

# SMART IRRIGATION SYSTEM USING IoT AND NodeMCU

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## Abstract

*Agriculture is one of the vital and emerging branches of occupations in India. About 70% of rural households depend on agriculture for their livelihood. Introducing the latest innovations into this has become one of the most important focuses. The scope of the proposed project is to bring about efficient use of one of the most important and widely utilized natural resources i.e., water. With the increase of population, scarcity of water is increasing. Hence, this project presents efficient irrigation techniques at an affordable price increasing yield for the farmers and helping them manage their crops in a better way.*

*Keywords: Agriculture, Irrigation, IOT, NodeMCU, Cloud, Sensors, Increase in yield.*

## I. INTRODUCTION

Agriculture is one of the wide spread and vastly practiced occupation in India. Following a traditional and well-versed practice of agriculture has been one of the major challenges to the farmers and the scientists who have been working tirelessly towards increasing yield and bringing maximum profit to the farmers.

Irrigation techniques that exist currently have vast applications and are traditional in nature. Through this project we aim at bringing about betterment in these irrigation techniques by incorporating IoT and its concepts to keep a track of the moisture content in the soil and supply adequate water and resource supply on basis of the crop in the field. These IoT integrated smart irrigation techniques promise increase in crop yield by utilization of sensors and IoT customized boards which can be interfaced with each other to bring about a complete circuit for the purpose.

## II. EXISTING METHODOLOGIES

Nor Adni Mat Leh et cetera all <sup>[1]</sup>, proposed a system where a microcontroller called Arduino Mega 2560. This microcontroller is interfaced with sensors for carrying the smart irrigation process. An application known as Blynk is used to keep track of the moisture content and temperature of the soil. This helps in carrying out the irrigation of crops. All the statistics for each crop are considered and irrigation is carried out accordingly.

J. Karpagam et cetera all <sup>[5]</sup>, presented a paper where the main role of this project is to develop a Microcontroller system to irrigate the plant automatically and the information is been sent to the farmers. The project is developed by using the Microcontroller i.e., Arduino UNO and it plays a main role in this automated system. The sensors like soil moisture sensor, water level sensor and the temperature sensor are connected to the microcontroller. Thus, the output of these sensors is fed into the Arduino UNO. They have used Global System for Mobile Communication which is mainly used for mobile communication. With the help of GSM, the information regarding the ON and OFF state of the pump can be sent to the user. To transfer the message to the user this GSM module uses the TDMA technique. This project gives benefits on the economic side and the proposed Smart Irrigation will be the best solution.

MS. Swapnali et cetera all <sup>[6]</sup>, proposed a system where Raspberry Pi 3 module is interfaced with 3 types of sensors, Soil moisture sensor, Temperature sensor and Ultrasonic sensor. A

web cam is connected to the module via a Wi-Fi module to collect and store data for retrieval. Two relays are connected to the module which are used to connect to the external motor and the lamp to control water flow and light supply to the crops. The second relay is connected to a LDR sensor which is connected to the lamp. The Wi-Fi network is connected to the user's device for monitoring and control.

Vaishali et cetera all <sup>[2]</sup>, through their project have proposed an irrigation system using Wireless Sensor Networks (WSN). Main irrigation canals are connected to water level sensors to keep track of water level. Wireless gateways send server the data periodically. This data is read by the IMS and accordingly messages are sent to the farmer.

### III.METHODOLOGY

This project, Smart Irrigation System using WSN enables an innovative and crisp methodology. A Smart Irrigation System, contrary to traditional irrigation methods regulates water supply according to the needs of fields and crops. The mechanism of this system is a network of wireless sensors integrated with the aid of computer chips like Arduino and raspberry pi. The network of sensors includes Digital Humidity and Temperature sensor (DHT), water level sensor and soil moisture sensor. The basic idea of the project is to maintain a threshold water level in the storage tanks to avoid overflow, operation of the water pumping motors using an application via the internet and providing ample water supply by avoiding wastage on the basis of the crop culture in the field. The DHT sensor works on the external environmental temperature and humidity. The water level sensor works on the level of water in the storage tanks and the soil moisture sensor works on moisture level in the soil. As a whole, the project methodology utilizes currently emerging technologies such as Internet of Things (IoT) and Machine Learning.

#### A. System Architecture

The below shown figure 1 shows the system architecture of the proposed project. The central block represents the NodeMCU microcontroller which is a low-cost open source IoT platform. It initially contained firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added. The system architecture can be divided into 2 sections. The section on the left represents all the external devices connected to the NodeMCU block which take input from the microcontroller and function according to the commands received. This section consists of the water pump receiving on and off commands, the solenoid valve and relay which help with functioning of the water pump. The right section of the architecture consists of three types of sensors namely Soil moisture sensor, DHT (Digital Humidity and Temperature) sensor which sends Analog data to NodeMCU. The setup also consists of a standard power supply to keep it running and a cloud to mobile app connectivity for the user to monitor and control the entire system via the internet by the use of simple User Interface based Commands or Buttons.

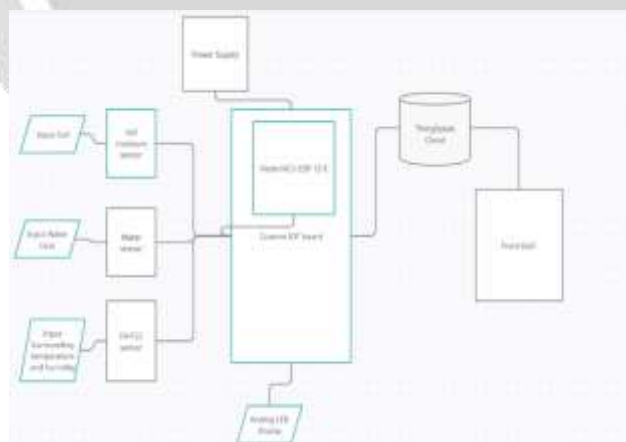


figure 1. System Architecture

#### B. Hardware Design

The designed project shows a major microcontroller "NodeMCU". NodeMCU consists of a Micro-USB port which helps power the board. A 3.3V regulated power supplied to this pin to power the board, ground pins and an External Power Supply.

It consists of 6 pin categories:

1. Control Pins - EN, RST
2. Analog Pins - A0
3. GPIO Pins - GPIO1 to GPIO16
4. SPI Pins - SD1, CMD, SD0, CLK
5. UART Pins - TXD0, RXD0, TXD2, RXD2
6. I2C Pins

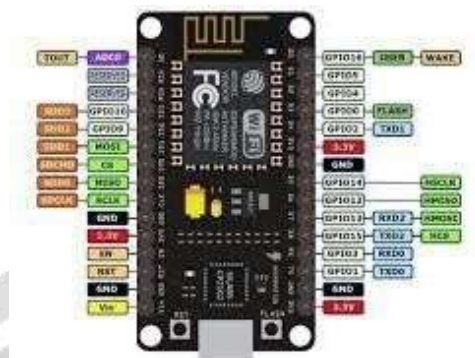


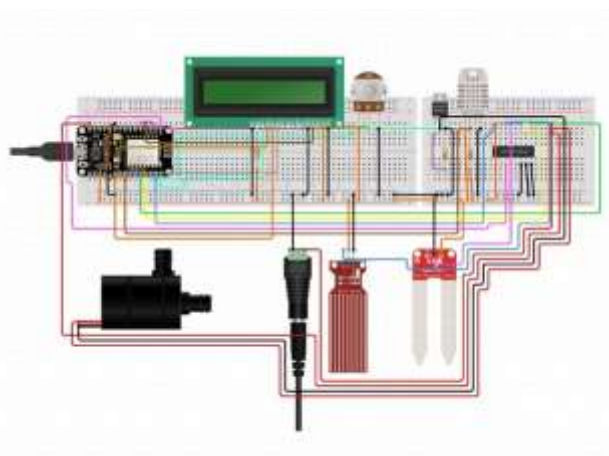
Figure 2: NodeMCU Pins Features of NodeMCU

1. Microcontroller: Ten silica 32-bit RISC CPU Extensa LX106
2. Operating Voltage: 3.3V
3. Input Voltage: 7-12V
4. Digital I/O Pins (DIO): 16
5. Analog Input Pins (ADC): 1
6. UARTs: 1
7. SPIs: 1
8. I2Cs: 1
9. Flash Memory: 4 MB
10. SRAM: 64 KB
11. Clock Speed: 80 MHz
12. USB-TTL based on CP2102 enabling Plug n Play
13. PCB Antenna

The hardware design of the project is depicted below in Figure 3. Moving from the right end of the hardware design there can be seen a miniature water pump which pumps water from after receiving the command. The command is received from the chain of sensors connected to the NodeMCU. The soil moisture sensor and the DHT sensor are connected to the Digital Pins on the NodeMCU. The analog signal received from

these sensors is automatically transmitted as digital signals through the NodeMCU and sent across to the relay. The relay in turn assists the switching ON and OFF of the water pump.

The commands mentioned above are primarily received from a Web Interface designed from scratch and connected to the hardware via the internet. As NodeMCU is a form of ESP8266 no external Wi-Fi modules are required to pair it to



the Web Interface via APIs and Wi-Fi connectivity.

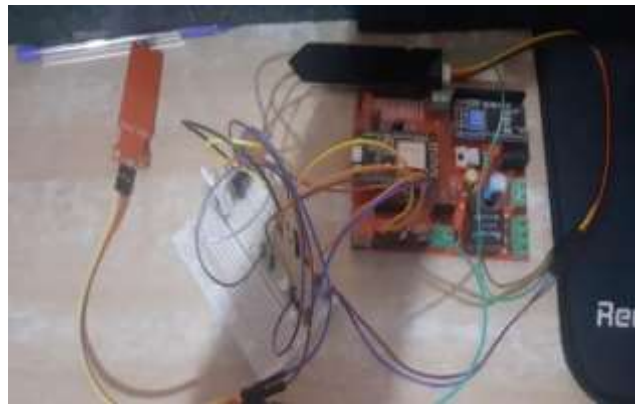


Figure 3: Hardware Design

**C. Software Design**

The software design of the project depicts a Web UI consisting of blocks to control the flow of water for irrigation from the Water storage to the fields. Initially the data from the microcontroller is sent as digital signals to the IoT cloud - ThingSpeak. It is an open-source Internet of Things (IoT) application and API to store and retrieve data from IoT devices using the HTTP and MQTT protocol over the Internet or via a Local Area Network. The Web User Interface is designed using the basic knowledge and idea of HTML, Bootstrap and JavaScript. The Interface consists of interactive and easy to use buttons to control and command the water supply to the fields for better automated irrigation facilities to save water and bring about better yield of crops thus increasing profits

The ThingSpeak API enables the connection of the designed front end to the cloud resting on its own platform.







Fig. 4. Web User Interface

#### IV. CONCLUSION

Through the proposed project, our team promises to bring about 40% to 50% reduction in the wastage of water on the agricultural field. The system being crop specific puts forth an eminent and ample water supply to every type of crop under culture. The use of wireless sensor networks aids the farmers to feasibly control and operate the irrigation system on their mobile devices reducing physical labor. Hence, the project promises reduced manpower, increasing efficiency, smart utilization of agricultural techniques therefore increasing yield, profit and gaining highly effective and safe agricultural production to bring significant impact on ensuring efficient usage of water resources as well as ensuring the efficiency and stability of agricultural production.

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