Universiteit van Amsterdam

Remote Sensing in Agriculture

Helping Agurotech give better advice to farmers

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Introduction

Agurotech is a company that has made its mission to make farming more sustainable by using less water to create a more efficient food-producing system. With an app that farmers get they get precise information about soil indices of their crops and what to do next.

Problem

This project aims to investigate novel methods of achieving more accurate predictions and providing more effective advice to farmers that utilize the services of Agurotech. Satellite imagery and weather data are used to calculate the NDVI (Normalized Difference Vegetation Index), providing farmers with guidance about the next steps to take.

Workflow

Literature review

What factors, and models are useful at predicting the NDVI?

Data

Gathering high-quality data from open-sources and cleaning it.

Modeling

Implement and optimize the models to get the best performing model.

User Interface

Building a user interface with the best model & user validation.

Research

Literature Review

A literature review gave us the following factors and models that we could use for predicting the NDVI:

Data

- Vegetation Indices:
  - NDVI
  - NDMI
  - Soil index
- Weather Data:
  - Temperature
  - Precipitation
  - Wind speed

Models

- Prophet (Trend analysis)
- TCN
- LSTM

Data

The data was gathered via the **Sentinel-hub API** & **Meteostat API**

- Data gathered over 6 years (2016-2022)
- 20 different fields (polygons) in the netherlands
- Data interpolated (via Akima method) to get data for each day in those 6 years
- After cleaning the data we got 50.000 data points

Models

Prophet: Trend Analysis based on NDVI only. The model works best with time serie data that shows seasonality.

LSTM: type of Recurrent Neural Network (RNN) which is capable of remembering past inputs and providing new, relevant outputs

TCN: Utilizes dilations and causal 1D convolutional layers for predicting time-series data. Dilations go back into previous predictions of the model, such that long term relationships can be captured.

Results

After optimizing the TCN and Prophet models, their RMSEs were compared. The TCN model was chosen for the interface, as it was able to encapsulate all polygons in one model, whereas the Prophet model used a distinct model for each polygon.

Model	RMSE
Prophet	0.14
LSTM	0.72
TCN	**0.12**

Interface

The initial interface developed was simply composed of a selection of polygons and an associated prediction of NDVI. However, following further exploration of the interface, as well as taking into account user experiences and feedback from stakeholders, a weather prediction panel and textual feedback for the farmer have been added in order to increase overall user-friendliness. This has enabled a more comprehensive and accurate approach to forecasting, and also provides a more reliable and efficient way for farmers to stay informed about the conditions of their land.

Conclusion

This study has shown that it is possible to get good-quality data through open-source portals. Moreover, a TCN model was developed to predict the NDVI via satellite imagery accurately. Implying this proof of concept developed is an excellent addition to the model that Agurotech already has. Finally, a user interface was built with the farmer as the end-user in mind. The user interface was further developed after feedback from the stakeholders and users.