

| **CODEDU’s Students’ Training Course** | | | | | | |
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| **Section 7: Final Project and Showcase** | | | | | | |
| **Subject: Introduction to Arduino** | **Duration (in hours):**  **3-4 hours** | | | | **Module 7.1 Final Project Development**  **Module 7.2 Project Showcase and Celebration** | |
| **Target audience: Upper-primary and Secondary School Students** | | | | | | |
| **Training methodology: -** | | | | | | |
| **Level (and cycle, if applicable) of the learning experience: Beginner – Intermediate** | | | | | | |
| **Assessment method:** | | **Form of participation in the learning activity:** | | | | |
| **Expected Learning outcomes:**   * Guide students in planning, designing, and building an Arduino-based project. * Encourage problem-solving, troubleshooting, and applying all the knowledge gained during the course. * Promote teamwork, time management, and documentation skills. | | * Physical * Online | | | | |
| **Prerequisites needed to enrol in the learning activities (if needed):** | | | | | | |
| **Supervision and identity verification during an assessment:** | | | |  | |  |
| • Unsupervised with no identity verification. | | |  |  | |  |
| • Supervised with no identity verification. | | |  |  | |  |
| • Supervised online or onsite with identity verification. | | |  |  | |  |
| **Key words:**  Arduino  Presentation  Project  Demonstration  Feedback  Peer review | | | | | | |

| **Module 7.1** |
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| **Final Project Development** |
| The Final Project Development is an essential part of a project where students do all the stuff that they have done once and prepares themselves for a project showcase. In this phase, two key pillars are Finalizing Your Project for the Showcase and Preparing a Presentation and Demonstration. During this process, students make sure that their projects are completely functional and optimal and well documented, all the while honing in on their communication and presentation skills. By mastering these aspects, students gain confidence in their technical abilities and enhance their ability to convey complex ideas to an audience.  **Finalizing Your Project for the Showcase**  It is crucial to make sure that all parts work properly, the code is optimized, and the project is thoroughly documented before presenting it. Examining and troubleshooting a project in detail is the first step towards its completion. Students should verify the wiring, connections, and power supply, as well as test every component to make sure everything functions as it should. While troubleshooting typical difficulties relating to sensors, actuators, or communication protocols ensures that the project runs smoothly, using debugging tools like the Serial Monitor can help detect software flaws. Students reduce the likelihood of experiencing technical issues during the live display by thoroughly testing their creations. Performance and code optimization take precedence after the project is operational. In order to make their code more readable, students should include comments and eliminate unnecessary lines. Logically arranging variables and functions enhances readability and facilitates future changes. Furthermore, efficiency can be increased by minimizing lag or processing inefficiencies through the optimization of loops and delays. Code that is well-organized and polished guarantees a seamless demonstration and makes troubleshooting easier when necessary.  Beyond the program, it's critical to secure and assemble the hardware. A well-constructed prototype ought to be both aesthetically pleasing and robust. The project can be made more robust by switching from a breadboard configuration to a more stable form, like a PCB or soldered connections. Wires should be properly arranged to prevent loose connections that could cause issues during the display. The project can also look more professional and be simpler to handle and present by mounting it on a board or utilizing an enclosure.  Students should produce a project summary that functions as a reference document in order to finish the finalization process. A succinct explanation of the project's goals, features, and purpose should be included in this synopsis. A visual aid for comprehending the circuit is a wiring diagram that shows the connections between the various components. Important programming ideas and design decisions are highlighted by including significant code samples. Furthermore, recording any difficulties encountered and the solutions put in place provides insight into the development process and demonstrates problem-solving abilities. Students can use this project summary as a useful guide for future enhancements in addition to using it to discuss their work during the showcase.  **Preparing a Presentation and Demonstration**  After completing the assignment, students need to present their work to an audience in an effective manner. A polished presentation not only demonstrates technical proficiency but also fosters professionalism and self-assurance. The audience will be able to comprehend the project with ease if the presentation is correctly structured. Students should start with an introduction that details the issue they hope to resolve with their project and the sources of their motivation. A technical summary should then clearly and succinctly outline the circuit design, programming logic, and key components. The live demonstration, in which students exhibit the project in use while breaking down its functionality step-by-step, is the most important component of the presentation. Furthermore, talking about difficulties and lessons learned enables pupils to consider their own growth and emphasize how they overcome barriers. Students can offer suggestions for future additions or improvements they would want to see included in the final version. The audience will remain attentive and comprehend the importance of the project if the presentation is well-structured.  Students could make visual aids like slides or posters to improve the presentation's clarity. These resources should use diagrams, pictures, and brief films to illustrate difficult ideas while condensing important information into a little amount of text. To illustrate important programming concepts, code snippets can be used, but they must be presented in an understandable manner. Both technical and non-technical audiences will find the presentation more interesting and approachable when technical knowledge is successfully communicated using visual aids.  Rehearsing the demonstration is an essential part of giving a successful presentation. To guarantee a fluid flow and prevent mistakes, students should practice several times. A pre-recorded video of the project functioning properly is one example of a backup plan they should have ready in case of any technical issues. Timing the presentation also ensures that students cover all of the essential components of their project within the allocated time. Students who practice in advance are more self-assured and equipped to deal with any unforeseen problems.  A fascinating presentation must engage the audience in addition to providing information. Pupils should talk with assurance and clarity, making sure their explanations are simple to comprehend. The showcase can be made more dynamic by enabling audience participation and encouraging questions. Students should be ready to modify their wording when describing the technical parts based on how well-versed the audience is on Arduino ideas. An audience that is actively involved is more likely to recognize and comprehend the project's worth  To sum up, students gain useful skills from the Final Project Development process that go beyond Arduino and electronics. Students enhance their problem-solving skills and gain a deeper technical grasp by putting all of the principles they have learnt during the course into practice. Students gain patience, resilience, and attention to detail via the process of debugging, optimizing, and building a project. Additionally, the process of creating and presenting a presentation improves their public speaking and technical communication abilities, which are essential for success in both the classroom and the workplace. Students' confidence in their skills is also increased during this last curricular level. They get a sense of accomplishment when they successfully create a project from inception to completion, and they can practice professional communication when they show their work to an audience. Furthermore, developing the ability to accurately communicate complicated concepts aids students in future collaboration and knowledge sharing. In addition to having finished a working Arduino project, students will also be prepared to present it successfully, which is a crucial ability for jobs in engineering, technology, and other fields. |

| **Activity** | |
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| **Activity 1** | **Creating a Project Summary Document** |
| **Learning outcomes:**  *After this module you will be able to:*   * *Improved ability to* ***summarize and document projects****.* * *Enhanced understanding of* ***technical writing****.* * *Readiness for future* ***engineering project documentation****.* |
| **Sources:**  *Article:* "How to Write a Project Report" by University of Sheffield   * *Link:* <https://www.sheffield.ac.uk/ssid/301/study-skills/writing/project-reports> * *Description:* This guide provides detailed instructions on structuring and writing comprehensive project reports. |
| Objective: Teach students to document their project for easy reference and explanation.   * Description:   + Students will prepare a concise project summary including:     - Project title, description, and objectives.     - List of components and their functions.     - Wiring diagram.     - Key code snippets (with comments).     - Challenges faced and solutions.   + The summary should be visually appealing, using images, tables, or charts. |

| **Module 7.2** |
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| **Project Showcase and Celebration** |
| The last and most satisfying stage of the Arduino curriculum is the Project Showcase and Celebration. It gives students a chance to showcase their work, get and give comments, think back on their educational path, and celebrate their successes. This stage encourages individuals to investigate potential future applications and ongoing education while fostering communication, self-assurance, and community involvement.  **Presenting Your Project to Peers, Teachers, and the Community**  The ability to present finished work in a detailed manner is important for academic and professional purposes. This event provides an opportunity for students to present work to their classmates, teachers, and possibly parents or the community. This event will further develop their ability to articulate complex concepts effectively.  In the presentation, students need to explain the rationale behind the project – detailing its objectives, thought processes, and possible use cases. They should then systematically demonstrate the outlined key aspects, parts, and programming logic and guide the audience with the project flow. Since the audience may have some technique background, students should be ready to make alterations to their speeches that will allow everyone to understand them.  The presentation needs to be constructed in such a manner that enables them to explain a deemed technical task alongside a creative solution. They should be willing to speak about their thoughts through the process of development while taking into account the steps they took to overcome the hurdles and the lessons they learned. This results in making a presentation insightful as well as practical, enabling the audience to realize the amount of effort and participant growth needed to build the project.  To enhance the appeal of the projects, students can add slides, posters, and even videos that demonstrate the different features or stages of development of their project. In addition, the audience can actively participate in a hands-on showcase to enable a more interactive experience.  Whether delivering a presentation or being a part of a panel, speaking in front of an audience helps to build confidence and communication skills, both invaluable assets when approaching further education or a career. It also allows students to take pride in their work and receive credit for their contribution.  ***Practical tips***:   1. **Establishing credibility**  * In order to prevent your attire from detracting from your presentation, dress appropriately for the audience and the circumstances. * Stand up, face the audience in the eyes, and refrain from nervous tics like twitching your hands or clicking your pen to project confidence through your body language. * Establish credibility at the outset of the presentation by outlining the presenter's qualifications to deliver the project. * Finally, prepare every element of the presentation in advance, including the usage of excellent visuals and speaking practice.  1. **Utilize your area as much as possible**   In addition to giving the impression that the speaker is more in control of the situation and confident in their presentation, moving around on stage in a classroom or conference room will keep the audience more interested by adding energy to their presentation. However, this does not entail walking nonstop because excessive movement can be annoying and distracting.   1. **Don't be scared of silence**   It is tempting to talk nonstop to fill up any silences, but doing so deprives the listener of sufficient time to process what you are saying. Another way to come across as an anxious speaker is to talk too much and too quickly. The audience will absorb and remember more information if you allow for pauses and periods of stillness. One tactic, for instance, is to wait after introducing a significant issue or solution and allow the audience to absorb the impact of that information. Or, when displaying a key image or graphic, let some of the presentation's visual components do the talking. Silence may be a powerful ally in impressing an audience if it is practiced.   1. **Stop focusing on your errors**   Errors are human, and mistakes happen. Devices may malfunction, laptops may crash, or one may forget some important words or ideas. It is more likely that audiences will respect a speaker's growth than they will criticize them for their errors. If something goes wrong, it's crucial to move on and not dwell on it.Executive manager standing beside monitor showing marketing graphs explaining company strategy during business meeting in startup office. Diverse businesspeople working at financial presentation  **Receiving and Providing Feedback**  Evaluations form an integral part of any educational process. The showcase allows students to share their work and receive helpful suggestions not only from their teachers and fellow students, but even from industry or local community members. By being open and helpful, students are encouraged to acknowledge where they excel and where they need to do better.  Students must be ready to respond to queries and explain the technical aspects of their work, the design and the modifications that can be done to improve it. Constructive criticism enables a student to strengthen their understanding and develop their reasoning skills.  On the other side of the argument, students ought to be allowed to assess other students’ projects by giving feedback in an organized manner. Teachers can facilitate this process by using a simple evaluation framework that encourages students to focus on key aspects, such as:   * **Innovation** – How unique or creative is the project? * **Functionality** – Does the project work as intended? * **Presentation** – Was the explanation clear and engaging? * **Challenges & Solutions** – How well did the student handle technical difficulties?   Providing feedback allows students to **analyze different approaches** and gain insights from their peers’ projects. It also reinforces their **critical thinking and communication skills** while fostering a sense of collaboration and mutual learning.  **Reflecting on the Learning Journey and Celebrating Achievements**  Contemplation can be one of the most effective and constructive tools for learning. After presenting their projects, students ought to spend some time thinking about their retrospective journey towards learning. Below are some questions that teachers can use to help them reflect on their work:   * What was the hardest thing to do in the project? * What activities did they enjoy the most? * What new skills or competences do they think they gained? * If they were to attempt the project again, what would they do differently?   Having students ask themselves these questions will help them to better understand their learning, ideally in a short reflection journal, which could also be discussed in groups.  Along with self-reflection, participants of the showcase should also consider including an element of festivities to celebrate the hard work and creativity put forth by the attendees. These may include the distribution of certificates, the selection of outstanding projects under various criteria like “most innovative project” or “best presentation,” or just having a great closing ceremony where students can celebrate their achievements together.  The celebratory element of the showcase is what inspires students and gives them confidence, a sense of accomplishment, or pride in their work.  **Discussing Future Applications and Continued Learning**  The showcase, or the bigger picture and reflection of the work, is not at the end of the project. Rather, it is at the beginning of endless opportunities of learning and implementing anew. Teachers should use this moment of the project to help students foray deeper into Arduino, electronics, and programming outside the classroom.  To use foster a discussion, the following questions could be posed:  • In what ways can students enhance or add to their existing projects?  • What issues in the real world could be addressed using similar technologies?  • What other intermediate or advanced working concepts in Arduino can they do next?  • How do these skills get utilized by professionals in the fields of engineering, robotics, and IoT?  Prompting students to make these connections allows them to contextualize what they have learned and recognize its relevance. Teachers may further facilitate the students’ skills development by suggesting online materials, workshops, or even competitions.  By providing insight and the bigger picture, students It becomes clear that the Arduino project does not become the endpoint of their learning journey. Rather it turns out, it is a starting point for learning and creation of limitless innovations.  The Project Showcase and Celebration, is the most significant learning event. In particular, students present their works in order to strengthen their public speaking and technical communication abilities. Through feedback and reflection, critical thinking skills are developed, and self-assessment skills are also acquired. Moreover, self-motivation and their work ethic is praised through the event’s celebratory nature in order to understand its value. Finally, discussing further motives encourages students to think outside the classroom and strive to learn and innovate.  This not only helps students hone their skills and creativity, but also prepares them for the real world where they will need to defend their ideas, accept criticism, and perfect their skills. In their pursuit of further education, be it in electronics, engineering, or any other field, the skills attained from the show case will undoubtedly aid them in their academic advancement and future career. |

| **Activity** | |
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| **Activity 2** | **Preparing a Presentation & Live Demonstration** |
| **Learning outcomes:**  *After this module you will be able to:*   * *Confidence in* ***public speaking and technical presentations****.* * *Ability to* ***simplify complex information*** *for different audiences.* * *Mastery of* ***demonstrating technical projects live****.* |
| **Sources:**   * **Presentation Skills:**   + *Article:* "How to Successfully Showcase a Project: 6 Key Tips" by Twproject     - *Link:* <https://twproject.com/blog/successfully-showcase-project-6-key-tips/>     - *Description:* Offers practical advice on delivering effective project presentations, including tips on engaging the audience and using visual aids. * **Creating Visual Aids:**   + *Tool:* Canva Presentation Templates     - *Link:* <https://www.canva.com/en_gb/templates/presentations/>     - *Description:* A free tool providing a variety of presentation templates to help students create visually appealing slides. |
| Objective: Teach students how to effectively communicate and present their project.   * Description:   + Students will prepare a 5-minute presentation including:     - Introduction to their project.     - Live demonstration showing the project in action.     - Discussion of the challenges they faced and how they overcame them.     - Future improvements and applications.   + They must use visual aids such as:     - Slides with diagrams and images.     - Short videos of the project in action.     - Live demonstration on stage. |

| **Activity** | |
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| **Activity 3** | **Feedback Exchange – Peer Review Session** |
| **Learning outcomes:**  *After this module you will be able to:*   * *Ability to* ***critically evaluate projects*** *and offer meaningful feedback.* * *Exposure to* ***different approaches and creative solutions****.* * *Development of* ***collaborative learning*** *skills.* |
| **Sources:**   * **Peer Review Guidelines:**   + *Article:* "Peer Review: A Guide for Students" by University of Leeds     - *Link:* <https://library.leeds.ac.uk/info/14011/writing/112/peer_review>     - *Description:* Provides guidelines on how to conduct peer reviews effectively, including tips on giving and receiving constructive feedback. * **Evaluation Rubric Examples:**   + *Resource:* "Sample Peer Evaluation Rubrics" by Carnegie Mellon University     - *Link:* <https://www.cmu.edu/teaching/assessment/assesslearning/groupWork-formsrecipients/SamplePeerEvaluationForms.pdf>     - *Description:* Examples of rubrics that can be adapted for evaluating Arduino projects during peer review sessions. |
| **Objective:** Help students develop **constructive feedback skills** and refine their project based on peer input.   * **Description:**   + Students will **pair up** and evaluate each other’s projects using a structured **feedback rubric** based on:     - **Innovation** (Is the project unique and creative?)     - **Functionality** (Does the project work as intended?)     - **Presentation** (Was it clear and engaging?)     - **Challenges & Solutions** (How well did they address problems?)   + Students will provide **written feedback** and suggest **one improvement** for their peer’s project. |

| **Activity** | |
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| **Activity 4** | **Reflecting on the Learning Journey** |
| **Learning outcomes:**  *After this module you will be able to:*   * Development of **self-awareness and critical thinking**. * Appreciation of **progress and technical growth**. * Motivation for **continued learning** in Arduino and beyond. |
| **Sources:**   * **Reflective Writing Guide:** * *Article:* "Reflective Writing: A Basic Introduction" by University of Portsmouth   + *Link:* <https://www.port.ac.uk/student-life/help-and-advice/study-skills/reflective-writing>   + *Description:* An introduction to reflective writing, providing insights into how to critically evaluate one's learning experiences. * **Reflection Prompts:** * *Resource:* "Reflective Practice Writing Prompts" by University of Edinburgh   + *Link:* <https://www.ed.ac.uk/reflection/reflectors-toolkit/reflecting-on-experience/writing-prompts>   + *Description:* A collection of prompts to guide students in reflecting on their learning journey. |
| **Objective:** Encourage students to reflect on their **growth, achievements, and future goals**.   * **Description:**   + Students will write a **one-page reflection** on:     - **What they learned throughout the project.**     - **What they found most challenging and rewarding.**     - **How they have improved in problem-solving, programming, or design.**     - **How they might apply their skills in the future (careers, hobbies, etc.).**   + They will then **discuss their reflections in small groups**, sharing insights and takeaways. |

Use as many activities as you find adequate to evaluate the course.

| **Activity 5 (Assessment of Module 7.1 – 7.2)** |
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| **Type: Multiple questions** |
| **Answer the questions and then move on the check the correct answers. For better results try to complete the questions without looking the answers.**  **1. What is the primary goal of the Final Project Development phase?**  A) To create an initial prototype and test basic concepts B) To finalize, optimize, and prepare a project for presentation C) To memorize Arduino programming syntax D) To conduct research on the history of Arduino  **2. What is the main reason for optimizing and debugging an Arduino project before the showcase?**  A) To ensure that the project runs smoothly without errors during the demonstration B) To make the project code as long and complex as possible C) To avoid using Arduino IDE and rely only on hardware functionality D) To prevent the project from working properly in future experiments  **3. Which of the following is NOT a key component of a successful project presentation?**  A) Explaining the project's purpose and inspiration B) Providing a detailed breakdown of every Arduino function used C) Demonstrating the project’s functionality live D) Discussing challenges faced and solutions implemented  **4. How can students benefit from receiving and providing feedback during the showcase?**  A) It allows them to compare their grades with their peers B) It helps them analyze different approaches and improve their work C) It ensures that they do not have to present their project again D) It allows them to memorize feedback for future exams  **5. Why is reflection an essential part of the final project process?**  A) It helps students identify areas of improvement and future learning opportunities B) It ensures that students do not have to complete another project in the future C) It replaces the need for debugging and troubleshooting the project D) It helps students remember every detail of their Arduino code |
| **Answers:**   1. **To finalize, optimize, and prepare a project for presentation** 2. **To ensure that the project runs smoothly without errors during the demonstration** 3. **Providing a detailed breakdown of every Arduino function used** 4. **It helps them analyse different approaches and improve their work** 5. **It helps students identify areas of improvement and future learning opportunities** |

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