# Designing IOT Solutions
# A Project Report
# on
# Smart Irrigation System Using IOT


**A Project Work Submitted in Partial**

**Fulfilment of the requirements for**

**DEGREE In**

**ELECTRONICS AND COMMUNICATION ENGINEERING**

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# INTRODUCTION

## AGRICULTURE

The economy of many countries depends on agriculture. To achieve the best quality from this research, it is important to focus on some vital characteristics such as the appropriate amount of electricity as well as water supply and a suitable schedule for irrigation of crops. Farmers are facing problems in meeting these standards, especially those living in poverty.

The main objective of this project is to provide an automatic Smart Irrigation System to minimize the number of workers in a crop field, control and save water and electricity, increase agricultural production using small quantities of water, minimize manual intervention in watering operations with increasing watering speed and preserving plants from fungi.

## OBJECTIVE OF THIS PROJECT

- Simplify the irrigation system by installing and designing the whole irrigation system.
- Save energy
- Optimize water consumption
- Automated system fully
- Decrease the cost of operation
- Make system easy to use by farmers

## CONCEPTS AND DEFINITION

Agriculture is the backbone of all developed countries. It is the major source of income for the largest population in India and is major contributor to Indian economy. Agriculture is the backbone of Indian Economy. The agriculture sector is biggest sector of India as it provides employment to 50% work force of India.

In today's world, as we see rapid growth in global population, agriculture becomes more important to meet the needs of the human race. However, as agriculture requires irrigation and with every year we have more water consumption than rainfall, it becomes critical for growers to find ways to conserve water while still achieving the highest yield.

But in the present era, the farmers are still using irrigation technique through the manual control called the conventional techniques, in which they irrigate the land at the regular interval. Conventional farming methods are susceptible to unpredictable weather and over irrigation or under irrigation due to miscalculations or human error. These problems lead to waste of resources and can lead to huge losses for farmers and possible increased prices of farm goods at consumer's end.

Therefore, efficient water management is the major concern in many cropping systems and an automated irrigation system is needed to optimize water use for agricultural crops. An automated irrigation system determines the necessity to irrigate large farm lands based on the collected environment information and also keeps track of the soil moisture level and help farmers make better decisions by providing them with data which was not available before. Hereby they provide the right amount of water and reduce wastage of water and electricity. Farmer can access the server about the field condition anytime, anywhere thereby reducing the man power and time.

## INTERNET OF THINGS:

The Internet of Things (IoT) is a technology where in a mobile device can be used to monitor the function of a device. It is concerned with interconnecting communicating objects with capabilities to perform remote sensing, actuating and live monitoring of certain sort of data. Internet of Things (IoT) is a type of network technology, which senses the information from different sensors and makes IOT devices to join the Internet to exchange information with other connected devices and application either directly or indirectly, or to process and send data to various servers.

## OVERVIEW OF THE PROJECT

### IOT APPLICATION IN AGRICULTURE:

IoT is changing the agriculture domain and empowering farmers to fight with the huge difficulties they face. The agriculture must overcome expanding water deficiencies, restricted availability of lands, while meeting the expanding consumption needs of a world population. New innovative IoT applications are addressing these issues and increasing the quality, quantity, sustainability and cost effectiveness of agricultural production. By using Internet technology and sensor network technology we can control water wastage and to maximize the scientific technologies in irrigation methods. Hence it can greatly improve the utilization of water and can increase water productivity.

### HARDWARE COMPONENTS

- Arduino UNO board and programming cable
- ESP 8266-01 Wi-Fi module
- Soil Moisture sensor
- Temperature and Humidity sensor
- Rain sensor
- Servomotor
- Water level sensor
- Potentiometer
- 9V Battery
- Battery connector
- Pipe
- Female to female single pin connector
- Male to female single pin connector
- Breadboard
- Red LED

## 1) ARDUINO UNO

The Microcontroller used here is an Arduino UNO. Arduino is an open-source electronics platform based on Atmega328.

It's an easy-to- use hardware and software. Arduino Uno consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It allows the designers to control and sense the external electronic devices in the real world. The software used for Arduino devices is called IDE (Integrated Development Environment). Arduino has been used in thousands of different projects and applications

## 2) ESP 8266 WI-FI MODULE

The ESP8266 Wi-Fi module with integrated TCP/IP (Transmission Control Protocol/Internet Protocol) protocol stack gives any microcontroller access to any Wi-Fi network. It's a leading platform for Internet of Things. Each ESP8266 module comes pre-programmed meaning, it can be simply hooked up to Arduino device to get Wi-Fi ability. It works in the power range of 3.0 to 3.6 volts and we will use the 3.3 Volt pin of the Arduino to power the ESP for the same reason. It's essentially a System on a chip (SoC) with capabilities for a 2.4 GHz WiFi. This module has a powerful enough on-boarding process, low cost, multiple GPIOs and high storage capacity that allows it to be integrated with the sensors and other application specific devices.

## 3) SOIL MOISTURE LEVEL SENSOR

The soil moisture sensor is used to measure the volumetric water content of soil. It has a level detection module in which we can set a reference value. We will use a soil moisture sensor module to collect data of soil moisture levels at all times. We write the code on Arduino software (IDE) and load it to an Arduino UNO board. We will program the Arduino to process the data and turn on and off the pump to supply water based on the moisture levels. It turns on the pump whenever the moisture content in the soil goes below a certain threshold.

The water pump and the servo motor are coupled with the output pins. If the sensors depart from the predefined range, the controller turns on the pump. The servo motor is used to control the angular position of the pipe, which ensures equal distribution of water to the soil.

## 4) RAIN SENSOR

The rain sensor detects the rain, the basic principle of working is checking resistance of sensor, and the sensor comprises two different conduction printed leads on whole surface. When water droplets fall on surface of sensor it completes the circuit and thus creating a resistance which is far less than open circuit resistance of sensor and the sensed data is sent to controlling unit.

## 5) DHT11 SENSOR [Temperature and Humidity Sensor]

DHT11 sensor is used for measuring temperature and humidity. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air. Humidity sensors are used for measuring moisture content in the atmosphere. The value of temperature and humidity is necessary to reduce the watering frequency. That is when the weather gets cooler, less water is needed whereas vice versa in the other case. This sensor is cost effective, provides low power consumption and it is simple to use, but requires careful timing to grab data. Then current temperature, humidity values are sent to the microcontroller, those values will display in the excel sheet and also graphically displayed on thingspeak.

## 6) SERVO ACTUATOR

Actuators are used as a mechanism to induce or control motion in mechanical systems. They are devices which transform an input signal (usually electrical) into motion. The servo motor is used to control the angular position of the pipe, which ensures equal distribution of water to the soil.

## 7) WATER LEVEL SENSOR

The Water Level Indicator employs a simple mechanism to detect and indicate the water level in an overhead tank or any other water container. It is placed in the tank to calculate water level. There's also an LED connected to this sensor. When the water level is below a certain threshold level the RED LED will turn on to indicating the tank is empty.

## SOFTWARE COMPONENTS

## ARDUINO IDE

The Arduino Integrated Development Environment is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux.

## ThingSpeak

ThingSpeak is an open source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

ThingSpeak has integrated support from numerical computing software MATLAB from Math works. Allowing ThingSpeak users to analyze and visualize uploaded data using MATLAB.

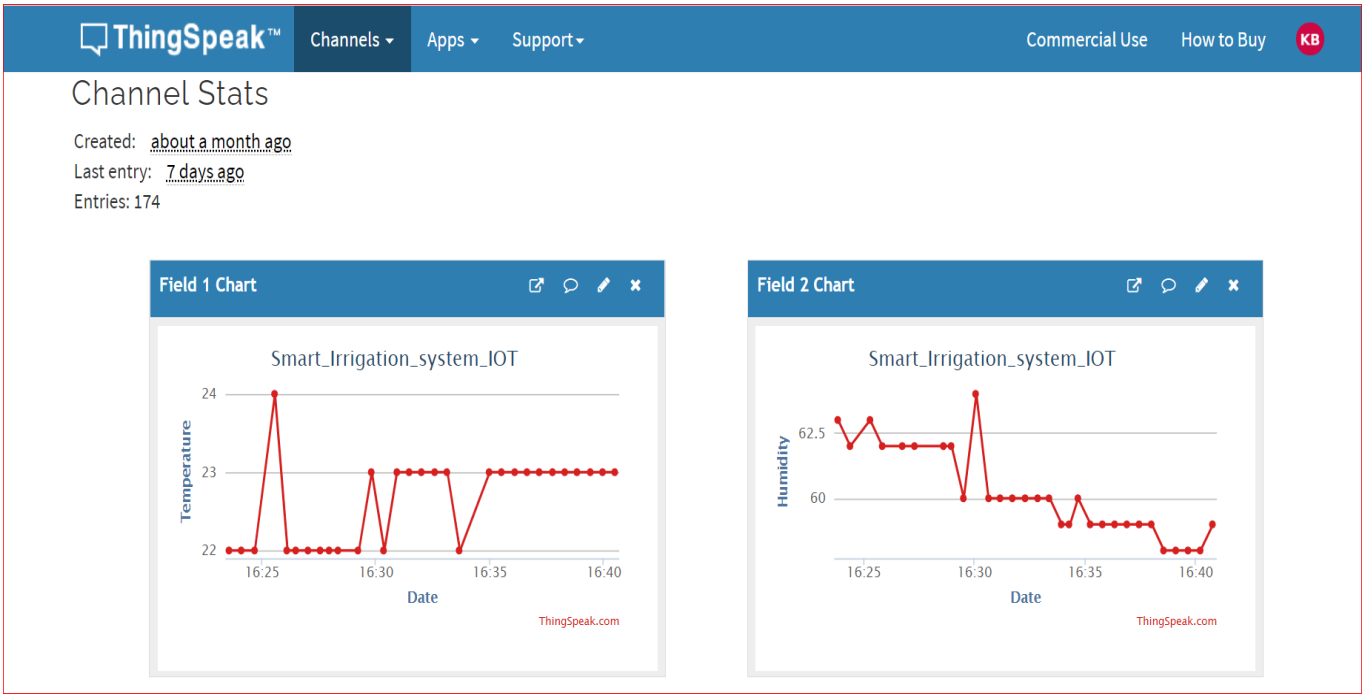
We are using DH11 temperature and Humidity sensor, rain sensor and soil moisture level sensor to monitor the environment condition. We will then load the data on ThingSpeak IOT analytics platform which is set up using ESP8266 Wi-Fi module. By using this application, we can collect and monitor our data from the sensors, Analyze and Visualize the data and trigger an action using the channels and applets provided by ThingSpeak.

i.e. 1) ThingHTTP to connect ThingSpeak and IFTTT

2) React to trigger an action whenever certain conditions are met.

We are using IFTTT platform to connect ThingSpeak for email/message service so that an alert message can be sent whenever the soil moisture level is less. All the values collected are recorded over ThingSpeak and google sheets using Webhooks so that the farmer's crop can be monitored from anywhere over internet.

## OUTPUT GRAPHS




# PROJECT WORKING

## ALGORITHM

Step 1: initialize ESP8266 and connect to WIFI, establish communication with Arduino via Software Serial.

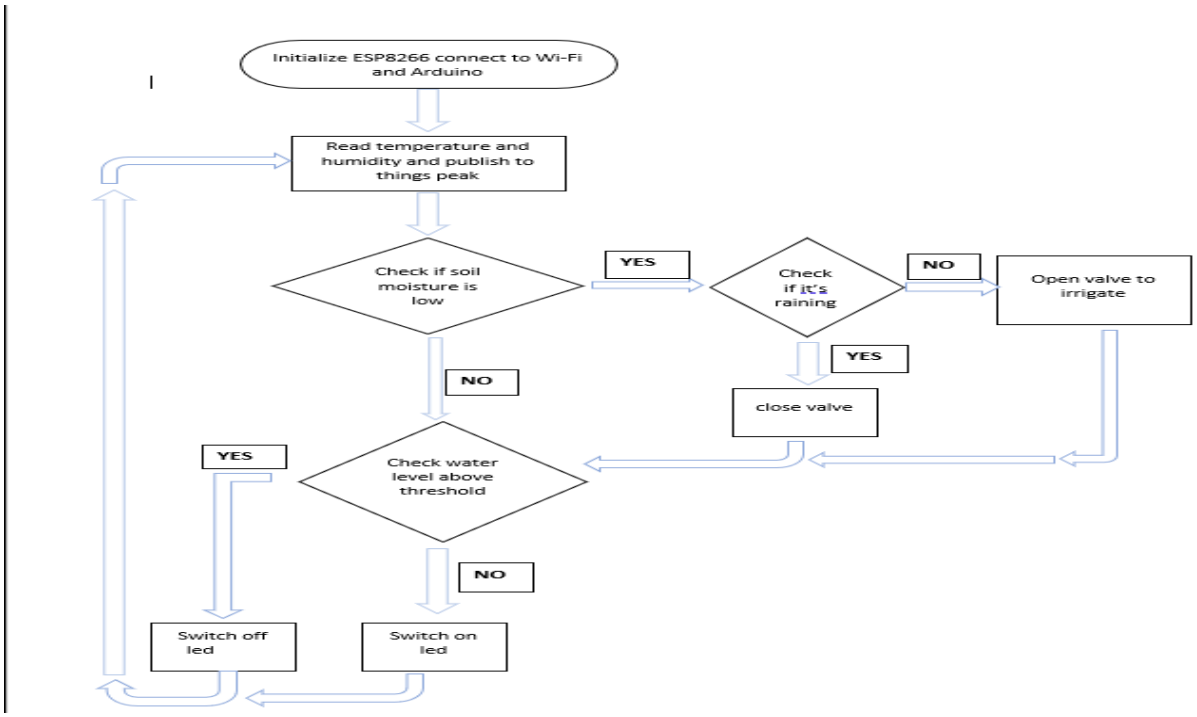
Step 2: Obtain temperature and humidity values and publish it to thingspeak

Step 3: Check if soil moisture is above threshold and irrigate the plants if it is not raining

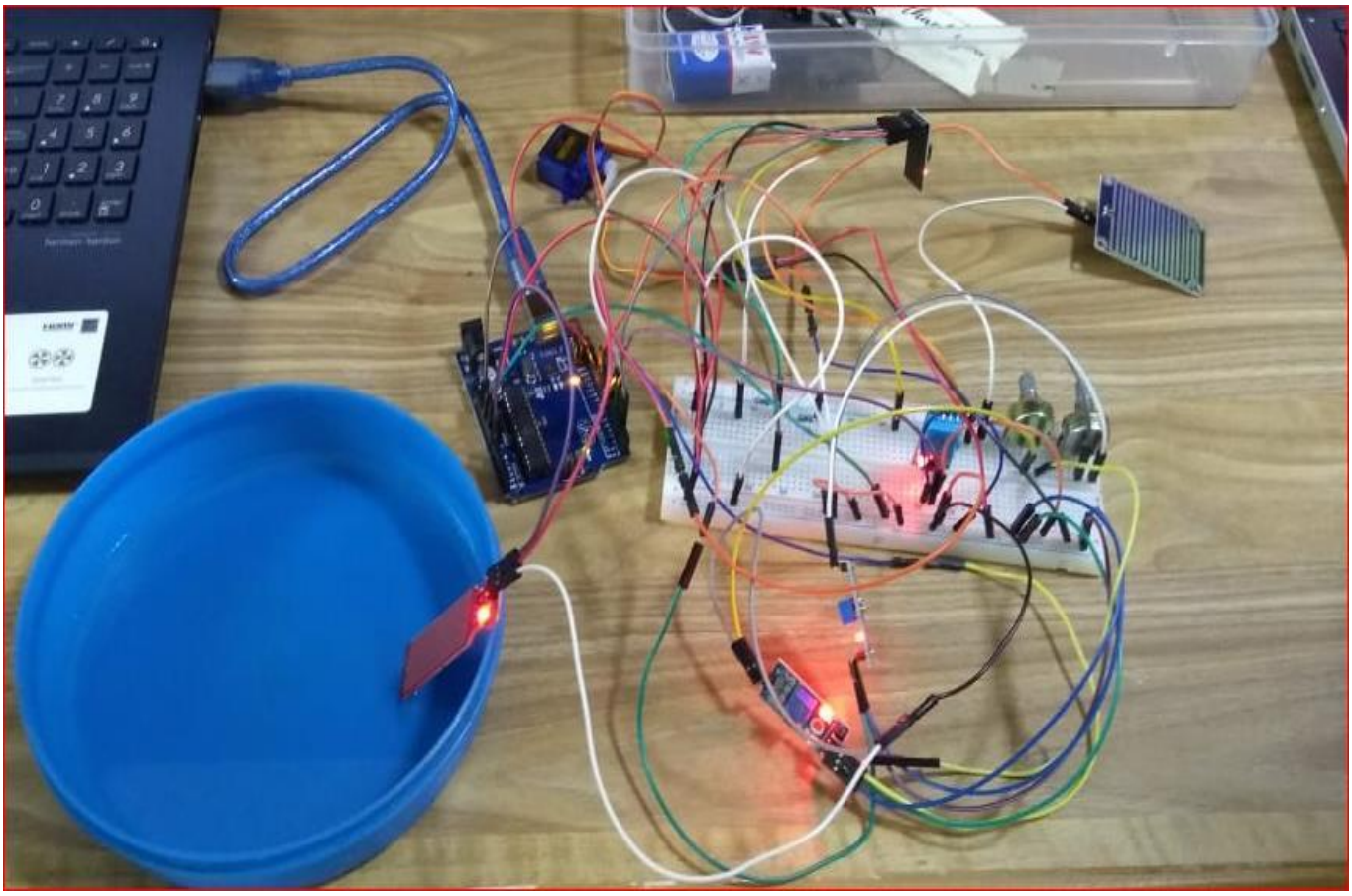
Step 4: Check water level and alert user if it is low

Step 5: Go back to step

# FLOWCHART




# PROJECT MODEL



# CONCLUSION AND FUTURE SCOPE

## DRAWBACKS

Since more than 10 devices were connected to the Arduino, wires connections were complex to connect. The batteries of this project drain quickly when in use.

Working with Arduino was quite challenging, because a single mistake can damage any electrical part.

As it works with Wi-Fi and often agricultural land is far from the city, so the network is not good in these areas.

## CONCLUSION

With more advancement in the field of IoT expected in the coming years, these systems can be more efficient, much faster and cheaper. This system helps the farmer by working automatically and smartly. With placing multiple sensors in the soil, water can be only provided to the required piece of land. This system requires less maintenance so it is easily affordable by all farmers. This system helps to reduce water consumption. With using this system, the crop production increases to a great extent.

## FUTURE SCOPE

As per future perspective, this system can be made as an intelligent system, where in the system predicts user actions, rainfall pattern, time to harvest, animal intruder in the field and communicating the information through advanced technology like IoT can be implemented so that agricultural system can be made independent of human operation and in turn, quality and huge quantity yield can be obtained. We can focus more on increasing sensors on this system to fetch more data especially with regard to Pest Control and by also integrating GPS module in this system to enhance this IoT Technology. With using Machine Learning algorithms more advancements can be done in the future which will help farmer a lot and water consumption can also be reduced in agriculture.