Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2022

Computer Science

Coursework Project Brief

Higher and Ordinary Levels

Time: 12 weeks

90 marks

Information for candidates

The project is worth 90 marks, which is 30% of the overall marks for Leaving Certificate Computer Science. The remaining 210 marks (70%) are for the final examination. You will carry out the project over a period of twelve school weeks, beginning on **Wednesday December 8th 2021**. The coursework must be completed by **Tuesday March 22nd 2022**. You will present the report in the form of a website comprising of one or more webpages.

Carrying out the project involves responding to a brief by producing a computational artefact and an accompanying report. You will submit the project in digital form. If your artefact has physical elements, such as might arise with an embedded system, you will not be sending these physical items to the State Examinations Commission. You will capture video footage and/or images of the artefact in operation and embed this into your report.

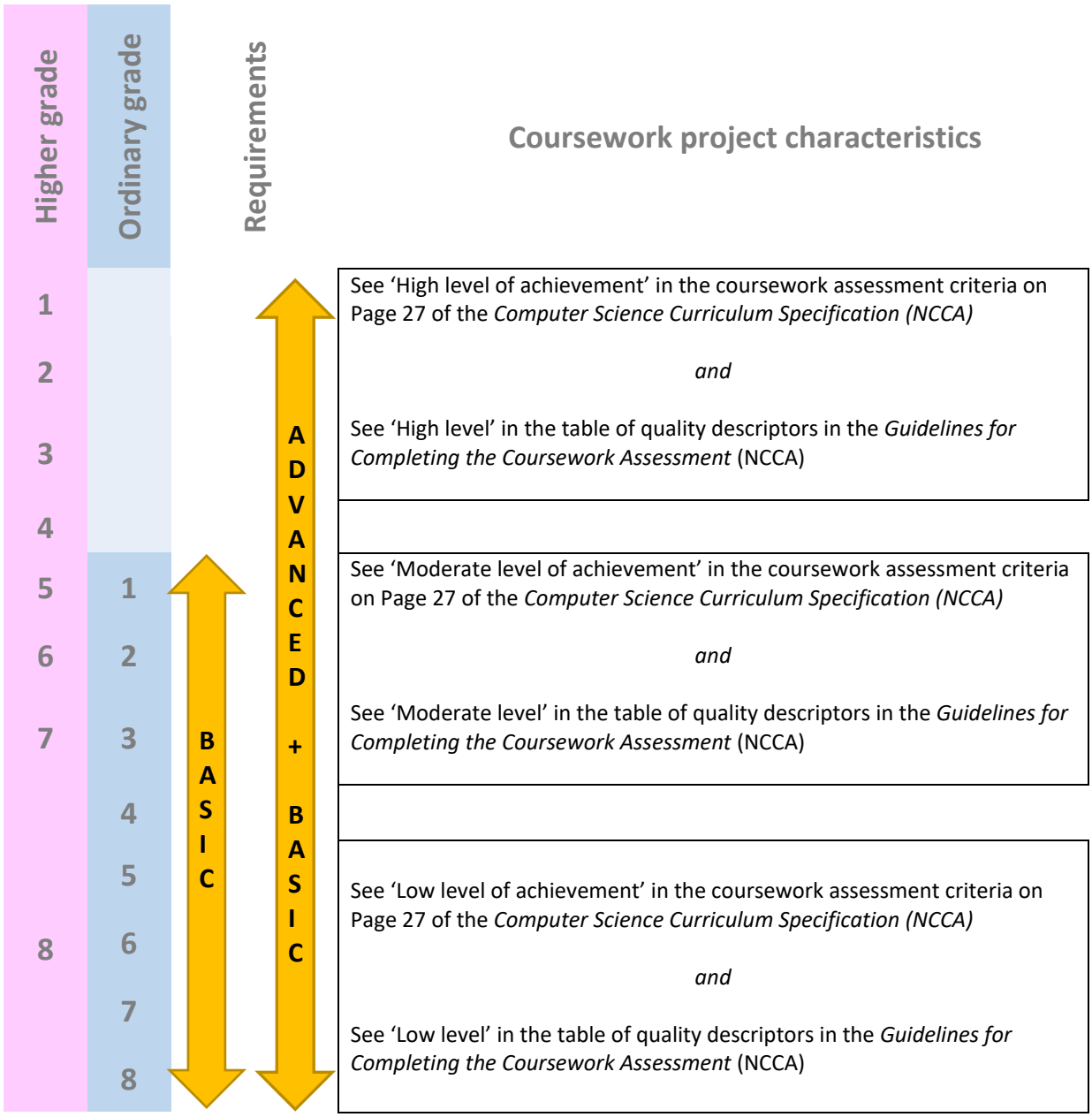
Although you are used to carrying out projects for the *Applied Learning Tasks* in groups, this is an *individual* project. You must carry it out independently of other candidates, and the work you submit must be your own unaided work.

Apart from your initial investigation and research, you must carry out the project in school under the supervision of your teacher. This allows your teacher to authenticate your work to the State Examinations Commission. Because you are carrying out the work under teacher supervision, the teacher is able to guarantee to us that it is your own work, and that nobody gave you any inappropriate help. If you include work that was not supervised by your teacher, then they cannot authenticate it, even if they believe that you really did do it yourself. We cannot accept work for assessment if your teacher cannot authenticate it, so you will forfeit the marks for the project work. Note also that we cannot give partial marks for 'partially authenticated' work. That is, unless *all* of your work can be authenticated by your teacher, we cannot accept *any* of it for marking.

The same project brief applies to Higher and Ordinary level candidates. However, you do not need to make a final decision about which level you are taking when you submit your project. We will grade your project in line with the standards that apply to the level at which you take the final examination.

The project brief sets out some *basic requirements* and *advanced requirements* of the artefact. The way that the standards at the two levels are aligned with each other is illustrated on the left-hand side of the graphic on the next page. This means that, for example, a project that would get a grade 2 at Ordinary level will automatically get a grade 6 at Higher level. You can also see that any project that would get a grade 4 or better at Higher level exceeds the highest standard of work expected at Ordinary level. Because of this, a project of this quality would automatically get full marks at Ordinary level.

It should be evident from the graphic that it is possible to achieve full marks at Ordinary level by attempting the basic features only. Similarly, it is not possible to achieve grade 4 or more at Higher level without attempting the *advanced requirements*.


Higher grade
Ordinary grade
Requirements
Coursework project characteristics
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
8
BASIC
ADVANCED + BASIC
See 'High level of achievement' in the coursework assessment criteria on Page 27 of the Computer Science Curriculum Specification (NCCA)
and
See 'High level' in the table of quality descriptors in the Guidelines for Completing the Coursework Assessment (NCCA)
See 'Moderate level of achievement' in the coursework assessment criteria on Page 27 of the Computer Science Curriculum Specification (NCCA)
and
See 'Moderate level' in the table of quality descriptors in the Guidelines for Completing the Coursework Assessment (NCCA)
See 'Low level of achievement' in the coursework assessment criteria on Page 27 of the Computer Science Curriculum Specification (NCCA)
and
See 'Low level' in the table of quality descriptors in the Guidelines for Completing the Coursework Assessment (NCCA)

The project brief

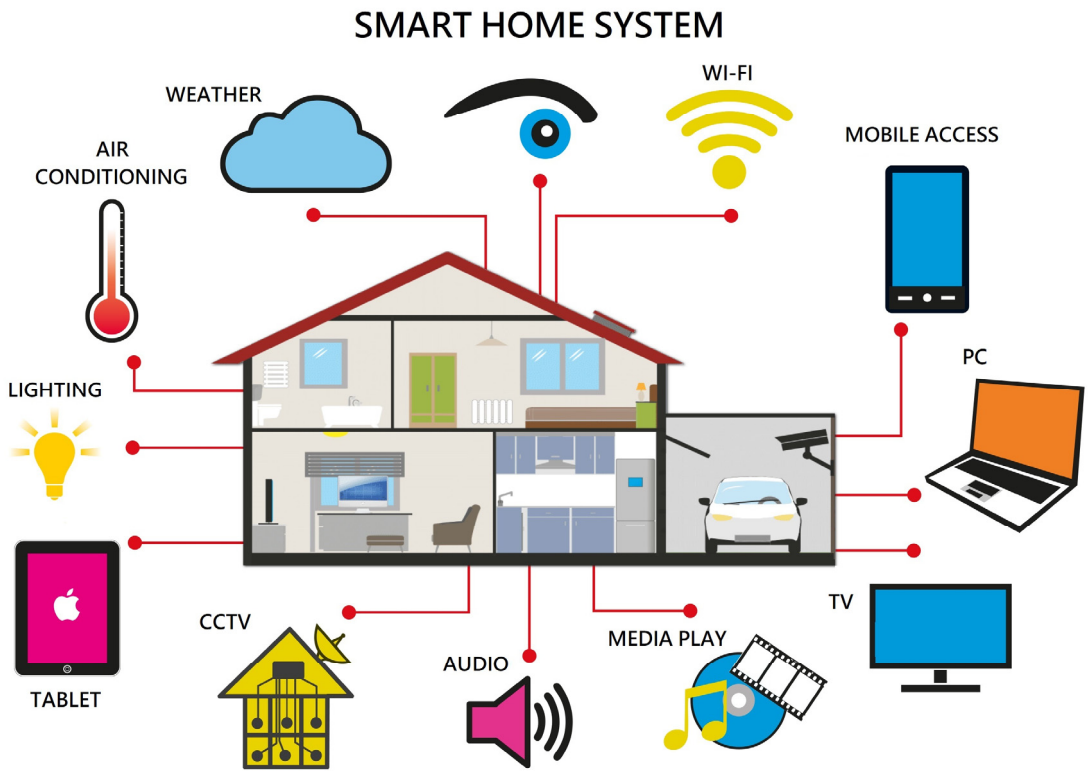
Context of the Brief

According to GlobalData[1], the smart home market was worth $35.9bn in 2020 and will grow to $75.3bn by 2025.

A smart home is a home that incorporates automation systems to provide home owners with added security, convenience and energy efficiency. Smart homes make use of embedded system devices, also known as home automation devices, which enable home owners to monitor and/or manage domestic appliances and systems through remote web applications or some other networked device.

Ultimately, smart homes are about making living spaces more enjoyable, secure and convenient for home owners through the use of automation to enhance the building's functions. For example, smart home systems may be used to control lighting, temperature, multi-media, air quality, grant or deny home access through smart locks, window and door operation, check in on security cameras and even automate feeding pets as well as many other functions.

Some of the areas where home automation systems are used are shown in the illustration below.



Source: http://visioforce.com/smarthome.html

[1] https://www.verdict.co.uk/smart-homes-inside-a-new-fast-growing-market-set-to-be-worth-75bn-by-2025/#:~:text=Smart%20homes%20are%20smart%20business,)%20of%20just%20under%2016%25.

Home automation is used in a variety of ways, including, but not limited to, the following:

- Heating, ventilation and air conditioning system
- Lighting control system
- Occupancy-aware control system
- Appliance control
- Home robots and security
- Leak detection, smoke and carbon monoxide detectors
- Home safety for the elderly and disabled
- Pet and baby care
- Air quality control
- Smart kitchens
- Voice control devices like Amazon Alexa or Google Home used to control home appliances or systems.

Further Context

Below are some links to more detailed information relating to the context of the brief. The list is neither exclusive nor exhaustive and is supplied to assist you with your own ideas and research. Some may provide inspiration for the task set out in the next section of this document.

What is a Smart Home or Smart Building?	www.youtube.com/watch?v=IC0mkHh7MaA
Smart home or building	internetofthingsagenda.techtarget.com/definition/smart-home-or-building
Your Complete Smart Home Guide	www.security.org/smart-home/
Information Society Statistics - Households 2020	www.cso.ie/en/releasesandpublications/ep/p-isshh/informationsocietystatistics-households2020/smarttechnology/
Putting the Human First in The Future Home	www.accenture.com/_acnmedia/pdf-98/accenture-putting-human-first-future-home.pdf
The Race to The Smart Home	www.accenture.com/t20170303T051308__w__/us-en/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_26/Accenture-The-Race-to-the-Smart-Home.pdf

The Task

For this project you are required to design and develop:
1. An interactive website on behalf of a fictional home automation company.
2. An embedded system that could be used as part of a home automation system.

The basic and advanced requirements for both the website and the embedded system are set out as follows:

Basic requirements
The basic requirement is to create both a website and a stand-alone home automation embedded system. You must decide on the exact requirements for both the website and the embedded system. These requirements should address some specific problem or set of user needs as identified by the owner of the company.

Website
The website should be created to meet the needs of the owner of a fictional company that has recently entered into the home automation business. The type of business can be of your own choosing and you can decide on its name, as well as the range of services and/or products it specialises in.

Specifically, the basic requirements are to incorporate the following front-end features into a working website:

- A minimum of four separate pages, including a home page and a user-friendly navigation system. You should dedicate one of the pages to highlight the main issue addressed by your embedded system as well as its main features.
- A clean, crisp, consistent visual design with clearly defined regions and well formatted content that is informative, concise and easy to read.
- The use of a combination of headings, paragraphs, lists, tables, links, images and multimedia elements such as video, sound and animation.

Accessibility should be a consideration in the design of your website. An accessible website is one that is usable by all people to the greatest extent possible without the need for adaptation.

The website must comply with the school's Acceptable Usage Policy and with GDPR. In particular, the content should not contain any information that would enable you to be identified.

Embedded System

For the basic requirements the embedded system can be implemented as a standalone device i.e. remote operation is not a requirement. However, once started (manually) the system should operate automatically or with minimal user intervention.

In simple smart home scenarios, events can be timed or triggered locally. Timed events are based on a clock, for example lowering the blinds at 6pm, while triggered events depend on actions in the automated system; some examples are:

- When a room gets too hot the air conditioning is automatically switched on.
- When a home owner approaches their own front door it automatically unlocks and the lights go on.
- When the level of carbon monoxide exceeds a certain level, an alarm is triggered.

Finally, you should note that neither data capture nor storage are required to fulfil the basic requirements.

Advanced requirements

In more sophisticated home automation systems home owners can control and monitor their homes remotely via web applications or some other networked device.

For the advanced requirements you are required to extend and integrate the website and embedded system so that the website can be used to control and/or monitor the home automation embedded system.

Specifically, for the advanced requirement you are required to:

- Make any changes necessary to the artefacts created for the basic requirements so that they can operate as part of a single system.
- Add one or more data capture forms to your basic website. While you can decide on the exact purpose of the form(s) and the nature and type of the data they are used to collect, you should ensure to include a variety of different user interface controls such as labels, text boxes/scrolling text areas, push buttons, radio buttons, check boxes, drop down lists, sliders, spinners, calendars and similar.
- Implement validation checks using clearly defined validation rules as appropriate.

Coursework report – content and structure

The report should be presented as a website and be structured using the headings outlined in the following pages and in the outline marking scheme.

The report should contain no more than 2500 words. You should ensure that the file structure of your artefact is clear, so that you can clearly reference files or programs in your report.

1. Investigation and Plan (approximately 600 words)

In this section of the report you should show evidence of your own research on the thematic brief, including research on existing solutions, systems or ideas that are aligned to the brief. As a starting point you may consider using the URLs provided earlier in this document, but please note that this list is neither exclusive nor exhaustive. All references should be included in the reference section of your report.

You should outline a number of possible responses to the brief and demonstrate your understanding of the problem(s) each response could address. The actual system you intend to develop should be explained along with a clear description of the scope of your envisaged solution(s). A full list of the initial system requirements should be specified. The target end-user(s) of your system and any ethical or social implications of the system should also be described.

Once you have identified your system requirements you should engage in deeper research on the artefact you will develop and the potential technologies you will use.

2. Design (approximately 600 words)

This section of the report should contain a clear description of how the artefact was designed to meet the brief.

There should be a diagram illustrating the overall system architecture. The various components of the system and how they relate to one another should be highlighted and explained.

You should use any combination of diagrams, wireframes, flowcharts, prototypes, pseudo-code and similar to explain how the requirements of the system were met.

3. Implementation and Testing (approximately 1000 words)

This section should provide a clear description of how the system was implemented. You should show the timeline of your project highlighting key dates and project milestones. You should explain any changes made to the original design while the project was being carried out. You may wish to explain any problems that you encountered during the implementation and how that impacted on the development process.

As part of your report you are required to include a video showing the artefact in operation. The video must not be more than 5 minutes in duration and be no more than 1GB in size.

In deciding the content of your video, you should refer back to the description of the task. The video should demonstrate how your artefact has achieved each of the basic and/or advanced requirements. The video should only demonstrate the functionality of the artefact, with all other information relating to the design and development being contained in the report.

You may wish to explain your code design by providing a high-level description of how the different modules of the system interact with one another. You could also provide a detailed explanation of certain selected sections of code you have produced. The code could be annotated and explained.

You should describe the extent of testing you carried out, and major problems you encountered during the testing and development cycle. Details of testing may include the type of testing carried out, the test cases and test data that were used and any implications to the design as a result of the testing.

4. Evaluation **(approximately 300 words)**

You should evaluate the final product in relation to the brief. In particular, you should reflect on:

- How well you achieved your design ambitions and met your design requirements.
- The degree to which you met the requirements of the brief – you should examine each of the artefact features listed in the brief, and explain how your artefact meets, or does not meet, these features.
- How well the needs of the envisaged end user were met. Include reference to any unexpected results encountered in the application of your artefact.

Suggest, with justification, how your artefact could be improved in future iterations of the design cycle. If you can, identify other possible applications of your artefact, whether as it currently is or as it might be with future improvement or expansion.

5. References

You must reference any information used in your report or in the creation of your artefact, such as: publications including books, professional journals and government reports; online sources and other types of media; source code. To include such material without properly referencing the source will be considered plagiarism. The word count in this section does not count towards your overall word count.

6. Summary word count

You must include a summary of the word count of your report. This could be presented in the form of a table, as shown below, and should show the word count for each section as well as the overall word count.

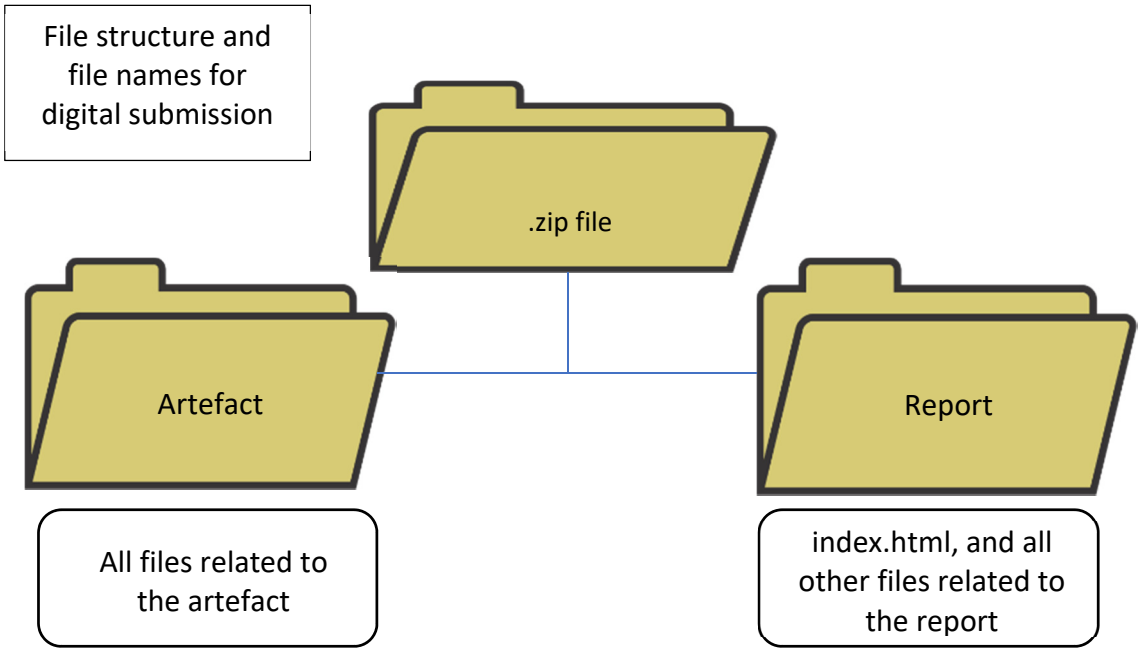
Section	Word Count
1. Investigation and Plan	
2. Design	
3. Implementation and Testing	
4. Evaluation	
Total:	

Outline marking scheme

Coursework (90 marks in total)	
1. Investigation and Plan	***Marks***
• Initial research into the context of the brief and existing solutions. • Planning and outlining potential solutions to the brief; identifying the potential stakeholders and end-users; consider social implications and how the artefact can be inclusive for all users; refine, list and describe the objectives for the artefact that you will develop. • Deeper research on the chosen solution and potential technical solutions that will achieve the artefact objectives.	**20**
2. Design	
• Clearly describes how the requirements of the system are met. • Description of the key aspects of how the artefact will be structured; an overview of how different parts of the system will interact which may include a system architecture diagram or system flowchart, data flow diagram(s), algorithms or flowcharts, data model, wireframes, hardware selection and similar.	**20**
3. Implementation and Testing	
• A brief timeline of key dates and milestones achieved in the development of the artefact. • Clearly describes the development of the artefact and any problems that were encountered during the process • Clearly demonstrates the operation of the system. This should be demonstrated through the use of the video and supporting text if required. • Fundamental programming skills are demonstrated, such as using a modular approach, using high level data structures, algorithms, programming constructs, minimal duplication of code, readability, effective use of commenting and similar. • A description of the type and extent of testing that took place which may include test cases/table and test data; an explanation of the impact of testing on the development of the artefact.	**40**
4. Evaluation	
• Explains the extent to which your artefact meets your design objectives; how well the needs of the envisaged end-user are met. • Describes with justification how your artefact could be modified and improved.	**10**
References and Summary word count	
• You must also include references and/or a bibliography. • Include a summary of the word count of the report, including the total word count.	**0**

Instructions on completing and submitting the coursework

1. Your coursework project that is submitted for assessment must comprise of the following two components:
   - The digital components of the computational artefact, including all relevant programs in the prescribed languages.
   - A coursework report, submitted on a website, of no more than 2500 words, including a video presentation of no longer than 5 minutes. The video should be no more than 1GB in size. This readily can be achieved by using standard definition (720 x 480) at 25 frames per second and a suitable commonly used format. Individuals should not be identifiable in the video but you may include a voiceover in order to explain the features of your artefact. Penalties may apply where the overall word count or video length or size is exceeded.
2. Some of the research and investigation that you carry out for the project and describe in section 1 of your report, 'Investigate and Plan', can be completed outside of class time. However, the actual writing of the report and all of the work on the artefact itself must be done in class under the supervision of your teacher so that they can authenticate your work.
3. Your coursework project must be saved in a single zipped file (.zip). The project will be submitted through the online School's Portal, with details, including the naming convention for the zip file, following in advance of the submission date.
4. The .zip file, when extracted, should be a folder that contains exactly two subfolders, as in the diagram below.



a. One of these sub-folders should be called “Report” and should contain all of the files relating to the report. It should be possible to access the complete report by opening a file named “index.html” at the top level within the “Report” folder. That is, all of the content of the report should either be in this file itself or be accessible via links from within this file to local files. Any subsidiary files, such as additional html files, css stylesheets, image files, and so on, must also be in the “Report” folder, either at the same level as index.html or within a further suitable folder structure.

b. The other sub-folder should be called “Artefact” and should contain the essential digital components of your artefact. The file structure of your artefact should be made clear. For example, if there is a main, supervising program, from which other programs are imported or called, this program should be clearly named in the sub-folder and referenced in the description in the coursework report.

5. It is **your** responsibility to ensure that all electronic materials submitted are free from viruses, so that examiners can open all required files for assessment, and all code supplied can be evaluated.

6. As you will not be submitting your physical embedded system it is essential that your video demonstrates fully how your artefact works.

7. All data and information in the artefact should be anonymised and comply with GDPR. If an artefact uses programming languages other than Python and JavaScript, these files can also be included in this sub-folder. In such cases, you cannot assume that the examiner will be familiar with the programming language concerned, so the responsibility for demonstrating its accuracy rests with you.

8. It is your responsibility to ensure that all of the required files are contained in the zipped file prior to submission of the work. You may lose marks if required files are omitted. Marks may be lost for not conforming to the filing structure outlined above, and for not using a clearly labelled file structure for the artefact. A **backup copy** of the submitted files must be retained in your school until the assessment process is complete.

IMPORTANT
It is essential that you double check that your artefact and report can be accessed by the examiner or you may not be credited for the work you have done. Once completed, put the zipped project on a removable medium, bring it to a device that was not used when working on any part of the project. Disconnect that device from the internet. Unzip the project and check that the artefact and the report including all images, video(s), and other files are present and that all links between them are working correctly.