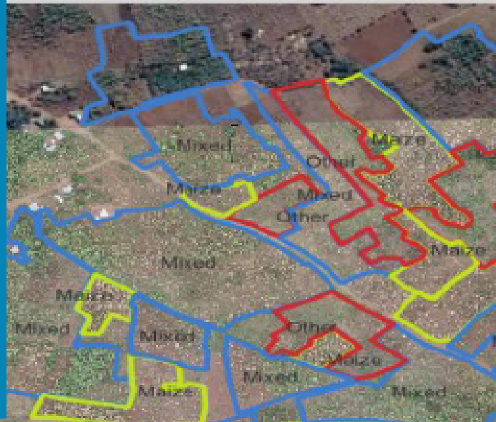
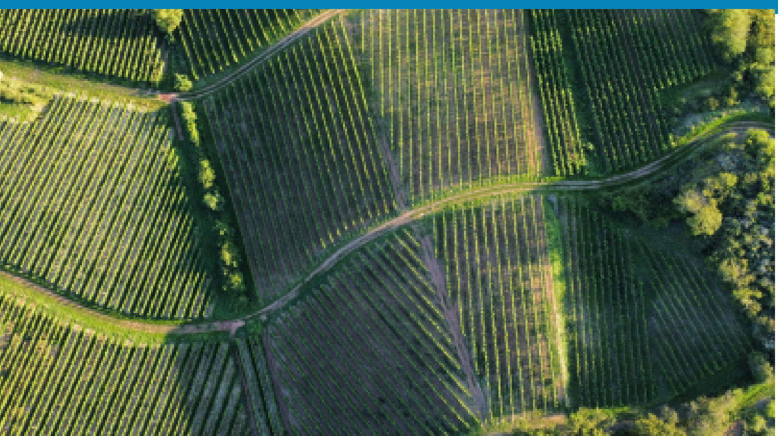
Agricultural Land Identification and Geospatial Hub



GEOSPATIAL HUB

Geospatial hub is an agricultural system solution that integrates technology and agriculture. Smart Agriculture is the adoption of advanced technologies and data-driven operations to optimize and improve sustainability in agricultural production. The technologies used for smart agriculture include artificial intelligence (AI), automation and satellite imagery. The primary objective of smart agriculture is to increase food production by optimizing crop yields and minimizing resource wastage. The adoption of smart agriculture technologies is driven by urgent concerns such as food security, climate change, and profitability challenges faced by the agricultural sector. By leveraging smart farming technologies, farmers can better adapt to the uncertainties brought by climate change, mitigate environmental impacts, and promote resilience in agricultural production.



Agricultural CHALLENGES

Climate Change

Temperature Extremes, Changes in Precipitation Patterns, Shifts in Growing Seasons, Rising Carbon Dioxide Levels

Depletion of cultivable land

Reduced Agricultural Productivity, Soil Erosion, Increased Dependence on Chemical Inputs, Loss of Biodiversity and Ecosystem Services

Crop Monitoring & Management

Yield Variability, Early Detection of Pests and Diseases, Increased Operational Costs, Resource Inefficiency

Yield Prediction

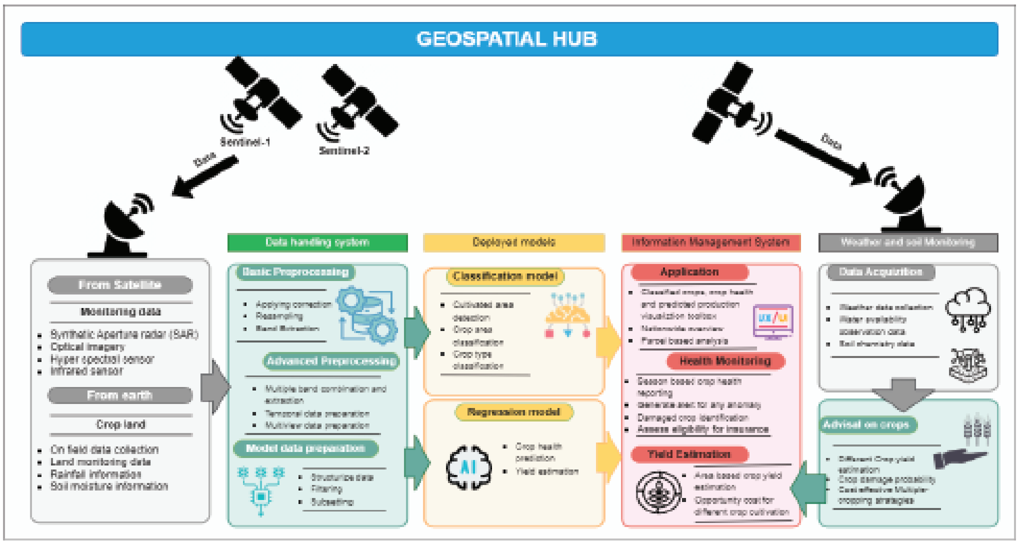
Climate Variability, Pest and Disease Dynamics, Technological Adoption and Access, Market and Economic Factors

Agricultural Sustainability

Resource Depletion, Biodiversity Loss, Climate Change Impact, Economic Vulnerability

Resource Efficiency

Water Conservation, Economic Viability, Reduced Environmental Impact, Water Conservation



SOLUTION ARCHITECTURE

Since 2010, HawarIT get involved in mapping Large Scale Topography in the Netherlands known as BGT, which is basically a land use map of the whole Netherlands. HawarIT took part to digitize more than 30 Municipalities BGT map, which includes mapping of Buildings, Roads, Private areas, public recreation centers, hospitals etc.

1 Integrated Precision Agriculture Framework

In response to the challenges posed by climate change, an integrated precision agriculture framework harnesses advanced technologies, including remote sensing and climate modeling. By forecasting specific weather conditions, farmers gain the ability to cultivate resilient crop varieties, ensuring consistent yields despite changing climates. This solution not only addresses climate change-induced food insecurity but also contributes to effective crop monitoring and management.

2 Sustainable Land Use & Resource Optimization

To counteract the depletion of cultivable land amidst population growth, a holistic approach focuses on sustainable land use planning and resource optimization. Remote sensing technologies provide detailed information on land characteristics, enabling farmers to make informed decisions about which crops to plant where, thereby optimizing land use. Concurrently, the integration of precision farming techniques minimizes resource waste, ensuring efficient utilization of limited agricultural land.

3 Predictive Analytics for Yield Optimization

Addressing the challenge of inaccurate yield predictions, an advanced predictive analytics approach leverages machine learning algorithms and historical data analysis. Factors such as the multifactorial nature of crops, spatial and temporal variability, and limited accessibility to historical data are considered in creating robust models for predicting crop yields. This solution not only empowers farmers with accurate yield forecasts but also contributes to agricultural sustainability by optimizing resource allocation and reducing uncertainties in production.

4 Precision Farming and Resource Efficiency

In the pursuit of overall agricultural sustainability, a comprehensive agricultural intelligence hub integrates technologies for crop monitoring, disease and pest detection, precision farming, and resource efficiency. By consolidating data from various sources, including remote sensing, this hub provides farmers with real-time insights into crop health, enabling early detection of diseases and pests. Simultaneously, it facilitates precision farming practices and resource-efficient decision-making, ensuring a well-rounded approach to addressing the multifaceted challenges in modern agriculture.

KEY FEATURES

1 Identification of arable vs non-arable across the country

The identification of arable versus non-arable land across the country is essential for effective land-use planning and agricultural development, as it allows policymakers to allocate resources strategically based on the land's productive potential.

2 Identification of Cultivated vs not cultivated area

The identification of cultivated versus non-cultivated areas across the country involves utilizing satellite imagery and remote sensing technologies to discern patterns of land use and vegetation cover.

3 Crop Insurance Tool

Crop insurance is a risk management tool designed to protect farmers from financial losses due to unforeseen events such as adverse weather conditions, pests, or other natural disasters. By providing a financial safety net, crop insurance helps stabilize farmers' incomes, encouraging them to invest in their crops without fear of devastating losses.

4 Crop type classification tool (Including Multi-crops fields)

A crop type classification tool is a sophisticated technology utilizing remote sensing and machine learning algorithms to accurately identify and categorize different crops within agricultural fields. This tool is particularly adept at handling multi-crop fields, providing a valuable resource for precision agriculture by enabling farmers to monitor and manage diverse crops with tailored strategies for optimal productivity.

5 Crop yield/production Estimation tool

A crop yield/production estimation tool is a data-driven instrument designed to assess and predict the potential output of crops based on various factors such as weather patterns, soil conditions, and historical data. By utilizing advanced analytics and modeling techniques, these tools assist farmers and policymakers in making informed decisions related to agricultural planning, resource allocation, and risk management.

6 A database for Crop Signature

A database for crop signatures serves as a comprehensive repository of spectral information and characteristics unique to various crops. It enables researchers and farmers to analyze and identify specific crop types based on their distinct signatures, facilitating precision agriculture practices and informed decision-making in crop management.

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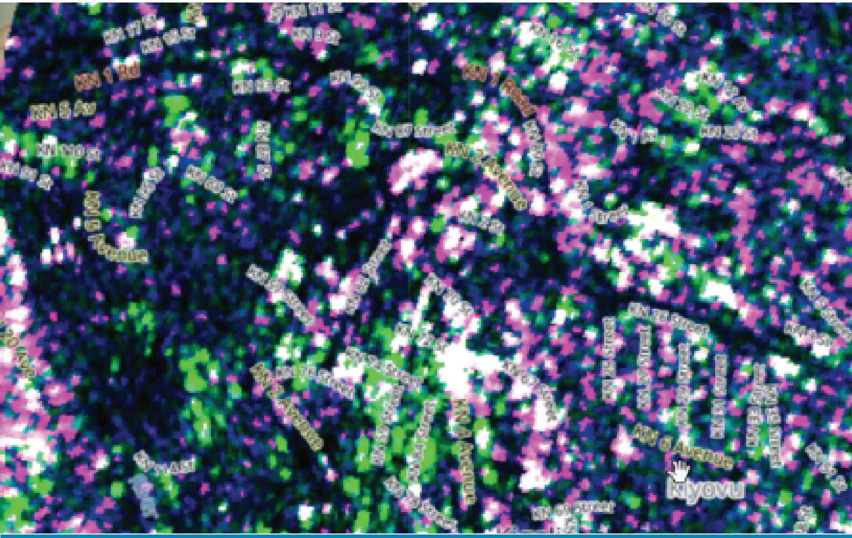
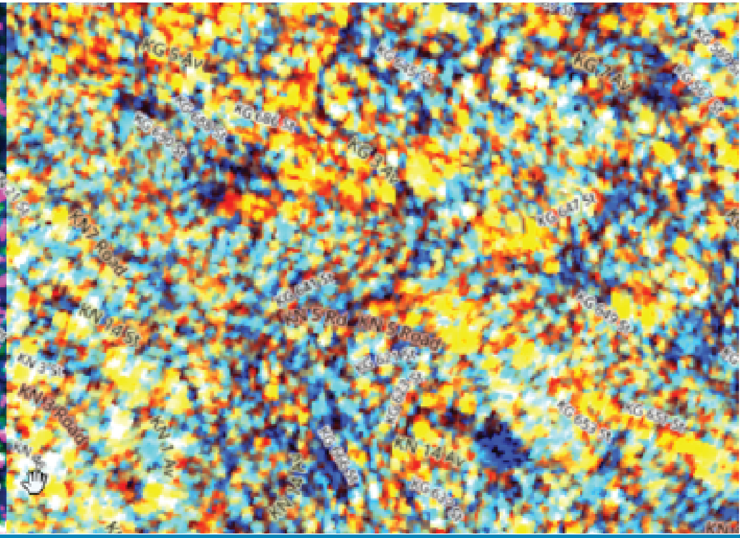
8 Disease Pressure Risk Prediction

Disease pressure risk prediction involves the use of advanced data analytics, including machine learning and predictive modeling, to anticipate and assess the likelihood of disease outbreaks in crops or livestock. By analyzing various factors such as weather patterns, historical data, and biological indicators, these predictive systems enable farmers to proactively implement preventive measures, optimizing resource use and minimizing the impact of diseases on agricultural yields.

DATA ACQUISITION AND ANALYSIS

SATELLITE DATA UTILIZATION

In the proposed solution, we harnessed the potential of two distinct types of satellite dat

Sentinel-1 (RADAR/SAR Data)

Sentinel-1 operates in the microwave region, providing all-weather, day-and-night imaging capabilities. This Synthetic Aperture Radar (SAR) data is adept at penetrating cloud cover and offering high-resolution images. Study targeted the timeframe from October 1, 2018, to March 31, 2019, utilizing Sentinel-1 to capture soil moisture levels, crop growth patterns, and surface deformation.

Sentinel-2 (OPTICAL Data)

In contrast, Sentinel-2 captures optical imagery across various spectral bands, enabling detailed observations of land cover, vegetation health, and crop types. The timeframe aligns with objectives, emphasizing the period from October 1, 2018, to March 31, 2019. To enhance data richness, we implemented cloud coverage filtering during data acquisition.

SATELLITE DATA DESCRIPTION

Sentinel-1 SAR Data

The Synthetic Aperture Radar (SAR) data sourced from Sentinel-1 is a cornerstone in the agricultural analysis. It provides crucial insights into surface roughness, soil moisture levels, and crop structure. The continuous monitoring capabilities of Sentinel-1, acquired from the Copernicus public datastore, enable us to track dynamic changes in agricultural landscapes. Notably, study incorporates a multiview approach, synergizing SAR data with optical data for a comprehensive understanding of the agricultural terrain.

Sentinel-2 Optical Data

The optical data obtained from Sentinel-2 is a diverse array of spectral bands, with Red, Green, and Blue (RGB) contributing color information and Near-Infrared (NIR) bands aiding in vegetation health and biomass assessment. Sourced from the Copernicus public datastore, the optical data adheres to high standards of reliability. The stringent data selection criteria, considering acceptable cloud coverage, ensures the robustness of the optical dataset. This data was not only used individually but also integrated with SAR data for a multiview analysis, enhancing the depth of agricultural insights.

Multiview and Temporal Analysis

The solution approach extends beyond individual datasets. By seamlessly integrating SAR and optical data, we achieve a multiview analysis, capitalizing on the complementary nature of the two data types. Furthermore, temporal analysis, involving data acquisition from different timeframes on the same Region of Interest (ROI), provides a dynamic perspective on evolving agricultural patterns. This synergistic combination enhances the precision and depth of the agricultural assessments, paving the way for a holistic understanding of the changing landscape over time.

METHODOLOGY

Smart agricultural solutions are information-driven and satellite imagery-based. We implement a variety of AI and traditional machine learning models in order to deliver the solutions. Following the acquisition of the processed data as a result of feature accumulation-based data analysis, we proceed in the following order:

1 Crop Area Detection

Convolutional Neural Networks (CNNs) is an architecture that can effectively learn and extract spatial features from satellite imagery. They consist of filters (also called kernels) that slide over the input image, extracting local features. These filters learn to detect patterns like edges, corners, and textures. As we move deeper into the network, these filters become more sophisticated, learning complex hierarchical features. The network depth has been purposefully optimized to capture both low-level and high-level features. The classification process is executed by initially utilizing the capabilities of CNN in order to distinguish: (a) Crop land (b.) Structure (c.) Forest (d.) Water . It is anticipated that the nature of the area will remain constant during cultivation periods, so area detection is conducted on a seasonal basis.

2 Boundary Delineation

On top of the Detected crop land a semantic segmentation model is used that is based on Fully Convolutional Networks (FCNs) architecture. These types of models capture contextual information and provide precise localization, making it well-suited for farmland boundary delineation in remote sensing imagery. Leveraging this model can lead to accurate and reliable segmentation results, crucial for the success of the classification model. Boundary Delineation is also done following the crop area detection

3 Classifying Crops

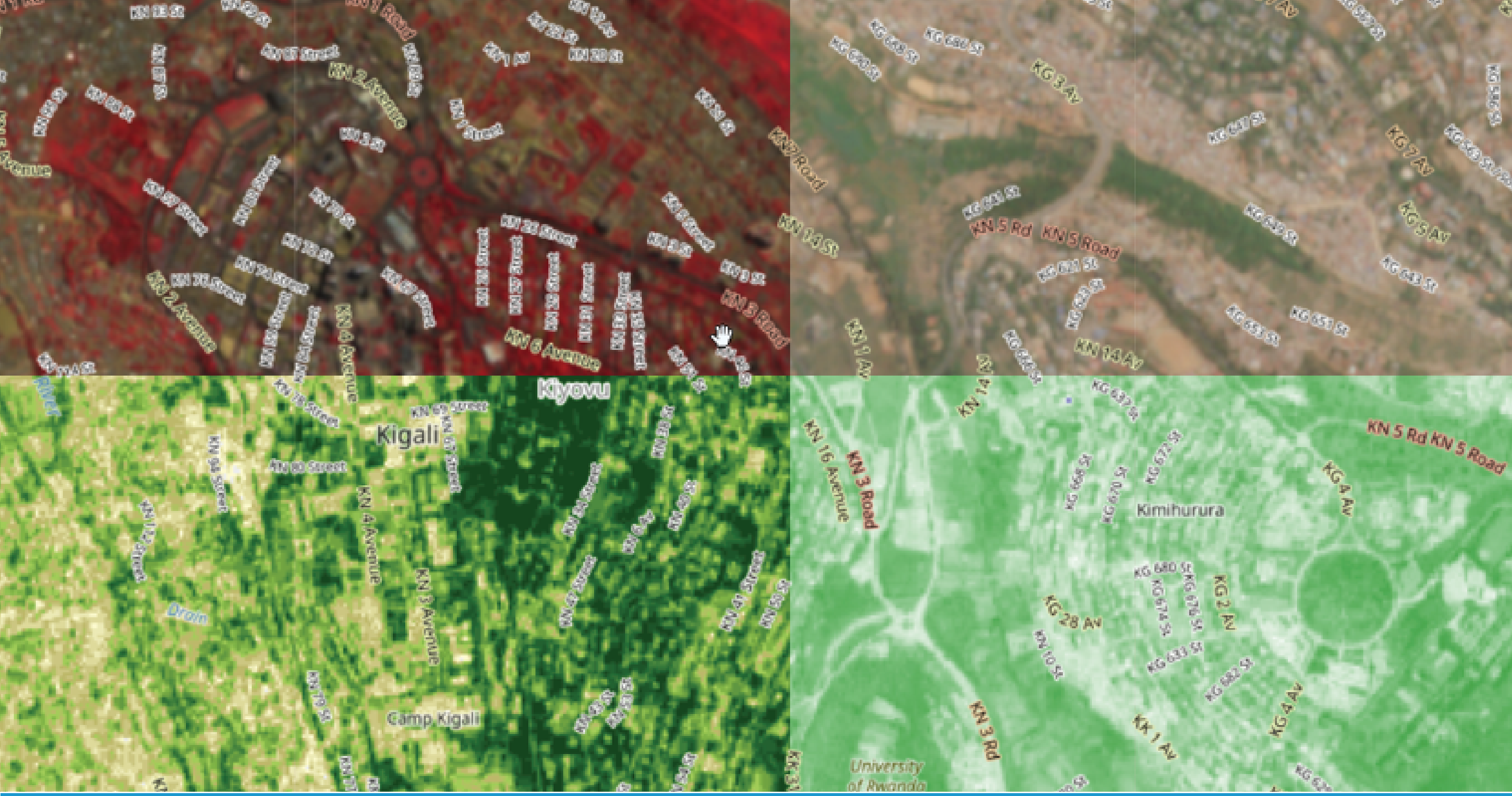
A number of methodologies, including Multiview and Multi-temporal analysis, are employed during the classification procedure in order to ascertain the crop area and parcel. Machine learning models based on statistics performed satisfactorily with regard to SAR data multi-temporal datasets. Fusing the outcomes of multiple models increases confidence in the quality of the results. In accordance with the statistical model, CNN models were also applied to multi-view and multi-temporal datasets. The model was able to more precisely identify crop type with the aid of the features extracted from the data analysis with different band combination and polarization. Satellite data that undergoes weekly updates must be utilized in real time to update the dataset in order to ensure optimal performance of the models.

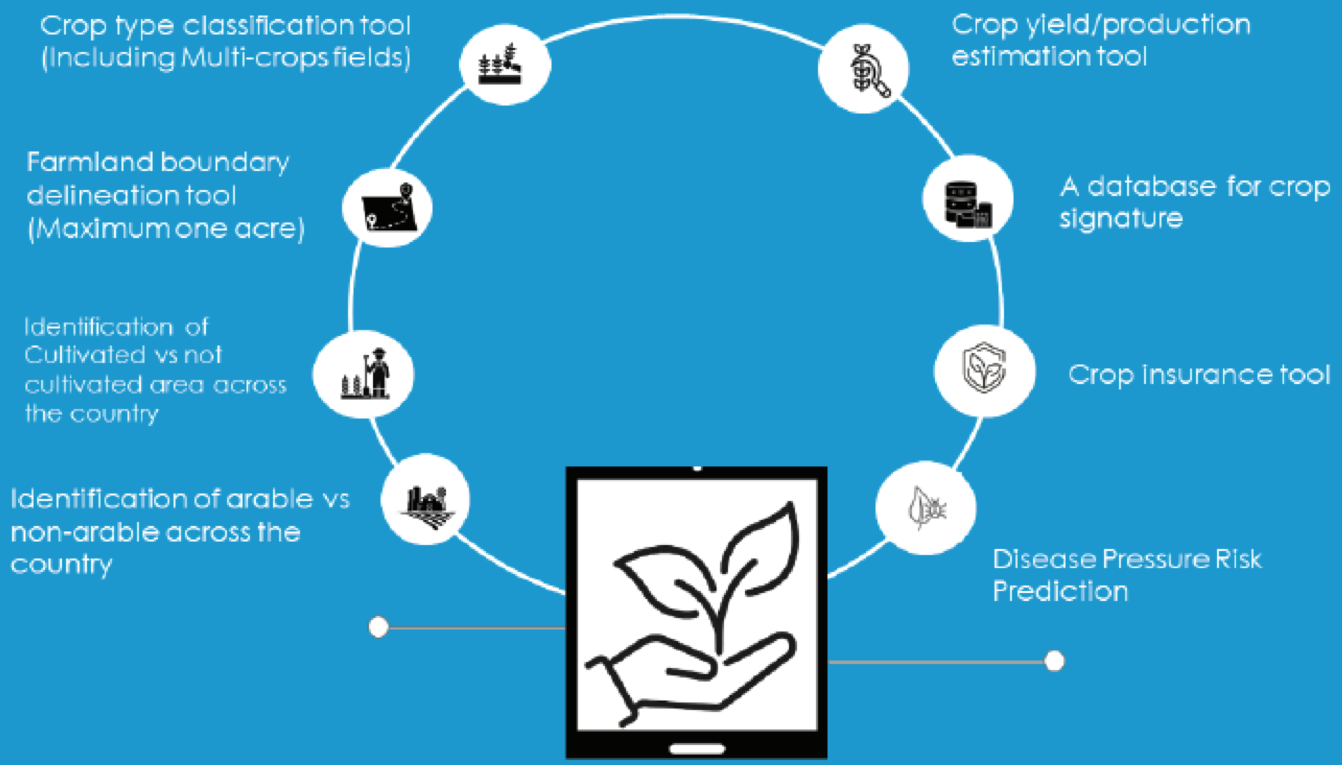
4 Yield Estimation

A yield estimation model for crop classification is a technique that quantifies the quantity and variety of crops produced in each area by utilizing data from multiple sources, including field surveys, meteorological data, environmental conditions, and remote sensing imagery. The crop growth process and the interplay between crops and environmental factors are both replicated by mechanism models. Regression or correlation analysis are statistical models' methods for determining the relationship between explanatory variables and crop yield. Furthermore, the crop height is obtained from SAR data and incorporated into the model as a crop characteristic. With help of the Temporal analysis the CNN model can predict yield estimation accurately. Crop calendars, real-time remote sensing data, and weather forecast information to provide accurate yield estimates.

5 Damage Detection

The deep learning model is trained on a diverse dataset that includes examples of various types of crop damage, such as diseases, pest infestations, or environmental stress. During inference, the model can accurately classify and locate damaged areas within the satellite imagery. This automation streamlines the process of monitoring large agricultural landscapes, providing a rapid and efficient means of identifying crop health issues. Among multiple deep learning models, the CNN model will be used to do this inference. Damage detection works similarly to yield estimation. Combined with the SAR data, a multi-temporal optical dataset is prepared for training a CNN model with seasonal model adjustment.





HawarIT

A Dutch-Bangladeshi Company

HawarIT is a Dutch-Bangladeshi IT services company established in 2000. HawarIT is specialized in the domain of Custom Software and GIS Applications Development, Engineering Drawing and Modeling, GIS Data Services and Photogrammetry.

25th ANNIVERSARY

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