TU Clausthal

# Project Report

## Different Stages of Maturity Detection of Oyster Mushrooms Growing Indoor Chambers

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# Road Map

- Introduction
- Experimental setup
- Related studies
- Image Analysis – ML/DL algorithms
- Conclusion

## Introduction

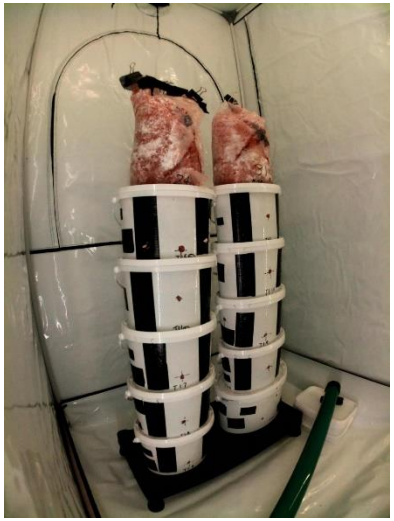
- As the future is vertical farming for a sustainable circular economy aiming for profitable framing an experimental setup was built in the Digit lab, Goslar.[1][2]

- Two chambers were arranged in a controlled environment for the optimal growth of Oyster mushrooms where temperature and humidity are controlled. Moreover, cameras were fixed to observe the growth of the Oyster mushrooms

# Experimental set up

Growth chamber of Oyster Mushroom in a controlled environment

(a) Indoor grow chambers



(b) Mushroom substrate stack

# Procedure of development of Mushroom

- Inoculate the substrate for 10 to 15 days and transferred it to the plastic bags/buckets for colonization
- After complete colonization of the bag or buckets, i.e. the full white block they were kept in for fruiting in the chambers with a suitably controlled growing environment
- Proper cuts or holes are made for fruiting (popping out of the mushrooms)
- Uncolonized mycelium is considered contaminated.

# Making of Mushroom pods

- Oyster Mushroom pods

inside the growth chamber stacked replica to vertical farming as it saves space

A sample image from one of the cameras fixed inside the chambers before labelling.

# Search Strings Used

- Quality classification of edible mushrooms
- Methods to classify mushrooms
- Harvest time of mushroom
- Identification of maturity of oyster mushrooms
- Oyster mushroom maturity identification using deep learning
- Instance segmentation for oyster mushroom classification
- Image analysis of mushrooms
- Segmentation for oyster mushroom classification

# Selection Criteria

- The title, abstract introduction and conclusion of papers [3] to[6] were observed and added to the final stage of deriving the answer to the research question.

# Deep Learning and ML algorithms

As the literature review where done , Deep Learning and Machine Learning algorithms are used to identify the object from the picture moreover  classify them to categories.

Deep Learning algorithms is a branch of machine learning where takes any kind of complex algorithms  and detect the objects, voice, text etc and analysis it.

# CNN-VGG16

- Grey Oyster Mushroom Classification toward a Smart Mushroom Grading System for Agricultural Factory [3]
- Algorithms:- CNN, convolutional neural network large kernel net is used so that the image classification is better in greyscale.
- VGG16- the pre-trained network is used and intra-classification of grey oyster mushrooms is done. VGG is a specific CNN that is particularly designed for the localization and classification of objects in the picture.

# Single Shot Multi Box Detector-SSD

- A Field-Tested Harvesting Robot for Oyster Mushrooms in Greenhouse [4]
- Real-time detection and localization using SSD method for oyster mushroom picking robot [5]

The Oyster mushroom growing in the pods is detected using the algorithm SSD and analyzed the maturity.

The position of the mushroom is detected by the bounding box. The presence of the mushroom inside the bounding box is calculated.

When the bounding box overlaps with the highest degree of other bounding boxes, it results in object prediction (accurately)and its location.

# YOLO v5

- Recursive-YOLO-v5 Network for Edible Mushroom Detection in Scenes With Vertical Stick Placement [6]
- Deep learning-based research on the quality classification of Shiitake Mushroom [7]
- Compared to other DL algorithms, the YOLO gives rapid and accurte identification of algorithms and outperforms the other DL algorithms in terms of identification.
- The efficiency and growth status were calculated. The surface texture of the shiitake mushrooms is correctly observed.

# DL Algorithms for object detection and localization

- SSD , YOLO,CNN - VGG-16 , R-CNN are the best algorithms for object detection as they outperform the other deep learning algorithms when considering the accuracy and minimum  error rate

# Conclusion

- Proceeding with YOLOv5, SSD, and VGG-16 being some of the best methods to analyse the image and detect the object in the picture which can be used to detect the oyster mushroom in this study.

# References


- [1] Mohd Salim Mir, Nasir Bashir Naikoo, Raihana Habib Kanth, et al. \Vertical farming: The future of agriculture: A review". In: The Pharma Innovation Journal (2022), pp. 1175{1195}.
- [2] ETCE official website. Accessed:2023-01-01. url: https://etce- lab.com/.
- [3] Nik Mohd Zarie Hashim, Muhammad Danish Shaharudin, Anuar Jaafar, et al. \Grey Oyster Mushroom Classification toward a Smart Mushroom Grading System for Agricultural Factory". In: 2022 2nd International Conference on Intelligent Technologies (CONIT). IEEE. 2022, pp.16.
- [4]Jiacheng Rong, Pengbo Wang, Qian Yang, et al. \A field-tested harvesting robot for oyster mushroom in the greenhouse". In: Agronomy 11.6 (2021), p. 1210.
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- [6]Bohan Wei, Yao Zhang, Yufan Pu, et al. \Recursive-YOLOv5 Network for Edible Mushroom Detection in Scenes With Vertical Stick Placement". In: IEEE Access 10 (2022), pp. 40093 - 40108.
- [7]Qiang Liu, Ming Fang, Yusheng Li, et al. \Deep learning based research on quality classification of shiitake mushrooms". In: LWT 168 (2022), p. 113902.

# Thank you