

# Using UAV images to monitor rice paddy with artificial intelligence

Ming-Der Yang<sup>1,2</sup>, Hui-Ping Tsai<sup>1,2</sup>, Yu-Chun Hsu<sup>2</sup>, Cloud Tseng<sup>2</sup>

<sup>1</sup> Department of Civil Engineering, National Chung Hsing University, Taichung 402, Taiwan

<sup>2</sup> Innovation and Development Center of Sustainable Agriculture, National Chung Hsing University, Taichung 402, Taiwan

## Project Goal



- A smart rice paddy unmanned aerial vehicle (UAV) monitoring system will be established with cloud-based image processing techniques based on a combination of UAV images and a huge amount of environmental data.
- Artificial intelligent (AI) techniques will be implemented for agriculture applications such as growth monitoring, yield prediction, crop moisture content evaluation, damage assessment, and disease monitoring, etc.
- The proposed smart rice paddy UAV monitoring system is expected to provide scientific bases which are crucial in a labor-shortage modern community for efficient agricultural management strategies establishment.

## Highlights

### UAV agricultural multi-source image database



Establishing a UAV agricultural multi-source image database which covers the whole life cycle of rice growing stages, nutrient levels, and associated diseases.

### UAV Image Analysis



Implementing a variety of image analyses combining AI techniques for growth monitoring, yield prediction, crop moisture content evaluation, damage assessment, and disease monitoring.

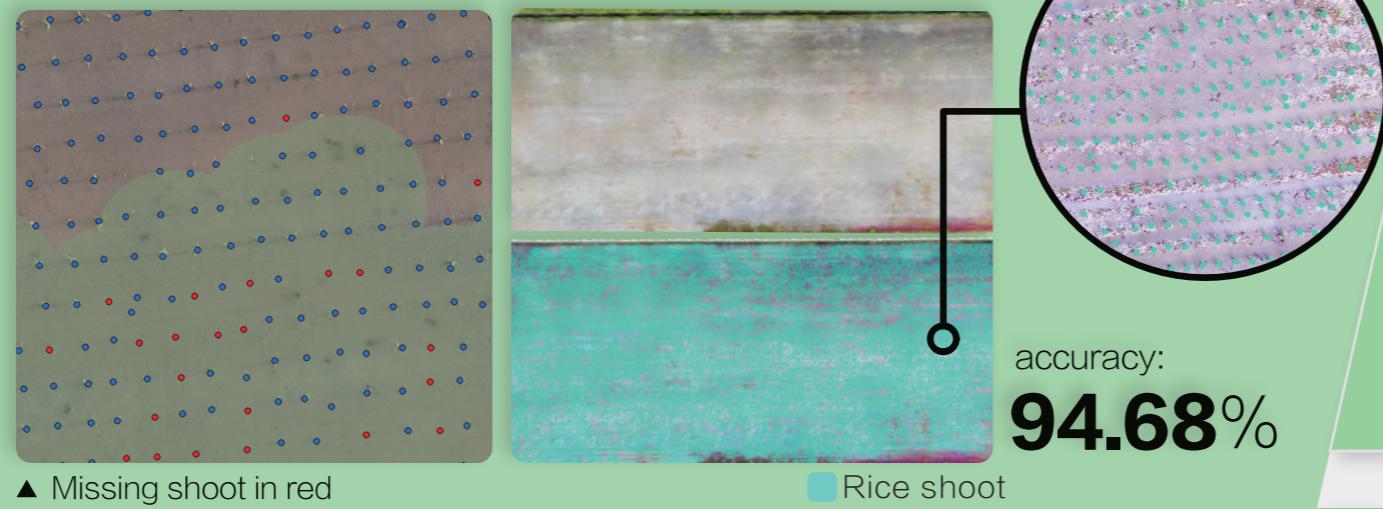
### UAV Cloud-based Platform



Establishing a UAV cloud-based platform to combine functions of UAV image analysis and expert advice support system.

## Applications

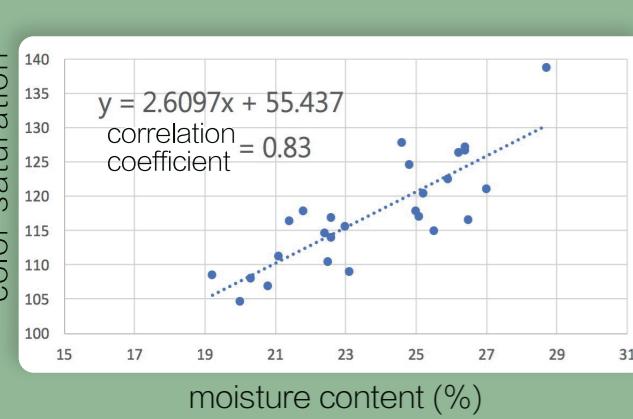
UAV images can be used to detect undesired situations during growth stages. For example, in the seedling stage, missing shoot caused by disease or insufficient nutrient can be detected from UAV images to evaluate the cost of replenishment for farmers.



Ear of rice estimation → accuracy: 80%



▲ Morphological image processing



Grain moisture content is important to determine the best timing of harvest. UAV images can be used to analyze the relationship between image spectral reflectance and grain moisture content. A reliable estimation of grain moisture content is expected to provide valuable harvest timing suggestions and prevent undesired rush harvest loss.



▲ Traceability example

Establishing rice traceability system is important for customers to understand and appreciate their food on the table. A complete life cycle of rice can be retrieved from the rice traceability system such as agricultural practices, UAV images, and associated analyses, etc.

Rice is vulnerable to natural disasters such as typhoons so that Taiwan's government offer compensation to farmers whose damages of crops over 20%. UAV images are helpful in assessing damage and can provide precise measurement to accelerate the current manual assessment process.



96.17% accuracy

### Disease Detection



Multi-source UAV images can provide deeper understandings of diseases. With a combination of edge computing technique, precision agriculture practices such as site-specific fertilizing or pesticide application can be performed.

### Research Team



Ming-Der Yang  
Civil Engineering department



Yuan Shen  
Agriculture and Natural Resources college



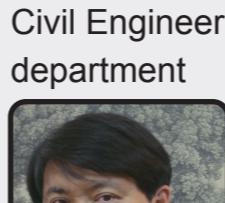
Jen-Yu Han  
Civil Engineering department(NTU)



Chin-Ying Yang  
Agronomy department



Hui-Ping Tsai  
Civil Engineering department



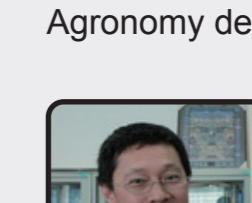
Fang-Pang Lin  
Excellence for Cyber Enablement of Applications center



Bo-Jein Kuo  
Agronomy department



Su-Chin Chen  
Agriculture and Natural Resources college



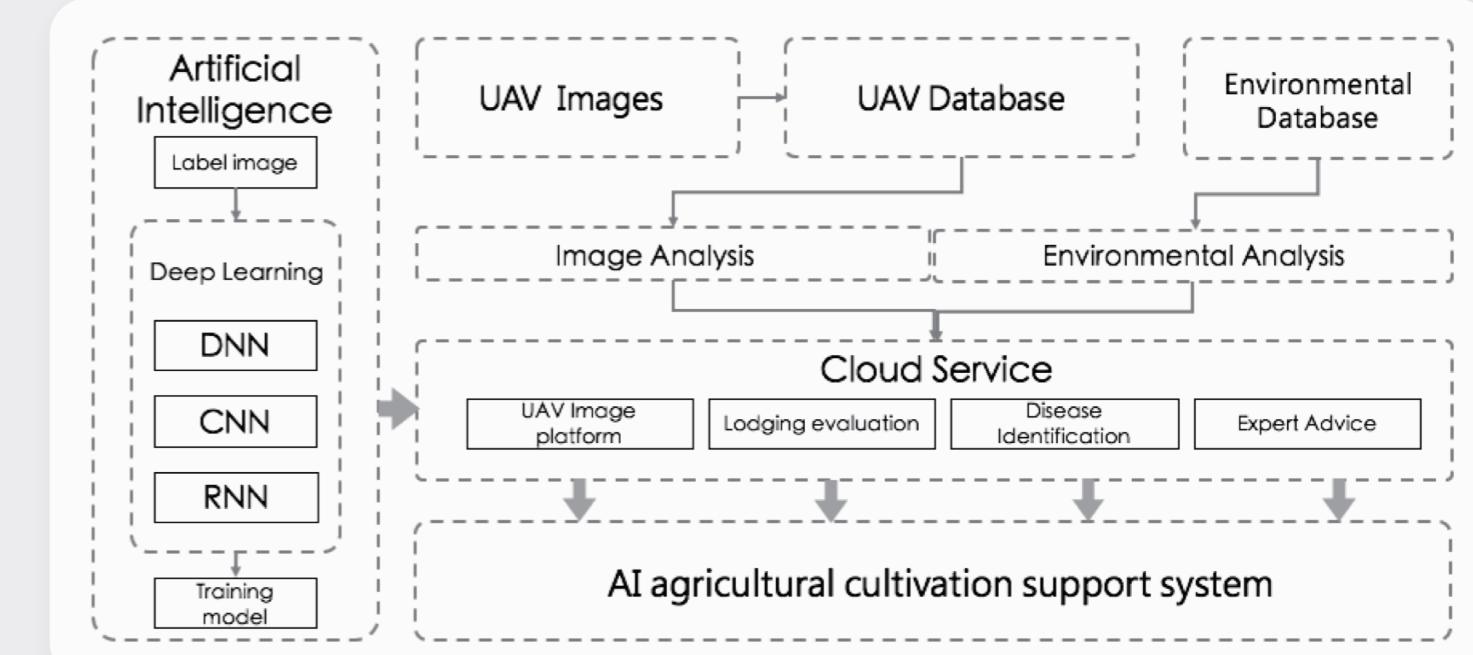
Hsing-Juh Lin  
Life Sciences department



Chi-Ling Chen  
Taiwan Agricultural Research Institute  
Council of Agriculture

Yi-Ting Hsu  
Agronomy department

## Research flow



## Agricultural Cloud-base Platform



The system provides functions such as UAV images uploading, automatic orthophoto mosaicking, and Google Map overlapping with GPS information. Multiple image tasks and historical tasks can be managed and displayed on the platform.

- 3D Models can be established automatically and displayed on the agricultural cloud-based platform (Beta).
- A sparse point cloud mode is set as the quick view mode.

UAV provides low-cost, high temporal and spatial resolution images which are helpful for agriculture applications such as growth stage monitoring, yield prediction, grain moisture content assessment, rice traceability system, damage assessment, disease detection, etc. The proposed smart rice paddy monitoring system alongside with AI techniques development is valuable to initiate a scientific-based management support system and expect to ease labor shortage and ensure a sustainable rice production in Taiwan and further southeast Asia countries.

This work was supported in part by the Ministry of Science and Technology of Taiwan under Project MOST107-2634-F-005-003 and the Ministry of Education of Taiwan under the Higher Education Sprout Project.

## Prospects

## Acknowledgement