinkercad itself.

```
// C++ code
//
int Temperature = 0;

void setup()
{
  pinMode(A1, INPUT);
  Serial.begin(9600);

  pinMode(10, OUTPUT);
  pinMode(5, OUTPUT);
  pinMode(2, OUTPUT);
}
```

```
void loop()
{
  Temperature = -40 + 0.488155 * (analogRead(A1) - 20);
  Serial.println(Temperature);
  if (Temperature < 30) {
    digitalWrite(10, HIGH);
    digitalWrite(5, HIGH);
    digitalWrite(2, LOW);
  }
  if (Temperature > 45) {
    digitalWrite(10, LOW);
    digitalWrite(5, HIGH);
    digitalWrite(2, HIGH);
  }

  Temperature;
  delay(10); // Delay a little bit to improve simulation performance
}
```

HIGHLIGHTS AND CHALLENGES

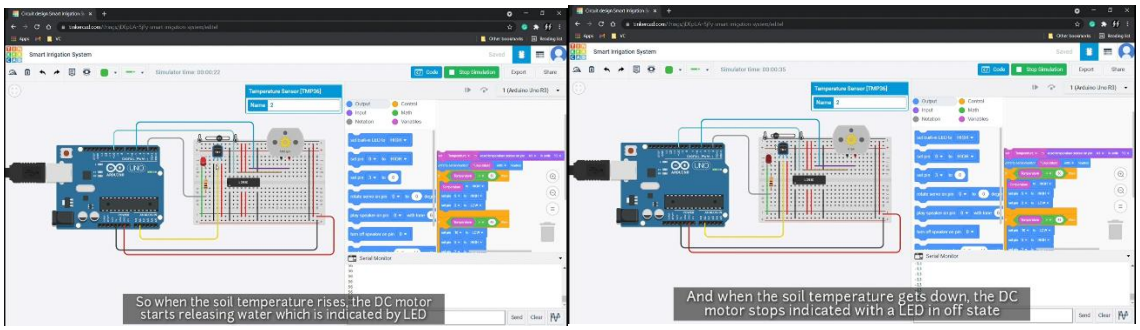
- **Highlights**: The advantages of this Smart Irrigation System are wide. It helps to reduce the wastage of water. It receives the local weather data by soil temperature and determines when should the land be moisturized. It does things without human intervention. So, even when you are traveling or engaged in other work, the land will be irrigated on its own by the soil temperature. It reduces water bills.

- **Challenges**: The primary challenge of this smart irrigation system is that it costs depending on the size of the property. The land must dig to install pipe which takes time of days or a week without the use of the yard. Heavy winds might change the direction of water sprinklers. Underground pests may damage water-delivery systems. The repairs may cost more.

Even there are challenges, the highlights of this system are more effective.

CONCLUSION

The Smart Irrigation System is framed in such a way that it is affordable for optimizing water resources. This system allows cultivation in places with a shortage of water. This makes an increase in productivity and reduces heavy water consumption. The proposed system is implemented in a way that the water tap will be on/off based on the soil humidity. Through this project, we can conclude that the technology will also help to develop and improve traditional practices. There can be considerable development in cultivation with those of IoT and Automation. This system is a solution for the problems faced while irrigating. This project not only imply agriculture, but also lawn, home-grown plants, etc. This system is framed in a way that there is no need for human intervention for a dedicated time. This system helps to be smarter in irrigation.



You can find the simulation through the below link. Kindly check it.

Video Link: https://bit.ly/apssdc-project_Sujith

REFERENCES

This project report on Smart Irrigation System is completely based on the work done, papers, and references. The practical and theatrical knowledge of this report is based on knowledge gained through the classes conducted by APSSDC. The following were also referred to make a successful and appropriate report.

- Arif Gori, Manglesh Singh, Ojas Thanawala, Anupam Vishwakarma, Prof. Ashfaque Shaikh "Smart Irrigation System using IOT".
- Gauri Tope, A. S. Patel "Smart Irrigation System".

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