



Programming a Cloud Light Detection system

Duration	90 minutes
Age group	15-19 yo.
Objectives	<p>Aim: Creating a project using a microcontroller and a light sensor to measure the light level and store data on the cloud.</p> <p>Objectives:</p> <ul style="list-style-type: none">• Understand how IoT devices communicate and send data to the cloud.• Interface a light sensor (e.g., LDR or BH1750) with the ESP8266 microcontroller.• Connect the ESP8266 to Wi-Fi and transmit data to a cloud service.• Visualize collected data via a dashboard or online platform.
Learning Outcomes	<p>Computer Science / Programming</p> <ul style="list-style-type: none">• Students will write Arduino/ESP8266 programs to read sensor input.

**in Line with
Curriculum**

- Students will debug and troubleshoot hardware–software communication errors.
- Students will understand the use of APIs and how data is transmitted over Wi-Fi.
- Students will apply coding logic for conditional actions based on sensor values.

Math:

- Students will analyze numerical light–intensity values.
- Students will observe trends and interpret graphed data over time.
- Students will utilize measurement, comparison, and threshold calculations to make decisions.

Science / Physics:

- Students will understand the concept of photons, luminosity, and light measurement.
- Students will relate sensor physics to real-world phenomena (day vs night, room lighting, shadows).
- Students will use hypothesis-based observations and experimental verification.

Cross-Curricular Skills (Key Competences for Lifelong Learning – European Reference Framework):

1. Problem Solving

- Students diagnose wiring, coding, or connection issues.
 - They experiment with different light conditions to refine results.
 - They iterate the design based on testing outcomes
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	<p>2. Critical Thinking</p> <ul style="list-style-type: none">• Students evaluate sensor readings for reliability.• They reason about data interpretation (e.g., why readings change).• They consider environmental factors affecting measurements. <p>3. Creativity & Innovation</p> <ul style="list-style-type: none">• Designing an original IoT solution.• Proposing new features (alarms, notifications, automation).• Thinking beyond the classroom—smart homes, agriculture, smart cities. <p>4. Collaboration & Teamwork</p> <ul style="list-style-type: none">• Students work in pairs or groups to assemble the circuit.• They divide roles: programmer, hardware technician, data analyst.• They communicate findings and provide peer feedback.
Teaching Methods	<ul style="list-style-type: none">• Expository: Presentation, storytelling.• Problem-solving: Questions prompting reflection.• Practical: Manual, light detector construction.• Interactive: Brainstorming, group discussion.

Materials Needed

- ESP8266 (NodeMCU)
- Traffic Light Module
- Female-female Jumper Cables (ab. 10 pc) and USB-microUSB cables
- Light sensor (Digital light sensor such as BH1750)
- Laptop with Arduino IDE installed
- Internet access / Wi-Fi

- Cloud platform (e.g., ThingSpeak, Adafruit IO, MQTT broker)
- TUNIOT FOR ESP8266 (attachment 15)
- Teacher Guide (attachment 16)

Workshop/Lesson Plan

Duration	Description	Notes
10 minutes	<p>Introduction to Embedded systems and with real world applications</p> <p>Asking the students about their prior knowledge about Embedded systems.</p> <p>Showing a short video about Embedded system.</p>	<p>Resource 1: What is an Embedded system (attachment 17)</p>
20 minutes	<p>The LED programming</p> <ul style="list-style-type: none"> ○ Blinking the Internal LED <ul style="list-style-type: none"> ○ Create the blink program with TUNIOT ○ Upload the program <p><u>Challenge 1</u> : Make a change to the program using TUNOT and blink the LED faster.</p> <p><u>Challenge 2</u>: Make a change to program using the ARDUINO IDE and blink the LED slower.</p> <ul style="list-style-type: none"> ○ The Traffic light Module <ul style="list-style-type: none"> ○ Connect the traffic light module to the NODEMCU. Use the resource 5 ○ Test your module by turning on all 	<p>Resource 2: Blink the Internal LED (attachment 18)</p> <p><u>Challenge 1 answer key:</u> Resource 3 (attachment 19)</p> <p>Challenge 2 answer key: Resource 4 (attachment 20)</p>

	<p>the LEDs. Use the resource 6</p>	<p>Resource 5: Traffic light wiring (attachment 21)</p> <p>Resource 6: The traffic light Module (attachment 22)</p>
10 minutes	<p>The Light Sensor programming</p> <ul style="list-style-type: none"> ○ Hardware setup <ul style="list-style-type: none"> ○ Connecting the light sensor to the NODEMCU ○ Software setup <ul style="list-style-type: none"> ○ Displaying the value of the light sensor on the serial Monitor 	<p>Resource 7: BH1750 wiring (attachment 23)</p> <p>Resource 8: The light Sensor Module (attachment 24)</p>
5 minutes	<p>Quiz 1: Embedded systems (attachment 25)</p>	
5 minutes	<p>Introduction to IOT</p> <p>What is IoT? What is an object? How objects are connected together?</p>	<p>Resource 9: What is IOT? (attachment 26)</p>
15 minutes	<p>Connecting the ESP8266 to WIFI</p> <p><u>Challenge 3:</u> Make some modification to the program: when the board is not connected to a wifi network, the Red LED is turned ON. When the board is connected the Green LED is ON.</p>	<p>Resource 10: Connecting to Networks (attachment 27)</p> <p><u>Challenge 3 answer key:</u></p>

		Resource 11: Connecting to networks with LED (attachment 28)
20 minutes	Sending data to the cloud <ul style="list-style-type: none"> ○ Creating an account with Thingspeak ○ Sending random data to ThingSpeak ○ Sending sensor's data to the cloud ○ Take readings in different lighting environments 	Resource 12: Sending data to Thingspeak (attachment 29)
5 minutes	Quiz 2: IOT (attachment 30)	

Reflection Questions

Embedded Systems & IoT

- What makes an embedded system different from a general-purpose computer?
- Why is a microcontroller suitable for specific tasks in everyday devices?
- How does the ESP8266 support Internet of Things (IoT) applications?
- Why is built-in Wi-Fi an advantage in smart device design?
- What information does the BH1750 sensor provide?
- How does the sensor's light measurement relate to real-life environments (e.g. classroom, sunlight, dark room)?
- What did you learn from programming the traffic light module?
- What challenges did you face during wiring or programming?
- How could this project be expanded into a real smart-city or environmental monitoring system?

Higher-order Reflection

- How can embedded systems help solve environmental problems such as light pollution?
- In what ways does this activity connect programming with real-life problem solving?
- How might IoT technology be used to improve energy efficiency in cities or schools?

Additional materials

<http://easycoding.tn/index.php/nodemcu/video-tutorials/>

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