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## **Arduino + IoT + Computer Vision Roadmap**

**Duration:** ~6 months (Adjustable based on your schedule)

### **Phase 1: Electronics & Arduino Fundamentals (Weeks 1–3)**

**Goal:** Build a strong base in electronics, Arduino IDE, and C++ logic.

**Core Topics:**

* Voltage, current, resistance (Ohm's Law)
* Breadboard + schematics
* Digital & analog I/O
* Arduino IDE + syntax

**Projects:**

1. Blink an LED
2. Traffic Light Controller
3. Digital Thermometer (LM35 + LCD)
4. Potentiometer-based LED Brightness

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### **Phase 2: Sensor Interfacing & Data Handling (Weeks 4–6)**

**Goal:** Work with real-world sensors to gather data.

**Sensors to Use:**

* LDR (Light)
* PIR (Motion)
* Ultrasonic (Distance)
* DHT11/22 (Temperature & Humidity)
* Soil Moisture
* IR Sensor

**Projects:** 5. Intruder Alert System (PIR + buzzer)  
 6. Smart Parking (Ultrasonic sensor + LEDs)  
 7. Environment Monitor with LCD (DHT + LDR + Soil)

### **Phase 3: Actuators, Outputs, and Automation (Weeks 7–9)**

**Goal:** Control physical world using motors and outputs.

**Topics:**

* Servo, DC, and stepper motors
* Relays and solenoids
* LCD, OLED displays
* PWM and external power

**Projects:** 8. Smart Fan (DC motor + Temp sensor)  
 9. Servo Lock + Password System  
 10. Relay-controlled Smart Light System

### **Phase 4: Intro to IoT with Arduino + ESP8266 (Weeks 10–12)**

**Goal:** Send sensor data to the cloud; monitor/control remotely.

**Skills:**

* Wi-Fi connection with ESP8266 / NodeMCU
* HTTP requests, APIs, IFTTT
* MQTT basics
* Cloud platforms (Blynk, ThingSpeak, Firebase)

**Projects:** 11. Wi-Fi Weather Station  
 12. Smart Plant Monitor (Soil + Temp + Water pump)  
 13. Home Automation with App (Lights + Fan)

**Bonus Tools:**

* MIT App Inventor for building phone apps
* Telegram bot integration for alerts

### **Phase 5: Data Logging & Visualization (Weeks 13–14)**

**Goal:** Store and visualize data for analysis and real-time insights.

**Topics:**

* SD card module
* Real-time Clock (RTC)
* Cloud dashboards (Google Sheets, Firebase, Blynk Graphs)

**Projects:** 14. Smart Farming Logger (Soil, Temp, Humidity to SD Card)  
 15. Real-time Data Plotter (ESP to Google Sheets)

### **Phase 6: Edge AI & Computer Vision (Weeks 15–18)**

**Goal:** Use AI and vision to make smart decisions.

**Platforms:**

* Edge AI with **OpenMV Cam**, **Arduino Portenta**, or **Raspberry Pi**
* Use **Teachable Machine**, **Edge Impulse**, or **MediaPipe**

**Topics:**

* Object detection
* Gesture recognition
* Simple ML models on microcontrollers

**Projects:** 16. Face Detection Door Lock (OpenCV + Raspberry Pi + Servo)  
 17. AI Trash Sorter (Image classification)  
 18. Gesture-Controlled Robot (Camera + ML model)

**AI Tools:**

* [Edge Impulse](https://www.edgeimpulse.com/) (Train ML for Arduino)
* Google Teachable Machine (Quick prototyping)

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### **Phase 7: Final Capstone Projects (Weeks 19–24)**

**Goal:** Solve a real-world problem using full system integration (hardware + cloud + AI).

**Capstone Project Ideas:**

1. **Smart Traffic Control System**
   * Sensors + Camera + AI for vehicle detection
   * Adaptive light switching
   * Cloud data dashboard
2. **Smart Healthcare Monitor**
   * Heart rate, temperature, SpO2 + AI fall detection
   * Alerts via Telegram or mobile app
   * Data logs + visualization
3. **Smart Recycling Bin**
   * Servo-operated lid
   * AI model to detect metal/plastic/paper
   * Firebase-connected usage stats
4. **Agritech Solution**
   * Soil, temp, humidity sensors
   * Cloud alerts, automatic irrigation
   * Weather API integration

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## **Bonus Tracks (Optional Mastery)**

### **Track A: Mobile App Development for IoT**

* Build Flutter apps to control Arduino/ESP
* Use REST APIs or MQTT
* Connect app to Firebase

### **Track B: Professional Development**

* Document project on GitHub
* Build portfolio with photos, videos, and code
* Create a LinkedIn post and YouTube demo

## **Hardware You’ll Need:**

| **Item** | **Quantity** |
| --- | --- |
| Arduino Uno | 1–2 |
| ESP8266 / NodeMCU | 1 |
| Raspberry Pi (or OpenMV Cam) | 1 (optional for CV) |
| Breadboard & Jumper Wires | 1 kit |
| Sensors (LDR, PIR, DHT, Soil, Ultrasonic) | 1 each |
| Motors (Servo, DC + L298N) | 2–3 |
| SD Card Module + SD Card | 1 |
| LCD (I2C preferred) / OLED | 1 |
| Relay Module | 1 |
| Power Supply (Battery or Adapter) | 1 |

## **Software & Tools:**

* **Arduino IDE**
* **Tinkercad Circuits** (Simulations)
* **Edge Impulse** (ML on Arduino)
* **Teachable Machine**
* **Blynk / Firebase / ThingSpeak**
* **OpenCV (Python)**
* **Fritzing** (for diagrams)
* **Flutter (for mobile control)**

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## **Supportive Resources:**

* **Courses:**
  + *Paul McWhorter Arduino Full Playlist* (YouTube)
  + *IoT with Blynk & NodeMCU – Udemy*
  + *Edge AI with TinyML – Coursera*
  + *Computer Vision with OpenCV – freeCodeCamp*
* **Books:**
  + “Arduino Cookbook” – O’Reilly
  + “Make: Electronics” – Charles Platt
  + “Python for Computer Vision” – Adrian Rosebrock

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