CHAPTER 1

INTRODUCTION

1.1.OVERVIEW OF SMART IRRIGATION USING IOT

Agriculture is classified as a main sector in India because it employs the majority of the population. As a result, the country's development is dependent on a high rate of growth in the agricultural sector. It provided roughly 16% of the country's overall GDP and 10% of its total exports. The primary resource for agriculture is water. Water is a finite and essential resource for all forms of animals on Earth, and its applications are limitless. As a result, water conservation is a critical aspect in the current situation due to global drought conditions.

Water scarcity and flooding have become an unavoidable problem to deal with in recent years. Water plays a crucial function in a person's day-to-day life. .Drought is already affecting a large portion of India's agricultural land and businesses; however, with the help of modern technology, this problem can be mitigated to some extent. Today's technology need a user-friendly gadget that is both inexpensive and effective, which the Arduino board provides. Because of the widespread usage of smartphones and computers in today's generation, sending a notification to an IoT platform is highly convenient. The entire system is split into two steps. Setting up an Arduino Board and connecting it to the various sensors is the first step. The IoT platform must be developed and connected to the server in the second step. Because the ESP 8266 Wi-Fi module is used, the transmission becomes easier and faster. It also allows the owner to keep track of the system from anywhere in the world. The farmer can turn on/off the motors parenthetically after gathering the necessary information about the field. This method is intended to enhance security, adaptability, and eliminate faults in the current system.

1.2 NEED OF THE PROJECT:

Different kind of problems faced by the farmers motivated us for the recommended system that is: the Indian farming is on the hitch because of the limited technical know-how of the best and efficient agricultural practices and moreover they are still dependent on conventional methods of agriculture that leads to lesser productivity of crops. So by using upcoming technology the productivity of crops can be maximized at minimal cost. This also reduces burden of taking up of heavy loans on farmers which they have incurred on themselves in order to sustain their livings or to get good yields of their crops. Apart from these issues scarcity of resources also adds up in their problem causing hindrance or stopping framers from cultivating and hence Indian economy is also additionally getting influenced to large extent as most of the fruitful lands of the nation are being destroyed that forms the vital part of GDP. So through this framework we are presenting solution for this issue by introducing an automated and systematic farming strategies that enable farmers to cultivate in a productive way also with limited resources and greater yield which is assured and efficient.

1.3.EXISTING SYSTEM :

For data processing, the existing agriculture system employs processors such as ARM7. The sensors are attached to the ARM7 processor's 64 pins. Environmental conditions are detected by the sensors, and the data collected is reviewed and displayed on the LCD. It also sends the information to the ARM7 microcontroller. Meanwhile, the sensed data is acknowledged when threshold levels are reached. The data is then transferred using the Wi-Fi module. Cellular connection, including 3G and 4G, is utilised for data transport. The bandwidth of the signal is set based on the demand. When there is a lack of coverage in a particular location, data is transferred via techniques such as LPWAN. The data from the sensors is collected using a mesh networking structure. All of the acquired data is sent to a centralised controller, where it is both stored and

processed. The mechanism of data transfer is more difficult to construct, and there is no end-to-end connection.

The existing system also has a limited number of CPUs, such as Raspberry Pi. Although it has many advanced features, such as camera interfacing, it is prohibitively expensive for a farmer.

CHAPTER 2

LITERATURE SURVEY

This chapter gives an overview of researches carried out related to the project work on “Smart irrigation using IOT”.

S. K. Roy, S. Misra, N. S. Raghuwanshi and S. K. Das, "AgriSens: IoT-Based Dynamic Irrigation Scheduling System for Water Management of Irrigated Crops," in IEEE Internet of Things Journal, vol. 8, no. 6, pp. 5023-5030, March15, 2021, Using the Internet of Things, a real-time automated dynamic and manual watering system for heterogeneous crop fields is developed. The AgriSens maintains dynamic irrigation treatments depending on the needs of different stages of a crop's life cycle, as well as remote watering based on the farmer's or expert's inputs. The AgriSens is beneficial for efficient water management of heterogeneous crops, while improving yield productivity by at least 10.21 percent over the traditional manual irrigation method, network performance, and system functionalities over the existing system, according to the experimental results.

A. Aldegheishem, N. Alrajeh, L. García and J. Lloret, "SWAP: Smart WAter Protocol for the Irrigation of Urban Gardens in Smart Cities," in IEEE Access, vol. 10, pp. 39239-39247, 2022, Smart water management solutions can focus on not only reducing water usage, but also on wastewater treatment and reuse, as well as water collected from infrastructures like rainwater tanks.A communication protocol for smart irrigation systems as part of a Smart City solution is designed. providing specialised messages for certain activities and notifications. This protocol also works with a network that includes both WiFi and LoRa devices.

E. -T. Bouali, M. R. Abid, E. -M. Boufounas, T. A. Hamed and D. Benhaddou, "Renewable Energy Integration Into Cloud & IoT-Based Smart

Agriculture," in IEEE Access, vol. 10, pp. 1175-1191, 2022, The SA system in use makes use of cutting-edge technology. For data collection and control, IoT devices (sensors and actuators) is employed. Cloud Computing was also used for data processing, visualisation, and storage. Furthermore, we used fuzzy logic to create a fuzzy irrigation control unit that uses real-time processed data to determine the suitable Id (Irrigation Duration). This method conserves water and energy while providing ideal growing conditions for plants, resulting in increased crop yield. Furthermore, by relying entirely on solar energy, this permits better monitoring of the water level in the basin and corresponds to the traditional eco-friendly practise of sustainable agriculture.

F. B. Poyen, A. Ghosh, P. Kundu, S. Hazra and N. Sengupta, "Prototype Model Design of Automatic Irrigation Controller," in IEEE Transactions on Instrumentation and Measurement, vol. 70, pp. 1-17, 2021, The prototype model of IoT based Automatic Irrigation Controller is named as Smart Automatic Irrigation Controller (SAIC). The simulation and field-study results showed that water usage is reduced by 27% and production yield is improved by 40%. So it is satisfactorily inferred that the objectives of the model i.e. reduction of water usage and wastage and improvement in product yield are successfully achieved. The ease of operation and low cost, and high efficiency are the unique selling point (USP) of this device. The data uploaded in the cloud-server can be accessed by other researchers providing the platform for live feedback and discussion on the betterment of the process. Thus it can have a significant impact in the irrigation scheduling process and agriculture in the long run.

Prathiba, et.al, 2017, focused on the generation of decisions from the data provided by the sensors. They clearly explained the read and requirement for the implementation of agricultural system. The necessary conditions that include

water, humidity and moisture and their influence in the growth of crops are explained as well. The usage of modern technology for example IoT provides enormous benefits in terms of time and water management. The continuous availability of network is required for the data transfer from Arduino to cloud/server. They also suggest an alternative method of sending message to the farmer using SMS.

CHAPTER 3

COMPONENT DESCRIPTION

3.1. ARDUNIO UNO:

3.1.1. Pin diagram:

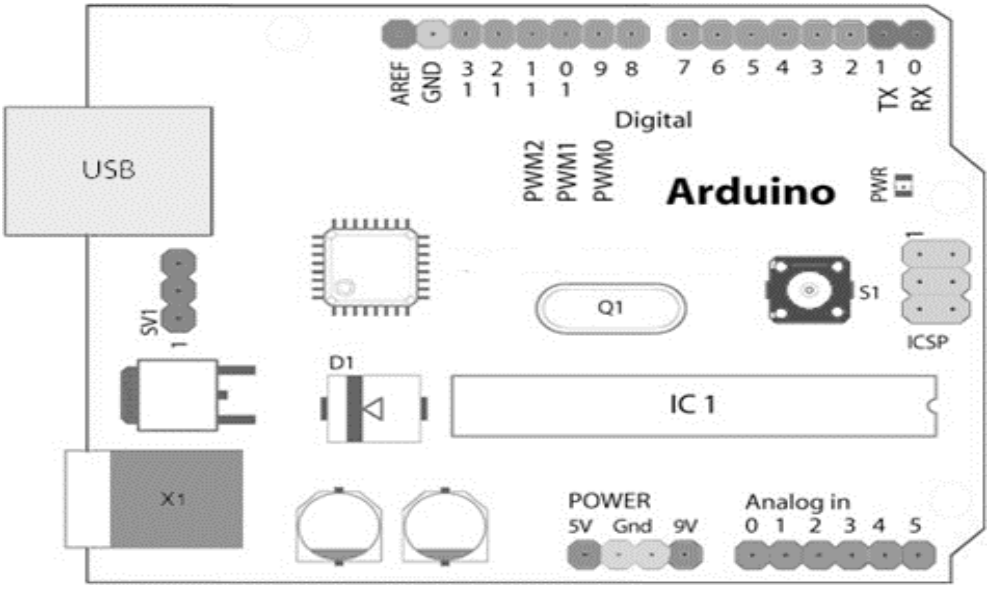

Figure 3.1

Pin diagram of Ardunio UNO is shown in Figure 3.1

The Arduino Uno is a type of Arduino board that is provided as an open-source board that uses an ATmega328p microcontroller in the board. The Arduino Uno contains a set of analog and digital pins that are input and output pins which are used to connect the board to other components. There are a total of fourteen I/O pins placed inboard in which six are analog input pins. The board has a USB connection that can be used to a power supply to the board. The board is used for electronics projects and used to design the circuit.

3.1.2. Feautures:

- The board contains the USB interface support that enables the board to act as a serial device and provide the functionality to connect the board to other interfaces. The USB interface is also used to provide power supply to the board.

- In the Arduino UNO board, there is a chip placed that is directly plugged to the USB port and acts as a virtual type serial port for the computer system. By this, communication becomes very smooth and helps the board to connect to various types of computer systems.

- The microcontroller used in the Arduino UNO board ATMega328 is easy to available and can be used easily. The board contains other components like PWM pins, timers, external interrupts or internal interrupts, and other types of sleep modes.

- The board is provided as an open-source tool that has its own advantage as a large number of users use this board and help to troubleshoot other problems related to the board. By this, the debugging activities related to the project become easy steps.

- The pins used in the board act as an oscillator that has a frequency of around 16 MHz that is beneficial for most of the applications. The speed of the microcontroller does not change by this.

- The board has another feature of voltage regulation that helps to regulate the power supply on the board. The board can be provided power supply directly without using external power and USB port can be used for this purpose. The 12V power supply can be used as an external power supply for the board.

- The Arduino UNO pins contain thirteen digital and six analog-type pins in it. The pins provide the functionality to the board to connect the hardware to the board. The computer capability can be increased using these pins.

- The tool has also one ICSP connector which helps to make the USB port bypass and connect the Arduino directly and act as a serial device.

- The board has a total of 32 KB size flash memory that is used to store the data in it.

- The board has also one LED fitted inboard to make the debugging process easy and help to find the bugs in the code.

- And the board has also one reset button that helps to restart the program using the board.

3.2.ESP8266:

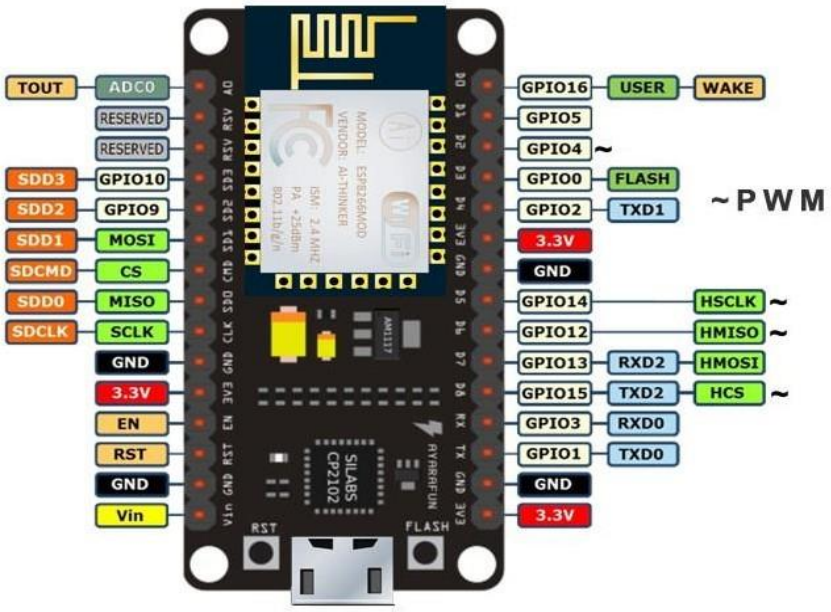

Figure 3.2.1

Pin diagram of ESP32 is shown in Figure 3.2.1

ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems, the developers of the famous ESP8266 SoC. It is a successor to ESP8266 SoC and comes in both single-core and dual-core variations of the Tensilica's 32-bit Xtensa LX6 Microprocessor with integrated Wi-Fi and Bluetooth.

The good thing about ESP32, like ESP8266 is its integrated RF components like Power Amplifier, Low-Noise Receive Amplifier, Antenna Switch, Filters and RF Balun. This makes designing hardware around ESP32 very easy as you require very few external components.

Another important thing to know about ESP32 is that it is manufactured using TSMC's ultra-low-power 40 nm technology. So, designing battery operated applications like wearables, audio equipment, baby monitors, smart watches, etc., using ESP32 should be very easy.

Block diagram:

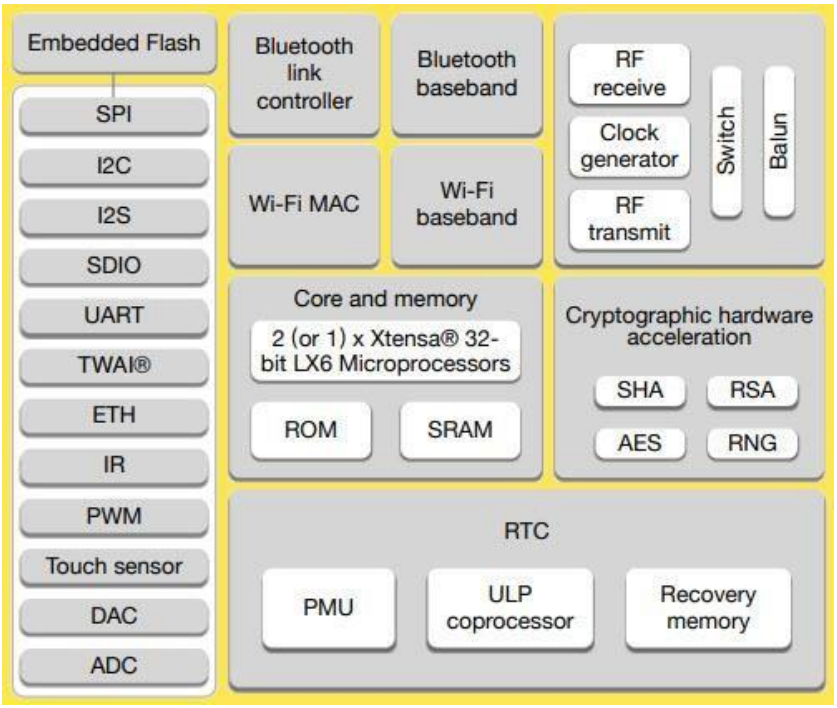

Figure 3.2.2

Block diagram of ESP32 is shown in Figure 3.2.2

3.2.1. Feautures:

ESP32 has a lot more features than ESP8266 and it is difficult to include all the specifications in this Getting Started with ESP32 guide. So, I made a list of some of the important specifications of ESP32 here. But for complete set of specifications, I strongly suggest you to refer to the Datasheet.

- Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240 MHz.
- 520 KB of SRAM, 448 KB of ROM and 16 KB of RTC SRAM.
- Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps.
- Support for both Classic Bluetooth v4.2 and BLE specifications.
- 34 Programmable GPIOs.
- Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC
- Serial Connectivity include 4 x SPI, 2 x I^2C, 2 x I^2S, 3 x UART.
- Ethernet MAC for physical LAN Communication (requires external PHY).
- 1 Host controller for SD/SDIO/MMC and 1 Slave controller for SDIO/SPI.
- Motor PWM and up to 16-channels of LED PWM.
- Secure Boot and Flash Encryption.
- Cryptographic Hardware Acceleration for AES, Hash (SHA-2), RSA, ECC and RNG.

3.2.2. Different Ways to Program:

A good hardware like ESP32 will be more user friendly if it can be programmed (writing code) in more than one way. And not surprisingly, the ESP32 supports multiple programming environments.

Some of the commonly used programming environments are:

- Arduino IDE
- PlatformIO IDE (VS Code)
- LUA
- MicroPython
- Espressif IDF (IoT Development Framework)
- JavaScript

As Arduino IDE is already a familiar environment, we will use the same to program ESP32 in our upcoming projects. But you can definitely try out others as well.

3.2.3. Layout diagram:

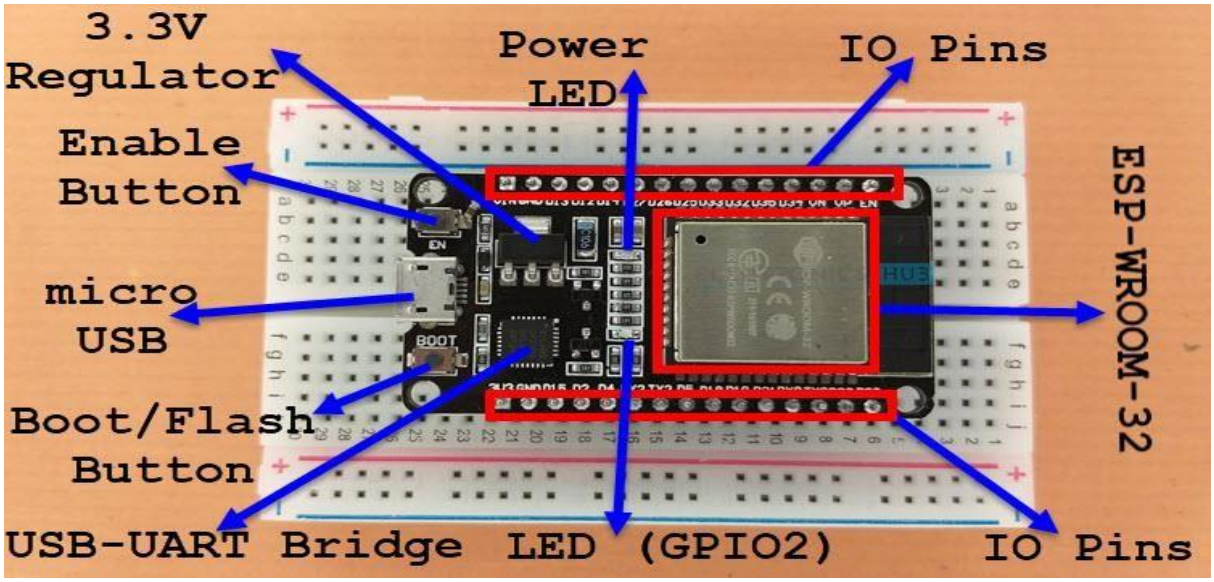

Figure 3.2.3

Layout diagram of ESP32 is shown in Figure 3.2.3

As you can see from the image, the ESP32 Board consists of the following:

- ESP-WROOM-32 Module
- Two rows of IO Pins (with 15 pins on each side)
- CP2012 USB – UART Bridge IC
- micro–USB Connector (for power and programming)
- Enable Button (for Reset)
- Boot Button (for flashing)

- Power LED (Red)
- User LED (Blue – connected to GPIO2)
- Some passive components

An interesting point about the USB-to-UART IC is that its DTR and RTS pins are used to automatically set the ESP32 in to programming mode (whenever required) and also rest the board after programming.

- AMS1117 3.3V Regulator IC

3.3. SOIL MOISTURE SENSOR:

This soil moisture sensor module is used to detect the moisture of the soil. It measures the volumetric content of water inside the soil and gives us the moisture level as output. The module has both digital and analog outputs and a potentiometer to adjust the threshold level.

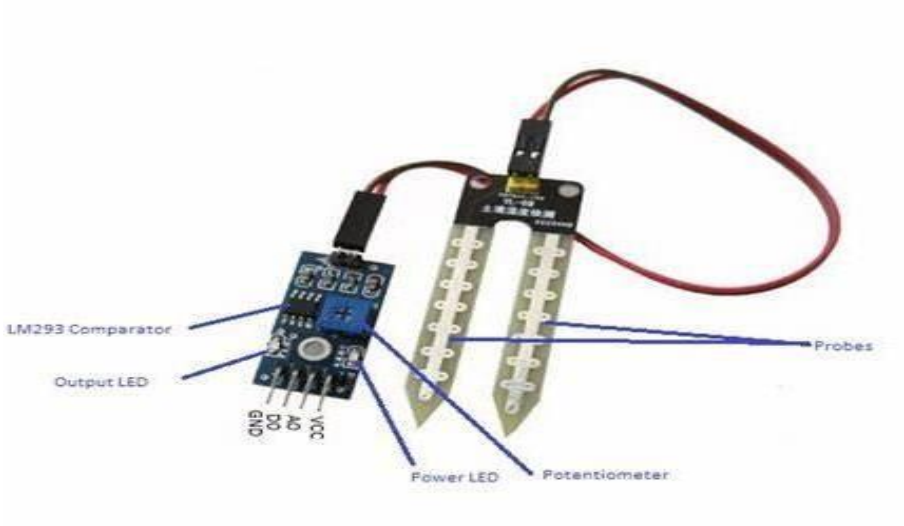

Figure 3.3

Layout diagram of Soil moisture sensor is shown in Figure 3.3

3.3.1. Pin configuration:

Pin Name	Description
VCC	The Vcc pin powers the module, typically with +5V
GND	Power Supply Ground
DO	Digital Out Pin for Digital Output.
AO	Analog Out Pin for Analog Output

3.3.2. Specifications

- Operating Voltage: 3.3V to 5V DC
- Operating Current: 15mA
- Output Digital - 0V to 5V, Adjustable trigger level from preset
- Output Analog - 0V to 5V based on infrared radiation from fire flame falling on the sensor
- LEDs indicating output and power
- PCB Size: 3.2cm x 1.4cm
- LM393 based design
- Easy to use with Microcontrollers or even with normal Digital/Analog IC
- Small, cheap and easily available

3.4. I2C LCD DISPLAY:

This is a 16x2 LCD display screen with I2C interface. It is able to display 16x2 characters on 2 lines, white characters on blue background.

Usually, Arduino LCD display projects will run out of pin resources easily, especially with Arduino Uno. And it is also very complicated with the wire soldering and connection. This I2C 16x2 Arduino LCD Screen is using an I2C communication interface. It means it only needs 4 pins for the LCD display: VCC, GND, SDA, SCL. It will save at least 4 digital/analog pins on Arduino. All connectors are standard XH2.54 (Breadboard type). You can connect with the jumper wire directly.

Figure 3.4

Layout diagram of I2C LCD Display is shown in Figure 3.4

3.4.1. FEATURES:

- Display Mode: STN
- Display Format: 16 Character x 2 Line
- Viewing Direction: 6 O'Clock
- Input Data: 4-Bits or 8-Bits interface available
- Display Font : 5 x 8 Dots
- Power Supply : Single Power Supply (5V±10%)
- Driving Scheme : 1/16Duty,1/5Bias
- Backlight (Side) : LED (Yellow)
- I2C Address:0x20-0x27(0x20 default)
- Supply voltage: 5V
- Adjustable contrast

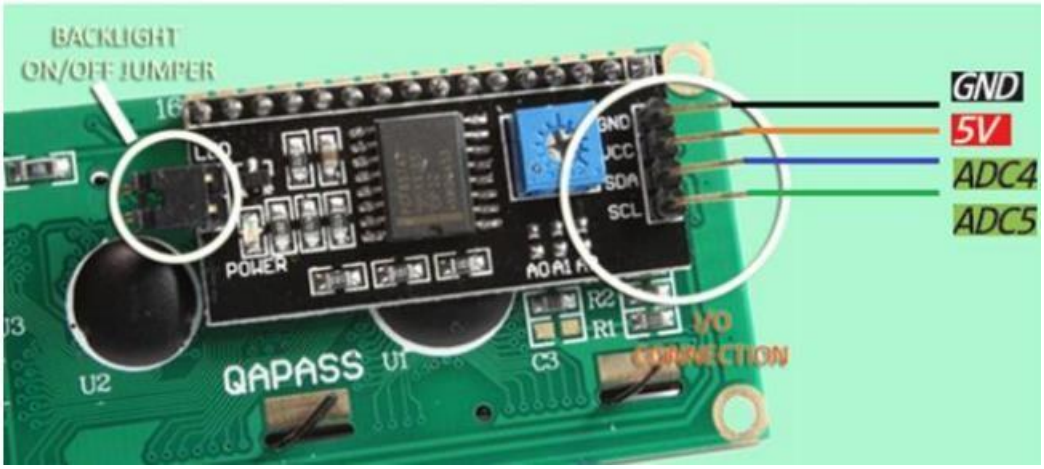

Figure 3.4

Layout diagram of I2C Module is shown in Figure 3.4

3.5. DTH11 SENSOR:

The DHT11 is a commonly used Temperature and humidity sensor that comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

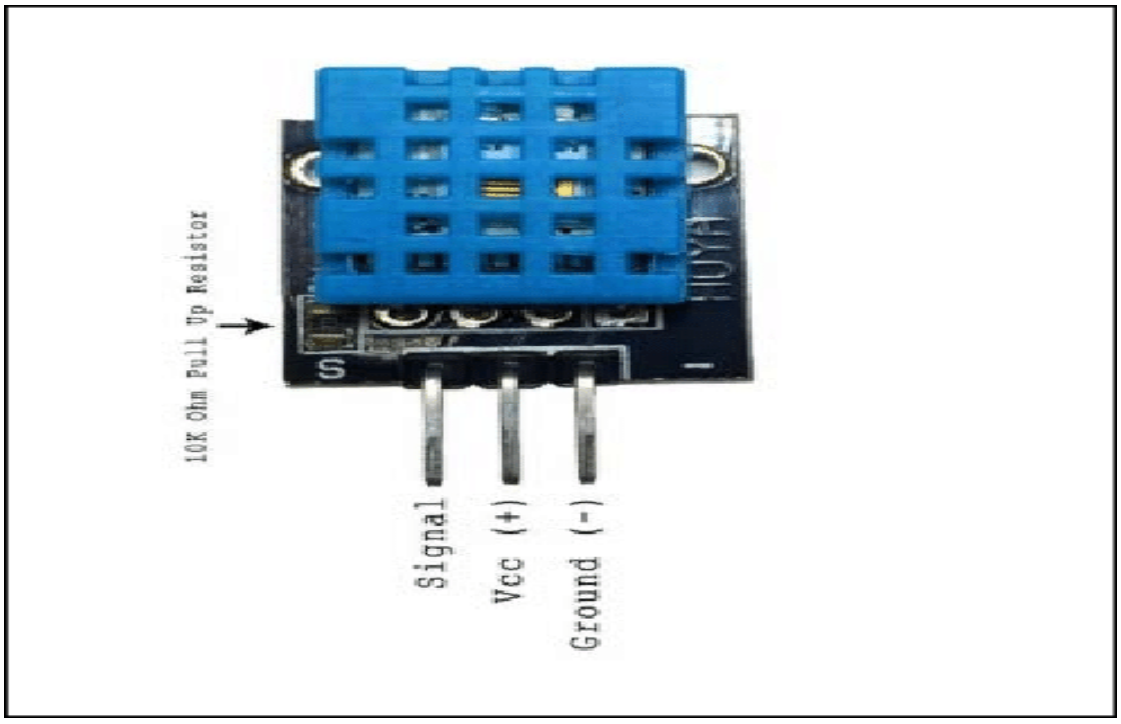

Figure 3.5

Layout diagram of DHT11 sensor is shown in Figure 3.5

3.5.1 Pin configuration:

No:	Pin Name	Description
For DHT11 Sensor		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	NC	No Connection and hence not used
4	Ground	Connected to the ground of the circuit

3.6. RELAY MODULE:

Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch. The single-channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not.

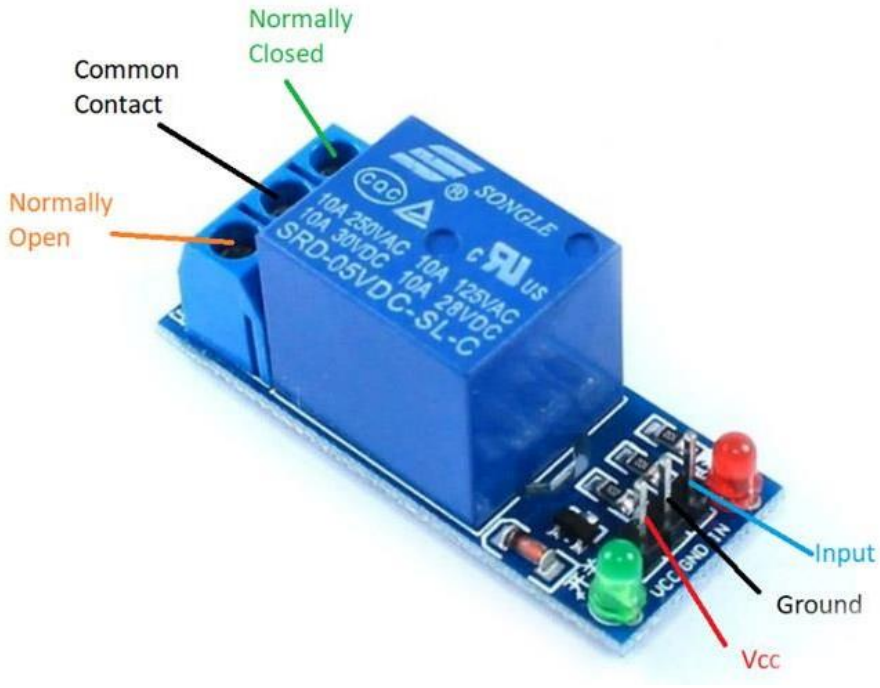

Figure 3.6

Layout diagram of DHT11 is shown in Figure 3.6

3.7. WATER PUMP:

A complete DIY kit that monitors soil moisture content and automatically runs a water pump when the soil moisture content is low.The kit requires no programming, so is easy to set up and get going.The kit Includes a Relay module, Mini water pump, Plastic Battery Storage Case Holder, USB power cable, Jumper wires, 0.5m Vinyl Tubing and Soil Moisture Detector Mod