

WEBPAGE

High Level Overview: a Bird's Eye View

Agricultural production incorporates some kind of risk of crop loss due to plant diseases, weeds and pests, too. A plant disease or pest model represent a simplification of the relationship between pathogen, crops, and the environment and produce predictions about plant disease epidemics.

This summary contains a solid description of PODS and gives a general view of the decision support systems, tactical plant protection management with pest and disease prediction based on plant forecasting models.

Features List

The Features List gives a short, essential, and textual summary of the expressly profitable and individual measurable properties or characteristics of phenomena expressed with the customer's terminology and can be observed directly by the customer.

PODS Details

The results of the plant disease or pest models can be applied easily and in a user-friendly way through a Decision Support System (DSS). The parts of a web-based DSS are an integrated system for real-time monitoring of arable land components (air, soil, plants, pests and diseases) and a web-based tool (Central Data Storage and Data Processing Server in the cloud, Customer Interface and System Administrator Interface).

PODS from AgrobyteX will be able to measure environmental parameters in the microclimate of the observed crop culture, compute phenological phases, plant disease and pest risk and provide up-to-date information in the form of alerts.

Crop Models

Continuously sensed environmental parameters: air temperature, soil temperature, air humidity, soil moisture, solar intensity. The listed environmental parameters provide indispensable inputs for the contamination- and infection-estimating models. Highly-sophisticated, complex, estimated BBCH value-based models are applied. Wide range of sensing mechanisms are used (terrestrial sensors, aerial- and satellite imagery).

PODS uses phenological modelling to estimate susceptibilities for the following pathogens and pests (Fungi, Insects, Acari)

for Canola:

- Grey mould (Botrytis cinerea)
- Black leg disease (Phoma lingam)
- Rape canker (Sclerotinia sclerotiorum)
- Pollen beetle (Meligethes spp.)

for Sunflower:

- Sunflower downy mildew (Plasmopara halstedtii)
- Sunflower white mould (Sclerotinia sclerotiorum)
- Sunflower stem cancer (Diaporthe helianthi)
- Black bean aphid (Aphis fabae)

[MB1] megjegyzést írt: lehet, hogy itt szenvedőszerkezet kell

[MB2] megjegyzést írt: to kimarad

[MB3] megjegyzést írt: Ehhez nem tartozik egy alcím?

[MB4] megjegyzést írt: ez nem mould=penész ?

- Leaf-curling plum aphid (Brachycaudus helichrysi)
- European sunflower moth (Homoeosoma nebulellum)

Previous Crop Model Examples

The plant protection experts of the AgrobiteX Ltd have been successfully engaged in modelling several apple and grape wine diseases, as well. The right side shows the modelling of the Erysiphe Necator's secondary infection: how to determine the next spraying date.

The Powdery mildew of grapevine is the most enduring and persistent disease problem in Vitis vinifera vineyards. The impact powdery mildew infection has on a vineyard often depends on the timing of the first infection. Powdery mildew can affect all succulent tissues on grapevine, including the stem, fruit, and leaves, all of which can show characteristic symptoms.

The primary and secondary infection models of the Erysiphe necator can also be downloaded as textfiles: [1] and [2]

A further model is also available for Venturia inaequalis. Apple scab caused by the fungus Venturia inaequalis is one of the most significant apple diseases. It causes serious damage in wet vintage. The susceptibility of varieties is different. Dark brown spots with feathery margins appear in 7 to 21 days following infection by the pathogenic fungus Venturia inaequalis.

Customer Interface

The Customer Request & Response Logic realizes a rich and user-friendly User Interface Logic. Similarly to that, the System Administration Logic ensures a simple and safe system administration.

Customers communicate with the system via Web-services. Smartphones with Android operating systems, iOS devices can be used in the same way.

There are no restrictions between tablets which can be used: wide browser-compatibility will be implemented. The system is also available via desktop computers.

Customer Interface Details

The detailed UX Draft shows the full customer menu details grouped into small, logical and well-divided classes. Both the customer UX and the PODS System Administration interface can be found in the draft.

A sophisticated Role Based Access Right Control (RBAC) structure provides safe and secure running.

BBCH Estimator

The Advanced BBCH estimator provides actual BBCH values to several plant disease forecast models. The estimator should be run from late autumn to the end of harvest, parametrized with different input target_heatsum values. The model uses two algorithmic steps:

Summarizing chill units from the starting_date to the calendar date when the daily minimum air temperature does not rise above a given value. So that depends on the formal parameters: variety_of_grapevine and 'koeppen_climatic_class'.

Summarizing the heat_sum from the first day of the current year to the calendar date until the so summarized heat sum achieves the value of a given value. This 'target_heat_sum' is uniquely associated with a BBCH stage. The heat_sum grows continuously, so the current calendar date when the previously mentioned match happens is the output of the model.

[MB5] megjegyzést írt: szerintem szenvedő szerkezet kell Present Perf.-ben és nem kell a previously, és az engaged vonzata: in, a modelling után nem kell az of AgrobiteX Ltd have been successfully engaged in modelling severalpreviously nem kell

[MB6R5] megjegyzést írt: previously nem kell

[MB7] megjegyzést írt: the (?)

[MB8] megjegyzést írt: helyesen: infection models

[MB9] megjegyzést írt: a damage szónak ebben a jelentésében nincs többes száma

[MB10] megjegyzést írt: ??

[MB11] megjegyzést írt: ??

[MB12] megjegyzést írt: nem világos

[MB13] megjegyzést írt: ??

Javítás
?

Rapeseed Return Calculations

Double fair returns are needed when developing and marketing new products: not only **should** the customers **be** convinced with the outcome of the product, but **also** the investors who finance the **initial** developing of the product, **must be satisfied**.

One **percent** of the averaged rapeseed yield price as monthly rental cost for using the PODS seems to be more than acceptable, given that a minimum 3.4 % of yield-surplus is available using the PODS, or **significantly** more. **From this follows** a minimal rapeseed arable area where PODS is used, depending on the number of years return. A 3 year return gives an acceptable 4.200 ha (42 km²) area, as the table shows.

The return calculation of the of the Sunflower can and will similarly be computed/estimated.

[MB14] megjegyzést írt: inversion

PDFs

PODS - Plant Observer & Diagnostic System | High Level Overview

1. Environmental Information Sources
The PODS is based on several environmental information elements. The environmental data are transferred via GSM network and Internet to central data processing servers
2. Central Data Storage & Processing Server in the Cloud
One or more (self-scalable) Data Storage & Processing Servers take care of business logic. They contain Relational Database Management System (RDBMS), Crop Models, and highly-sophisticated control logic
3. Customer Client Interface
[Customers](#) communicate with the system via Web-services. Browser-based electronic devices can be used
4. System Administrator Interface
Similarly to (3) the System Administration Logic ensures a [simple](#) and safe system administration

PODS: Plant Observer & Diagnostic System Features* List

1. Currently supported plant cultures: Canola (*Brassica napus* L. ssp. *napus*) Sunflower (*Helianthus annuus*)
2. Continuously sensed environmental parameters: air temperature, soil temperature, air humidity, soil moisture, solar intensity. The listed environmental parameters provide indispensable inputs for the contamination- and infection-estimating models. Highly-sophisticated, complex, estimated BBCH value-based models are applied. Wide range of sensing mechanisms are used (terrestrial sensors, aerial- and satellite imagery)
3. Using [phenological](#) modelling to estimate susceptibilities for the following pathogens and pests (Fungi, Insects, Acari)
 - 3.1. [for Canola:](#) [Grey mould](#) (*Botrytis cinerea*) Black leg disease (*Phoma lingam*) Rape canker (*Sclerotinia sclerotiorum*) Pollen beetle (*Meligethes* spp.)
 - 3.2. [for Sunflower:](#) Sunflower downy mildew (*Plasmopara halstedtii*) Sunflower white [mould](#) (*Sclerotinia sclerotiorum*) Sunflower stem cancer (*Diaporthe helianthi*) Black bean aphid (*Aphis fabae*) Leaf-curling plum aphid (*Brachycaudus helichrysi*) European sunflower moth (*Homoeosoma nebulellum*)
4. Estimating volume and date of harvest of the supported plant species
5. Early warning of growth stages
6. Integrated, automatically updated, countrywide dependent chemical database to minimized and professional spraying with allowed chemicals
7. Field-book handling (administering working actions on the plant). Standardized interfaces for frequently used extant [accounting](#) subsystems
8. All the features are remotely controlled via Internet by any browser based device (desktop computers, notebooks, tablets, or smartphones)
9. Wide range of marketing methods, close co-operated, flexible business structures, individual needs, continuous technical and business advisement are evidently available

*Remark:

The feature is (1) an expressly profitable and individual measurable property or characteristic of a phenomenon (2) expressed with the customer's terminology and (3) being observed directly by the customer

[MB15] megjegyzést írt:

[MB16] megjegyzést írt: mould (?)

PODS — Plant Observer & Diagnostic System | High Level Overview

- (1) The Crop Models (13) are based on several environmental information elements
- (2) The sensors on the arable fields: soil temperature and humidity, air temperature and humidity, solar intensity, and leaf wetness. The sensors are coupled to Data Acquisition & Communication Modules to transfer their data via GSM network
- (3) High-resolution aerial images are used from several sources (drones, satellites)
- (4) The system is using various ag-specific weather data services to obtain precise weather forecast information
- (5) Topography has a huge impact on the flow of water and nutrients in the soil and in the field. The System uses Digital Elevation Maps (DEM) retrieved from various sources
- (6) The environmental data are transferred via GSM network to the Internet with custom-interfaces
- (7) One or more (self-scalable) Data Storage & Processing Servers put the business logic through
- (8) Relational Database Management System provides data persistence
- (9) The Crop Model Parameters ensure the BBCH Estimator's input
- (10) Two level areal partition ensures precise plant area registering
- (11) Detailed Customer Data are stored in the system (for service access, available environmental sources, geographical data, etc.)
- (12) The Environmental Sources Structural Data represent the technical details of the information sources
- (13) The Crop Models give disease and pest forecast information
- (14) The BBCH Estimator gives indispensable input information for the Crop Models
- (15) The Crop Model Scheduler provides the periodic running of the Crop Models according to the Crop Model Parameters (9)
- (16) Detailed Logging Facility ensures the system maintainable work
- (17) The System Administration & Configuration Facility is a key component of a manageable computerized system
- (18) The Customer Request & Response Logic realizes a rich, and user-friendly User Interface Logic
- (19) Similarly to (18) the System Administration Logic ensures a simply and safe system administration
- (20) The customers communicate with the system via Web-services
- (21) (25) All browser-based electronic devices are able to communicate with the system without preliminary software installation
- (22) Smartphones with Android operating systems, Apple iPhones can be used in the same way
- (23) There are no restrictions between tablets which can be used: wide browser-compatibility will be implemented
- (24) The system is also available via desktop computers

PODS — Plant Observer & Diagnostic System | Crop Model Overview

BBCH Estimator

The BBCH estimator provides actual BBCH values to several plant disease forecast models. The estimator should be run from late autumn to the end of harvest, parametrized with different input 'target_heatsum' values. The estimator uses two **algorithmic** steps:

Summarizing chill units (in cases of the annual plants, as well) from a 'starting_date' to the calendar date when the daily minimum air temperature does not rise above a given value. **Doing that depends** on the formal parameters 'variety_of_grapevine' and 'koeppen_climatic_class'.

Summarizing the heat_sum from the **first** day of the current year to the calendar **date until the so summarized heat sum achieves the value of a given value**. This 'target_heat_sum' is uniquely associated with a BBCH stage. The heat_sum grows continuously, so the current calendar date, when the previously mentioned match happens, is the output of the estimator.

Crop Model Controller

PID Controller (provides proportional, integral, and derivate calculations to make control actions)

Its setpoint is the estimated BBCH value provided by the BBCH estimator. The measured process variables are environmental parameters (soil/air temperature/moisture, solar intensity leaf wetness, rain precipitation, ...)

The controller output and the plant variety compose selection parameters to the Chemical Database to advice the customer.

Chemical Database

The database contains several types of plant protection chemicals (acaricids, fungicids, herbicids, and molluscicids). The database does contain detailed information (product sheet, approving date, price, ...) about each chemical items.

The Plant Observer and Diagnostic System ensures continuous actualizing of the database according to the official regulations.

Sophisticated Control Logic provides smooth communication between the software components and prepares the content **for** the customer interface.

Crop Model Scheduler

Provides regular running environment for the Crop Models: Each plant area on each estate needs dedicated crop **model according** to the local plant varieties and environmental parameters.

[MB17] megjegyzést írt: algorithmic

[MB18] megjegyzést írt: Itt már érthetőbb ez a mondat, mégis javítsunk rajta egy kicsit: Doing that depends on.....

[MB19] megjegyzést írt: first

PODS — Plant Observer & Diagnostic System | Customer Interface Overview

Customer Interface

The Customer Request & Response Logic realizes a **rich and** user-friendly User Interface Logic. Similarly to that, the System Administration Logic ensures **a simple** and safe system administration.

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[MB20] megjegyzést írt: simple

PlantCT System | Advanced BBCH Estimator

The Systems Engineering Model captures the requirements, operating conditions and performance constraints of the Advanced BBCH Estimator. It captures the design of the (sub)system in terms of distinct, configurable, reusable components.

Technical Target

Phenological models are well proven tools to forecast phenological events of grapevine (*Vitis vinifera* L.), for example bud burst, flowering or veraison. The main variable is the temperature. The aim of this model is to estimate the calendar date of different BBCH values **in the case** of grapevine.

Technical Concept

The Advanced BBCH estimator provides actual BBCH values to several plant disease forecast models. The estimator should be run from late autumn to the end of harvest, parametrized with different input 'target_heatsum' values. The model uses two **algorithmic** steps:

Summarizing chill units from the 'starting_date' to the calendar date when the daily minimum air temperature does not rise above a given value. **Doing that depends** on the formal parameters 'variety_of_grapevine' and 'koeppen_climatic_class'.

Summarizing the heat_sum from the first day of the current year to the calendar **date until the so summarized heat sum achieves the value of a given value**. This 'target_heat_sum' is uniquely associated with a BBCH stage. The heat_sum grows continuously, so the current calendar date, when the previously mentioned match happens, is the output of the model

The Requirements Model contains the defined system requirements, its desired behaviour, and operating constraints the subsystem must conform to.

The Operational Domain Model contains the SysML blocks that describe the operating conditions under which the design subsystem will operate.

The Design Model contains the SysML blocks that describe the subsystem's structure. It describes how reusable components fit together to fulfil the design needs.

The Implementation Model describes the computing hardware and software artifacts necessary to implement the actual embedded, software-intensive subsystem

The Library would contain a collection of reusable SysML blocks to develop the design and constraints of this subsystem and others in this project.

The System Design is focused on the (sub)system as a whole: It emphasizes its total operation. **Its looks at the (sub)system from the outside, that is, and its interactions with other (sub)systems and the environment, as well as from the inside.** ->: **It looks at the (sub)system and its interactions with other (sub)systems and the environment from the outside as well as from the inside.**

[MB21] megjegyzést írt: in the case

[MB22] megjegyzést írt: space kell

[MB23] megjegyzést írt: Doing that depends on

[MB24] megjegyzést írt: Itt nem értem, hogy miért van a 'that is' a mondat közepén.
Javaslatom : It looks at the (sub)system and its interactions with other (sub)systems and the environment from the outside as well as from the inside.