

Literature Review - Report

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1 Defining the main research question

Question: How to detect the different growth stages (not matured, matured, over matured) of Oyster mushrooms from the digital photos collected from the fixed cameras inside the growing chambers?

2 Defining keywords

2.1 First keywords

AI, image processing, Oyster mushroom cultivation, mushrooms, image measurement, image analyzing, Optimal growth, Mushroom harvesting, mushroom cultivation, Oyster mushroom classification, segmentation.

2.2 New words and Synonyms

From the scientific paper "Development of a Mushroom Growth Measurement System Applying Deep Learning for Image Recognition" [1]

New words and Synonyms:-

Image Measurement, Measurement period, Monitoring, Temperature sensors, IoT, convolutional neural network, mushroom size, Growth conditions of crop, growth status, growth rate, micro climate control, captured image size, image processing technology, image recognition technology, size classification of mushroom, identification results, image localization, mushroom cap size.

From the scientific paper "Deep learning based research on quality classification of shiitake mushrooms" [2]

New words and synonyms:-

Classification and detection, channel pruning mechanism, pruned model, identification and quality inspection, feature extraction, defect detection, surface texture, computer vision technology, detection technology, deep learning, spectral analysis, grading mushroom, quality classification networks, spectral characteristics/problems, generalization ability of network model, data marking tool-labeling images

From the scientific paper "A novel image measurement algorithm for common mushroom caps based on convolutional neural network" [3]

New words and synonyms:- Measure diameter of cluster mushroom, micro climate data, image measurement system, size of mushroom caps, generate growth rate, mushroom cap, identification, innovate score-punishment (SP) algorithm, Circle Hough Transform (Open CV implementation), state of the crop, computer vision technology, Image measurement system, Circle diameter of mushroom, YOLO Algorithm, Identify small-medium-large images, fine grained features, feature extraction, calculate number of pixel (prior circle in addition to pixel) fine tuning.

From the scientific paper 'Recursive-YOLOv5 Network for Edible Mushroom Detection in Scenes With Vertical Stick Placement' [4]

New words and synonyms:- Mushroom detection, optimal picking cycle, ripe edible mushroom, object detection algorithm, growth status, recursive YOLOv5, edible mushroom recognition algorithm, automatic recognition of ripe mushroom, target tracking, behavioral recognition, physique recognition, semantic

segmentation,image segmentation, foreign object occlusion,target overlap, image distortion,target detection networks,adaptive anchor algorithm

From Scientific paper "Image Analysis of Mushroom Types Classification by Convolution Neural Networks" [5] New words and synonyms:-

poisonous substances,classification of types of mushrooms,CNN,characteristics of mushrooms, recognition and classification of mushrooms ,mold plant(mushroom),opening cap level,nondestructive technique (recognize mushroom fragrance), useful groups and harmful groups (classification) by CNN tensor flow

These were the first keywords and synonyms used to search for the scientific papers related to the study.For defining the search string these words are rearranged such a way that it results relevant papers.

3 Defining search string

(inspection OR evaluated OR classify OR Classification OR selected OR categorized OR calculated OR optimize OR results OR conditions OR Validate) AND (texture OR pattern OR features OR characteristics OR types OR quality) AND (methods OR tools OR function OR algorithms OR models OR technologies OR system Or assessment OR identification) AND (learn Or learning OR prediction OR tuning OR policy OR study) AND (extract OR simplify OR enhanced OR sampling OR remove OR reduce OR verify OR target) AND (product OR crop OR mushroom cap) AND (growth rate OR harvested time OR stage OR size OR cycle OR region)

4 Defining search engines

The readings was done from the search engines defined below:

- IEEE Xplore
- Science Direct(Elsevier)
- Springer
- ACM
- Google Scholar
- Google

5 String refinement

These are the strings that are parsed(also changed the order of appearances) to obtain the relevant scientific works. They are:

mushroom image classification -pattern classifier - image recognition mushrooms-image analysis-
- quality classification - methods to classify-deep learning based mushroom classification-nutritional
mushroom classifier-harvest time of oyster mushrooms-image segmentation-instance segmentation
-maturity identification.

The search strings that doesn't contribute to the study were removed.

6 Search string execution

Date of the execution, number of articles returned (from similar date) are updated on a spreadsheet a database for scientific papers are created. The search strings used, articles returned and date of executions are arranged in Table1. The search strings contributing to the study was saved. The search strings that didn't give relevant outputs are removed.

Search Strings used	Search Engine	Date of execution
Quality classification of edible mushrooms	IEEE Xplore	15-09-2022
Methods to classify mushrooms	IEEE Xplore	26-09-2022
Harvest time of mushroom	IEEE Xplore	29-09-2022
Identification of maturity of oyster mushrooms	Google scholar/Springer	24-09-2022
Identification of maturity of oyster mushrooms	Science Direct	29-09-2022
Oyster mushroom maturity identification using deep learning	Google scholar/MDPI	24-09-2022
Instance segmentation for oyster mushroom classification	IEEE Xplore	27-09-2022
Image analysis of mushrooms	ACM	24-09-2022
Segmentation for oyster mushroom classification	IEEE Xplore	27-12-2022

Table 1: Search string execution

7 Downloading and storing search results

The search strings are executed,downloaded and files are stored in .bib file format named ref.bib

From reference [6] to [32] the scientific papers which showed similar study pattern were downloaded from different search engines and saved.

8 Defining the Selection Criteria

The search string were executed in the defined search engines the number of papers returned was classified into relevant and not relevant by adding an column that shows the status whether it is included or excluded.The study was focusing mainly on Oyster mushroom on top of that mushroom growing as indoor farming.

The inclusion criteria was to focus on Oyster mushrooms, indoor growing and image processing.Other crops and related study and common mushrooms like button mushrooms were excluded as they don't contribute much information to this project.As shortlisted from the spreadsheet database, the Title, Abstract, Introduction and Conclusion of the scientific papers was analyzed.

9 Selection of Papers - Analyzing Relevant Headings of the Papers Downloaded

The priority was given to Oyster mushroom and maturity detection which precisely focusing on the research question.A priority number was assigned to the papers.After review from the advisors most relevant papers where selected to the next stage.

Moreover,[2], [4], [14], [17], [23], [29], [30] and [3] were selected by analyzing the title, abstract, introduction and conclusion.Language English was set as restriction.

After checking the quality of the papers additionally to the data set used [2], [4], [23], [29], [30] are selected to derive the answer to research question.

10 Deriving the Results

After closely observing similar studies the methods used to identify growth status of the mushrooms uses Deep learning methods that process images and classify them to different labels. Versions of YOLO (Recursive-YOLO5, YOLO5),SSD , VGG-16 was some of them which used in these similar works. This can be adopted in this present situation as these methods shows more that 90% accuracy in detecting objects.

Mask R-CNN and YOLACT ++ are some of the other methods which can be used to detect object if the probability of noise in the image is higher.

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