

**School of Engineering**

**aCADEMIC YEAR 2024/25**

Assessment Brief

# Submission details

**Module title**: Machine Vision

**Module code**: UFMFRR-15-M

**Assessment title:** Group Report on Apple Counting in Orchards

**Assessment type**: Report - Written Group Project Report

**Assessment weighting:** 50% of total module mark

**Size or length of assessment:** Maximum word count 5,000

**Module learning outcomes assessed by this task:**

1. Interpret the current key research issues in machine vision.

2. Identify requirements of an application task; formulate and constrain a machine vision problem.

3. Design and implement machine vision solutions to real-world problems and evaluate algorithm performance.

4. Explain, compare and contrast machine vision techniques including image acquisition, feature extraction and machine learning.

**Use of Generative AI (GenAI) in assessment:**

|  |  |
| --- | --- |
|  | You can use Generative AI in this assignment for checking spelling, grammar etc. |

**Guidance on Referencing (inc AI):**

Please note that the aim of referencing is to demonstrate you have read and understood a range of sources to evidence your key points. You need to list the references consistently and in such a way as to ensure the reader can follow up on the sources for themselves.

You must use the UWE Bristol Harvard referencing style.

[Referencing - Study skills | UWE Bristol](https://www.uwe.ac.uk/study/study-support/study-skills/referencing)

[Using generative AI at UWE Bristol - Study skills | UWE Bristol](https://www.uwe.ac.uk/study/study-support/study-skills/using-generative-ai-at-uwe-bristol)

# Submission and feedback dates

**Submission deadline:** Before 14:00 on 7th January 2025

This assignment is eligible for the 48-hour late submission window but not the Reasonable Adjustment to deadline.

**Submission format:**

1. A 5,000-word group report as a MS Word document (**compulsory**). If you use LaTeX to prepare the report, please submit a PDF file instead.

For any student completing this assignment as a group of one, the word count limit is reduced to 2,000.

1. A peer assessment form using the template “PeerAssessmentForm\_24-25.xlsx” that can be found in Blackboard->Assessments (**compulsory**). Not applicable to any student completing this assignment as a group of one.
2. python scripts as .py files or .ipython files, compressed into a single .zip file (**compulsory**). Do not upload trained models or datasets. This file will only be used if the marking team feel that additional verification needs to be carried out.

**Marks and Feedback due on:** 4th February 2025

N.B. all times are 24-hour clock, current local time (at time of submission) in the UK

**Marks and Feedback will be provided via:** Blackboard

# Completing your assessment

**What am I required to do on this assessment?**

Detection, counting, and localisation of fruits in orchards are important tasks in agricultural automation, which can assist with automated fruit picking. Amongst the various types of sensors employed to achieve this reliably in a real-world environment, visual sensors - primarily cameras - have been the most widely used. Despite the differing computer vision approaches utilised to analyse fruit images in the literature, a number of challenges have not been resolved to date, including varying illumination conditions, great variability in fruit/fruit tree appearance, fruit occlusions, and variable camera viewpoint.

The specific requirements are outlined below:

1. You are required to design, implement and evaluate algorithms for **apple counting** in an orchard environment.
2. You must use the **template at the end of this document** for report writing. Read carefully the marking criteria that have been embedded in the template.
3. You are **not** expected to carry out physical data capture experiments, but you are required to identify relevant and publicly available datasets from the internet, such as (**but not limited to**) the MinneApple dataset (Naeni, Roy and Isler, 2019) downloadable from this [webpage](https://conservancy.umn.edu/handle/11299/206575).

Haeni, Nicolai; Roy, Pravakar; Isler, Volkan. (2019). MinneApple: A Benchmark Dataset for Apple Detection and Segmentation. Retrieved from the Data Repository for the University of Minnesota, https://doi.org/10.13020/8ecp-3r13.

1. You are required to propose, implement, and compare **a conventional image processing based approach** and **a machine learning approach** for apple counting (choose one approach only if you are completing this assignment as a group of one). It is not expected that both approaches will achieve outstanding performances, but you need to show that careful considerations have been made to the design of algorithms and interpretation of results.
2. Each group member is expected to contribute equally to the assignment, with every group member actively participating in technical development tasks (beyond literature review and report writing).
3. You must use Python for coding. You may choose to use a python IDE on your local computer or use the Google Colab. Be aware that you *may* need a GPU if you employ certain deep learning models.

**Where should I start?**

Attend the weekly Group Tutorial session and use the exercises and the provided templates to help you make progress with this assignment.

**What do I need to do to pass?**

Refer to the marking criteria and achievement of the minimum mark which is 50%.

**How do I achieve high marks in this assessment?**

Refer to the marking criteria.

**What additional resources may help me complete this assessment?**

* <https://www.uwe.ac.uk/study/study-support/study-skills>
* [Critical thinking and writing - Reading and writing | UWE Bristol](https://www.uwe.ac.uk/study/study-support/study-skills/reading-and-writing/critical-thinking-and-writing)
* [Writing - Reading and writing | UWE Bristol](https://www.uwe.ac.uk/study/study-support/study-skills/reading-and-writing/writing)
* [Writing feedback - Writing | UWE Bristol](https://www.uwe.ac.uk/study/study-support/study-skills/reading-and-writing/writing/writing-feedback#section-4)

Use relevant academic publications, GitHub repositories, and online tutorials to help you improve the breadth and depth of this report.

**What do I do if I am concerned about completing this assessment?**

It is recommended that you review all of the relevant materials on Blackboard. You can also speak to your module leader for advice and guidance.

UWE Bristol offer a range of Assessment Support Options that you can explore through [this link](https://www.uwe.ac.uk/study/academic-information/personal-circumstances), and both [Academic Support](https://www.uwe.ac.uk/study/study-support/student-support-advisers) and [Wellbeing Support](https://www.uwe.ac.uk/life/health-and-wellbeing/get-wellbeing-support) are available.

For further information, please see the [Student](https://www.uwe.ac.uk/study/academic-information/academic-survival-guide) study essentials.

**How do I avoid an Assessment Offence on this module?**

Use the support above if you feel unable to submit your own work for this module.

# Understanding the University rules and requirements around assessment offences is your responsibility: <https://www.uwe.ac.uk/-/media/uwe/documents/study/academic-conduct-policy-and-academic-misconduct-procedures.pdf>

# Marks and Feedback

**Your assessment will be marked according to the following marking criteria (embedded in the template at the end of this document).**

**You can use these to evaluate your own work before you submit.**

1. In line with UWE Bristol’s [Assessment Content Limit Policy](https://www.uwe.ac.uk/about/structure-and-governance/policies) (formerly the Word Count Policy), word count includes all text, including (but not limited to): the main body of text (including headings), all citations (both in and out of brackets), text boxes, tables and graphs, figures and diagrams, quotes, lists.
2. UWE Bristol’s [UWE’s Assessment Offences Policy](https://www.uwe.ac.uk/study/academic-information/assessments/assessment-offences) requires that you submit work that is entirely your own and reflects your own learning, so it is important to:
   * Ensure you reference all sources used, using the [UWE Harvard](https://www.uwe.ac.uk/study/study-support/study-skills/referencing/uwe-bristol-harvard) system and the guidance available on [UWE’s Study Skills referencing pages](https://www.uwe.ac.uk/study/study-support/study-skills/referencing).
   * Refer to peer reviewed primary sources, rather than using AI or secondary sources
   * Avoid copying and pasting any work into this assessment, including your own previous assessments, work from other students or internet sources
   * Develop your own style, arguments and wording, so avoid copying sources and changing individual words but keeping, essentially, the same sentences and/or structures from other sources
   * Never give your work to others who may copy it
   * If an individual assessment, develop your own work and preparation, and do not allow anyone to make amends on your work (including proof-readers, who may highlight issues but not edit the work) and

**When submitting your work, you will be required to confirm that the work is your own,** and text-matching software and other methods are routinely used to check submissions against other submissions to the university and internet sources. Details of what constitutes plagiarism and how to avoid it can be found on UWE’s Study Skills [pages about avoiding plagiarism](https://www.uwe.ac.uk/study/study-support/study-skills/reading-and-writing/plagiarism).

# Assignment Resit

Specific resit information will be sent to you at a later date. The resit report will be based on a similar but different task.

**Group Report Template with Marking Criteria**

**Texts in Blue are not included in the word count**

Please complete the form below which serves to provide additional group-work information to the peer assessment process.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Name of group members** | **Contribution to project** | **Contribution to report** | **Signature** |
|  | e.g., Wenhao Zhang | e.g., Data pre-processing, implementation of approach A | e.g., Section 1, 80% of section 5 |  |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |

1. Introduction **(5%)**

Introduce the background of the project. Illustrate any assumptions made, for example, the lighting conditions you need to deal with in an orchard environment. Clearly show the aim and objectives of this project and discuss the challenges.

2. Related works **(10%)**

Conduct a short literature review on methods relevant to apple counting. For example, if algorithms proposed in prior works on berry detection/counting are deemed applicable to apple counting, you may include a critical review of these as well.

In later sections, you may use this literature review to assist with justification of your methodology as well as with discussing its capabilities and limitations. You will be assessed on the breadth and depth of the review.

3. Data acquisition and datasets **(10%)**

Note that you are not expected to carry out any physical data capture experiment. Instead, illustrate the types of image sensors/imaging systems that can be employed to achieve effective apple counting in a real-world application. Describe the process of data acquisition using the sensor(s) of your choice.

Describe the dataset(s) you employed in this project. Discuss data quality, variability, appropriateness for use in this project, and briefly how they were used in this project with reason.

4. Methodology **(30% in total, 15% per approach), (or for any student completing this assignment as a group of one, 25% in total)**

Present the approach(es) you proposed. Show technical breadth and depth. Justify the use of specific algorithms. Use flowcharts to illustrate the process if applicable. You are welcome to use any image processing/machine learning approach, however basic it may seem, as long as you can justify it well, e.g. why do you think the proposed approach can deal with the challenges identified in Section 1 and 2. Refer to Requirement 4 for more information.

4.1 Approach A

4.2 Approach B (not applicable to an as a group-of-one assignment)

5. Experiment and Implementation **(15%), (or for any student completing this assignment as a group of one, 20% in total)**

Demonstrate that you are able to implement the proposed approaches (introduced in Section 3) using Python programming. Describe the Python IDE/platform/hardware used, core python packages used, how you trained your machine learning model(s) if applicable, parameter tuning/optimisation of key algorithms if applicable. For example, if you used manual thresholding for binarization, explain how you chose an appropriate threshold. If you used deep learning models, explain how you loaded your images and ground truth data; how you split the data for training, validation and testing; and justify the training epochs used. Note that you are not expected to describe each line of your code here. Use flowcharts, diagrams and/or pseudocode where applicable.

6. Results and Evaluation **(15%)**

Present results; evaluate the proposed approaches (quantitatively and qualitatively) using appropriate metrics; and interpret findings. Make sure you explain how results were obtained and what they mean. Having a method that can detect all apples in all your images does not automatically grant you high marks.

Compare approach A and approach B and discuss their respective capabilities and limitations. For a group-of-one assignment, compare your approach with those in the literature. Use your results to support your statements but also explain this from a theoretical point of view.

7. Conclusions and Future works **(5%)**

Conclude the project. Identify challenges relevant to apple counting (as well as detection and localisation) that have not been fully resolved within the scope of this project. Propose future works to deal with these challenges, e.g. is it possible to employ 3D approaches?

The remaining **10%** of the mark is allocated to report presentation including logical structure and clarity, quality of writing, spelling, grammar, diagrams, figures and tables, clarity of expression and use of English, and accuracy, consistency and completeness of citations and references.