



## An FMIS for Nitrogen Sensor

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# An FMIS for Nitrogen Sensor

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The objective of this DTU B.Eng. project is to demonstrate and implement a cloud-based farm management information system for the Nitrogen Sensor project based upon Daisy, the mechanistic simulation of agricultural fields. An intuitive and robust user interface is to be provided for the inputs required for the simulations and for the simulation results. An application programming interface for further development is to be provided.

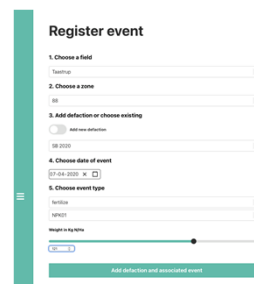


Figure 2. Registering a management operation

## Background

The Nitrogen Sensor project is developed to demonstrate and implement a service for the estimation and prediction of nitrogen content, primarily for cereal farming, such that timing and fertilization amounts are optimized. The simulation model used by the Nitrogen Sensor is Daisy, developed by the Agrohydrology group at the University of Copenhagen. As a minimum, Daisy requires the user to provide information about the soil profile, weather data and management operations. The input parameters required by the Daisy model are provided through setup files (.dai files) and are written in a specific custom format. Daisy is intended to be installed on a local computer and run using a text editor. Similarly, the output is intended to be viewed using a spreadsheet application. This requires a certain level of expertise from the user to run simulations. In order to simplify the use of Daisy and to enable Nitrogen Sensor to be used by a broader segment, a cloud based application with a graphical user interface is desired.

## Requirements

The primary users of the FMIS are considered to be farming industry consultants. An initial set of user stories were defined as starting point for the subsequent design process:

- US01: As a farming consultant, I want to define a field in order to register management operations.
- US02: As a farming consultant, I want to view the management operations in each zone in a field in order to see the activity history.
- US03: As a farming consultant, I want to define an activity in a zone in order to conform to the registration of fertilization regulations.

## Design and Implementation

A client/server architecture has been implemented as shown in Figure 1. The client consists of a React single page web application which provides the UI for logging in, registering and displaying fields and management operations, displaying zones in Google Maps API, showing simulation results etc. Examples of the UI are shown in Figures 2 and 3 for registering a management operation and displaying a timeline of operations. The backend consists of several distributed components on Google Cloud Run and Google Cloud Compute

Engine VM, providing services through REST APIs:

- Daisy Wrapper
- FMIS Converter
- FMIS Manager

Daisy Wrapper is an API which runs a Daisy simulation, providing the related input files and returns the simulation results in a zip file.

The FMIS Converter is a service for converting a json file from the UI to a Daisy management file (.dai) and vice versa.

The FMIS manager is used by the client and is responsible for contacting the required services such as the FMIS Converter and the Daisy Wrapper. Data persistence is implemented using a MongoDB database. Authentication is provided by a Firebase Auth module.

## Further Developments

Due to the project timescale, some inputs have been hardcoded and future developments should extend the FMIS Manager API to cover the extent of Daisy parameterization and simulation outputs.

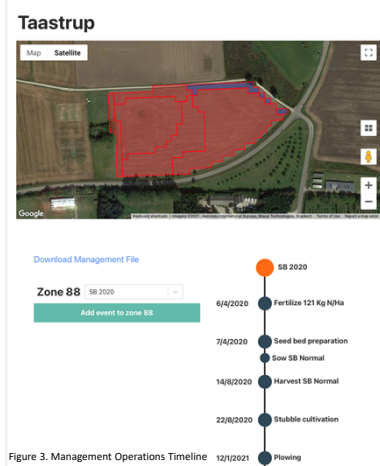


Figure 3. Management Operations Timeline

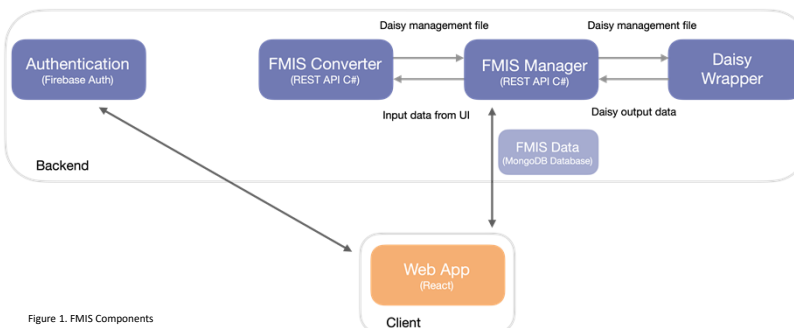


Figure 1. FMIS Components