Lab Assignment No: 01

AIM: Arduino Programming, Integration of Sensors and Actuators with Arduino, Raspberry Pi, Implementation of IoT with Raspberry Pi.

OBJECTIVES:

- To understand the basic architecture and functionality of Arduino microcontrollers.
- To identify and interface various sensors (temperature, humidity, light, distance) with Arduino.
- To understand the architecture and setup process of Raspberry Pi.
- To understand the role of Raspberry Pi in IoT ecosystems.

Components Required:

- **Arduino Board** (e.g., Uno, Mega, Nano)
- **USB Cable** (for programming via PC)
- **Arduino IDE** (software for writing and uploading code)
- **Ultrasonic Sensor (HC-SR04)** – Distance
- **IR Sensor** – Obstacle detection.
- Raspberry Pi 3

THEORY:

1. Arduino Programming

The main objective is to understand the basic structure and syntax of Arduino programming using the C/C++-based Arduino IDE.

Key Concepts:

- Arduino Board Architecture (UNO, Nano, Mega, etc.)
- Pin Modes: INPUT, OUTPUT
- Functions: setup(), loop()
- Digital I/O: digitalRead(), digitalWrite()
- Analog I/O: analogRead(), analogWrite()
- Delay and timing functions

Sample code:

```
void setup() {
  pinMode(13, OUTPUT);
}
```

```
void loop() {
  digitalWrite(13, HIGH);
  delay(1000);
  digitalWrite(13, LOW);
  delay(1000);
}
```

2.Integration of Sensors with Arduino

The o**bjective is to l**earn how to read data from sensors using Arduino.

Common Sensors:

- DHT11**: Temperature & Humidity Sensor**
- LDR**: Light Dependent Resistor**
- HC-SR04**: Ultrasonic Distance Sensor**
- IR Sensor**: Obstacle Detection**

Sample Use Case (DHT11):

- Measure temperature and humidity
- Display on serial monitor or LCD

Code Snippet (DHT11 using library):

```
#include "DHT.h"
#define DHTPIN 2
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

void setup() {
  Serial.begin(9600);
  dht.begin();
}

void loop() {
  float temp = dht.readTemperature();
  float hum = dht.readHumidity();
  Serial.print("Temp: "); Serial.print(temp);
  Serial.print(" Humidity: "); Serial.println(hum);
  delay(2000);
}
```

3.Integration of Actuators with Arduino

The main objective is to control devices based on sensor input or user commands.

Common Actuators:

- **Buzzer**
- **Relay Module** (for switching appliances)
- **Servo Motor** (for angular motion)
- **DC Motor** (with motor driver)

Example:

- Automatic Fan control using DHT11 + Relay
- Smart Door using IR + Servo Motor

4. Introduction to Raspberry Pi

The main objective is to understand the basics of Raspberry Pi, a Linux-based single-board computer used for IoT and embedded applications.

Key Concepts:

- Raspberry Pi models (3B, 4, Zero)
- OS Setup using Raspberry Pi Imager (Raspberry Pi OS)
- Basic terminal commands
- Python programming environment

5. Interfacing with Raspberry Pi

- **Objective:**

  Interface sensors and actuators using GPIO pins via Python.

- **Example: Blink an LED**

```
import RPi.GPIO as GPIO
import time

GPIO.setmode(GPIO.BCM)
GPIO.setup(18, GPIO.OUT)

while True:
    GPIO.output(18, GPIO.HIGH)
    time.sleep(1)
    GPIO.output(18, GPIO.LOW)
```

time.sleep(1).

6. Implementation of IoT with Raspberry Pi

The main objective is to use Raspberry Pi to collect sensor data and send it to the internet (cloud) for remote monitoring.

Key Technologies:

- MQTT (Message Queuing Telemetry Transport)
- HTTP API
- Cloud platforms: ThingSpeak, Blynk, Firebase

Example Project: Weather Monitoring System

- Collect data from DHT11
- Push data to ThingSpeak channel
- Monitor graphs on web dashboard

Python Snippet (ThingSpeak):

```
import requests
url = https://api.thingspeak.com/update
params = {
   "api_key": "YOUR_API_KEY",
   "field1": 25.5,
   "field2": 70.2
}
response = requests.get(url, params=params)
print(response.text)
```

CONCLUSION: