Hardware Overview

- Processor: Quad-core ARM Cortex-A72 64-bit SoC @ 1.5 GHz or better
- Memory: 4GB LPDDR4-3200 SDRAM or better
- Wireless LAN: Dual-band 802.11 b/g/n/ac (2.4GHz and 5GHz)
- Bluetooth: Bluetooth 5.0, Bluetooth Low Energy (BLE)
- Ethernet: Gigabit Ethernet
- USB Ports: 2 × USB 3.0, 2 × USB 2.0
- Video Output: 2 × micro-HDMI ports supporting up to 4Kp60 resolution
- Audio & Video: 4-pole stereo audio and composite video port
- Storage: Micro-SD card slot
- Expansion: 40-pin GPIO header (Raspberry Pi HAT compatible)
- Interfaces: Camera (CSI), Display (DSI)
- Power: 5V DC via USB-C connector or GPIO header (flexible power options)

Key Concepts – Raspberry Pi Board

1. **Embedded Computing**: High-performance computing for home automation, industrial control, and media servers using the ARM Cortex-A72 SoC

2. **Wireless Connectivity**: Dual-band Wi-Fi and Bluetooth 5.0 for seamless communication with cloud services, peripherals, and IoT devices

3. **Multimedia & Graphics**: Supports dual 4K video output, suitable for multimedia applications, digital signage, and advanced graphical interfaces

4. **Edge Computing**: Local data processing reduces latency and enhances privacy, essential for real-time analytics, edge AI, and smart camera systems

5. **Flexible Expansion**: 40-pin GPIO header allows extensive sensor, actuator, and expansion board interfacing for versatile IoT projects

6. **Cloud Integration**: Compatible with AWS IoT, Azure IoT, and Google Cloud IoT for remote monitoring, data storage, and analytics

7. **Power Efficiency**: Multiple power supply options suitable for portable and stationary IoT solutions

Experiment List

1. **Getting Started with GPIO and Python**

Note: Specifications are subject to change, Photos shown above are Indicative, Actual Product can Vary.

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- Objective: Learn GPIO pin configuration and basic I/O operations using Python
- Key Concepts: GPIO manipulation, digital I/O, event handling

2. **UART Communication Setup**
   - Objective: Configure UART for data exchange between Raspberry Pi and external devices
   - Key Concepts: UART communication, serial debugging, data logging

3. **Sensor Integration Using I2C & SPI**
   - Objective: Interface and read data from various sensors
   - Key Concepts: Sensor communication (I2C, SPI), data acquisition, sensor interfacing
   - Sensors:
   ▪ HTU21 (Temperature & Humidity)
   ▪ BH1750 (Light)
   ▪ MPU6050 (Accelerometer & Gyroscope)

4. **MQTT Communication with Cloud**
   - Objective: Publish sensor data to cloud using MQTT
   - Key Concepts: MQTT protocol, cloud integration, IoT data transmission

5. **Real-Time Dashboard with Node-RED**
   - Objective: Create a local dashboard for visualizing sensor data
   - Key Concepts: Node-RED, real-time visualization, IoT monitoring

6. **Camera-Based Data Logging**
   - Objective: Capture images/video for analysis
   - Key Concepts: Image processing, data logging, storage management

7. **Edge AI Model Deployment with TensorFlow Lite**
   - Objective: Train/deploy an AI model for object detection
   - Key Concepts: ML model training, edge inference, TensorFlow Lite deployment

8. **IoT-Based Environmental Monitoring**
   - Objective: Collect environmental data, cloud storage, remote visualization
   - Key Concepts: Remote monitoring, cloud storage, real-time analytics

9. **Designing a Home Automation System**
   - Objective: Automate home appliances with mobile app control
   - Key Concepts: IoT automation, mobile integration, system control

10. **Anomaly Detection Using Machine Learning**
    - Objective: Implement anomaly detection in sensor data
    - Key Concepts: Anomaly detection, data analysis, ML application

11. **Building a Web Server**
    - Objective: Set up a web server for local/remote IoT data access
    - Key Concepts: Web server configuration, HTTP protocols, data serving

Platform and Workstation Details

- Training Environment Setup:

  - Display: 4-inch capacitive touch LCD for interaction with the Raspberry Pi system

  - Connectivity: USB OTG, I2C, SPI, UART for external device interfaces

  - Power Supply: USB-C or GPIO header for flexible power options

Note: Specifications are subject to change, Photos shown above are Indicative, Actual Product can Vary.

- Enclosure: Plastic or durable case for industrial protection

• Expansion Options: 40-pin GPIO header allows integration with additional sensors, actuators, and peripherals

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