Third International Workshop on "Artificial Intelligence in Agriculture"

Jeonbuk National University, South Korea

November 21, 2024

Organized by: Core Research Institute of Intelligent Robots, Jeonbuk National University, South Korea.

Co-organized by: Tianjin International Joint Research Center for Intelligent Computing and Biometric Recognition Technology, China.

Jeonbuk RICE Intelligence Innovation Center, Jeonbuk National University, South Korea

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Hybrid Event

Introduction

Welcome to the Third International Workshop on Artificial Intelligence in Agriculture!

As agriculture faces an evolving landscape of challenges, from escalating operational costs and labor shortages to changing consumer demands, innovation has become essential. Artificial intelligence is playing a transformative role in meeting these challenges, empowering modern agriculture to achieve new efficiencies and productivity.

A major frontier of this innovation is in the deployment of autonomous systems capable of performing complex tasks across farming operations. These systems—supporting disease prediction, plant growth monitoring, and even harvesting—generate invaluable insights from a vast network of sensors. The data they provide enhances resource use, reduces losses, and optimizes every stage of the cultivation process.

Our workshop aims to bring together researchers to exchange knowledge, share insights, and explore the latest developments in AI applications for agriculture. Through engaging presentations and discussions, our speakers will offer their experiences and perspectives, contributing to the growth of research and collaboration in this field. We hope this event will not only advance current research but also foster meaningful connections among institutions.

Organization of the Workshop

General Chair:

- **Sook Yoon**, Mokpo National University, South Korea

General Co-Chairs:

- **Jucheng Yang**, Tianjin University of Science and Technology, China
- **Alvaro Fuentes**, Jeonbuk National University, South Korea

Committee Members:

- **Hyongsuk Kim**, Jeonbuk National University, South Korea
- **Dong Sun Park**, Jeonbuk National University, South Korea
- **Sangcheol Kim**, Jeonbuk National University, South Korea
- **Alvaro Fuentes**, Jeonbuk National University, South Korea
- **Jongbin Park**, Jeonbuk National University, South Korea
- **Jonghoon Lee**, Jeonbuk National University, South Korea
- **Mingle Xu**, Jeonbuk National University, South Korea
- **Yongchae Jeong**, Jeonbuk National University, South Korea
- **Sang Jun Lee**, Jeonbuk National University, South Korea
- **Wei Guo**, University of Tokyo, Japan
- **Marisol Lopera**, Tecnologico of Medellin, Colombia
- **Haeyoung Na,** Mokpo National University, South Korea
- **Zhihui Wang**, Shandong University of Science and Technology, China
- **Ram Kaji Budhathoki**, Kathmandu University, Nepal
- **Haeyoung Na**, Mokpo National University, South Korea
- **Changju Yang**, National Institute of Agricultural Sciences, South Korea
- **Abhishesh Pal**, Accenture, Norway

General Information

Language:

The official language of the workshop is English.

Location:

Jeonbuk National University, Engineering Building 2-8, room 203.

Address:

567 Baekje-daero, Deokjin-gu, Jeonju-si, Jeonbuk, 54896 South Korea

https://maps.app.goo.gl/QuGJA9gww6L6xwVE8

Online link:

https://us06web.zoom.us/j/83919034806?pwd=EF1cP4Uw6DmkawVFLbINQ2Ga3rGbaB.1

Meeting ID: 839 1903 4806

Passcode: 241121

Presentation guidelines:

- Presenters should prepare their presentation using Microsoft PowerPoint or Portable Document Format (PDF).
- Each presentation is allocated 30 minutes: 20 minutes for the talk and 10 minutes for a Q&A session.

Workshop Schedule (Korea Time GMT+9)

Time	Content	Speaker	Affiliation
9:40-9:50	**Welcome and Opening Remarks**	Sook Yoon	Mokpo National University, South Korea
Session 1 **Session Chair: Alvaro Fuentes (Jeonbuk National University)**			
10:00-10:30	Human-centered machine learning driven phenotyping techniques for advancing sustainable food production.	Wei Guo	University of Tokyo, Japan
10:30-11:00	Development and Research with Communities: A Multi-perspective Approach from the Social Appropriation of Knowledge.	Marisol Lopera	Tecnologico of Antioquia, Colombia
11:00-11:30	Innovative Smart Farm Technologies for Horticultural Crops: Cooling and Heating Technology, Fulfillment Automation, Quality Seedling Management, and Byproduct Recycling.	Haeyoung Na	Mokpo National University, South Korea
11:30-12:00	Data-Driven Agriculture: Enhancing Crop Health and Efficiency with AI Technology.	Alvaro Fuentes	Jeonbuk National University, South Korea
12:00-14:00	Lunch Break		
Session 2 **Session Chair: Dong Sun Park (Jeonbuk National University)**			
14:00-14:30	Introduction to research cases of artificial intelligence technology in the agricultural field.	Changju Yang	National Institute of Agricultural Sciences, South Korea
14:30-15:00	Cow Behavior Recognition Using Video Surveillance and Deep Learning Methods.	Jucheng Yang	Tianjin University of Science and Technology, China
15:00-15:30	Modified neural networks with individual-group relevance for online breeder tracking.	Zhihui Wang	Shandong University of Science and Technology, China
15:30-16:00	Smart Hydroponics: IoT Automation and CNN-Based Tip Burn Detection in Lettuce.	Ram Kaji Budhathoki	Kathmandu University, Nepal

16:00-16:30	The Future of Agriculture through Disruptive Technology.	Abhishesh Pal	Accenture, Norway
16:30-16:35	**Closing Remarks**	Hyongsuk Kim	Jeonbuk National University, South Korea

Workshop Presentations

Thursday, November 21, 2024:

Session 1 – Morning

Session Chair: Alvaro Fuentes (Jeonbuk National University, South Korea)

10:00-10:30

Wei Guo
Associate Professor
Institute for Sustainable Agro-ecosystem Services (ISAS) & Laboratory of Field Phenomics
Department of Agricultural and Environmental Biology
The University of Tokyo, Japan

Biography: Wei Guo, Ph.D., is an Associate Professor and PI at the Laboratory of Field Phenomics, Graduate School of Agricultural and Life Sciences, the University of Tokyo, Japan. Trained as an engineer in computer science/informatics in China and Japan, he received his Ph.D. in agriculture, majoring in agro-informatics at the University of Tokyo in 2014. He established the "Laboratory of Field Phenomics," Japan's first plant phenomics laboratory, as a core member in 2017. His research focuses on field-based phenotyping using advanced sensing platforms and technologies such as drones and ground robots, image processing, and machine learning approaches. In 2020, Guo received the Young Researcher's Award from the Japanese Society of Agricultural Informatics. He is also the Senior editor of the journal "Plant Phenomics".

Human-centered machine learning driven phenotyping techniques for advancing sustainable food production.

Abstract – Human-centered machine learning driven phenotyping focuses on developing tools and pipelines tailored to the needs of farmers, breeders, agronomists, researchers, and agricultural stakeholders. These AI systems leverage machine learning algorithms and advanced image-sensing techniques to provide accurate, real-time data on crop health, growth patterns, and environmental interactions. This presentation will introduce the current research activities of the Laboratory of Field Phenomics at the University of Tokyo.

10:30-11:00		**Marisol Lopera** Professor Tecnologico of Antioquia Colombia
	Biography: Bachelor's degree in Natural Sciences and Environmental Education with a master's degree in Environment and Sustainable Development. Completed doctoral studies in Transdisciplinary Research in Education at the University of Valladolid (Spain) and postdoctoral training in the "Global Talents for Local Transformation" program by the German Ministry of Education and the University of Vechta (Lower Saxony), Germany. Leader of the international cooperation project "Education for the Sustainable Development Goals – Capacity Building for Educators" at the University of Antioquia. Currently, she is a professor at Tecnologico de Antioquia and leads the research group "Maloca: Science and Sustainability in Education."	
	Development and Research with Communities: A Multi-perspective Approach from the Social Appropriation of Knowledge. *Abstract* – The presentation recognizes the fundamental role of universities and research centers in generating knowledge, especially in the areas of sustainability and the environment, and in driving social transformation. These institutions have led the development of scientific solutions to address environmental and social challenges. However, new methodologies are now being explored that connect people and communities with diverse knowledge and experiences, enhancing the relevance and impact of projects. This approach, known as the social appropriation of knowledge, allows communities to understand and apply the knowledge generated, fostering collaboration that transcends the instrumental use of individuals. In this way, co-creation of solutions that incorporate local perspectives is encouraged, ensuring that projects are more inclusive, sustainable, and suited to today's environmental challenges. Social appropriation values people as active agents of transformation, strengthening the links between knowledge, sustainability, and community development.	

		**Haeyoung Na** Professor Department of Horticulture and Forestry, College of Life and Medical Sciences, Mokpo National University
	Biography: – Na Haeyoung is a professor in the Department of Horticulture and Forestry at Mokpo National University in Korea. She received her Ph.D. degree in Horticulture from Seoul National University in 2007. From 2008 to 2011, she worked as a senior researcher at the National Institute of Horticultural and Herbal Science and the College of Agriculture and Life Sciences at Seoul National University. In March 2012, she joined Mokpo National University as a professor in the Department of Horticulture, where she has been working ever since. Before joining Mokpo National University, she conducted research on microspore culture, virus-free plants, and micro rapid mass propagation using tissue culture. Since 2012, she has been actively engaged in research aimed at solving challenges in the agricultural field.	
11:00-11:30	**Innovative Smart Farm Technologies for Horticultural Crops: Cooling and Heating Technology, Fulfillment Automation, Quality Seedling Management, and Byproduct Recycling.** *Abstract* – Due to climate change, annual sunlight hours are decreasing, while solar radiation and average temperatures are rising. As a result, year-round cultivation in greenhouses becomes challenging during the high-temperature summer season due to poor environmental conditions. To ensure stable year-round production in greenhouse horticulture and address the impacts of abnormal weather, the development of high-efficiency cooling and heating systems for smart greenhouses is essential. Our research team conducted a study titled “development of smart greenhouse cooling and heating package technology for abnormal climate”, achieving the following results: (1) Determined optimal conditions for plant growth through targeted cooling and heating systems. (2) Developed a new hybrid cooling and heating system utilizing super hydrophilic cooling pads. (3) Designed a complex heat pump-based targeted cooling and heating system. (4) Created optimal operation algorithms, control systems, and mobile applications for a combined heat pump-based greenhouse and targeted cooling/heating system. (5) Additionally, to address challenges in the agricultural field, we are pursuing the following research projects: (1) Development of Robotic Fulfillment APC for Fresh Agricultural Products. (2) Development of Growth and Environmental Control Technology Applying - Production Management Standards for High-Quality Seedlings. (3) Development of	

	Optimization Technology for Remodeling Existing Glass Greenhouses to Implement Intelligent K-Farm Greenhouses. (4) Establishment of Greenhouse Cultivation Waste Recycling Technology and Analysis of Ripple Effects.
11:30-12:00	 **Alvaro Fuentes** Research Professor Core Research Institute of Intelligent Robots Department of Electronics Engineering Jeonbuk National University, South Korea
	Biography: Dr. Alvaro Fuentes is a Research Professor at the Core Research Institute of Intelligent Robots (CRIIR) and the Department of Electronics Engineering at Jeonbuk National University, South Korea. He holds a Ph.D. and M.Sc. in Electronic Engineering with a specialization in Artificial Intelligence and Computer Vision from Jeonbuk National University, as well as a degree in Mechatronics Engineering from the Technical University of the North, Ecuador. Throughout his academic and professional career, Dr. Fuentes has also participated in several research stays and academic exchanges in Germany, as a fellow of the DAAD. He has authored and co-authored several high-impact publications, particularly in the area of Artificial Intelligence for Smart Agriculture. His primary research and teaching interests include Computer Vision, Deep Learning, Machine Learning, and Robotics, with applications in agriculture and medicine.
	Data-Driven Agriculture: Enhancing Crop Health and Efficiency with AI Technology. *Abstract* – This presentation introduces advanced AI-driven techniques for enhancing automation and precision in agriculture, with a particular focus on greenhouse environments. It delves into the development of robust methods for plant disease detection and crop monitoring, addressing critical challenges such as plant diversity, environmental variability, and limited labeled data. Highlights include deep learning techniques that enhance classification accuracy and adaptability, along with domain adaptation strategies specifically designed for controlled agricultural settings. Large-scale vision and language models are also discussed for their capacity to increase model robustness and enable scalable, real-time disease detection. Complementing these AI advancements, the role of robots and in-field sensors in crop monitoring is examined, illustrating how data-driven technologies support informed decision-making and resource optimization. These innovations offer transformative solutions for achieving precise, resilient, and sustainable agricultural practices.

Session 2 – Afternoon

Session Chair: Dong Sun Park (Jeonbuk National University, South Korea)

Changju Yang
Researcher
National Institute of Agricultural Sciences
Rural Development Administration
South Korea

Biography: Dr. Changju Yang is an agricultural researcher at the National Institute of Agricultural Sciences, Rural Development Administration, South Korea. He received his Ph.D. in Electronics Engineering from Jeonbuk National University, South Korea, in 2014. Subsequently, he worked as a postdoctoral researcher until 2016, a research professor until 2018, and as the head of research at a venture company until 2020. In the field of artificial intelligence, he has conducted research on memristor-based neural network design and image sensor-based object recognition. In the field of control systems, he has researched data error correction algorithms and Battery Management System (BMS) design. His main research interests focus on intelligent agricultural machinery control technology using sensor-based digital data for agricultural environments.

14:00-14:30

Introduction to Research Cases of Artificial Intelligence Technology in the Agricultural Field.

Abstract – This presentation provides an introduction to two recent AI technology applications in the agricultural field that enhance automation and precision. The first technology uses stereo vision sensors integrated with a deep learning model to recognize crop objects and accurately determine their 3D positions. By interpreting point cloud data, this approach provides precise information on the location and shape of crops, enabling effective monitoring of crop growth and facilitating autonomous machinery control. The second technology features an autonomous rice transplanter equipped with a variable rate fertilizer applicator, guided by a digital farmland map created using GNSS (Global Navigation Satellite System). This system dynamically adjusts fertilizer distribution according to soil conditions and nutrient requirements for each field zone, improving productivity and resource efficiency. These case studies illustrate how AI is being leveraged to advance agricultural practices and promote sustainable farming solutions.

14:30-15:00

Jucheng Yang
Professor
College of Artificial Intelligence
Tianjin University of Science and Technology
China

Biography: Professor, Doctoral Supervisor. Director of the Artificial Intelligence Practice Base at Tianjin University of Science and Technology, he has been the Dean of the School of Artificial Intelligence and the School of Computer Science and Information Engineering at Tianjin University of Science and Technology. He is the Tianjin Distinguished Professor, "Haihe Scholar" Distinguished Professor, Tianjin 131 First-Level Talent, Tianjin Leading Talent in Disciplinary Fields, the vice Chairman of the Tianjin Artificial Intelligence Society. He was the visiting scholar at the University of Surrey in the UK, and the University of New South Wales in Australia. In recent years, he has led or participated in 11 national projects, of which 6 were hosted. He published over 140 papers in authoritative international journals such as IEEE Transactions on Industrial Informatics and international conferences: co-authored 8 volumes in the Biometrics series with scholars from Europe and America, as well as 4 chapters in books. Awarded 11 prizes including the First Prize for Scientific and Technological Innovation by the China Business Federation, Second and Third Prizes for Technological Progress by Tianjin Municipality, and the First Prize for Teaching Achievements by Tianjin Municipality. Holds over 100 patent applications, with more than 30 patents granted.

Cow Behavior Recognition Using Video Surveillance and Deep Learning Methods.

Abstract – How to identify cow behavior using video surveillance and deep learning methods, and the team's independently developed monitoring and early warning system for abnormal cow behavior. The system uses video surveillance and deep learning methods, and is designed for environments with low-quality surveillance videos, complex lighting changes, and changeable weather. It involves a new two-stream inflated EMA Inception3D ConvNet network and an new cow behavior recognition method with Multi-layer Mamba-Like Linear Attention (MLLAttention) mechanism. They can accurately identify abnormal cow behaviors, such as estrus, mounting, fighting, and resistance. The system integrates high-performance cameras, edge computing devices, and cloud data analysis platforms to achieve all-weather monitoring and real-time early warning, effectively solving the current behavioral monitoring challenges faced in dairy farming.

15:00-15:30		**Zhihui Wang** Professor College of Computer Science and Engineering Shandong University of Science and Technology China
	Biography: Zhihui Wang received the Ph.D. degree in electronics and information engineering from Jeonbuk National University, Korea, in 2015. From 2016 to 2019, he worked was a Post-Doctoral Research Fellow at Hisense Group Co., Ltd., China. Since 2019, he has been a Lecturer with the College of Computer Science and Engineering, Shandong University of Science and Technology, China. His current research interests include artificial intelligence, pattern recognition, and visual tracking.	
	Modified neural networks with individual-group relevance for online breeder tracking. *Abstract* – Visual tracking is a vitally important task in computer vision, which is widely used in intelligent surveillance and traffic control, etc. Currently, real-time multiple object tracking methods are still not mature in practical applications and still need to be further refined to enhance their performance especially in complex and crowded environments. Here, we introduce the motivations and main structures of two tracking methods proposed by our team, based on the individual-group relevance and pedestrians' properties.	
15:30-16:00		**Ram Kaji Budhathoki** Professor Department of Electrical and Electronics Engineering Kathmandu University Nepal
	Biography: Ram Kaji Budhathoki received the B.E degree in Electrical and Electronic Engineering from Kathmandu University, Nepal in 2001. He received the M.E. degree in Computer Engineering from Pokhara University, Nepal in 2009 and the Ph.D. degree in Electronics and Information Engineering from Chonbuk National University, Jeonju, South Korea in 2015. Dr. Budhathoki is currently working as a Professor and Head in the Department of Electrical and Electronics Engineering at Kathmandu University, Nepal. He has worked as an Associate Professor in the department of Electrical and Electronics Engineering at Kathmandu University from 2018 to 2024. He has worked as a full-time faculty (Teaching Assistant to Associate	

	Professor) at Nepal Engineering College, Nepal from Aug 2002 to June 2018. He was awarded Nepal Vidya Bhusan 'Ka' award from honorable president of Nepal for his doctorate degree. Dr. Budhathoki has been editorial board member of several international journals and technical program committee member of several international conferences. Dr. Budhathoki has registered 1 patent and is (co)author of 16 peer-reviewed journal articles, 32 conference papers and 2 book chapters. His current research interests include circuit design, analysis of memristor and memristive systems neural networks and electronics in agriculture.
	Smart Hydroponics: IoT Automation and CNN-Based Tip Burn Detection in Lettuce. *Abstract* – The escalating demand for lettuce and green vegetables has presented formidable challenges in meeting local market needs, exacerbated by escalating production costs, limitations in off-season traditional farming practices, land degradation, and recurrent disease outbreaks. To address these multifaceted challenges, this presentation explores a pragmatic approach of IoT-based automation and monitoring in hydroponics farming of lettuce. By enabling continuous monitoring and evaluation of critical parameters such as nutrients, temperature, pH, electrical conductivity (EC), and humidity, IoT facilitates smart farming, resource optimization, and environmental sustainability by providing proactive disease management and enabling cultivation in adverse environmental conditions. A comprehensive experiment was conducted on a closed hydroponics farm, strategically positioned at a corner of the university, to monitor and visualize different parameters both on site and remotely. Furthermore, this presentation presents a novel approach to address one of the most common challenges in hydroponic farming, namely tip-burn identification. To address this issue, a robust dataset comprising 3,800 images was captured from the hydroponics farm settings with varying lighting and backgrounds. A custom-designed CNN model was trained on this dataset, achieving remarkable classification accuracy of 98% for tip-burn instances and 95% for healthy leaves and overall testing accuracy of 97.36%. The webpage is developed through which tip-burn physiological disorder detection can be performed by taking lettuce image samples.

16:00-16:30

Abhishesh Pal
Robotics & AI Innovation & Strategy Consultant
Accenture, Nordics
Norway

Biography: Dr. Abhishesh Pal is a Robotics & AI Innovation & Strategy Consultant at Accenture, Nordics. He holds a Ph.D. from the Norwegian University of Life Sciences (NMBU), completed in 2024, an M.S. in Mechanical Systems Engineering from Jeonbuk National University, South Korea (2017), and a B.Tech. in Mechatronics Engineering from the University of Petroleum and Energy Studies (UPES), India (2014). He wSas a visiting researcher at the Lincoln Center for Autonomous Systems (L-CAS) in 2019. His research focuses on data & AI and mobile robotics applications across sectors like agriculture and energy. His work includes advancements in computer vision for human activity recognition, autonomous robot navigation, and human-robot collaboration policies. At Accenture, he focuses on developing GenAI-enabled disruptive technologies and aligning technical solutions with business objectives to drive enterprise success.

The Future of Agriculture through Disruptive Technology.

Abstract – The agricultural industry is experiencing a profound shift, driven by disruptive technologies that are redefining traditional farming practices. This session explores key innovations transforming agriculture, focusing on how advancements in artificial intelligence, robotics, IoT, and data analytics are enhancing efficiency, sustainability, and productivity across the sector. By enabling human-robot collaboration in complex tasks like fruit harvesting and introducing data-driven insights for better resource management, these technologies are paving the way for smarter, more resilient farming. These innovations tackle challenges like labor shortages and sustainability, paving the way for smarter, resilient farming. With cutting-edge technologies, agriculture is ready to meet future demands through scalable solutions that enhance productivity and support environmental goals.