Project List: IoT & Robotics 6th to 9th

Here is a revised compilation of project ideas, focusing exclusively on ESP boards, with more detailed component lists and updated costs suitable for your workshops.

1. LoRa-Based Remote Control System (Smart Irrigation)

- **What it Does:** This system allows you to control a water pump from a long distance (1-2 km) without needing an internet connection. A button press on a transmitter sends a signal via LoRa to a receiver, which then activates the pump.
- **Detailed Creative Idea:** "The Farm of the Future Challenge." Students can create a miniature farm model. They'll set up the LoRa system to water a specific crop patch. The challenge could be to see whose system can be activated from the furthest point in the school field.
- **Items & Estimated Cost:**
    - ESP8266 (NodeMCU) (x2): ₹700
    - LoRa Module (Ra-02) (x2): ₹1200
    - 5V Relay Module: ₹150
    - Mini Submersible Water Pump: ₹250
    - Push Button & Switch: ₹50
    - Breadboards (x2): ₹150
    - Jumper Wires: ₹100
    - **Project Total Estimate:** ₹2600

2. Sun Tracking Solar Panel

- **What it Does:** The solar panel automatically follows the sun to capture the maximum amount of light throughout the day, making it more efficient.
- **Detailed Creative Idea:** "The Mars Rover Power Challenge." Students can build a small model of a Mars rover with a sun-tracking solar panel. They can measure the power output of a fixed solar panel versus their sun-tracking one to see the difference.
- **Items & Estimated Cost:**
    - ESP8266 (NodeMCU): ₹350
    - LDRs (Light Dependent Resistors) (x4): ₹50
    - SG90 Servo Motors (x2): ₹350
    - Small Solar Panel (6V): ₹300
    - TP4056 Charging Module: ₹100
    - 18650 Li-Ion Battery & Holder: ₹350
    - Breadboard & Jumper Wires: ₹150

- ○ **Project Total Estimate:** ₹1650

3. Smart Railway Crossing Automation

- **What it Does:** This system automatically closes a railway gate when a train approaches and opens it after the train has passed, using sensors to detect the train.
- **Detailed Creative Idea:** "The Safe City Project." Students can build a model of a city intersection with a railway crossing. They will program the system to not only close the gate but also activate warning lights and sounds for pedestrians and cars.
- **Items & Estimated Cost:**
  - ○ ESP8266 (NodeMCU): ₹350
  - ○ IR Sensors (x2): ₹150
  - ○ SG90 Servo Motor: ₹180
  - ○ Buzzer & LEDs (Red, Green): ₹70
  - ○ Breadboard & Jumper Wires: ₹150
  - ○ 9V Battery & Connector: ₹100
  - ○ **Project Total Estimate:** ₹1000

4. Smart Room/Home Automation

- **What it Does:** Control lights and fans using motion sensors and a mobile phone app.
- **Detailed Creative Idea:** "The Ultimate Smart Dorm Room." Students can design and build a model of a smart room. They can program it so that when someone enters, the lights turn on. They can also add a feature to control these appliances with a smartphone app like Blynk.
- **Items & Estimated Cost:**
  - ○ ESP8266 (NodeMCU): ₹350
  - ○ 2-Channel Relay Module: ₹200
  - ○ PIR Motion Sensor: ₹150
  - ○ Mini Bulb & Holder, Mini Fan: ₹150
  - ○ Smartphone App (Blynk/similar): Free
  - ○ Breadboard & Jumper Wires: ₹150
  - ○ **Project Total Estimate:** ₹1000

5. ESP Drone

- **What it Does:** A small, remote-controlled drone that uses a gyroscope for stability and can be controlled wirelessly.
- **Detailed Creative Idea:** "The Drone Rescue Mission." Students can build their own mini-drones and then try to navigate them through an obstacle course to "rescue" a small object.
- **Items & Estimated Cost:**
  - ESP32: ₹550
  - MPU6050 Gyro/Accelerometer: ₹200
  - Coreless Motors (4x) & Propellers: ₹500
  - A-30 FET/Motor Driver Module: ₹350
  - 3.7V LiPo Battery & Charger: ₹900
  - Drone Frame (3D printed or custom): ₹400
  - Jumper Wires: ₹100
  - **Project Total Estimate:** ₹3000

6. Surveillance Car (ESP32-CAM)

- **What it Does:** A remote-controlled car that streams live video to a web browser, allowing you to see what the car sees in real-time.
- **Detailed Creative Idea:** "The Explorer Bot." Students can build a surveillance car to explore areas they can't easily reach. They can set up a mission to find a hidden object using only the video feed from the car.
- **Items & Estimated Cost:**
  - ESP32-CAM with Programmer: ₹950
  - L298N Motor Driver: ₹200
  - BO Motors & Wheels (x4): ₹400
  - Robot Car Chassis: ₹250
  - 18650 Li-Ion Batteries (x2) & Holder: ₹600
  - Jumper Wires & Switch: ₹100
  - **Project Total Estimate:** ₹2500

7. Obstacle Avoidance Car

- **What it Does:** A car that can navigate on its own by sensing obstacles in its path and automatically changing direction to avoid them.
- **Detailed Creative Idea:** "The Self-Driving Challenge." Students can build a small maze and challenge their cars to navigate it from start to finish without any human intervention.
- **Items & Estimated Cost:**

- ESP8266 (NodeMCU): ₹350
- HC-SR04 Ultrasonic Sensor: ₹150
- L298N Motor Driver: ₹200
- BO Motors & Wheels (x2): ₹250
- Robot Car Chassis (2WD): ₹200
- 18650 Li-Ion Batteries (x2) & Holder: ₹600
- Breadboard & Jumper Wires: ₹150
- **Project Total Estimate:** ₹1900

8. Motion Detection Camera

- **What it Does:** A camera that automatically takes a picture when it detects motion and can send it to you via an app like Telegram.
- **Detailed Creative Idea:** "The Wildlife Camera Trap." Students can set up their motion-activated cameras to try and capture pictures of "wildlife" (e.g., pets, siblings, or even toy animals).
- **Items & Estimated Cost:**
  - ESP32-CAM with Programmer: ₹950
  - PIR Motion Sensor: ₹150
  - 3.7V LiPo Battery & Charger: ₹500
  - Small Enclosure/Case: ₹150
  - Jumper Wires: ₹50
  - **Project Total Estimate:** ₹1800

9. Smart Blind Stick

- **What it Does:** A walking stick that helps visually impaired people by detecting obstacles and warning them with a sound or vibration.
- **Detailed Creative Idea:** "The Super Sense Device." Students can design and build their own smart stick. They can then test it by navigating an obstacle course while blindfolded (with supervision).
- **Items & Estimated Cost:**
  - ESP8266 (NodeMCU): ₹350
  - HC-SR04 Ultrasonic Sensor: ₹150
  - Buzzer & Vibration Motor: ₹150
  - 18650 Battery, Holder & TP4056 Module: ₹450
  - Stick/Casing & Switch: ₹100
  - Jumper Wires: ₹50

- ○ **Project Total Estimate:** ₹1250

10. Spy Cam

- **What it does:** This project lets you build a small camera that can record or stream video secretly.
- **Detailed Creative Idea:** "The Secret Agent Mission." Students can be tasked with a "mission" to discreetly record a specific event or object without being noticed.
- **Items & Estimated Cost:**
  - ○ ESP32-CAM with Programmer: ₹950
  - ○ Small 3.7V LiPo Battery: ₹400
  - ○ Micro SD Card (16GB): ₹350
  - ○ TP4056 Charging Module: ₹100
  - ○ Small Enclosure/Case: ₹150
  - ○ **Project Total Estimate:** ₹1950

11. Automatic Plant Watering System

- **What it does:** This system detects if the soil is dry and automatically waters the plant when it needs it.
- **Detailed Creative Idea:** "The Guardian of the Galaxy's Plant." Students can be tasked with keeping a "rare and exotic" plant alive. They'll build a system that waters the plant and sends a notification when the water reservoir is low.
- **Items & Estimated Cost:**
  - ○ ESP8266 (NodeMCU): ₹350
  - ○ Capacitive Soil Moisture Sensor: ₹150
  - ○ Mini Submersible Water Pump: ₹250
  - ○ 5V Relay Module: ₹150
  - ○ Vinyl Pipe & Container: ₹100
  - ○ Breadboard & Jumper Wires: ₹150
  - ○ **Project Total Estimate:** ₹1150

12. Visitor Counter

- **What it does:** Counts people entering and exiting a space and shows the count on a display.
- **Detailed Creative Idea:** "The Big Event Tracker." Students can set up their visitor counters at the entrance of a classroom or a school event. They can track how many people attend over a certain period.

- **Items & Estimated Cost:**
  - ESP8266 (NodeMCU): ₹350
  - IR Sensors (x2): ₹150
  - OLED Display (0.96 inch): ₹300
  - Power Supply/Adapter: ₹200
  - Breadboard & Jumper Wires: ₹150
  - **Project Total Estimate:** ₹1150

13. Smart Rain Detection System

- **What it does:** Detects rain and can trigger an alarm or an action, like sending a notification.
- **Detailed Creative Idea:** "The Automated Laundry Saver." Students can build a system that, when it detects rain, sends a notification to their phone, warning them to bring the laundry inside.
- **Items & Estimated Cost:**
  - ESP8266 (NodeMCU): ₹350
  - Rain Sensor Module: ₹120
  - Buzzer: ₹50
  - Power Supply/Adapter: ₹200
  - Breadboard & Jumper Wires: ₹150
  - **Project Total Estimate:** ₹870

14. Human Following Robot

- **What it does:** A robot that follows a person as they walk.
- **Detailed Creative Idea:** "The Robot Butler." Students can design their robot to follow them around and carry a small object. This project is a great introduction to more advanced robotics, involving multiple sensors.
- **Items & Estimated Cost:**
  - ESP32: ₹550
  - HC-SR04 Ultrasonic Sensor: ₹150
  - L298N Motor Driver: ₹200
  - DC Motors & Wheels (x4): ₹400
  - Robot Car Chassis (4WD): ₹300
  - 18650 Batteries (x2) & Holder: ₹600
  - Jumper Wires & Breadboard: ₹150
  - **Project Total Estimate:** ₹2350

15. Light Following Robot

- **What it does:** A robot that moves towards the strongest source of light.
- **Detailed Creative Idea:** "The Moth-Bot." Students can create a robot that behaves like a moth, always moving towards a flashlight beam. They can have races to see whose robot can follow a light path the fastest.
- **Items & Estimated Cost:**
  - ESP8266 (NodeMCU): ₹350
  - LDR Sensors (x2) & Resistors: ₹50
  - L298N Motor Driver: ₹200
  - DC Motors & Wheels (x2): ₹250
  - Robot Car Chassis (2WD) with Caster Wheel: ₹200
  - 18650 Batteries (x2) & Holder: ₹600
  - Breadboard & Jumper Wires: ₹150
  - **Project Total Estimate:** ₹1800

16. Air Quality Monitoring

- **What it does:** Measures the level of pollution and gases in the air and displays it.
- **Detailed Creative Idea:** "The Environmental Detective." Students can use their air quality monitors to test the air in different locations around the school and compare the results, logging data to the cloud.
- **Items & Estimated Cost:**
  - ESP8266 (NodeMCU): ₹350
  - MQ-135 Gas Sensor: ₹250
  - DHT11 Temperature & Humidity Sensor: ₹180
  - OLED Display (0.96 inch): ₹300
  - Breadboard & Jumper Wires: ₹150
  - Power Supply: ₹200
  - **Project Total Estimate:** ₹1430

17. Wi-Fi Controlled Car

- **What it does:** A car that can be driven using a smartphone over a Wi-Fi connection.
- **Detailed Creative Idea:** "The Remote Rover." Students can create their own Wi-Fi controlled cars and then design a challenging obstacle course to navigate using a web interface on their phones.

- **Items & Estimated Cost:**
  - ESP8266 (NodeMCU): ₹350
  - L298N Motor Driver: ₹200
  - BO Motors & Wheels (x2): ₹250
  - Robot Car Chassis (2WD): ₹200
  - 18650 Batteries (x2) & Holder: ₹600
  - Jumper Wires: ₹50
  - **Project Total Estimate:** ₹1650

18. Gesture Control Robot

- **What it does:** Control a robot car using hand movements.
- **Detailed Creative Idea:** "The Force-Controlled Car." Students build a car and a separate gesture controller. They can control the car by tilting their hand, as if using "the Force."
- **Items & Estimated Cost:**
  - **Car:** ESP8266 (NodeMCU), L298N Driver, Motors (x2), Wheels (x2), Chassis, Battery Pack: ₹1500
  - **Controller:** ESP8266 (NodeMCU), MPU6050 Accelerometer, Battery Pack, Casing: ₹1000
  - **Project Total Estimate:** ₹2500

19. Dancing Robot

- **What it does:** A robot that can perform programmed dance moves with its arms and display graphics on a screen.
- **Detailed Creative Idea:** "The Robot Dance-Off." Students can choreograph their own dance routines for their robots and have a "dance-off" to see which robot has the best moves.
- **Items & Estimated Cost:**
  - ESP32: ₹550
  - SG90 Servos (x4): ₹700
  - 1.8" TFT Display: ₹450
  - 18650 Batteries (x2) & Holder: ₹600
  - 3D Printed Robot Frame/Body: ₹500
  - Mini Breadboard & Wires: ₹100
  - **Project Total Estimate:** ₹2900

20. AI Parking System

- **What it does:** An automated system that finds empty parking spots and indicates their status with LEDs.
- **Detailed Creative Idea:** "The Smart City Parking Garage." Students can build a model of a parking garage. Their system will use sensors to detect which spots are empty and light up corresponding LEDs (Green for empty, Red for taken).
- **Items & Estimated Cost:**
    - ESP32: ₹550
    - Ultrasonic Sensors (HC-SR04) (x3): ₹450
    - LEDs (Red & Green, 3 each): ₹50
    - Resistors: ₹50
    - Breadboard & Jumper Wires: ₹150
    - Power Supply: ₹200
    - **Project Total Estimate:** ₹1450

21. Web-Controlled Robotic Arm

- **What it Does:** A robotic arm that can be controlled precisely from a web browser on any device on the same network. The interface will have sliders to control each joint of the arm.
- **Detailed Creative Idea:** "The Remote Bomb Disposal Bot." Students build the robotic arm and a web interface with sliders for each servo. The challenge is to perform a delicate task remotely, like picking up a small object ("a bomb") and dropping it into a safe zone, or stacking small blocks. This teaches web servers on ESP32, controlling multiple servos, and teleoperation.
- **Items & Estimated Cost:**
    - ESP32: ₹550
    - 3-Axis Robotic Arm Kit with Servos: ₹1000
    - 5V 2A Power Supply (for servos): ₹300
    - Breadboard & Jumper Wires: ₹150
    - **Project Total Estimate:** ₹2000

22. Smart Alarm Clock

- **What it Does:** An alarm clock that wakes you up with gradually increasing light and displays the time and weather forecast. It gets all its data from the internet.
- **Detailed Creative Idea:** "The Perfect Morning Machine." Students design an alarm clock that creates a pleasant wake-up experience. The alarm is set via a

simple webpage. When it's time to wake up, a Neopixel ring simulates a sunrise, and an OLED screen shows the time and a weather icon (sunny, cloudy, etc.). This project combines IoT, lighting, and display technologies.

- **Items & Estimated Cost:**
  - ESP8266 (NodeMCU): ₹350
  - OLED Display (0.96 inch): ₹300
  - WS2812B Neopixel Ring (12-16 LEDs): ₹250
  - Buzzer & Push Buttons: ₹70
  - Power Supply & Casing: ₹300
  - **Project Total Estimate:** ₹1270

23. Password-Protected Door Lock

- **What it Does:** A door lock that opens only when the correct password is entered on a keypad. It gives visual and audio feedback for correct or incorrect entries.
- **Detailed Creative Idea:** "The Secret Clubhouse Door." Students build a lock for a model door. They set their own secret password in the code. When the correct code is entered, the screen shows "Access Granted," a green LED lights up, and a servo retracts the "bolt." An incorrect code shows "Access Denied" and flashes a red LED. This is a very satisfying project that teaches about input (keypad), output, and programming logic.
- **Items & Estimated Cost:**
  - ESP8266 (NodeMCU): ₹350
  - 4x4 Matrix Keypad: ₹150
  - OLED Display: ₹300
  - SG90 Servo Motor (for the lock): ₹180
  - LEDs, Buzzer, Resistors: ₹100
  - Battery Pack/Power Supply: ₹300
  - Breadboard & Wires: ₹150
  - **Project Total Estimate:** ₹1530

Overall Estimated Cost

Total Estimated Cost for All 23 Projects: ₹40,330

Note: These prices are approximate and can vary based on the vendor and location.