



SAP  
Innovation  
Awards 2019



# SAP Innovation Awards 2019 Entry Pitch Deck

How SAP technology can help detecting Invasive Species  
using Drone Images

intelligence AG

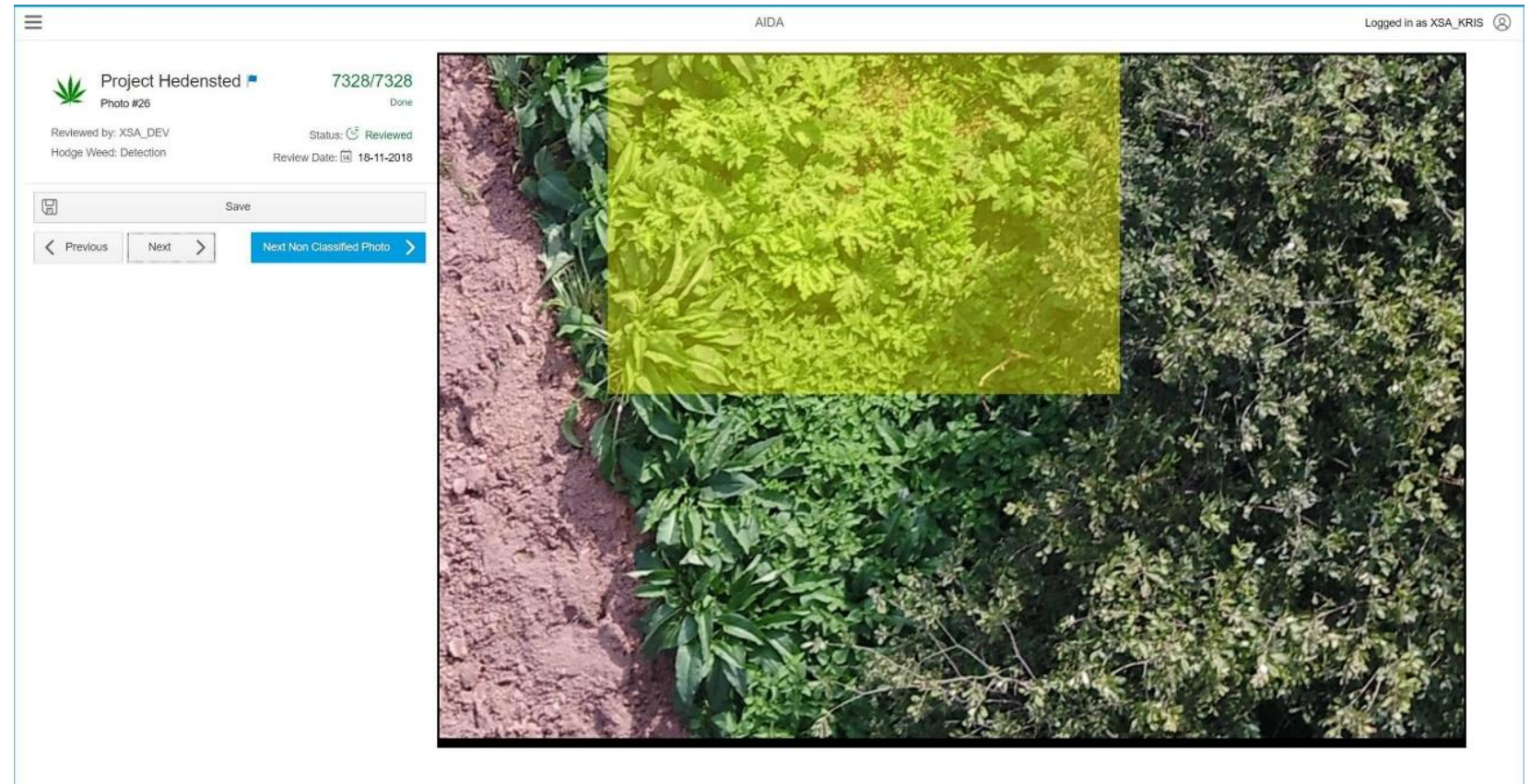
THE BEST RUN







[https://www.tv2ostjylland.dk/nyheder/04-01-2019/1930/droner-mod-bjorneklo?v=1\\_4xwcycay&autoplay=1#player](https://www.tv2ostjylland.dk/nyheder/04-01-2019/1930/droner-mod-bjorneklo?v=1_4xwcycay&autoplay=1#player)



# How SAP technology can help detecting Invasive Species using Drone Images

## intelligence AG

### “Quote”

On January 28th we participated in a meeting where we were presented to the results of our joint project.

We were happy to hear the results. [...]

We are confident that we can reach the results, that our customers expect.

### ProDrone

### Challenge

To create a solution that helps to automate the detection of invasive species and therefore support the eradication of such species.

### Solution

To deliver a minimum viable software product automating the detection of Giant Hogweed and at the same time delivering detection rates that are better and faster than the detection rates obtained by humans.

### Outcome

A solution was created that greatly improved the automated detection rate of Giant Hogweed at a much faster rate than a comparable process leveraging human resources would be able to do.

92% accuracy detecting Giant Hogweed (overall)

18 % of the Hogweed on the labelling images were not detected

Only approximately 10% false positives



## Partner Information

### ProDrone

### Provider of the images used in the project



On January 28th we participated in a meeting where we were presented to the results of our joint project.

We were happy to hear the results – and the expected results of the next phase.

We are confident that we can reach the results, that our customers expect.

Even with the results we have reached in the first project, we are confident that we can get even more municipalities to join as a test customer.

That will enable us to get even bigger variations on the areas that we fly.





## Business Challenge & Objectives

*Heracleum mantegazzianum*, also known as the Giant Hogweed is highly toxic plant originating in the Western Caucasus. It has spread across Central and Western Europe and there are sightings of Giant Hogweed reported from North America. Landowners are obliged to eradicate it, due to its toxicity and invasive nature. Finding and removing Giant Hogweed across large areas of land is a very cumbersome and expensive manual process.

The goal of this project is to automate the process of detecting Giant Hogweed and to support the removal of this plant by exploiting new technologies such as drones and image recognition/detection using neural networks and Deep Learning.





## Project / Use Case Details

**Step 1: Image gathering:** Images are gathered by drones flying over public land such as fields, parks, forests, etc. ProDrone has evaluated different altitudes, zoom levels and image resolutions to determine the best results. These images are transferred to AWS S3.

**Step 2: Manual Labeling Process:** The manual labeling process is done via a custom HTML5 application that was implemented for this project. Power users, such as the municipalities' resident Biologists access the app and mark all areas of the pictures where they can manually detect Giant Hogweed.

**Step 3: Supervised Learning:** 80% of the labelled images (The training set) are then used to train a Convolutional Neural Network (CNN) model implemented in TensorFlow. After training the CNN is able to distinguish between images with and without hogweed in the training images.

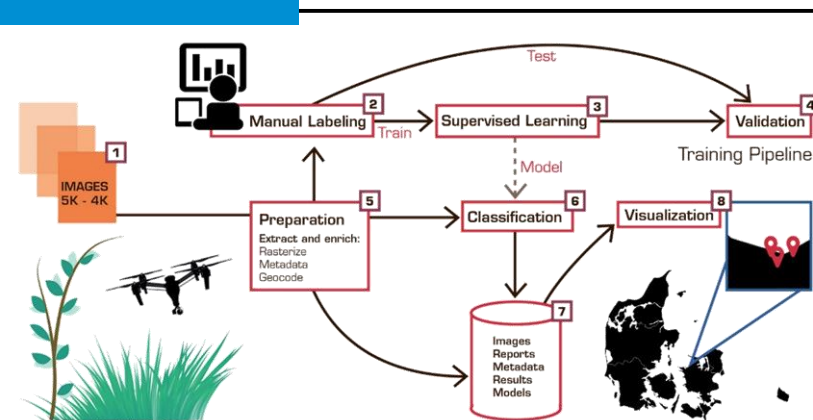
**Step 4: Model Validation:** The remaining 20% of the images (The validation set) are then used to validate the detection rate and accuracy of the CNN model. The images are feed into the model without disclosing the labels assigned by the biologist and labels are assigned by the algorithm. Labels assigned by the model are finally compared to labels assigned by the biologists to get a measure of the accuracy of the algorithm. If needed model parameters are adjusted and the process is executed again in order obtain higher accuracy.

**Step 5: Preparation:** The preparation pipeline split the raw images into images of manageable sizes and stores metadata like filename, date, time, geolocation and other EXIF data into the SAP HANA database. The pipeline process is implemented in Apache NiFi and Python.

**Step 6: Classification:** The trained model is applied to new unlabeled images to assign class labels in a batch process. The classification process is implemented in Python and TensorFlow.

**Step 7: Result creation:** All relevant data, including the classification results as well as the models are stored in the SAP HANA database. This includes oData Services to be used for visualization purposes.

**Step 8: Visualization:** A number of frontends were used in order to work with the images, the data and the results. This includes the Manual Labeling app (see above), an end user app to visualize instances of Giant Hogweed and verify the eradication process. Aggregated reporting was implemented using SAP Analytics Cloud.





# Benefits and Outcomes

## Business / Social

The overall results of this project are very promising.

We have a validation accuracy on 92% when we validate on images coming from the same project (area / municipality).

It is clear that the algorithms that we have developed can detect Giant Hogweed at a more than fair level. It still returns too many false positives which is a challenge that needs to be addressed in a future phase of the project. We have a few ways to technical improve our predictive models but the main issue is the current level of data quality.

## IT

Our solution concept is called “Flexible Data Processing Platform” which combines Hadoop and SAP HANA. Bringing the two platforms SAP HANA and the Hadoop framework together, leveraging the different characteristics of each technology stack is an effective way to set up an advanced data platform.

In this particular case we utilized the Hadoop stack to process unstructured image data with machine learning algorithms. SAP HANA was used as the database and application platform delivering performance and stability not easily achieved with Hadoop alone.

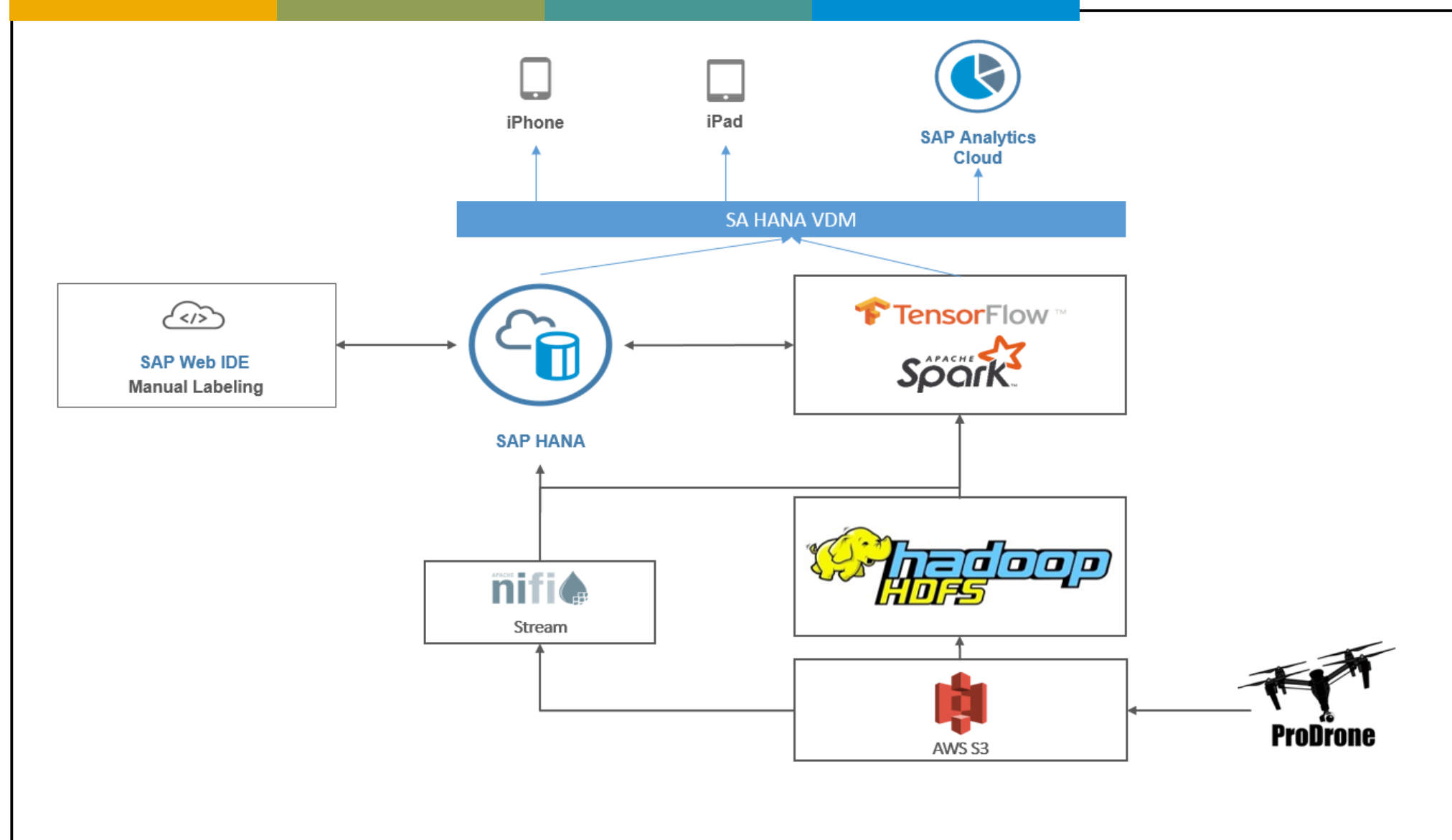
## Human Empowerment

Free up time (and resources) of the Biologists, Landowners and other people required to detect invasive species such as Giant Hogweed by using Deep Learning and Neural Networks.

Additionally, modern user interfaces and applications help the people to streamline the removal process of instances of the invasive species, help to detect patterns of the existence of the invasive species and improve the management of the overall eradication process.



# Architecture







## Deployment

Date of Deployment or POC: January 15, 2019

Number of live users: 1

### SAP Technologies Used:

Name	Status
SAP HANA 2.0 (XSA, Web IDE)	Live
SAP Analytics Cloud	Live
SAP UI5	Live

Server Processor: AMD64

Linux Distribution: Ubuntu CentOS Linux 7 x86\_64



## Emerging Technologies and Use Cases

The following Emerging Technologies and use-cases are part of the project and describe the contribution

	Technology or Use Case	Yes/No	Contribution to Project
1.	Machine Learning / Artificial Intelligence	Yes	Deep Learning used to train the Neural Network.
2.	IoT	No	
3.	3D printing	No	
4.	Blockchain	No	
5.	API Economy / Integrate the Intelligent Enterprise	No	
6.	Cloud Native / Event Based Architectures	Yes	The infrastructure was deployed on AWS
7.	Extending the digital core with SAP CP / ABAP in SAP CP	No	
8.	SAP Leonardo Application ( extending SAP application, using Industry Innovation Kits or result of Design Thinking workshop)	Yes	SAP HANA2.0 (including XSA, Web IDE, Spatial Engine, OData Services, UI5 Applications (Fiori)) plus SAP Analytics Cloud