I. Hardware Components

1.1 Arduino Mega

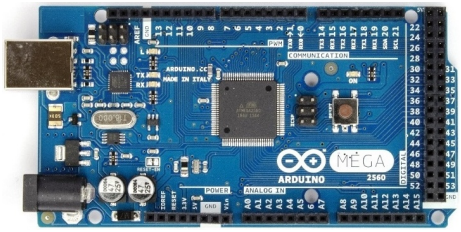

Figure 1. Arduino Mega

The Arduino Mega is a microcontroller board based on the ATmega2560. It provides 54 digital I/O pins (14 PWM), 16 analog inputs, 4 UARTs, a 16 MHz oscillator, USB, power jack, ICSP header, and reset button. It can be powered via USB, an AC-to-DC adapter, or a battery, and includes a base plate for protection.

1.2 ESP8266

The ESP8266EX offers a complete and self-contained Wi-Fi networking solution. It can host an application booting from external flash with integrated cache, or act as a Wi-Fi adapter for microcontroller-based designs through interfaces such as SPI, SDIO, or I2C/UART.

1.3 LCD

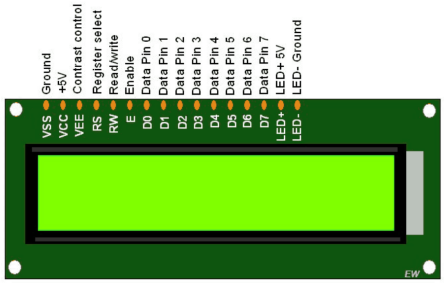

Figure 2. LCD

A Liquid Crystal Display (LCD) combines solid and liquid states of matter and uses liquid crystals to produce a visible image. LCD technology enables thin displays used in laptops, TVs, cell phones, and portable devices compared to CRT displays.

1.4 DHT11

The DHT11 humidity and temperature sensor is commonly used for environmental monitoring such as remote weather stations, home control systems, and farm or garden monitoring.

Ranges and Accuracy

1. Humidity Range: 20–90% RH
2. Humidity Accuracy: ±5% RH
3. Temperature Range: 0–50 °C
4. Temperature Accuracy: ±2 °C
5. Operating Voltage: 3 V to 5.5 V

1.5 Relative Humidity

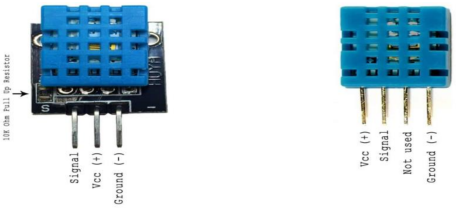

Figure 3. Relative Humidity

The DHT11 measures relative humidity, which is the amount of water vapour in air relative to its saturation point. At saturation, water vapour begins to condense and accumulate on surfaces, forming dew. There are different versions of the DHT11 available in practice.

1.6 Ultrasonic Sensor

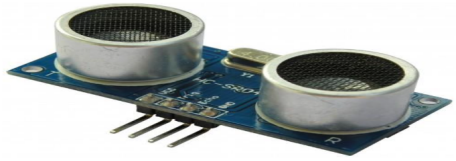

Figure 4. Ultrasonic Sensor

An ultrasonic distance sensor provides non-contact ranging from approximately 2 cm to 4 m. The module transmits eight 40 kHz pulses and checks for the returning echo. If an echo is received, a high-level pulse is produced on the *ECHO* pin whose width corresponds to the round-trip travel time.

Features

- Output: Digital sensor
- Voltage: 5 V DC
- Detection Distance: 2 cm–400 cm (0.02 m–4.0 m)
- Static Current: < 2 mA
- Level Output: High = 5 V
- Precision: up to 0.3 cm

1.7 LCD I2C Adapter

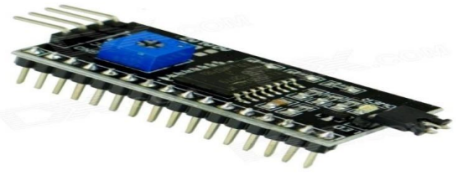

Figure 5. LCD I2C Adapter

The IIC/I2C interface adapter module is used with a 16×2 LCD display. It uses the PCF8574T IC to convert I2C serial data into parallel LCD data and reduces Arduino wiring to four connections.

Connection with Arduino

1. VCC: 5 V
2. GND: GND
3. SDA: A4
4. SCL: A5

1.8 Blynk

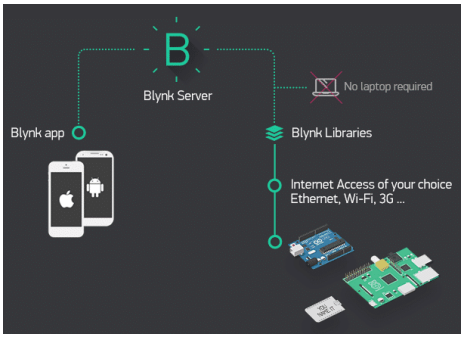

Figure 6. Blynk

Blynk is an IoT platform for remotely controlling hardware, displaying sensor data, and visualizing data through a mobile interface. It includes an app for building UIs with widgets and a server (cloud or local) to route commands and telemetry between mobile devices and hardware.

Features of Blynk

1. Similar API and UI across supported hardware and devices.
2. Cloud connectivity options:
   (a) Wi-Fi
   (b) Bluetooth and BLE
   (c) Ethernet
   (d) USB (Serial)
   (e) GSM
3. Set of easy-to-use widgets.
4. Direct pin manipulation with minimal code requirements.
5. Easy integration and extension using virtual pins.
6. Historical data monitoring using the History Graph widget.
7. Device-to-device communication using the Bridge widget.

1.9 Conductivity Sensor

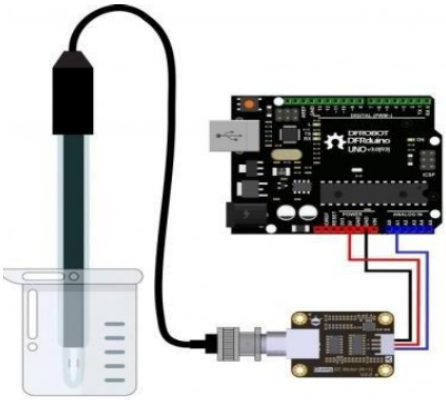

Figure 7. Conductivity Sensor

A conductivity sensor measures a solution's ability to conduct electrical current. Conductivity increases with ion concentration; therefore, it is often used to estimate nutrient concentration in hydroponic solutions.

1.10 Motor

Figure 8. Motor

An electric motor converts electrical energy into mechanical energy. The system uses a 15 W air-cooler pump rated at 220 V with a maximum discharge flow of 1100 LPH. The pump provides a water lifting capacity of 2 W and weighs 2.40 kg.

II. Electronic Configuration

We connect all the cables and electric system using an aluminum frame as support. It is connected to 220V using a 3A 12V power supply. On top of the structure we connected growing lights. Ours are 12V LED strips and consume approximately 0.5A per meter of length. At the bottom we connected the water pump that uses 1A. The main circuit, as shown in Figure 9, consumes approximately 0.5A.

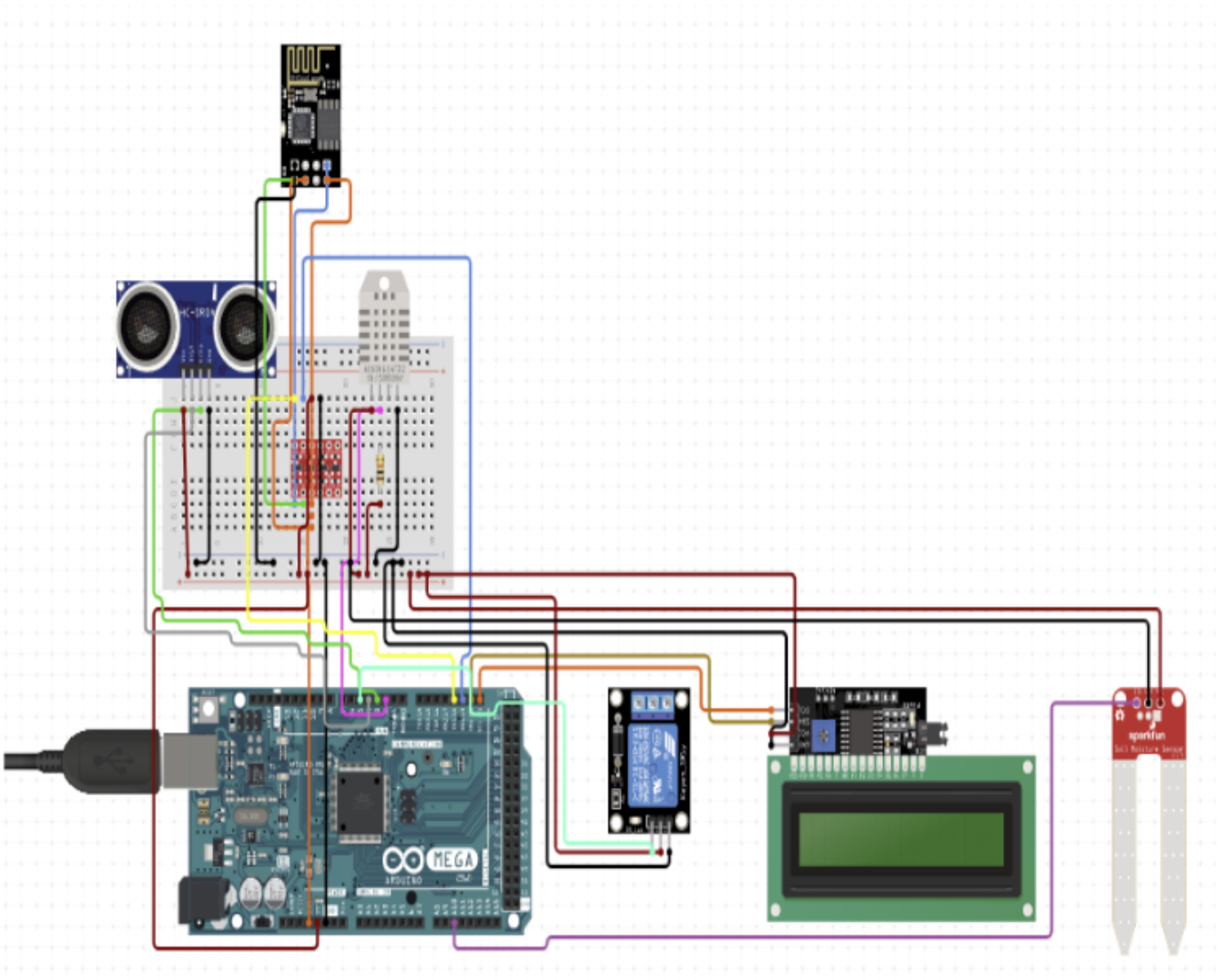

Figure 9. Circuit Diagram