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# IOT Based Smart Irrigation System Using Node MCU

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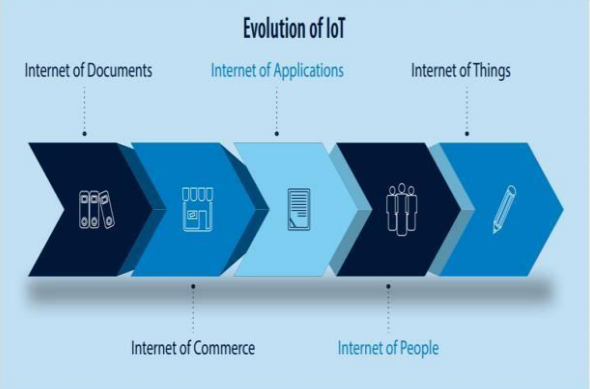
***Abstract – Irrigation plays an important role for development in food production. Farmers are using traditional methods of irrigation for farming and a large amount of water is getting wasted due to these methods. These outdated techniques have to be replaced with automated techniques. Internet of Things (IoT) is a milestone in the evolution of technology. IOT plays an important role in many fields. The irrigation system, which works based on the latest IoT technology to reduce the wastage of water and it also reduces manual work to irrigate the crops. Sensor is used to take sensor reading like soil moisture, temperature, air moisture and decision making is controlled by user (farmer) by using NodeMCU. The data received from sensors are sent to server database using wireless transmission. The irrigation will be automated when the moisture and temperature of the field is reduced. The farmer is notified with the information regarding field condition through mobile periodically. This system will be more useful in areas where there is scarcity of water.***

***Index Terms - IoT, Sensors, Automated Irrigation.***

## 1. INTRODUCTION

The phrase Internet of Things (IoT) refers to connecting various physical devices and objects throughout the world via internet. The internet of things or IoT, is a system which connects computing devices, machines etc. that are provided with unique identifiers (UIDs) and IoT provide ability to transfer data over a network without requiring any interaction. IoT is basically expansion of services provided by Internet [3]. The Internet of Things (IoT) is the network of physical objects like devices, vehicles, instruments and other items embedded with electronics, circuits, software, sensors and network connectivity that enables these objects to collect and exchange data over a network without requiring human-to-human or human-to-computer interaction [4]. The Internet of Things allows objects to be sensed and controlled remotely across existing Network infrastructure, also creating opportunities for more direct integration of the physical world into computer-based systems and resulting in improved efficiency and accuracy [5]. The evolution of the IoT we can classify it into five eras:

- The Internet of Documents: e-libraries, etc.
- The Internet of Commerce: e-commerce, etc.
- The Internet of Applications: Web 2.0
- The Internet of People: Social networks.
- The Internet of Things: Connected devices/machines.




IoT is able to interact without human intervention. Some primary IoT applications have been already developed in different fields [6]. IoT technologies are at their infant stages; however, many new developments have occurred in the integration of objects with sensors in the Internet [7].

One of those IoT systems is smart parking. It is to know the condition of parking slot via internet. This is related to parking problems which one of them is the difficulty of knowing the condition of vacant space in the parking area [8]. Due to this problem, the driver spends his time in finding a

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parking place. Problems related to parking can be solved if driver can be able to know the availability of parking space before reaching the destination [9].

Various approaches and research have been done to overcome parking problems. Since the early 1970s, smart parking has been implemented throughout various countries. The initial system will be displaying parking information such as availability status and/or the amount of space available [10]. More complex smart parking incorporates more advanced technology to serve customers with advanced information like slot status, slot number which is empty [11]. And also providing an efficient feature of slot booking. Currently, there are certain parking systems that are able to provide real-time information about available parking spaces. Such systems require efficient sensors to be placed in parking lots to monitor parking spaces and rapid data processing units to collect the data from different sources.

Hence, the IoT has been the trend of the next Internet. Every available thing is getting smart. There is a wide scope for research in IoT. The future of IoT is very bright. From our bills to vehicles everything would be connected providing a better lifestyle.

## 2. LITERATURE SURVEY

Earlier this project was not in a condition to determine state of soil and temperature. Even controlling the water motor status also not possible. This was the drawback in previous works [12]. And also, they didn't include any technique to send the status of the agriculture field to the user. To overcome all these drawbacks, we have implemented "IoT Based Smart Irrigation System Using NodeMCU". The humidity and soil moisture sensors are immersed in the soil field. Utilizing the Node MCU manages the field's water supply based on the senor values [13]. This system is entirely automated and can be controlled depending upon the state of soil. The motor pump Will operate depending upon the state of soil. Usingthis system, the user now can be able to know the status of agriculture [14].

## 3. PROPOSED SYSTEM

The proposed system is shown in below fig. the system is designed in such a way that soil moisture sensors are deployed to the ground. Soil moisture sensors are playing the key role for this irrigation system because these sensors have a capability to detect the soil moisture (water level in the soil). So, the characteristic of the sensor is utilized to find out the water level. Along with the DTH11 sensor to identify the humidity and temperature of the surrounding. These Soil moisture sensors & DTH11 sensor are directly connected to the microcontroller unit (NodeMCU).

A 16*2 LCD display is used as an output screen at area to display the status of the temperature, humidity and motor ON/OFF conduction. And also in MIT app we can observe and control. It does have automatic and manual mode of conduction.

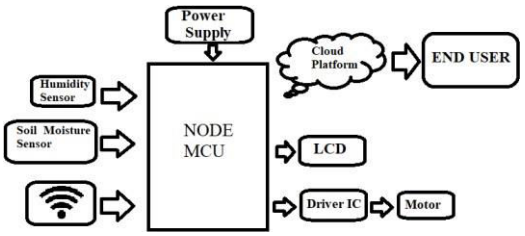


Fig: Block diagram

## 4. Hardware Requirements

### NodeMCU:

NodeMCU is an open-source software & hardware development environment that is built around a very inexpensive System-on-a Chip (SoC) called the ESP8266. NodeMCU development board comes with the ESP8266 module chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency.

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NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. NodeMCU have 11 digital I/O pins, 1 analogy pin

and supports SPI, UART and I2C. The operating voltage of ESP8266 is 3 to 3.3v. Its high processing power with in-built Wi-Fi and Deep Sleep Operating features make it ideal for IoT project. In this prototype we used NodeMCU module which was programmed using Arduino IDE.

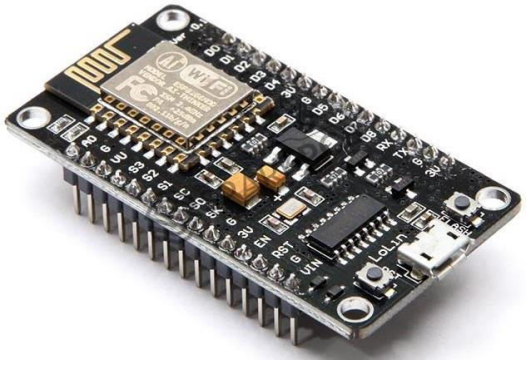

Fig: NODEMCU

**Soil Moisture Sensor:**

The soil moisture sensor is pretty straight forward. The fork-shaped probe with two exposed conductors, acts as a variable resistor (just like a potentiometer) whose resistance varies according to the water content in the soil.

This resistance is inversely proportional to the soil moisture:

- The more water in the soil means better conductivity and will result in a lower resistance.
- The less water in the soil means poor conductivity and will result in a higher resistance.

Fig: Soil moisture sensor

**Probe**

The sensor contains a fork-shaped probe with two exposed conductors that goes into the soil or anywhere else where the water content is to be measured. Like said before, it acts as a variable resistor whose resistance varies according to the

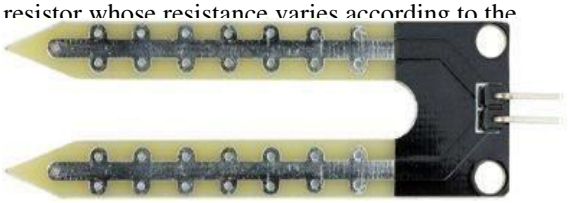

Fig : Probe

**Module**

The sensor also contains an electronic module that connects the probe to the Arduino. The module produces an output voltage according to the resistance of the probe and is made available at an Analog Output (AO) pin.

The same signal is fed to a LM393 High Precision Comparator to digitize it and is made available at an Digital Output (DO) pin.

The module has a built-in potentiometer for sensitivity adjustment of the digital output (DO).

You can set a threshold by using a potentiometer; So that when the moisture level exceeds the threshold value, the module will output LOW otherwise HIGH.

**DHT11:**

Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

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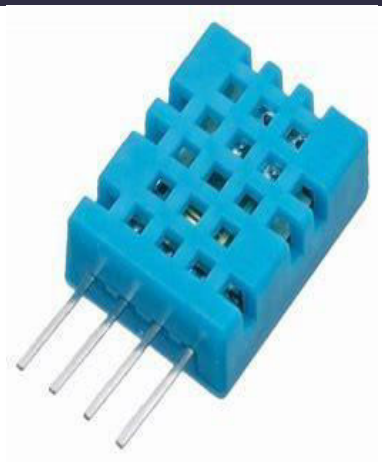

Fig : DHT11

Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20-meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

## Driver IC:

The L293D is a popular 16-Pin **Motor Driver IC**. As the name suggests it is mainly used to drive motors. A single **L293D IC** is capable of running two DC motors at the same time; also, the direction of these two motors can be controlled independently. So if you have motors which has operating voltage less than 36V and operating current less than 600mA, which are to be controlled by digital circuits like Op-Amp, 555 timers, digital gates or even Microcontrollers like Arduino, PIC, ARM etc. this IC will be the right choice for you.

Fig: L293D

**16*2 LCD Display:**

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc. It includes 16 Columns & 2 Rows so it can display 32 characters (16×2=32) in total & every character will be made with 5×8 (40) Pixel Dots. So, the total pixels within this LCD can be calculated as 32 x 40 otherwise 1280 pixels.

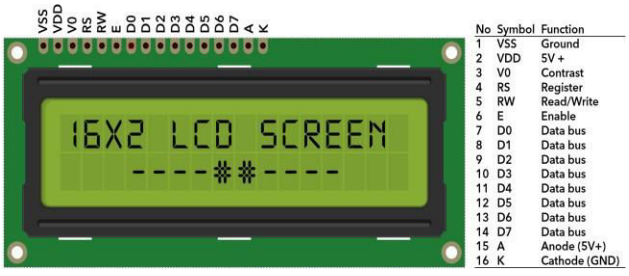


Fig:16*2 LCD

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**Mini Water Pump :**

Fig : Mini Water pump

This DC 12V Mini Submersible Noiseless Water Pump is a low cost, small size Submersible Pump Motor which can be operated from a 12V power supply. It can take up to 120 liters per hour with a very low current consumption of 220mA. Just connect the tube pipe to the motor outlet, submerge it in water, and power it. Make sure that the water level is always higher than the motor. Flow Rate : 80 ~ 120 L/H .Maximum Lift : 40 ~ 110 mm.

**Software Requirements**

**Arduino IDE:**

The Arduino Integrated Development Environment contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. It supports C/C++ language. Programming can be done for different boards using Arduino IDE.

**Firebase**

Firebase is a platform developed by Google for creating mobile and web applications. It was originally an independent company founded in 2011. In 2014, Google acquired the platform and it is now their flagship offering for app development. Firebase first product was the Firebase Realtime Database, an API that synchronizes application data across iOS, Android, and Web devices, and stores it on Firebase's cloud. The product assists software developers in building real-time, collaborative applications.

**MIT App Inventor:**

MIT App Inventor is a web application integrated development environment which is originally provided by Google, and now maintained by the Massachusetts Institute of Technology. MIT allows to create software application (apps) for operating systems (OS): Android, and iOS. It is free and open-source software. It uses a graphical user interface (GUI) very similar to the programming languages which allows users to drag and drop visual objects to create an application that can run on Android devices, while a App-Inventor Companion (The program that allows the app to run and debug on) that works on iOS running devices are still under development. MIT App Inventor is an intuitive, visual programming environment that allows everyone even children to build fully functional apps for smart phones and tablets.

## 5. IMPLEMENTATION & WORKING

This system is designed in such a way that soil moisture sensor is inserted into the ground. Soil moisture play the key role for this smart irrigation system because these sensors have a capability to find moisture level in soil. So, the use of sensor is to check the status of moisture. DHT11 sensor (humidity and temperature) is used to measure the temperature and humidity of the surrounding area. The soil moisture, DHT11 are directly connected to the NodeMCU. Depending upon the reading of the

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Sensor the NodeMCU will turn on/off the motor. A 16*2 LCD display is used as an output screen.

NodeMCU is connected over internet, a connection is built between NodeMCU & Firebase through Arduino IDE so that, information which is collected by NodeMCU will be updated to Firebaseand then MIT application.

**A) Automatic mode :**

In the automatic mode if the soil moisture sensor detects the dryness in the soil then it turn ONthe water motor by itself and turn OFF when the soilis wet.

**B) Manual mode:**

In the manual mode as reading shown by soil moisture sensor through the application. We cancontrol water motor to be ON/OFF.

## 6. RESULTS & DISCUSSIONS

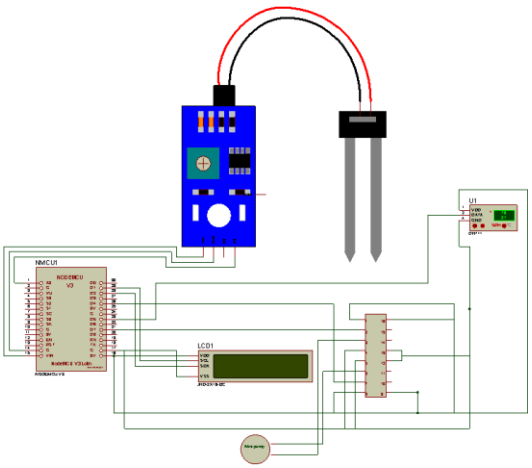

Fig: Schematic Diagram

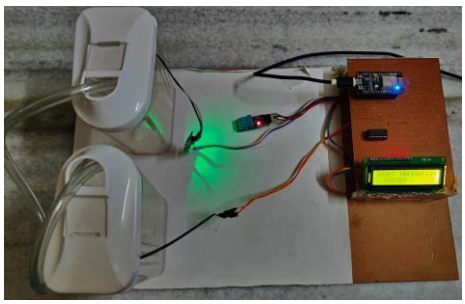

Fig : Kit

## 7. CONCLUSION & FUTURE SCOPE

implemented "SMART IRRIGATION USING NODE MCU" which helps the end user, i.e., farmer to view and analyze the factors that are to be considered while growing a crop such as temperature, humidity and moisture. The farmer can view and understand the pattern of changing environmental variables in real-time. Accordingly, user can manually control the motor conditions depending upon soil moisture sensor values. Thus, the system is efficient, reliable, flexible and user friendly.

Although the working system is efficient enough as per requirements, some future enhancements can be done which include, monitoring of the crop health based on the features of the leaves, detection of crop disease using image processing where farmers can upload image of diseased crop and get pesticide recommendations, implement smart irrigation system to monitor weather, recommend suitable fertilizers for certain crops, collection of details of soil class, latitude, longitude to predict soil type, and thus recommend crop more efficiently.

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