Robotics & IoT Project Curriculum: Grades 2-9

This document outlines a structured, project-based curriculum for students from Grade 2 to Grade 9. The plan is divided into two main stages:

- **Grades 2-5 (No-Code):** Focus on foundational skills in mechanics, basic electronics, and sensor-based cause-and-effect without any programming.
- **Grades 6-9 (Coding-Focused):** Introduce coding with ESP boards (ESP8266/ESP32) to build more complex IoT and robotics projects.

Each grade level features 6 projects designed to be age-appropriate and progressively build upon skills learned in previous years.

Grade 2: Exploring Basic Cause & Effect

Focus: Simple circuits, vibration, and magnetism. These projects provide immediate and fun feedback with minimal components.

1. **Scribble Bot:** Excellent for creativity and understanding how off-balance motors create movement.
2. **Bristlebot Racer:** Teaches the same vibration principle as the Scribble Bot but in a more directed, competitive way.
3. **The Hissing Snake:** A fun, creative build that reinforces the concept of using a vibrating motor to create motion.
4. **Floating Magic Carpet:** A perfect no-electronics introduction to a fundamental force of physics: magnetism.
5. **The Wobbly Penguin:** Introduces the tilt sensor, one of the simplest electronic sensors to understand.
6. **The Wind Power Generator:** A fantastic, hands-on demonstration of how kinetic energy can be converted into electrical energy.

Grade 3: Introduction to Basic Sensors

Focus: Using simple sensors like LDRs, sound sensors, and switches to trigger an output (light or sound).

1. **The Dragon's Treasure Guard:** A great introduction to light sensors (LDRs) in a fun, story-based context.
2. **The Magical Wishing Star:** Uses a sound sensor, which feels like magic to this age group ("clap-on").
3. **The Cookie Jar Guardian:** Introduces mechanical switches (limit switch) in a

practical, easy-to-understand scenario.

4. **The Wizard's Magic Wand:** Teaches the concept of a magnetically operated reed switch, which is another "magical" interaction.
5. **The Thirsty Plant Alert:** A safe and simple way to demonstrate conductivity using water to complete a circuit.
6. **The Mood Stone:** Introduces thermistors and the idea that electronic components can react to temperature.

Grade 4: Building Simple Systems

Focus: Combining multiple components and introducing more complex setups like solar power and IR sensors.

1. **The Automatic Forest Hut Lamp:** A classic LDR project that introduces the transistor as a switch to control a light.
2. **The Grumpy Volcano:** Combines a sound sensor with two outputs (vibration motor and LED), showing a single input can trigger multiple actions.
3. **The Sunflower Power-Up:** A simple and effective introduction to solar energy and how it can power a motor.
4. **Air-Gesture Magic Fan:** Introduces the IR proximity sensor for touchless control, a very engaging concept for kids.
5. **Junkbot Assemblage:** Shifts focus to creative mechanical design, encouraging recycling and imagination while using a basic motor circuit.
6. **The Secret Agent Laser Maze:** A slightly more complex build that is thrilling for kids and teaches about breaking a beam of light.

Grade 5: Pre-Coding Robotics & Automation

Focus: Mechanical robots that use clever electronic setups (no code) to perform automated tasks.

1. **The Light-Chasing Beetle Bot:** Uses two LDRs and motors to create simple "seeking" behavior, a foundational concept in robotics.
2. **The Bump-and-Turn Ant:** Teaches obstacle avoidance using mechanical limit switches, demonstrating how robots can react to their environment.
3. **The Crawling Inchworm:** A great mechanical challenge that uses a motor and a crank to create a unique crawling motion.
4. **The Propeller Racer:** Focuses on concepts of thrust, aerodynamics, and lightweight construction.
5. **The Helpful Robot Hand-Washer:** A practical automation project using an IR

sensor and a pump, showing how robotics can solve real-world problems.
6. **The Automatic Railway Gate:** A perfect pre-coding automation project demonstrating how a switch can trigger a servo/motor to perform a mechanical action.

Grade 6: First Steps with Coding (ESP8266/ESP32)

Focus: Introduction to the Arduino IDE/MicroPython, simple sensor readings, and controlling outputs with code.

1. **Smart Rain Detection System:** An ideal first coding project. The logic is simple: if rain is detected, then sound the buzzer.
2. **Automatic Plant Watering System:** Introduces controlling a relay module with code and reading a capacitive soil moisture sensor.
3. **Wi-Fi Controlled Car:** An exciting project that introduces controlling motors and receiving commands over Wi-Fi.
4. **Visitor Counter:** Teaches how to use two IR sensors to count entries/exits and display the result on an OLED screen.
5. **Light Following Robot (Coded Version):** Rebuilds the Grade 5 concept but uses code to read LDR values and control motors for more precise control.
6. **Smart Room/Home Automation:** Introduces using a PIR motion sensor and controlling a relay, with the added fun of connecting it to an app like Blynk.

Grade 7: Intermediate IoT & Robotics

Focus: More complex code logic, combining multiple sensors, and solving navigation challenges.

1. **Obstacle Avoidance Car:** The next logical step from a Wi-Fi car, using an ultrasonic sensor to make autonomous decisions.
2. **Smart Blind Stick:** A meaningful project that uses an ultrasonic sensor with vibration/sound feedback, showing the social value of technology.
3. **Sun Tracking Solar Panel:** Involves coding two servos to respond to readings from four LDRs, requiring more complex positioning logic.
4. **Air Quality Monitoring:** Teaches students how to interface with advanced sensors (MQ-135, DHT11) and display multiple data points.
5. **Smart Railway Crossing Automation (Coded Version):** Upgrades the Grade 5 project with IR sensors, LEDs, and a buzzer, all controlled by code.
6. **Motion Detection Camera (ESP32-CAM):** An introduction to the ESP32-CAM where motion triggers the camera to take and save a picture.

Grade 8: Advanced Systems & Communication

Focus: Wireless communication beyond Wi-Fi (LoRa), advanced sensors (accelerometers), and video streaming.

1. **Gesture Control Robot:** A challenging project where students build a wearable controller with an accelerometer to drive a robot.
2. **Surveillance Car (ESP32-CAM):** Moves beyond a single picture to streaming live video over Wi-Fi.
3. **LoRa-Based Remote Control System:** Introduces long-range radio communication, a powerful concept beyond typical Wi-Fi.
4. **Spy Cam:** Builds on the motion camera project by adding features like sending notifications to a service like Telegram.
5. **Password-Protected Door Lock:** Uses a keypad for user input and a servo as a lock, teaching about user input and state machines.
6. **Smart Alarm Clock:** Involves an RTC module and connecting to an NTP server over Wi-Fi to get the correct time automatically.

Grade 9: Capstone & AI-Based Projects

Focus: System integration, complex mechanics, and introductory AI/machine learning concepts.

1. **ESP Drone:** The ultimate mechanical, electronic, and software challenge, requiring an understanding of flight dynamics and PID controllers.
2. **Human Following Robot:** Requires a robust chassis and clever sensor programming to reliably track and follow a person.
3. **AI Parking System:** Uses multiple ultrasonic sensors and an ESP32 to manage a whole system, making decisions based on data from several sources.
4. **Dancing Robot:** A complex project that integrates multiple servos for "choreographed" movements.
5. **Web-Controlled Robotic Arm:** A great capstone project involving a web interface to control a 3-4 servo robotic arm smoothly.
6. **IoT Weather Station with Cloud Logging:** A comprehensive project combining multiple sensors to push data to a cloud platform for live visualization and analysis.