ISSN 2093-4025

제33권 제1호 KIIS

2023년도 한국지능시스템학회 춘계학술대회

Abstracts of KIIS Spring Conference 2023

Volume 33, Number 1, KIIS

KIIS

일 시 2023년 4월 13일(목) ~ 4월 15일(토)

장 소 제주대학교(언어교육원, 사회과학대학)

주 최 (사) 한국지능시스템학회

주 관 제주대학교

후 원 제주대학교 JEJU NATIONAL UNIVERSITY, LG U+, (주)하이제이컨설팅, 목포해양대학교 LINC3.0사업단, NSonesoft, MT 엠티데이타, 올포랜드, Selim 세림티에스지(주), Scobotsys, RIAN, 대신정보통신(주), SK broadband, ICTWAY 아이씨티웨이(주), KJ, 상용정보통신주식회사 Sangyong Information & Communications Corp., 클로센(주)

An Embedded Compact Transformer Vision System for Real-Time Health classification during Seedling Transplanting

Yu Zheng[1] Kyeong-Hwan Lee[1,2]

[1]Department of Convergence Biosystems Engineering, Chonnam National University, Gwangju

[2]Department of Rural and Biosystems Engineering, Chonnam National University, Gwangju

Introduction

Necessity

Seedling transplanting is an important step in plant production to transplant seedlings into low-density trays at specific growth stage. Simultaneously, it is necessary to decide and select the growth status of seedlings in order to improve production quantity and quality.

< Seedling transplanting >

Objective

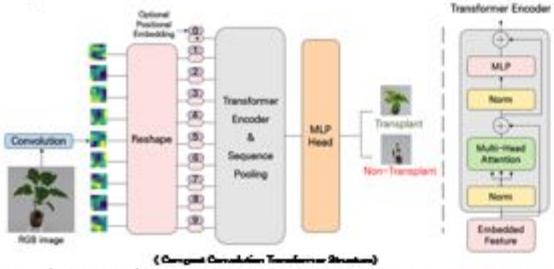
Propose a compact Transformer-based vision system for real-time health classification of seedlings during the transplantation process. The algorithm is designed to be simple and compact, making it suitable for use on embedded devices with limited computational resources.

Materials & Methods

Hardware system

< Hardware system configuration >

Compact Convolutional Transformer

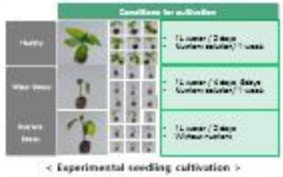


(Compact Convolution Transformer Structure)

- Based on CNN-Transformer model is proposed, including two convolutional modules, seven Transformer modules, sequence pools and MLP outputs.
- The attention mechanism of transformer module and sequence pool is used to map the output to a single category index and assign data sequences according to weights, which improves the efficiency and accuracy of feature extraction.

Seedling culture and data collection

< Seedling cultivation environment>

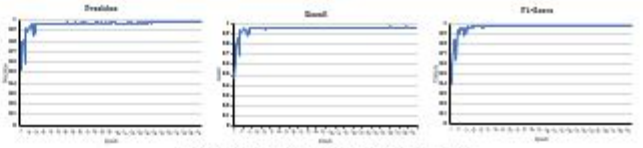


< Experimental seedling cultivation >

< Transplanting software interface >

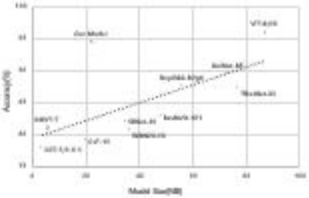
< Transplanting operation scenario >

Experiment and Results



< Model training results (Precision, Recall, F1-Score) >

< Part of the classification results >



< The Performance of Different Algorithms >

- The dataset consists of 604 paprika image data divided into training, validation and test according to the ratio of 6:2:2.
- The training parameters : Batch size: 5, Learning Rate: 0.0005, Iteration: 200.
- The results were Accuracy: 94.5%, Recall: 97.1%, Precision: 94.9%, F1-score: 95.9%, and FPS: 7.6.

Conclusions

- Reduce model size 2-4 times compared to SOTA while maintaining accuracy.
- Select embedded device as the computing platform to reduce costs while increasing deployment flexibility.

References

1. P. E. L. Otoya and S. R. P. Gardini, "A Machine Vision System based on RGB-D Image Analysis for the Artichoke Seedling Grading Automation According to Leaf Area," 2021 IEEE 3rd Eurasia Conference on IOT, Communication and Engineering (ECICE), Yunlin, Taiwan, 2021, pp. 176-181
2. Fu, W.; Gao, J.; Zhao, C.; Jiang, K.; Zheng, W.; Tian, Y. Detection Method and Experimental Research of Leafy Vegetable Seedlings Transplanting Based on a Machine Vision. Agronomy 2022, 12, 2899

Acknowledgements

This work was supported by Korea Institute of Planning and Evaluation for Technology in Food, Agriculture and Forestry(IPET) and Korea Smart Farm R&D Foundation(KosFarm) through Smart Farm Innovation Technology Development Program, funded by Ministry of Agriculture, Food and Rural Affairs(MAFRA) and Ministry of Science and ICT(MSIT), Rural Development Administration(RDA)(42103204) and by Korea Institute of Planning and Evaluation for Technology in Food, Agriculture and Forestry(IPET) through the Open Field Smart Agriculture Technology Short-term Advancement Program, funded by Ministry of Agriculture, Food and Rural Affairs(MAFRA)(32204003)