Robotics and IoT Take-Home Lab Manual

Institution: Aqaba University of Technology

Level: Undergraduate Students

Lab Focus: Arduino and Raspberry Pi with Sensors

Language: English

1. Introduction

This manual is designed to guide undergraduate students in conducting hands-on experiments using Arduino and Raspberry Pi in the field of Robotics and IoT. The goal is to help students develop practical skills in embedded systems, sensor integration, and internet-connected devices.

2. Lab Safety and Setup Guidelines

- Always work in a well-ventilated, static-free environment.
- Ensure correct polarity and connections before powering up.
- Handle sensors and microcontrollers with care.
- Never work with wet hands or liquids near electronics.
- Disconnect power before making any wiring changes.

3. Hardware Overview

Required components:
- Arduino UNO / Mega
- Raspberry Pi (any model with GPIO)
- Breadboard and jumper wires
- Sensors: DHT11 (Temperature & Humidity), Ultrasonic (HC-SR04), IR sensor
- Actuators: Servo motor, DC motors, L298N motor driver
- Wi-Fi connectivity module (if not built-in)
- Power supply, resistors, LEDs

4. Software Setup

- Install Arduino IDE from https://www.arduino.cc/en/software
- Install necessary libraries (e.g., DHT, Servo)
- For Raspberry Pi: Use Python 3 with libraries like RPi.GPIO and requests
- Optional: Setup ThingSpeak or Blynk for cloud IoT

5. Experiments

Exp 1: Blinking LED (Intro to Arduino GPIO)

Connect an LED to pin 13. Write a simple blink code to understand digital output.

Exp 2: Reading Temperature & Humidity (DHT11)
Connect DHT11 sensor. Read and display values on Serial Monitor.

Exp 3: Ultrasonic Sensor for Distance Measurement
Use HC-SR04 with Arduino to measure distance and display output.

Exp 4: Controlling a Servo Motor
Use Servo.h library to rotate a servo motor to specific angles.

Exp 5: Raspberry Pi: Reading Sensor Data via Python
Use Python and GPIO library to read IR or temperature sensor data.

Exp 6: IoT: Sending Sensor Data to ThingSpeak
Send temperature data via Wi-Fi to ThingSpeak using HTTP requests.

Exp 7: Basic Line-Following Robot
Use IR sensors to detect line path and control motors accordingly.

Exp 8: Remote Control of Robot via Web Interface
Control robot direction via simple web interface hosted on Raspberry Pi.

Exp 9: Final Project
Create a smart robot or monitoring system combining sensors, Wi-Fi, and mobility.

6. Troubleshooting
- Check all wiring connections.
- Ensure correct COM port and board type in Arduino IDE.
- Use serial prints for debugging.
- Make sure required libraries are installed.

7. Appendices
Included in future version: sample codes, wiring diagrams, datasheets.