Nonetheless, relays can "control" larger voltages and amperes by having an amplifying effect because a small voltage applied to a relays coil can result in a large voltage being switched by the contacts. Protective relays can prevent equipment damage by detecting electrical abnormalities, including over current, undercurrent, overloads and reverse currents. In addition, relays are also widely used to switch starting coils, heating elements, pilot lights and audible alarms.

5.1.3 Other Components

- **PIR Sensor**

Figure 5.4: PIR Sensor

The passive infrared motion sensor (PIR) allows to detect movement of a person or animal within a 6 meter range. Returned value will be true if presence is detected and false when no presence is detected. Presence can be detected within a 6-meter range. The PIR sensor responds with values 00 or 11 which reflects whether the motion of an object was detected or not. If the motion of an object is detected, the hall light gets switched on.

Figure 5.4: PIR Sensor Connection

This sensor detects emitted infrared energy from objects (humans and animals, but also cars) in the form of heat. In general differences of around 5-10º Celsius compared with the ambient temperature in the field of view and within a 10m /30ft range of the camera are detected. PIR sensors detect the difference in infrared (IR) energy or heat emitted by humans in motion from that of the background space. IR energy has a longer wavelength than visible light so it is invisible to the naked eye. The IR energy is captured by a mirror or lens that feeds this energy to a computer chip to record the changes as the object moves. The changes trigger the alarm. Features of PIR sensors include:

- Require a line of sight.
- Have limited sensitivity to minor (hand) movement at distances typically greater than 15 feet.
- Are most sensitive to movement laterally across the sensor's field of view.
- Are most suitable for smaller, enclosed spaces, such as hallways.
- Have a maximum coverage area of 1,000 ft^2.

- **Soil Moisture Sensor**

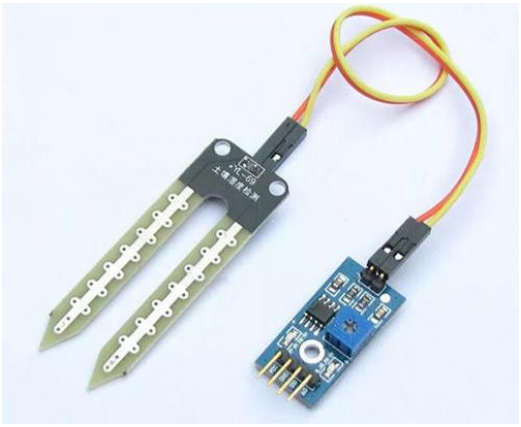

Figure 5.5: Moisture Sensor

The Moisture Sensor is used to measure the water content (moisture) of soil when the soil is having water shortage, the module output is at high level, else the output is at low level. This sensor reminds the user to water their plants and also monitors the moisture content of soil. It has been widely used in agriculture, land irrigation and botanical gardening. The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the

water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil.

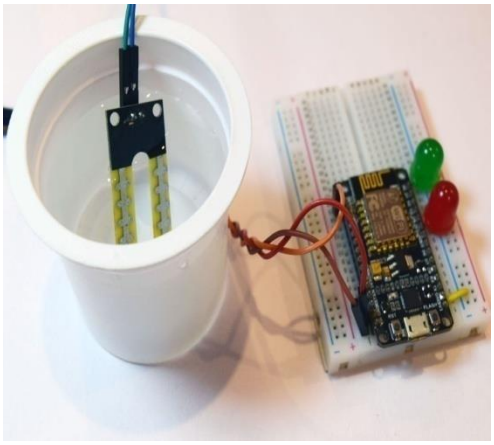

Figure 5.6: Moisture Sensor Demonstration

The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges. The Soil Moisture Sensor is used to measure the loss of moisture over time due to evaporation and plant uptake, evaluate optimum soil moisture contents for various species of plants, monitor soil moisture content to control irrigation in greenhouses and enhance bottle biology experiments. Specifications include:

- Working Voltage: 5V
- Working Current: < 20mA
- Interface type: Analog
- Working Temperature: 10°C~30°C

- **DHT11**

Figure 5.7: DHT11 Sensor

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.

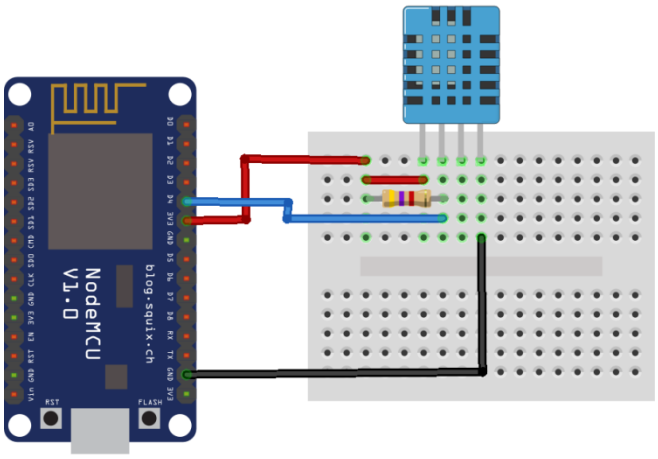

Figure 5.8: DHT11 Sensor Connection with NodeMCU

Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programs 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. Its specifications include:

- Supply Voltage : +5V
- Temperature range : 0-50 °C error of ± 2 °C
- Humidity : 20-90% RH ± 5% RH error
- Interface: Digital