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**DEVELOPMENT OF MUSHROOM BUD-THINNING STRATEGY MODEL
BASED ON DEEP LEARNING AND IMAGE PROCESSING**

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Abstract:

Mushroom is an important crop in Taiwan because it has high nutritional values and economic benefits. With the improving agricultural technology and increasing agricultural product quality requirements, smart mushroom greenhouses have been gradually implemented in traditional mushroom greenhouses. By digitizing greenhouse environmental information, the mushroom growth environment could be controlled precisely for stabilizing the production quality. In addition to greenhouse environmental control, mushroom bud-thinning is another important factor for producing high value and quality of mushrooms. However, nowadays, the mushroom bud-thinning strategy is dependent on experienced mushroom farmers and lacked objective references. As a result, it also increases the challenges of the mushroom bud-thinning experience inherit. To quantify the bud-thinning strategy of mushroom farmers, the purpose of this study is to develop a mushroom bud-thinning strategy model integrated with deep learning and image processing. Deep learning technique was used to locate mushrooms and mushroom bags in the captured image. Image processing was used to extract the characteristic parameters of mushrooms, such as size, roundness, distance, and growth uniformity. Afterwards, a mushroom bud-thinning strategy algorithm was established, according to characteristic parameters and the farmers' experience. Deep learning result shows the precisions of mushrooms and mushroom identifications are 100% and 78%, respectively, and that of recalls are 100% and 88%, respectively. In the mushroom bud-thinning algorithm, after 100 mushroom bags were randomly selected to compare different accuracy of bud-thinning strategies, the preliminary result demonstrated that the whole system was capable of providing similar strategies to that of accomplished and experienced farmers made. In the future, this system could combine with a conveyor belt to automatically photograph mushroom bag images, so that the consequence of the mushroom bud-thinning strategy can be displayed in real-time to help mushroom farmers make decisions. Furthermore, this system could be utilized in augmented reality glasses, and thus it enables farmers to work in narrowly spatial mushroom greenhouses, increasing convenience and flexibility.

Key Words: mushroom, strategy model, image processing, deep learning, bud, thinning