University of Central Lancashire UCLan Department of Computer Science	**UCLan Coursework Assessment Brief**	2022-2023
	Module Title: Maths and Technologies for Games	
	Module Code: CO3303	Level 6
	Post-Processing	This assessment is worth 50% of the overall module mark

RELEASE DATES AND HAND IN DEADLINE

Assessment release date: Monday 22nd February 2023
Assessment deadline date and time: **Thursday 11th May 2023, before 20:00**
Upload to Google Drive or similar and email a link to lsnoel@uclan.ac.uk.
Ensure the files are publicly accessible or it might be counted as late.

Please note that this is the final time you can submit – not the time to submit!
Your feedback and mark for this assessment will be provided 15 working days later.

THE BRIEF / INSTRUCTIONS

OVERVIEW

Post-processing techniques can enhance a game scene in a wide variety of ways. The vast majority of modern games use extensive post-processing to add polish to their core rendering techniques. Post-processing can be applied to the whole screen, to portions of the screen or to specific polygons. There are very many processes possible: filters, blurs, bloom / high dynamic range, feedback etc. In this assignment you must implement a range of post-processing techniques.
To **pass the assignment (40%-45%)** you must:

- Implement three basic full-screen post-processing techniques
- Write a short report discussing your implementation

To get further marks **(up to 90%)** you must:

- Add more advanced post-processing techniques, for example polygon effects or bloom. See below for the full list of options.
- Extend the report to cover your additional implementation.

Marks beyond this will be awarded for the use of more advanced techniques relevant to the module material. Research and implement effects as you see fit, but check with your tutor to make sure they provide sufficient challenge.

There is no starting project provided for this assignment. However, you may use lab work as a basis for your work. All further development must be your own work.
This is an individual project and no group work is permitted.

Assignment Tasks – To Achieve a Pass

Basic Requirements

- Create a project to display models in a scene. You may use any models you wish, including those from previous labs. There must be sufficient scenery to allow the post-processing effects to be seen clearly.
- Implement a full-screen **vertical colour gradient** post-processing effect. This is a colour tint over the whole screen where the tint colour varies from the top of the screen to the bottom. For example the top of the screen is tinted blue and the bottom yellow and the tint blends from blue to yellow from top to bottom. Allow the user to switch this effect on and off with the key '1'.
- Implement a full-screen **blur** post-processing effect. Allow the user to switch this effect on and off with the key '2'. Any blur algorithm may be selected, so long as it is noticeable.

- Implement a full-screen **underwater** post-processing effect. When this effect is enabled, the whole screen should be tinted blue and wobble slowly. Allow the user to trigger this effect with the key '3'.
- For a pass, you may assume that only one effect will be enabled at a time.

Implementation Report

- Write a short report explaining your implementation:
  - Describe generally the use of post-processing in a graphics application.
  - Explain the specific techniques used for your post-processing effects.
  - Discuss improvements or extensions you could make.

Assignment Tasks – For Further Marks

Extensions to Basic Effects

- Allow the user to enable multiple effects at the same time, e.g. blur and underwater simultaneously. Top marks will be awarded based on the flexibility of your solution (allowing your effects to be combined in any order, even multiple instances of the same effect – e.g. 2 blurs to get a stronger blur).

- Use the HSL colour space to make a gradual change to the colours in the gradient effect. Gradually increase the Hue component over time.

- Update the blur algorithm to a two-pass Gaussian blur algorithm. Extra marks awarded if the strength of blur is controllable by the user. You will need to research the algorithm required. Note that this is expected as two post-processes, not just two parts in a single post-process.
- Add feedback to the blur effect (see lecture worksheet)

Polygon Post-Processing

- You are provided with a wall model containing a single opening. Provide the ability to perform post-processing of only the area seen through this opening.
  - The opening is centred at (0, 10, 0) and is 10 units high and wide (in the X & Y axes). The opening points in the Z direction.
  - You may use any post-processing technique for the opening, but extra credit will be given for an original and suitable additional technique.
  - A second wall with multiple complex openings is also provided. Demonstrate different techniques for each opening for extra credit.
  - Ensuring area/polygon-based techniques work correctly at the same time as (multiple) full-screen techniques will also gain extra credit.
  - The models can be found along with this assignment brief on the blackboard page.

Advanced Post-Processing

- Implement **retro game mode**, where pixels are much larger and use a limited colour palette, but still show the scene being rendered.

- Implement a full-screen **bloom** post-processing effect. This should differ from a basic blur in that it will affect the bright areas only, *bleeding* them *significantly* into the remainder of the scene.
- Extend the bloom algorithm to add **lens "stars"** around the brightest zones. Any shape of lens star can be used and extra credit will be given if you can support widely differing shapes (e.g. movie-style extremely wide horizontal lines). Note that this is different from lens flare made of many circles of different sizes that move around along a diagonal of the lens. Instead, lens stars stay centred on the bright areas. Query your tutor if you are not sure. This task can be challenging and is worth many marks.

- Implement a full-screen **depth of field** post-processing effect. Models at a given *focal distance* from the camera should appear sharp. Nearer or further models should be blurred. Allow the user to switch this effect on and off with the key '4'. Also allow the user to increase or decrease the focal distance.

- For further credit, allow the user to select different models to focus on
- Document any controls that you add.
- An approximate technique will be adequate, it does not need to be optically correct to get the marks for this task. However, if you do research and implement a more physically accurate approach, then you will gain further bonus marks (difficult though).
- Alternative post processing techniques instead of depth of field will be accepted for this requirement. However, to gain equivalent marks the replacement technique(s) must be of equivalent technical complexity. If in doubt, check with your tutor and/or implement multiple replacement techniques. If you provide an alternative to depth of field, make a clear note of it in your report.

SUBMISSION DETAILS

Deliverables

See notes at the top of this document for submission method.

You must provide:

- Executable program of your solution
- All the source and project files required to build the executable
- Discussion / evaluation report
- All files should be sensibly named and in working order

LEARNING OUTCOMES

- Explain and implement a range of contemporary games development techniques.
- Investigate and critically evaluate new games development techniques
- Apply the skills and knowledge required to program a games console using a suitable API.
- Analyse and apply balanced optimisation techniques to games programs.

GRADING CRITERIA

Marks will be awarded based on the learning outcomes highlighted above.

To obtain **40-45%** and a **pass,** you must:

- Implement the **basic requirements** described above
    - Marks are awarded based on the clarity and robustness of the solution
- Write an **implementation report** as described above
    - Marks will be awarded based on the articulation and depth of analysis presented in the document

Up to a further **17%** will be awarded for:

- **Extensions to Basic Effects**, as described above

Up to a further **8%** will be awarded for:

- **Polygon Post-Processing,** as described above

Up to a further **20%** will be awarded for:

- **Advanced Post-Processing**, as described above

Marks awarded will be based on the challenge of each task and the solution quality.

Further marks **over 90%** will be awarded for:

- **Addition of advanced work** relevant to the module material to extend the project. You **must** document any such additional developments, or they may not gain credit.

A proportion of all the implementation marks will be given over to the readability and maintainability of your source code.
Note: Once you have satisfied the basic requirements, it is not necessary to address the remaining tasks in the order given. You may attempt any of the additional tasks in any order you wish.

HELP AND SUPPORT

- Support will be provided via Microsoft Teams and email. You will also have the opportunity to ask questions during lectures / labs. You may request a one to one meeting with a tutor during their office hours (as published on Starfish).
- For support with using library resources, please contact our subject librarian subjectlibrarians@uclan.ac.uk. You will find links to lots of useful resources in the My Library tab on Blackboard.
- If you have not yet made the university aware of any disability, specific learning difficulty, long-term health or mental health condition, please let us know. The Inclusive Support team will then contact you to discuss reasonable adjustments and support relating to any disability. For more information, visit the Inclusive Support site.
- To access mental health and wellbeing support, please complete our online referral form. Alternatively, you can email wellbeing@uclan.ac.uk, call 01772 893020 or visit our UCLan Wellbeing Service pages for more information.
- If you have any other query or require further support you can contact The Student Support Centre. Speak with us for advice on accessing all the University services as well as the Library services. Whatever your query, our expert staff will be able to help and support you. For more information, how to contact us and our opening hours visit Student Support Centre.
- If you have any valid mitigating circumstances that mean you cannot meet an assessment submission deadline and you wish to request an extension, you will need to apply online prior to the deadline.

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