Software Solutions s.r.l. Via Toscanini, 2 - 20020 Cesate (MI) - I - Tel. 02.99.06.82.28 Fax 02.99.06.82.30
P.IVA e Reg. Imp. 09711750159 - R.E.A. Milano 1314344 - Cap. Soc. € 99.000 - e-mail: softsol@softsol.it - http://www.softsol.it

Subject: Plant Disease Diagnostic (*PlantDiag*)

The "**Plant Disease Diagnostic"** (***PlantDiag***) Platform, aims to address the problems of efficient and effective disease diagnosis and pathogen detection, engendering cooperation of institutions and experts within countries and across national borders, with HW/SW Cloud infrastructure and on-line web-mobile services. The Project will be based on the eLegere Platform where will be designed and configured the web data base structures and the Smart Application modules that will implement the Workflow process that connect the Service Providers (Research Centers, Universities, Laboratories) which could deliver directly the services requested by the Service Users (ICT Villages, Governments, Institutions of underdeveloped countries).

The ***PlantDiag*** Platform, through innovative services and technologies, enables to support countries to develop adequate, rapid and efficient food security and safety policies

PlantDiag system will allow to streamline the workflow to manage and control the process from the detection to the diagnosis of plant disease up to the indication of the best-practice cares, integrating traditional and innovative knowledge and resources.

The ***PlantDiag*** Platform will supply its innovative services starting from the Villages, from where End Users will be connected up to the following work-flow main entities:

- the Farmer in the Village (Service User)
- the District in the Village (ICT village)
- the National Institutions Center (Local Scientific Institution) in the Country
- the Centers of Excellence (Service Providers), located in different countries in the world

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The proposed solution has the purpose to be exploited by all the actors acting at the various stages of the whole system, in such a way to carry out fast and qualitative diagnosis about plant disease.

Service Users of developing countries will be able to benefit from the skills achieved by the **Service Providers**, in order to transfer knowledge, solutions and enable faster skills development.

Internet of Things (IoT), Wearable Technologies and Mobile Devices are the new frontier of Digital Solutions and are widely used by the ***PlantDiag*** Platform. The information collected integrates advanced data processing such as: Artificial Intelligence, Machine Learning and Predictive Analytics.

The main workflow is targeted to solve an End User problem, by means of request to District, National Centers and Service Providers:

1. the **End User**:
    - Take one or more photos of the plant
    - Provide plant specific information
    - Submit Diagnosis Request through the web/mobile APP
2. the **District Service**:
    - Validates the Request and insert further notes and documentations
    - Provides initial feedback
    - Submits the Request to the **National Center**
3. the **National Center**:
    - Analyses the request topics
    - Monitors the environmental situation
    - Validates the Request and inserts further notes/attachments
    - Provides additional feedback
    - Submits the request to the **Service Provider**
4. the **Service Provider**:
    - Analyses the problem
    - Provides diagnosis
    - Sends an initial solution to the **National Center** (and through them, to the **District Services** and back to the **End User**)
    - Shares results
    - Updates Knowledge Base for intelligence services such as **AI-Machine Learning**

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The expected impact of the herein illustrated solution will be the following:

- provision of simple tools and solutions for preserving and increasing natural resources of specific agro-system
- identification of methods and tools for improving soil condition for water retention, increase in nutrient and organic matter
- potential scalability and transferability to further areas and countries in which their usage should be necessary
- capability and tools for increasing farm income within sustainability of long term farming

The following series of advantages will be offered by the completely web-based platform:

- the possibility to use Desktop, Tablet and Mobile, via Web, with Smart Data Input through Images, Text and Voice recognition, with Geolocation
- Profiled users with secure access and data history tracking (logging)
- Web DB to store information and georeferenced data, with geo-visual data navigation
- centralized data collection, validation and sharing, with user permission and restriction and workflow notification engine
- integration with external data sources and tools
- interoperability with IoT and intelligence services

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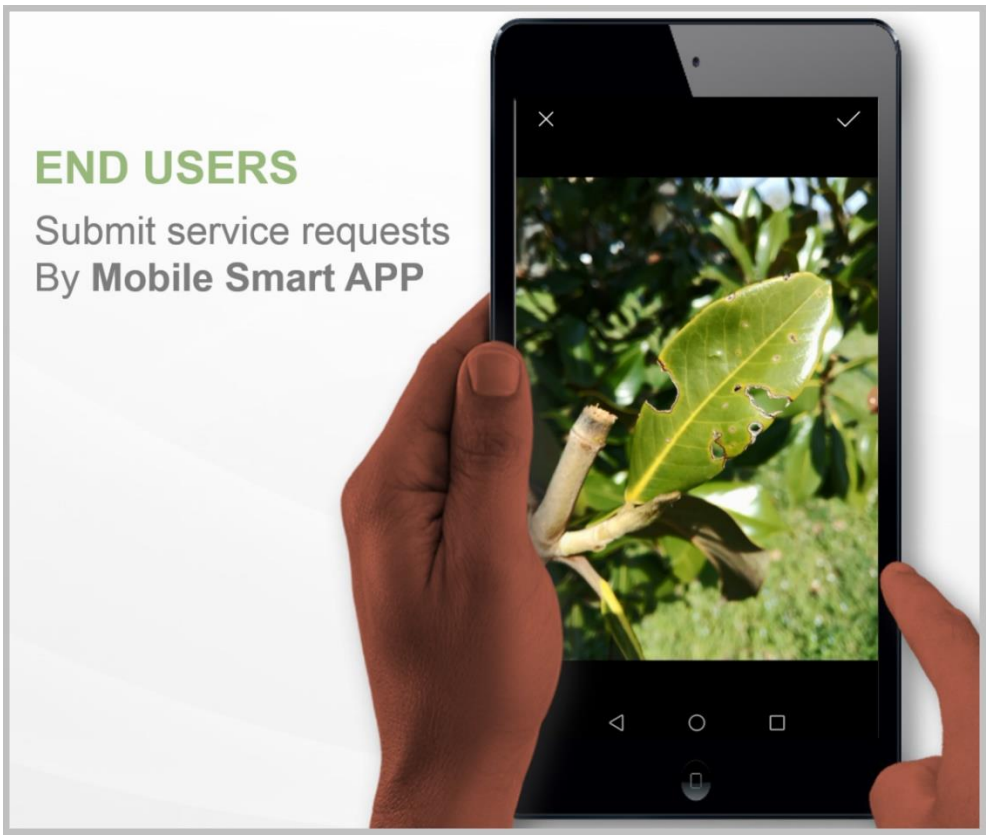

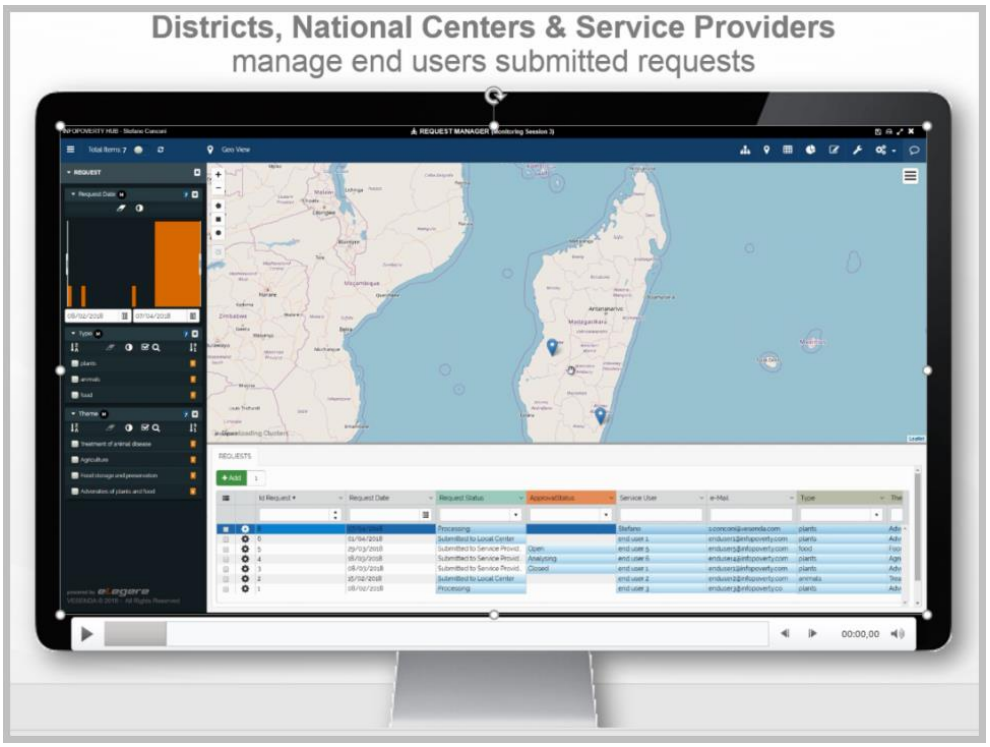

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The application development involved the following activity (sub task):

1.1 Service Model & Operational Process analysis and definition

- Service Model study and definition
- Entities Identification (actors, roles, data sources)
- Process work-flow rules analysis and identification for all actors and user roles
- Application modules use-cases and user experience definition and mapping to sub processes and user roles

1.2 Data Base Architecture - Modeling and Implementation

- Data sources analysis (type, format, protocol,…)
- Data entities and structures models and architecture design
- Database structure implementation

1.3 ETL data procedures design & implementation

- ETL procedures development for Data Elaboration Cleaning & Elaboration
- Data source import/synchronization procedures development

1.4 WEB-Mobile Smart Application Modules design & configuration

- Design and Storyboarding for Application module
- Configuration for data entry, navigation with security and work-flow rules for data accessibility, visibility, editability, exportability
- Work-Flow rules and actions (data & Service procedures) implementation
- Notification and Alerting

1.5 Data/Process Access & Security permission/restriction configuration

- Domain setting for the different Country and areas of study
- User group profiling and assignment
- Application module security permission and restriction assignment

1.6 Dashboard & Report design and integration

- Analytics metrics identification
- Layout and analytics procedure implementation
- Integration with application modules

1.7 IT Cloud-based infrastructure set-up

- Cloud HW/SW architecture dimensioning and setup
- Web, DB server (SQL-NOSQL), Reporting tools
- ***PlantDiag*** Software Platform Installation & configuration

1.8 Testing & Fine tuning

- Internal test
- live work-flow test
- Fine tuning

1.9 Delivery, Training and Rollout (TBD – To Be Defined)

- Delivery and Training to the **National Center** of the selected Countries
- Delivery and Training to the **Districts** of the selected Countries
- Delivery and Training to the **Service Providers** that will provide remote assistance
- Workflow supervision
- Remediation Plan test

PlantDiag *Project next steps:*

1. Study and integration of databases and web services for intelligent recognition of plant diseases starting from photographs taken in the field.

a. Identification of the best practices for the shooting based on the services and recognition algorithms

b. Check the "Microsoft Azure Cognitive Services"

c. Evaluating other DB and integration

d. Machine Learning & Artificial Intelligence implementation

2. Devices for detecting and diagnosing problems encountered on plants.

a. Study and manage external devices and IoT sensors

b. Definition of a ***PlantDiag*** application module to insert the results of the analysis

c. Possible communication services from the detection device to the mobile device

d. Analysis of IoT Connected Devices

e. Integration of results in the process of verification of support requests

Giulio Valeri

Giulio Valeri
Amministratore Unico
Mail: giulio.valeri@softsol.it
Tel: +39 02-99068228 int. 150
Mobile: +39 320-7219660; +39 335-1422906

Software Solutions S.r.l.
Via Toscanini, 2 - 20020 Cesate (MI) - Italy
Web: www.softsol.it
Tel: +39 02-99068228
Fax: +39 02-99068230