岩手県立大学
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ACHI 2022, The 15th International Conference on Advances in Computer-Human Interactions
PAVIP: Practical Applications of Visual Information Processing

Detection of Pesticide Mist Distribution to Avoid Spray Drift

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ACHI2022 | June 2022

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■ About Me

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- **Research of interest**
  - Spray drift detection
  - 3D model simulation

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■ Introduction:

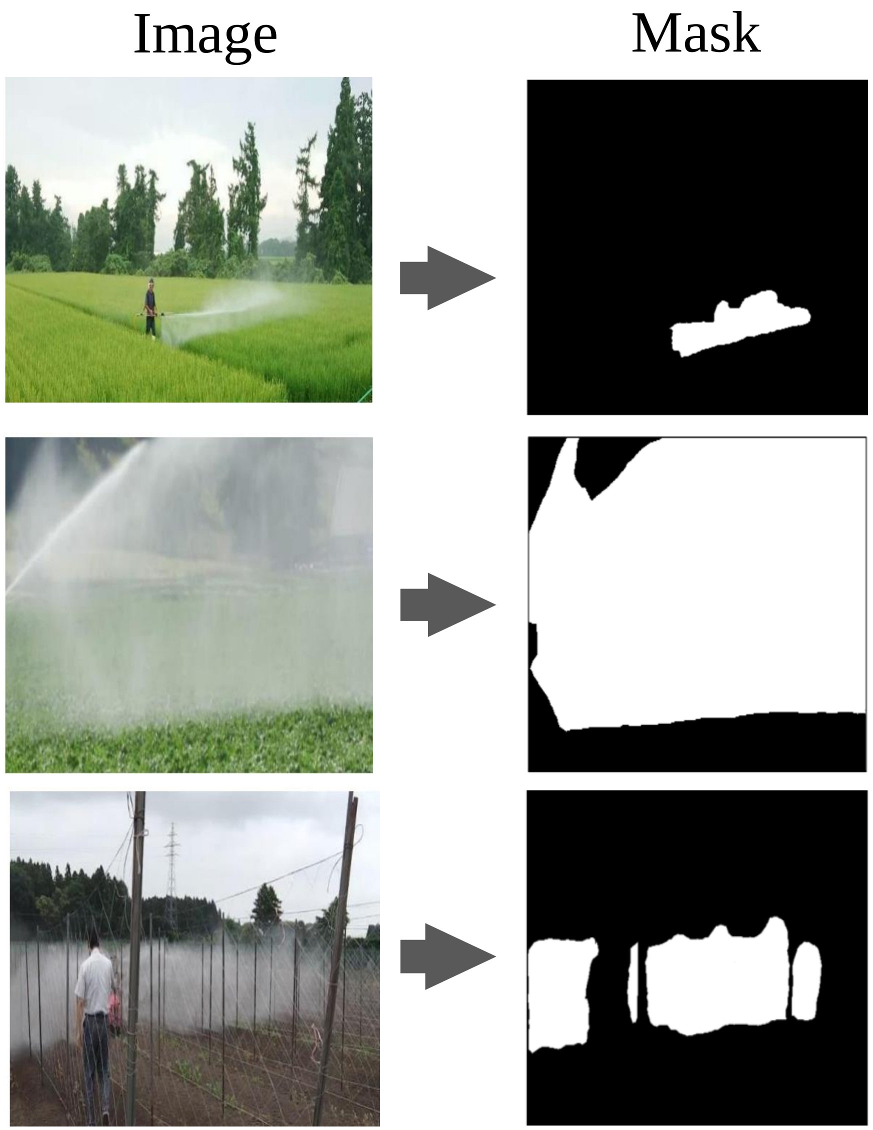
- Technological advancements are aiding large scale agriculture in many ways.
- High powered mechanical sprayers are used to spray pesticides in large fields.
- Spray drift might occur due to reasons like powerful sprayer nozzle and unstable weather, which will result in contaminating neighboring fields and water bodies.
- In this research, we are trying to mitigate spray drift by detecting spray patterns with AI techniques.
- Finally, this detection data can be turned into 3 dimensional volumetric data to gain a better perspective.

■ Motivation:

- Due to technological advancements in the modern age, large scale mechanical instruments are used in many key areas of the agricultural sector.
- One of them is mechanical pesticide sprayers.
- High powered spray and unstable weather might result in **spray drift**.
- Pesticides contaminate neighboring fields and water bodies.

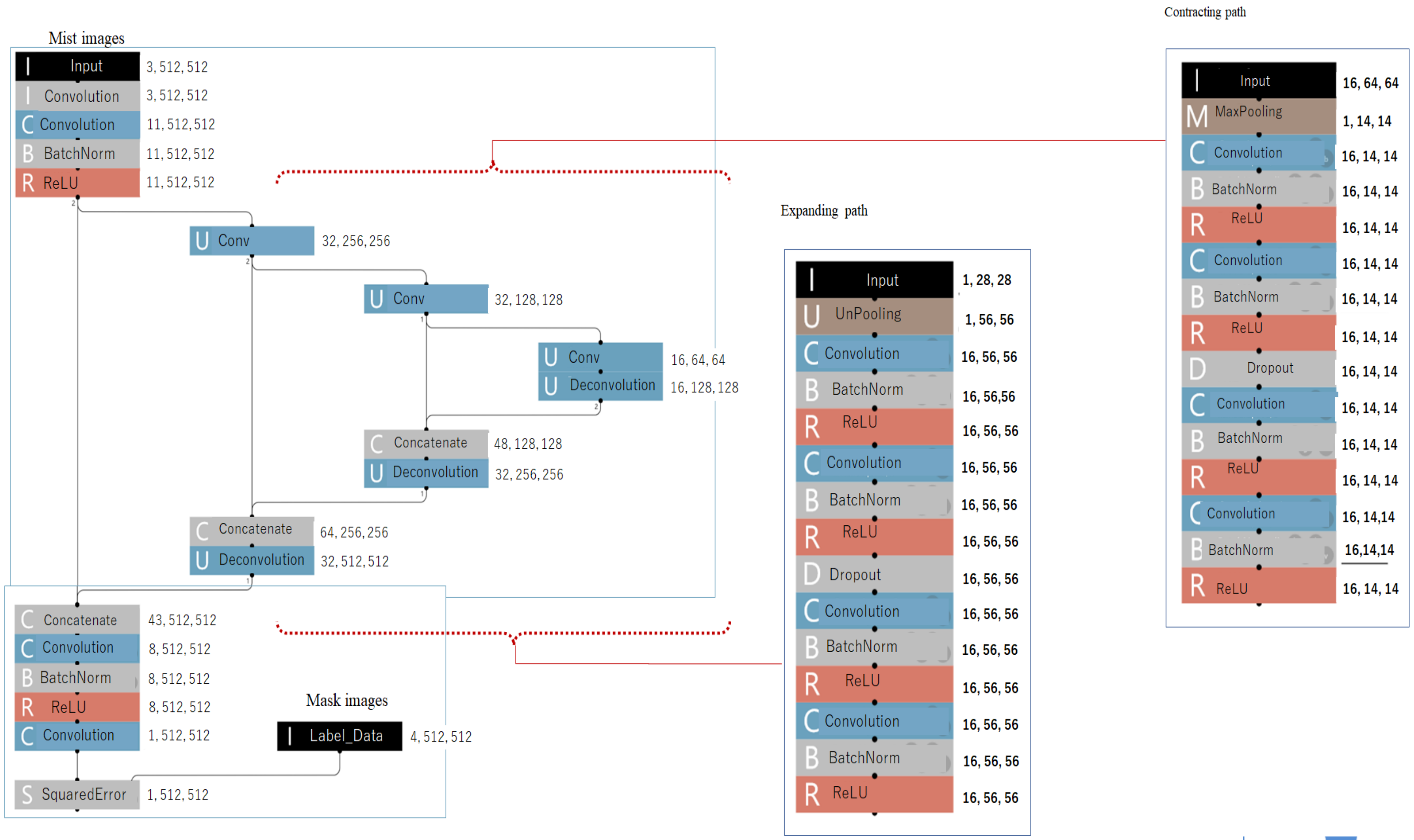
■ Preprocessing:

- Data Collection :
  - Images were collected from publicly available sources.
  - Image frames were extracted from videos.
- Image preprocessing :
  - Image data was converted to 512 x 512 pixels.
- Data annotation :
  - The image data was annotated with **Labelme**.
  - Masks were created to train our neural network.
  - The mists were not segregated according to the concentration of spraying.
  - All the mist areas were represented by a single type of mask.



■ Neural Network (U-net) Structure:

- **Sony Neural Network Console (NNC)[1]** was used to implement the neural network.
- In this research U-net was implemented to detect the spray mist.
- The neural network structure consists of two major parts:
  - ➢ The contracting part consisting of **Convolution layers**.
  - ➢ The expanding part consisting of **Deconvolution layers**.
- Each **convolution layer** is followed by a **batch normalization** and a **Rectified Linear Unit (ReLU).**
- In total, the network has 11 convolutional layers.
- The Mean Squared Error (MSE) is used as the loss function for the network optimization process.



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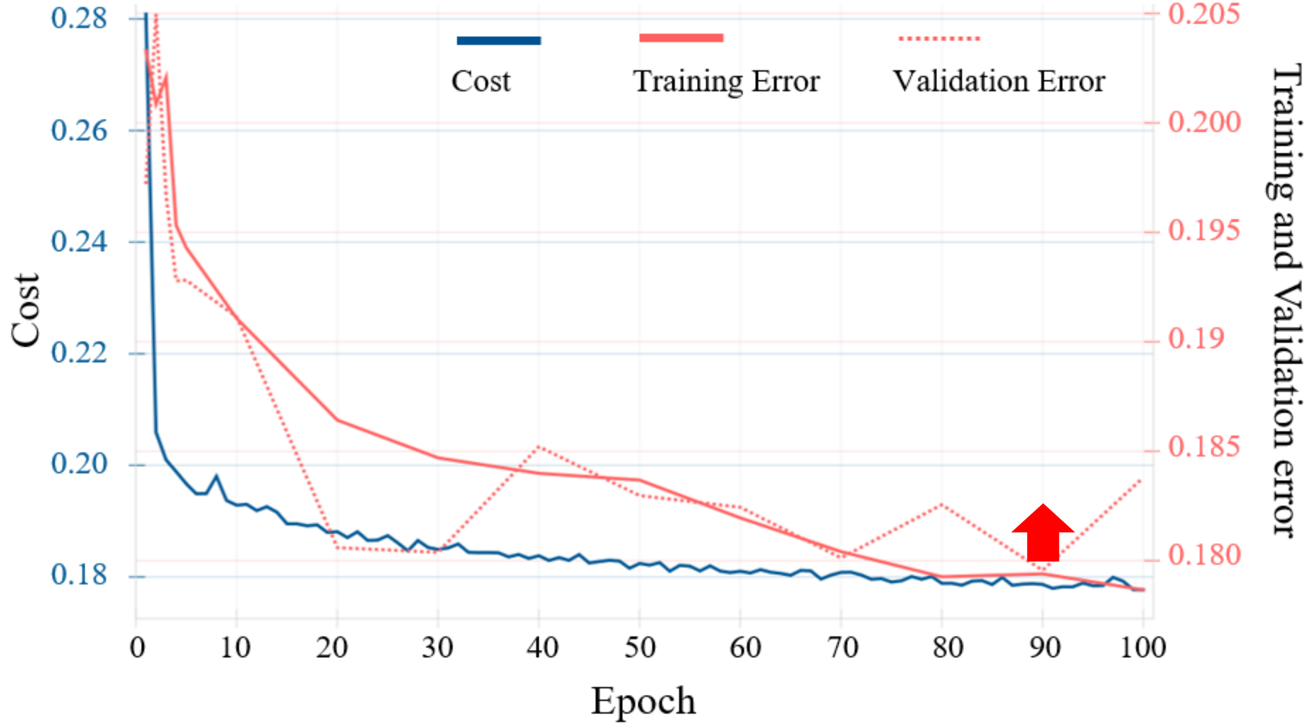
■ Training Neural Network (U-net):

- 546 images were used for this research.
- 430 of these images were used for training.
- The remaining 116 were used for validation.
- The learning and validation losses are smallest around the 90th epoch.
- The weights at this point were used as the final weights in this study, and the learned model was generated.



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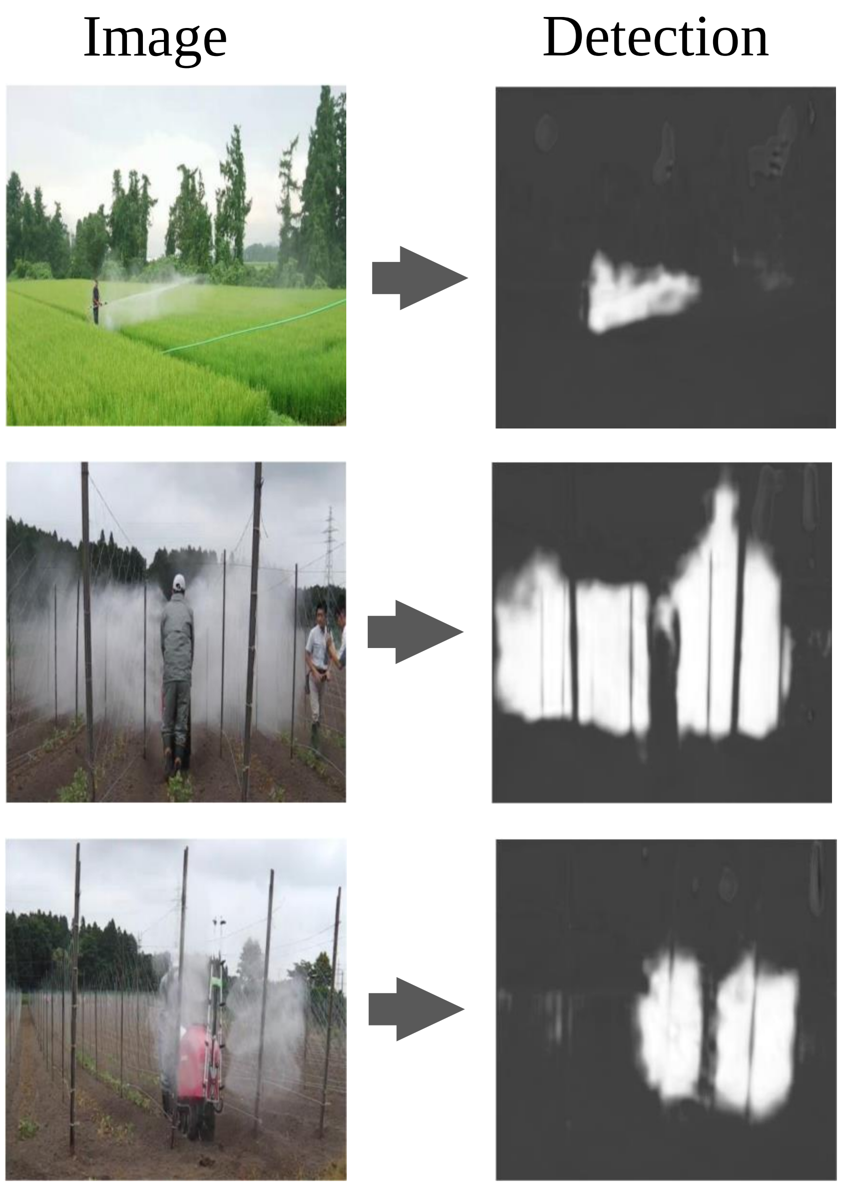
■ Detection Result:

- The result shows that the mists have been successfully detected.
- The mists have been successfully differentiated from the clouds, which are similar in color.
- The gardening poles and the people are successfully segregated despite being in the middle of the mist area.
- People behind the mist will be included in the mist.



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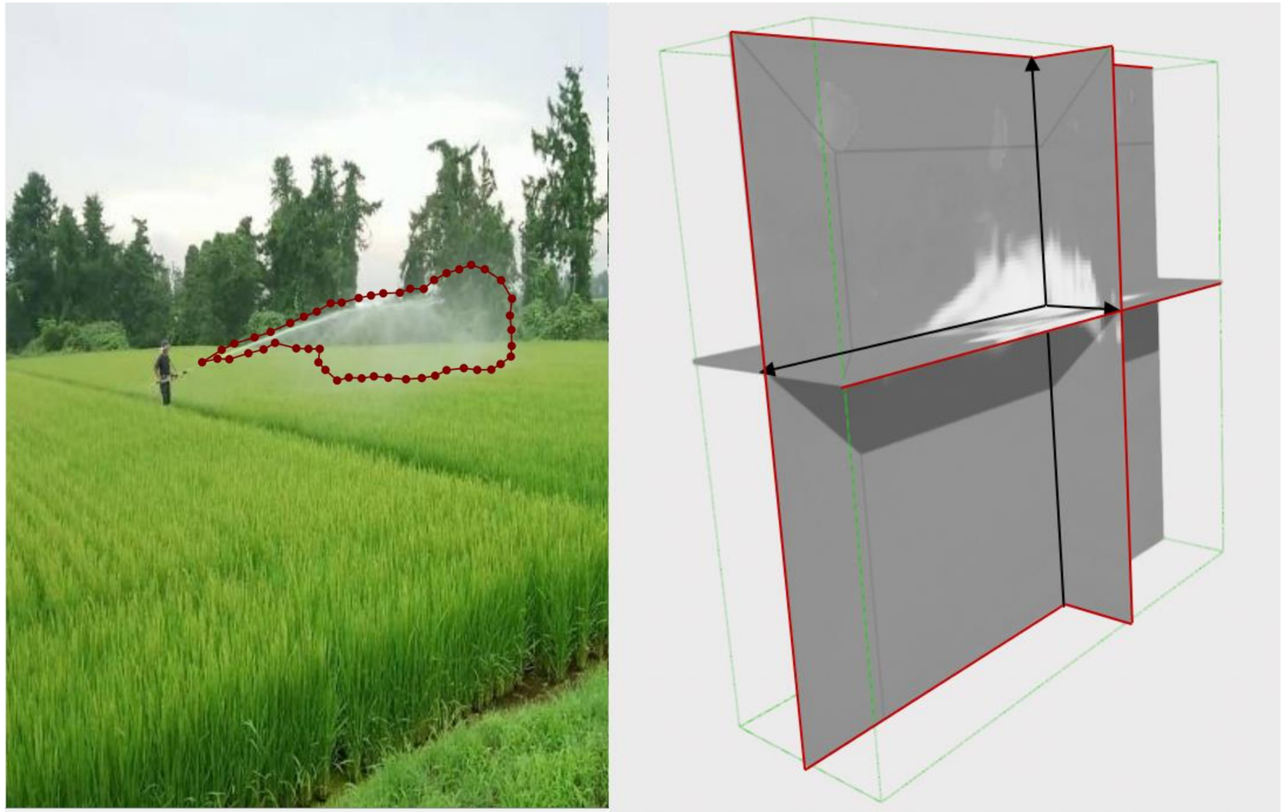
■ Visualization of 3D-Mist Model as volumetric data (1):

- The 3D-Mist Model (3D-MM) was generated by integrating the segmentation of the mist distribution in each frame from video footage data in the depth direction.
- These bundled image data were converted to point cloud data to generate volumetric data.
- Volumetric data can be sliced in any of the three axes allowing the distribution of mist at any point in the field to be viewed.



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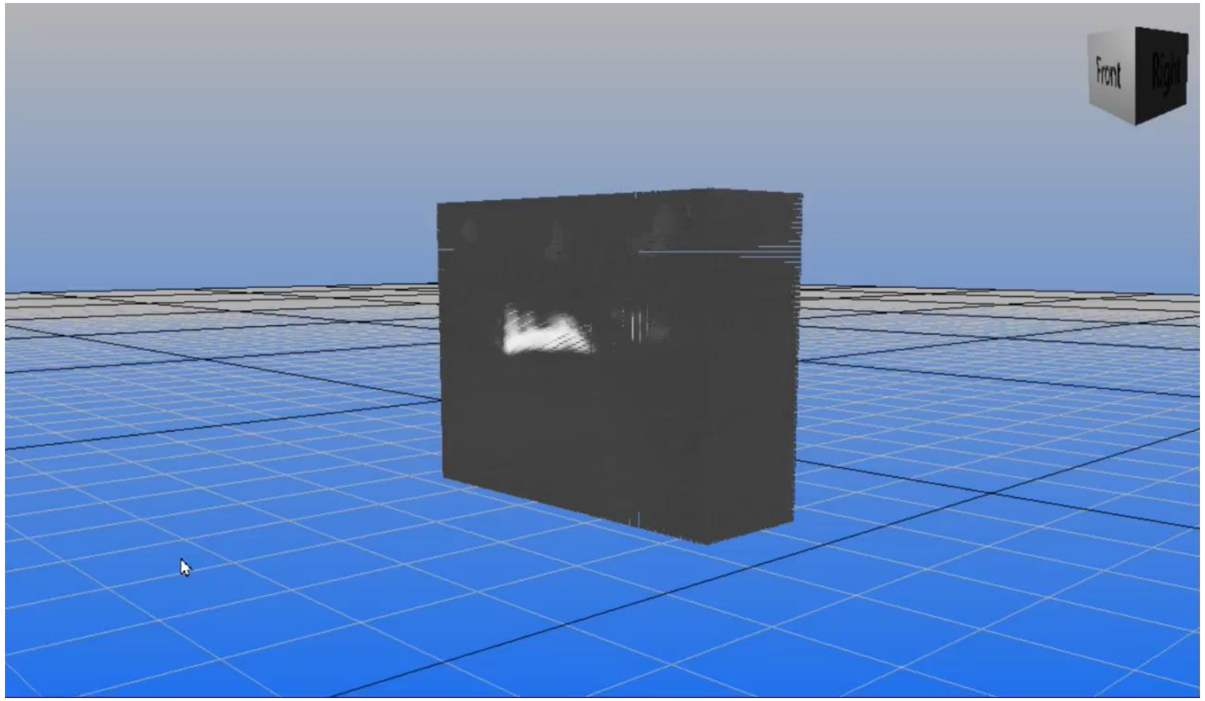
■ Visualization of 3D-Mist Model as volumetric data (2):

Detected Mist images

Volumetric data



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■ Conclusion

Achievements

- Our visualization method opens a new way to analyze mist distribution.
- During this research many new avenues were discovered and ideas were found, which will be reflected in our future research work.

Future Work

- By adding wind direction and speed information, the relationship between the mist distribution and the wind could be better understood.
- Present extraction of mist distribution relies on information solely from a single camera.
- Better results could be obtained by adding multiple cameras or by considering the orientation information of the sprayer.

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Thank You